EXHIBIT 6
[Filed Under Seal]

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
OAKLAND DIVISION

THE APPLE IPOD ITUNES ANTITRUST LITIGATION	)	Case No. C 05 00037 YRG C 06 04457 YRG
	)	HIGHLY CONFIDENTIAL

EXPERT REPORT OF ROBERT H. TOPEL

August 19, 2013

(Amended)

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I. INTRODUCTION AND BACKGROUND

1. I am Robert H. Topel, Isidore Brown and Gladys J. Brown Distinguished Service Professor of Economics at The University of Chicago Booth School of Business. I am also Director of the George J. Stigler Center for the Study of the Economy and State and Co-Director of the Energy Policy Institute at Chicago (EPIC), both at The University of Chicago. In addition, I am a Senior Consultant at Charles River Associates (CRA), an economics consulting firm that specializes in the application of economic theory and statistics to legal and regulatory issues.

A. Summary of Qualifications

2. I am an economist, and I specialize in (among other things) microeconomics, which is the study of markets, pricing, and firm and industry behavior. I received a B.A. in economics from the University of California, Santa Barbara in 1974, and a Ph.D. in economics from the University of California, Los Angeles in 1981. In addition to my position at the Booth School of Business at The University of Chicago, I have been a member of the faculties in the Department of Economics at The University of Chicago and the Department of Economics at the University of California, Los Angeles. At these institutions, I have taught courses on Markets and Prices, Economic Theory, Labor Markets, Empirical Methods in Economics, Compensation and Personnel Policies, Industrial Organization and Antitrust, Business Strategy, and Law and Economics.

3. From 1993 to 2003, I served as Editor of the *Journal of Political Economy*, and from 1991 to 1993 I was a member of the Editorial Board of the *American Economic Review*, two of the leading professional publications in economics and economic theory. I am also a past founding editor of the *Journal of Labor Economics* (1982-92), and I currently am a member of the Editorial Advisory Board of the *International Journal of the Economics of Business* and the Advisory Board of the Economics Research Network. I am a Research Associate of the National Bureau of Economic Research, an elected member of the Council on Income and Wealth, an elected Founding Member of the National Academy of Social Insurance, and a Fellow of the Stanford University Center for the Study of Poverty and Inequality. In 2004, I was elected a Fellow of the Society of Labor Economists. In 2005, I received the Eugene Garfield Award for

contributions to the economics of medical research, and, in 2007, I received the Kenneth Arrow Award from the International Health Economics Association.

4. I have held various visiting and research positions with the Board of Governors of the Federal Reserve, the World Bank, the Economics Research Center of the National Opinion Research Center, the Brookings Panel on Economic Activity, the Rand Corporation, and the Center for the Study of the Economy and the State. I have published numerous articles in the academic literature. My curriculum vitae appears in Appendix A.

B. Assignment

5. This case involves allegations of anticompetitive harm and damages suffered by purchasers of certain models of Apple's iPod portable music player. Plaintiffs allege that software and firmware updates included on certain generations of iPod models, beginning with the iPod Nano 2nd Generation introduced on September 12, 2006, caused prices of all iPods sold between September 12, 2006 and March 31, 2009 to be higher than they otherwise would have been had the updates not been released.[1]

6. Plaintiffs offer the declaration of Professor Roger Noll, who addresses both liability claims and damage calculations.[2] Professor Noll acknowledges that under Plaintiffs' "lock-in" theory, the challenged updates could potentially lower, leave unchanged, or raise the prices of affected iPods. He asserts that determining which of these effects occurred "is an empirical issue."[3] To resolve that issue, he relies on a "hedonic regression" analysis of iPod prices and product attributes from which he concludes that the challenged conduct raised iPod prices. [redacted].[4]

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1 Order Granting Plaintiffs' Motion for Class Certification, November 22, 2011, pp. 5, 9.

2 Declaration of Roger G. Noll on Liabilities and Damages, April 3, 2013, hereinafter "Noll declaration."

3 Noll declaration, pp. 15-17. See also Declaration of Roger G. Noll, January 18, 2011 (hereinafter, "Noll January 18, 2011 declaration"), in which he says that the introduction of Harmony initially made iPods more attractive to consumers because they were able to download music from vendors other than the iTMS (p. 54). The long run effect would be to increase competition, which presumably would have caused prices to fall. From an economic perspective, the opposite would also be true – the initial effect of disabling Harmony (if indeed there was any effect at all) would be to make iPods less, not more, attractive and thus prices would initially be lower, not higher.

4 Corrections to Declaration of Roger G. Noll on Liabilities and Damages, May 31, 2013, hereinafter "Noll corrections to declaration," pp. 1-2. [redacted]

7. I have been asked by counsel for Apple to examine whether Professor Noll's estimates of damages are scientifically valid, accurate and reliable.

8. This report sets forth my opinions and describes the bases for those opinions as well as the data and analyses that underlie them. My opinions are based upon my analysis of documents and data produced in this matter; discovery responses; deposition transcripts; declarations, pleadings, and other filings; declarations previously submitted by Professor Noll, Dr. Burtis, Dr. Martin, and Dr. Kelly; reports of Professor Noll, Dr. Martin, and Dr. Kelly and materials cited therein; data provided by both parties, and information from public sources. My opinions are also based upon my general expertise in economics. During the course of my work, I have had access to an electronic database that contains all the documents and data produced in this case. The materials and information I considered in forming my opinions are listed in Appendix B to this report.

C. Summary of Opinions

9. Based on my economic and econometric analysis described in detail below, my overarching opinion is that Professor Noll's hedonic regression analysis of iPod prices is flawed, unreliable and highly misleading. The model itself is inconsistent with the basic economics of Plaintiffs' and Professor Noll's theory of harm and is also inconsistent with the basic facts of this case. Moreover, even ignoring these conceptual flaws, Professor Noll has miscalculated the precision of his claimed effects — in truth, even the "overcharges" he estimates are not statistically distinguishable from zero.

10. My opinions include the following in addition to those expressed more fully herein:

- Opinion 1: Professor Noll has vastly exaggerated the statistical precision of his model. He incorrectly assumes that the millions of price observations in his data are statistically independent of one another. [redacted]

[redacted]

[redacted] But these observations are not independent; they are perfectly correlated — if one knows the price of one unit, one knows the price of all of them. By incorrectly treating millions of highly correlated observations as independent pricing decisions, Professor Noll has claimed to estimate his model with an absurd degree of precision. Correcting his error using standard econometric techniques that account for non-independence, I demonstrate that his estimates of alleged "overcharges" are indistinguishable from zero.

- Opinion 2: Professor Noll's regression analysis produces implausible results that are inconsistent with the economics of Plaintiffs' theory. His results are based on unsupported assumptions that are inconsistent with the basic facts of this case.
    - His regression purports to show that the challenged conduct had an immediate and uniform impact on prices of all iPods sold from September 12, 2006 onward. This is contrary to his and Plaintiffs' theory in which the degree of "lock-in" would be proportional to the increase in iPod owners' accumulated stocks of FairPlay-protected music caused by the challenged update. This effect was zero in September of 2006, so even under Plaintiffs' theory the update could not have raised iPod prices at that time. Professor Noll's regressions are incapable of determining when an overcharge, if any, would have occurred.
    - The regression also produces "but-for" prices that are contrary to the way in which Apple actually sets prices. [redacted]
- Opinion 3: Notwithstanding other flaws in Professor Noll's model, his overcharge estimates are based on an incorrect characterization of the "but-for" world that would have existed in the absence of the challenged update. [redacted] The DRM protection technology in versions of iTunes used prior to

that date — specifically in iTunes 4.7, 5 and 6 — has been found legal. Thus the proper "before-and-after" estimate of the effect of the [redacted] would compare the level of iPod prices after the introduction of iTunes 7.0 to the "but-for" price level that existed under the legal DRM technology of iTunes 4.7 through 6. Professor Noll incorrectly measures the but-for price level from a three-month period *before* the introduction of iTunes 4.7 in October 2004 — nearly two years before the introduction of iTunes 7. This means that he does *not* measure the incremental effect on iPod prices of the [redacted] contained in iTunes 7; rather he includes the legal "effect" of iTunes 4.7 technology and functionality in his estimate of an alleged overcharge due to iTunes 7. This error alone doubles Professor Noll's estimated of "overcharge" among resellers, and it increases his estimated "overcharge" among direct purchasers by a factor of six.

- Opinion 4: Professor Noll's regression model is incorrectly formulated. Among other errors:
    - His model does not and cannot separate the impact of the challenged [redacted] feature from other factors that impact iPod prices and occurred at the same time the [redacted] feature was introduced. Despite his claim to control for relevant product attributes and market forces, he omits many valuable attributes of iPods, iTunes, and iTMS that affect the prices of iPods. He also fails to account for the fact that 80 percent of the iTMS music catalogue was DRM-free on January 6, 2009, nearly four months before he turns on his indicator variable.
    - Professor Noll also incorrectly constrains his model so that iTunes 7 must have the same percentage impact on the prices of all iPod models, even models that could not invoke the challenged [redacted] feature and so continued to be compatible with Harmony. There is no economic or factual support for the assumption that any overcharge would be exactly the same for different products purchased by different class members, especially models that could not invoke the challenged [redacted] feature. At deposition, Professor Noll suggested that he might attempt to fix this problem by estimating product-specific price effects of the iTunes 7 introduction. But this is not a fix. Even ignoring his model's other flaws, this

approach yields estimated "effects" of iTunes 7 that are inconsistent with Plaintiffs' theory. Moreover, this approach cannot provide an "overcharge" estimate for the iPod Touch because it did not exist prior to the introduction of iTunes 7.

- Professor Noll's attempt to account for technological progress ("Moore's Law") by using the "log of time" is, by his own testimony, incorrect and inconsistent with standard econometric practice. As in other instances, each of these errors and omissions increased Professor Noll's estimates of overcharges.

- Opinion 5: Correcting Professor Noll's errors in the context of his own model causes his estimates of "overcharge" and "damage" to vanish.

- Opinion 6: A necessary predicate for his theory of damages is that enough iPod owners were purchasing RMS music, and would have continued to do so, to have an impact on iPod prices. Professor Noll merely assumes that this was the case — i.e., that iPod owners were in fact purchasing RMS music and would have continued to do so in sufficient quantities to impact iPod demand. To the extent this is not the case, Professor Noll's damages theory fails as a threshold matter. Professor Noll has offered no evidence that anyone, let alone a material fraction of iPod owners, would have used Harmony and RMS, or ever did. Prior to the challenged update, RMS accounted for only about three percent of all digital downloads, a share that would have been substantially lower among iPod owners.

II. BACKGROUND: ITUNES, IPODS AND THE CHALLENGED CONDUCT

11. This section presents a brief overview of the relevant products and technologies at issue and a timeline of relevant events.

A. The Development of the iTunes/iPod/iTMS Platform

12. Exhibit 1 is a timeline of key events in the evolution of the iTunes/iPod/iTMS platform.

1. iTunes

13. iTunes is a "jukebox" software program that allows users to import, manage and play digital music files on the users' computers. Apple introduced the first version of iTunes for its Mac line of computers in 2001 and iTunes for Windows in October 2003. Since iTunes was first introduced, there have been ten major (version) updates, or just under one per year on average. The first of these version updates, iTunes 2.0, added integration with iPods along with improvements in CD burning capabilities and enhanced sound capabilities.[5] In general, the new version updates enhanced the operation of the music player; added or supported new features in iPods, such as photo and/or video; and supported new content from the iTMS (e.g., movies, TV shows, and games).[6] There have also been 78 smaller updates: some added features or supported new iPods; others were released in order to "fix" particular technical issues. For example, iTunes 4.7 was released to support the new photo feature added to the iPod Classic, improved FairPlay in response to hacks, and fixed other bugs.[7] All told, there have been 88 different updates, the most recent of which (iTunes 11.0.4) was released on June 5, 2013.[8] (See Exhibit 2 for a history of the various versions of iTunes and the major updates to those versions through March 2012.)

2. iPod

14. Apple introduced the first iPod in October 2001. The iPod could play music from a variety of sources, including a CD collection copied or ripped to the user's computer and then synced or loaded to an iPod using iTunes; music obtained online without DRM protection, including from music stores that offered music without DRM; music that originally had DRM protection but had been copied to a CD and then copied back to a computer (burned and ripped);

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5 Apple Press Release, "Apple Announces iTunes 2; Best Digital Music Software Gets Even Better," October 23, 2001 (Apple_AIIA00974863-5).

6 Apple Press Release, "Apple Introduces iPod shuffle; First iPod Under $100," January 11, 2005 (Apple_AIIA00974708).

7 "iTunes version history," Wikipedia, The Free Enclyclopedia, http://en.wikipedia.org/wiki/ITunes_version_history (accessed June 25, 2013); Declaration of Dr. John P. J. Kelly in Support of Defendant's Renewed Motion for Summary Judgment, April 18, 2011 (hereinafter, "Kelly declaration in support of MSJ"), ¶22.

8 This number includes 10 versions after version 1, 26 sub-version updates, and 52 more minor updates. iTunes 4.7 is not counted as a separate version, but rather as one of the sub-version updates. See "iTunes version history," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/ITunes_version_history (accessed June 25, 2013 and verified July 17, 2013).

and later, music purchased from iTMS. From the time the iPod was first introduced, Apple released new generations that added features to the first model, which it later called the "classic," and introduced new iPod models that had significantly different features. (For a description of the evolution of iPod features over time, see Exhibit 3.) The following paragraphs offer a brief overview of these product introductions and enhancements.

15. iPod Classic. The first iPod (iPod Classic 1st Generation) was smaller and lighter than other devices then on the market, had only 5GB memory, and was touted for its ability to put "a thousand songs in your pocket."[9] Five months later, Apple introduced a second-generation iPod with twice the memory, and four months after that Apple introduced their next update with twice again the memory. In just nine months, the capacity of the iPod had quadrupled from 5GB to 20GB. Over the years, Apple continued to add memory to the iPod Classic: by September 2006 the iPod Classic 5th Generation was available with 80GB memory and a year later, the iPod Classic 6th Generation was available with 160GB. (See Exhibit 4 for a summary of enhancements to iPod memory.) At the same time, Apple continued to add features. In April 2003, Apple began to offer iPods with USB connectivity in addition to the FireWire cable that they had offered initially.[10] Over time, successive generations of the iPod Classic became smaller and lighter, had more memory and longer battery life, and were generally sold at prices lower than the models they replaced. Later, when photo and video were introduced, the iPod began to feature high-resolution color screens that improved with each new generation. (For a summary of the history of the iPod Classic, see Exhibit 5a.)

16. iPod Mini. The iPod Mini was introduced in January 2004. It was half the size of the original iPod. With 4GB of memory the Mini held 1000 songs – the smallest portable digital music player to do so at the time. According to Apple's press release, it could also transfer music at the rate of a song per second, and it could be conveniently charged using either the

[9] Apple Press Release, "Apple Presents iPod; Ultra-Portable MP3 Music Player Puts 1,000 Songs in Your Pocket," October 23, 2001 (Apple_AIIA00974636). See also http://www.vaughanpl.info/vortex/?p=5261.

[10] Although FireWire was faster at the time the iPod was introduced, it was also limited by the fact that it was not usually standard on personal computers. See, e.g., http://www.qimaging.com/support/pdfs/firewire_usb_technote.pdf.

included FireWire or USB cable.[11] The 2nd Generation Mini was introduced a year later. It was smaller, lighter, held 50 percent more music and featured increased battery life of up to 18 hours, and it sold for the same price as the previous model. While it was in production, the Mini was one of the most popular electronic products on the market.[12] (See Exhibit 5b.)

17. iPod Shuffle. On January 11, 2005, Apple introduced the iPod Shuffle, a digital music player based on iTunes' shuffle feature, which randomly selected songs from the user's library for placement on the iPod. In replaying the music, the Shuffle "shuffled" the music so that users got a new combination of music every time they listened. The Shuffle was smaller and lighter than a pack of gum and was available for less than $100.[13] (See Exhibit 5c.)

18. iPod Nano. In September 2005, Apple introduced the iPod Nano as a replacement model for the Mini. The Nano was a full-featured iPod that was smaller and lighter than anything then on the market and featured a redesigned color screen.[14] Industry commentators praised the Nano for its innovative design.[15] PC World named it one of five ground-breaking products in the audio category in its 2006 World Innovations Awards.[16] The 1st Generation Nano was 1.6 inches wide, 3.5 inches long, .27 inches thick and weighed 1.5 oz.; it had a stated battery life of up to 14 hours; and the screen was a 1.5-inch (diagonal) liquid crystal display panel at 176×132 resolution. The Nano could also hold and display between 15,000 and 25,000 photos.[17] The following year, Apple introduced a completely redesigned 2nd Generation Nano with twice the

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[11] Apple Press Release, "Apple Introduces iPod mini; Smallest 1,000 Song Music Player Ever Comes in Five Colors," January 6, 2004 (Apple_AIIA00974840).

[12] "iPod Mini," Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/wiki/IPod_Mini (accessed July 16, 2013).

[13] Apple Press Release, "Apple Introduces iPod shuffle; First iPod Under $100," January 11, 2005 (Apple_AIIA00974708).

[14] Apple Press Release, "Apple Introduces iPod nano," September 7, 2005 (Apple_AIIA00974603).

[15] The Nano turned out to be very popular – more than a million were sold in the 17 days following its introduction. Drew Turner, Daniel, "Apple hits $1 Billion in Profit for 2005," eWeek, October 10, 2011, http://www.eweek.com/c/a/Apple/Apple-Hits-1-Billion-in-Profit-for-2005/ (accessed July 16, 2013). PC World named it one five ground-breaking products in the audio category in its 2006 World Innovations Awards. "2006 PC World Innovations Awards," PR Newswire, January 4, 2006, http://www.prnewswire.com/news-releases/2006-pc-world-innovations-awards-winners-unveiled-53127872 html (accessed July 16, 2013).

[16] "2006 PC World Innovations Awards," PR Newswire, January 4, 2006, http://www.prnewswire.com/news-releases/2006-pc-world-innovations-awards-winners-unveiled-53127872 html (accessed July 16, 2013).

[17] http://support.apple.com/kb/sp42.

storage capacity and 24 hours of battery life for the same price as the previous generation.[18] Apple continued to introduce new generations of Nanos with additional innovative features. In September 2009, for example, it introduced the first Nano with a built-in video camera. (See Exhibit 5d.)

19. iPod Touch. The most recent addition to the iPod product line is the iPod Touch. Introduced in September 2007, the Touch featured a multi-touch interface, together with widescreen display and built-in Wi-Fi wireless networking, which allowed browsing and wireless viewing of internet videos. In addition, users could browse, preview, and buy and download songs from iTMS.[19] A year later, Apple introduced the 2nd Generation Touch. Smaller and lighter than the original, it featured a thin metal design and a 3.5-inch widescreen glass display. With the new Touch, users could "listen to millions of songs, watch thousands of Hollywood movies and now, thanks to the App Store [which opened at about the same time], download and play hundreds of great games on their iPods."[20] (For a summary of the history of the iPod Touch, see Exhibit 5e.)

3. The iTunes Store

20. Apple opened its online music store ("iTMS") in April 2003, which allowed users to purchase DRM-protected music files that could be played on an Apple personal computer or, after syncing with iTunes, on an iPod. The only way to access the iTMS was and is through iTunes. In October 2003, Apple introduced iTunes for Windows, which allowed owners of personal computers using the Windows operating system to use iTunes to purchase content from iTMS and to sync that content on iPods. When the iTMS opened in April 2003, it offered 200,000 songs.[21] By March 2004, there were more than 500,000 songs available, and in August 2004 Apple announced that its catalogue topped one million songs.[22] On February 23, 2006,

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[18] Apple Press Release, "Apple Introduces the New iPod nano; World's Most Popular Digital Music Player Features New Aluminum Design in Five Colors & 24 Hour Battery Life," September 12, 2006 (Apple_AIIA00974838).

[19] Apple Press Release, "Apple Unveils iPod Touch," September 5, 2007 (Apple_AIIA00974641).

[20] Apple Press Release, "Apple Introduces New iPod touch," September 9, 2008 (Apple_AIIA00974932).

[21] Apple Press Release, "Apple Launches the iTunes Music Store," April 28, 2003 (Apple_AIIA00974776).

[22] Apple Press Releases, "iTunes Music Store Downloads Top 50 Million Songs," March 15, 2004 (Apple_AIIA00974577); "iTunes Music Store Catalog Tops One Million Songs," August 10, 2004 (Apple_AIIA00974782).

Apple announced that one of its users had purchased and downloaded the one-billionth song from iTMS. At the time, there were two million songs available.[23] By January 2009, iTMS offered approximately ten million songs, approximately eight million without DRM; and by September 2012, it offered 26 million songs.[24] The competition lagged far behind. When the Real Music Store (RMS) opened in January 2004, it had a catalogue of 300,000 songs, which was about half the size of the iTMS catalogue at the time.[25] By the time the Amazon.com music store debuted in September 2007 with approximately two million songs,[26] iTMS had a catalogue with more than five million songs.[27]

21. Music is not the only thing available from the iTMS.[28] On October 12, 2005, the iTMS began to offer music videos, Pixar short films, and hit TV shows for $1.99.[29] At the same time,

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[23] Apple Press Releases, "iTunes Music Store Downloads Top One Billion Songs; Scholarship at Juilliard School of Music to be Created February 23, 2006 (Apple_AIIA00974735); Levy, Steven, *The Perfect Thing: How the iPod Shuffles Commerce, Culture, and Coolness*, hereinafter "The Perfect Thing," pp. 135-136.

[24] Apple Press Release, "Changes Coming to the iTunes Store," January 6, 2009, http://www.apple.com/pr/library/2009/01/06Changes-Coming-to-the-iTunes-Store html (accessed July 16, 2013); "Apple Unveils New iTunes; Featuring Dramatically Simplified Design & Seamless iCloud Integration," September 12, 2012, http://www.apple.com/pr/library/2012/09/12Apple-Unveils-New-iTunes.html (accessed July 16, 2013).

[25] CNET News, "Real offers new tech, song store," January 7, 2004, http://news.cnet.com/2100-1027-5136275.html (accessed July 16, 2013).

[26] Amazon.com began to offer digital downloads in a public beta test in September 2007. However, music from two of the major labels, Warner and Sony, was not available until January 2008. At that time Amazon's music catalogue reached over 3.1 million songs. See, e.g., ArsTechnica, "Amazon's MP3 store brings more DRM-free music at lower prices than iTunes Store," September 25, 2007, http://arstechnica.com/uncategorized/2007/09/amazon-launches-public-beta-of-mp3-music-store/ (accessed May 28, 2013); NY Times, "Amazon to Sell Warner Music Minus Copy Protection," December 28, 2007, http://www nytimes.com/2007/12/28/technology/28music html?_r=0 (accessed May 28, 2013); NY Times, "Sony Joins Other Labels on Amazon MP3 Store," January 11, 2008, http://www nytimes.com/2008/01/11/technology/11sony html (accessed May 28, 2013); Antone Gonsalves, "Amazon Adds Fourth Major Record Label To DRM-Free Music Store," Information Week, January 10, 2008, http://www.informationweek.com/amazon-adds-fourth-major-record-label-to/205602334 (accessed May 28, 2013).

[27] Apple Press Release, "Apple Announces iTunes U on the iTunes Store; Free Content From Top Universities Now Available." May 30, 2007 (Apple_AIIA00974843).

[28] With the release of iTunes 4.9 on June 28, 2005, Apple began to offer users the ability to discover, manage and subscribe and listen to podcasts right on their computers. In just the first two days, iTunes customers subscribed to more than one million Podcasts. Apple Press Release, "Apple Takes Podcasting Mainstream; Discover, Subscribe, Manage & Listen to Podcasts Right in iTunes 4.9," June 28, 2005 (Apple_AIIA00974620); Apple Press Release, "iTunes Podcast Subscriptions Top One Million in First Two Days," June 30, 2005 (Apple_AIIA00974799).

Apple introduced the iPod Classic 5th Generation (video) so that consumers could take advantage of the additional content. Over the first three weeks video was available, iTMS customers purchased more than one million videos.[30] The following September, Apple announced that the iTMS would start selling movies. When the service first became available, the iTMS offered 75 movies from Walt Disney Pictures, Pixar, Touchstone Pictures and Miramax Films that customers could download to watch on their computers and iPods.[31] By January 2007, the iTMS offered 250 feature films and 350 television shows.[32] By the end of May, there were more than 500 movies.[33] Also in September 2006, the iTMS began to offer downloads of popular video games for fifth generation Classic iPods, all available for $4.99.[34]

B. The Introduction and Use of DRM

22. [redacted]

Apple complied with this contractual requirement by developing and using its own proprietary DRM called FairPlay. Other music stores used different proprietary DRM such as RealNetworks' Helix and Microsoft's WMA DRM. The result was that DRM-protected music files purchased from a vendor using one of these methods could only be loaded and played on devices that supported that DRM technology. This meant that digital music downloads obtained from online music stores that used Microsoft's WMA DRM or downloads from the RMS could

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29 Apple Press Release, "Apple Announces iTunes 6 With 2,000 Music Videos, Pixar Short Films & Hit TV Shows," October 12, 2005 (Apple_AIIA00974906). At the time, the Chairman of record label Interscope Geffen A&M said: "Apple is giving music fans a great way to own their favorite music videos."

30 Apple Press Release, "iTunes Music Store Sells One Million Videos in Less Than 20 Days," October 31, 2005 (Apple_AIIA00974894).

31 Apple Press Release, "Apple Announces iTunes 7 with Amazing New Features," September 12, 2006 (Apple_AIIA00974982). Sometime between June and September, the name of the iTunes Music Store was changed to the iTunes Store. Nonetheless, I continue to refer to the store as the iTMS.

32 Apple Press Release, "iTunes Store Tops Two Billion Songs; 50 Million TV Shows & Over 1.3 Million Movies Sold." January 9, 2007 (Apple_AIIA00974561).

33 Apple Press Release, "Apple Announces iTunes U on the iTunes Store; Free Content From Top Universities Now Available," May 30, 2007 (Apple_AIIA00974843).

34 Apple Press Release, "Apple Announces iTunes 7 with Amazing New Features." September 12, 2006 (Apple_AIIA00974982).

not be played on iPods. Similarly, music obtained from the iTMS could not be played on devices that used other (non-FairPlay) DRM technology.

C. RealNetworks RealPlayer with Harmony

1. RealNetworks (Real), Harmony and the Real Music Store

23. RealNetworks operated the RMS. Like the iTMS, the RMS was an online store that sold downloadable digital media files that could be played on personal computers and portable devices. Similar to iTunes, RealPlayer was Real's proprietary program for acquiring purchased downloads from the RMS, managing digital files, and loading those files on a portable music player.

24. In July 2004, RealNetworks announced that version 10.5 of its RealPlayer jukebox would include a new feature, which it called Harmony.[35] [redacted].[37]

[redacted]

[35] Cohen, Peter, "RealNetworks' Harmony Promises iPod Compatibility," PCWorld, July 26, 2004, http://www macworld.com/article/1035237/harmony html (accessed May 28, 2013).

[36] See Expert Report of David M. Martin Jr., PH.D., April 8, 2013 (hereinafter, "Martin report"), ¶27; Robbin declaration in support of MSJ, ¶9; Kelly declaration in support of MSJ, ¶¶32-33.

[37] Apple_AIIA00093860, pp. 3-5. See also Cohen, Peter, "RealNetworks' Harmony Promises iPod Compatibility," PCWorld, July 26, 2004, http://www macworld.com/article/1035237/harmony html (accessed May 28, 2013); Declaration of David F. Martin in Support of Plaintiffs' Opposition to Apple's Motion for Summary Judgment, February 28, 2011, ¶¶26-27.

[redacted].[38] Importantly, the court has ruled that the improved version of FairPlay included in iTunes 4.7 was not anticompetitive.

26. On April 26, 2005, Real announced that it had updated Harmony and restored its ability to mimic the current FairPlay encryption technology and thus interoperate with iPods.[39] I understand that Harmony remained operational with all iPod models and generations of iPod models — old and new — through September 11, 2006.

27. [redacted] Moreover, these are sales to all consumers, not just to iPod owners, and thus even these figures overstate that significance of Harmony to the issues in this case. Professor Noll himself testified in his deposition of April 7, 2011 that he doubted customers would have taken advantage of the ability to buy music from the RMS and use Harmony after it was re-launched to load it onto their iPods "because the consumers had already experienced the prior disabling."[41] In other words, according to Professor Noll, there weren't many RMS sales for iTunes 7 to "block" because the legal technology contained in iTunes 4.7

[38] Note, when iTunes 4.7 was first released, users had the option of whether to upgrade, i.e., users could continue to purchase and download from the iTMS whether they had upgraded or not. Following the introduction of a particular hack of the iTunes system that stripped the FairPlay DRM from music prior to its download and subsequent complaints from the record labels, Apple began to require any user who wished to purchase and download from the iTMS to upgrade to 4.7 first. See, e.g., Mook, Nate, "Apple Blocks iTunes DRM Hack," BetaNews, March 21, 2005, http://betanews.com/2005/03/21/apple-blocks-itunes-drm-hack/ (accessed May 28, 2013); Borland, John, "iTunes hack disabled by Apple," CNET News, March 21, 2005, http://news.cnet.com/Apple-disables-iTunes-hack/2100-1027_3-5628616.html (accessed May 28, 2013); Smith, Tony, "Apple plugs PyMusique iTunes 'hole,'" The Register, March 22, 2005, http://www.theregister.co.uk/2005/03/22/apple_blocks_pymusique/ (accessed May 28, 2013).

[39] Borland, John, "RealNetworks rekindles iPod tech tussle," April 26, 2005, http://news.cnet.com/2100-1027_3-5685286.html (accessed June 26, 2013).

[40] [redacted]

[41] Videotaped Deposition of Roger G. Noll, April 7, 2011 (hereinafter, "Noll April 7, 2011 deposition"), p. 144:22-23.

had already dissuaded iPod owners from purchasing RMS music and using Harmony. This is clearly a major problem for Plaintiffs' theory, which requires that in the absence of iTunes 7 iPod owners would avail the RMS in substantial numbers. Yet, in the absence of iTunes 7, Professor Noll doesn't believe that iPod owners were using Harmony or RMS, an opinion that accords with the evidence on RMS sales.

28. Ignoring all of this, Professor Noll refers to RealNetworks' claim that it sold 3 million downloads during its three-week promotional sale when it launched Harmony in August 2004.[42] But the relevant question is not what Harmony was doing in 2004, but rather what its sales were at the time it was blocked in 2006.

D. Challenged Conduct

29. On September 12, 2006, Apple introduced iTunes 7, which included many enhancements and upgrades to iTunes functionality (see Exhibit 6). [redacted]

30. Two new iPod models were introduced at the same time as iTunes 7: the iPod Shuffle 2nd Generation and the iPod Nano 2nd Generation. In addition, Apple added some features to the iPod Classic 5th Generation (a.k.a. iPod video), which had been introduced the previous year, but did not introduce a new generation of the Classic. [redacted]

[42] Noll declaration, p. 53, note 93.

[43] See Martin report, ¶¶98-99.

[redacted]

31. [redacted]

32. I understand that, as of the date of his April 3, 2013 report, Professor Noll did not know which iPod models included the [redacted] and [redacted] and which did not. [redacted]

[44] Supplemental Declaration of Augustin Farrugia, July 3, 2013, ¶3; Martin report, ¶84.

[45] Martin report, ¶¶21-22.

[46] Martin report, ¶84; Supplemental Declaration of Augustin Farrugia, July 3, 2013, ¶¶2-3.

[redacted]

E. The End of DRM

33. As early as 1998, there was at least one paid service (eMusic) that offered paid downloads of music without DRM protection.[49] By September 2006, there were at least 24 sites that offered DRM-free music, all but four of which offered fully or partially paid service.[50] (See Exhibit 7.) On February 6, 2007 — less than five months after the introduction of iTunes 7 — Apple CEO Steve Jobs published an open letter called "Thoughts on Music." In it, he called on the major labels to allow Apple to sell their music without DRM protection: "This is clearly the best alternative for consumers, and Apple would embrace it in a heartbeat. If the big four music companies would license Apple their music without the requirement that it be protected with a DRM, we would switch to selling only DRM-free music on our iTunes store."[51]

34. Two months after Jobs' open letter, on April 2, 2007, EMI announced it was launching new premium download service and that, effectively immediately, all of its digital catalog would

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47 Declaration of Agustin Farrugia in Support of Defendant's Renewed Motion for Summary Judgement, ¶¶31-32.

48 Noll deposition, p. 200:9-19; Exhibits 15.1, 15.2.

49 eMusic was a subscription service that primarily sold music from independent labels. See "eMusic," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Emusic (accessed May 28, 2013).

50 Three of these – Kazaa, Morpheus and Limewire – were peer-to-peer file sharing sites, and all three were sued by the record industry. Kazaa converted to a "legal" site in 2006; Morpheus filed for bankruptcy in 2008; and Limewire was shut down by a judge in 2010. "Kazaa site becomes legal service," BBC News, http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/2/hi/technology/5220406.stm (accessed May 28, 2013); "Encyclopedia: Kazaa," PCMag.com, http://www.pcmag.com/encyclopedia/term/45734/kazaa (accessed May 28, 2013); "LimeWire," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Limewire (accessed May 28, 2013); "Morpheus (software)," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Morpheus_(software) (accessed May 28, 2013); "National Geographic unveils World Music downloads service," PC Pro.co.uk, http://www.pcpro.co.uk/news/90308/national-geographic-unveils-world-music-downloads-service (accessed May 28, 2013).

51 Jobs, Steve, "Thoughts on Music," February 6, 2007 (AIIA00093477).

be available with higher sound quality and without DRM restrictions through the iTMS.[52] Amazon.com launched a public beta test of its own online music store on September 25, 2007 with approximately two million DRM-free songs from EMI, Universal, and a number of leading independent labels.[53] At that point, iPod owners could purchase music from Amazon and load it on their iPods, or use it on some other brand of player. In January 2008, Amazon became the first music store to sell music without DRM from all of the four major music labels (EMI, Universal, Warner Music, and Sony BMG).[54] (See Exhibit 8.)

35. A year later, on January 6, 2009, Apple announced that all four of the major labels as well as thousands of independent labels would begin to offer their music through the iTMS in DRM-free format with higher quality encoding. Approximately eight million of Apple's ten million songs would be available immediately—the rest were to be available by the end of March 2009.[55]

F. Quality Adjusted iPod Prices Rapidly Declined During the Period at Issue

36. Exhibit 9 provides a summary of the impact of these product introductions and enhancements on quality-adjusted iPod prices. [redacted]

[52] Apple Press Release, "Apple Unveils Higher Quality DRM-Free Music on the iTunes Store," April 2, 2007 (Apple_AIIA00974869).

[53] Amazon Press Release, "Amazon.com Launches Public Beta of Amazon MP3, a Digital Music Store Offering Customers Earth's Biggest Selection of a la Carte DRM-Free MP3 Music Downloads," citing Business Wire, "Amazon MP3 Offers Over 2 Million Songs From More Than 180,000 Artists and Over 20,000 Labels, Including EMI Music and Universal Music Group," September 25, 2007. Available at http://phx.corporate-ir.net/phoenix.zhtml?c=176060&p=irol-newsArticle_pf&ID=1055053, last accessed 5/28/2013.

[54] See, e.g., "Amazon MP3," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Amazon_MP3 (accessed May 28, 2013); Jeff Leeds, "Amazon to Sell Warner Music Minus Copy Protection," The New York Times, December 28, 2007; Antone Gonsalves, "Amazon Adds Fourth Major Record Label To DRM-Free Music Store," Information Week, January 10, 2008.

[55] Apple Press Release, "Changes Coming to the iTunes Store," January 6, 2009, http://www.apple.com/pr/library/2009/01/06Changes-Coming-to-the-iTunes-Store html (accessed May 28, 2013).

[56] [redacted]

[redacted]

III. PLAINTIFFS' AND PROFESSOR NOLL'S THEORY OF IMPACT AND DAMAGES

37. Plaintiffs claim that the challenged update created a form of "lock-in" that made it more difficult for buyers of downloaded digital music to switch from iPods to other brands of music players. Before the introduction of RealPlayer with Harmony, iPods could play directly DRM-protected music from only iTMS unless they removed the DRM protection by burning and ripping, using a virtual burner or other means. According to Professor Noll, because an iPod owner's accumulated stock of iTMS music could not be easily transferred without incurring significant switching costs, as iPod owners accumulated iTMS music they become locked-in to purchasing an iPod as a replacement player. Putting it differently, the increase in the size of their iTMS libraries reduced the incentive or opportunity to purchase a non-iPod device. RealPlayer with Harmony allegedly reduced this lock-in effect by offering users an alternative source of DRM-protected music that could play on competing devices.

38. According to Professor Noll, the initial effect of Harmony would be to make iPods relatively more attractive—iPods could play music from two sources rather than one—which

[redacted]

would increase demand and ultimately prices for iPods.[58] As he recently explained at deposition, the amount of lock-in depends on the amount of iTMS music relative to other types of music (e.g., RMS music, DRM-free music) in an owner's library. Over the long run, according to Professor Noll, Harmony would have reduced the lock-in as iPod owners accumulated more RMS music than iTMS music.[59] His theory is that some of those iPod owners would have purchased competing players, reducing the demand for iPods and thus iPod prices.

39. According to Professor Noll, the introduction of iTunes 4.7 in October 2004 arrested the chain of events that would have led to lower iPod prices. Because the update disabled Harmony, over time iPod owners were allegedly more likely to purchase music downloads from iTMS, and less likely to purchase from RMS. Though blocking Harmony would initially have made iPods less attractive according to Plaintiffs' theory, at some future point the accumulating stock of iTMS-purchased music would make some iPod owners less likely to purchase a competing digital player. This is the "lock-in" that allegedly allowed Apple to charge higher prices.

40. Central to Professor Noll's and Plaintiffs' theory, in April 2005 Real introduced a new version of Harmony that worked around iTunes 4.7. For roughly the next 18 months, iPod users could acquire and play DRM-protected music purchased from RMS, which would allegedly reduce the "lock-in" of some iPod owners—the ones who chose to purchase from the RMS. The introduction of iTunes 7 in September 2006 disabled Harmony on certain iPod models. Going forward, according to their theory, owners of affected iPod models who would otherwise have purchased music downloads from the RMS would no longer do so. At some future date, after they built iTMS libraries and increased their switching costs, the incremental lock-in of iPod owners who would otherwise have used Harmony made them less likely to switch to other brands of music players. The incremental lock-in caused by iTunes 7 allegedly allowed Apple to

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[58] Noll January 18, 2011 declaration, p. 54.

[59] [redacted] Plaintiffs' theory was that the alleged drop in iTMS sales and corresponding increase in Real sales showed that Harmony allowed Real to capture iTMS sales and that ultimately fewer iPod owners would be locked into buying an iPod for the next purchase. The evidence suggests that if Real's or iTMS's sales were impacted by Real's three-week, half-price music sale in July 2004, it was a temporary effect due to the temporary discount offered to introduce Harmony to the market. See Plaintiffs' Notice of Motion and Renewed Motion for Class Certification and Appointment of Lead Class Counsel, p. 7, and Noll declaration, pp. 53, 60.

overcharge for all iPod models sold between September 12, 2006 (when iTunes 7 was introduced [redacted] and March 31, 2009 (when all music on the iTMS was available without DRM).

IV. PROFESSOR NOLL'S HEDONIC PRICE REGRESSION AND INFERENCE OF DAMAGES

41. Professor Noll uses a hedonic multiple linear regression in an attempt to estimate damages by comparing iPod prices during the proposed class period to prices during a "before" period that, he assumes, represents what would have occurred "but-for" the challenged conduct, while at the same time attempting to control for factors such as product features and functionality that would also affect iPod prices.[60] Using his regressions, he claims to show that the [redacted] caused an anticompetitive increase in the price of all iPod models. His regression predicts that the effect was immediate and constant, beginning on September 12, 2006 when the [redacted] was introduced and lasting until March 31, 2009, the end of the class period. He also claims that the percentage overcharge was exactly the same for each iPod model, even models that could not invoke the [redacted].

42. I begin with a brief overview of regressions. Next I discuss the concept of "hedonic" models of prices and how regressions have been used to estimate such models. With these elements as background, I then turn to a description of Professor Noll's regressions.

A. Multiple Linear Regression

43. A multiple linear regression is a statistical technique for estimating the empirical relationship between one measureable variable, call it P, and "multiple" other variables, $X = \{X^1, X^2, X^3, \ldots, X^K\}$, which are often called "explanatory variables." In the current context, P might measure the price of a particular model (m) of MP3 player at a particular date (t), which we could denote P_{mt}. For example, the retail price (P) of an iPod Touch with 8 GB of storage capacity (m) in September 2007 (t) was $299, so $P_{mt} = \$299$. X^1 might be a continuous variable that measures some valuable characteristic of the Touch, such as the megapixel resolution of its screen, and so on.

[60] Noll declaration, p. 71.

44. An indicator variable (or "dummy variable") is used to indicate that a particular condition is true or false. It takes the value 1.0 if the condition is true, and zero otherwise. For example, let X_{mt} be an indicator for whether model m had a touch screen at date t. Then this indicator would take the value $X_{mt} = 1$ if the model had a touch screen and $X_{mt} = 0$ otherwise. (The iPod Touch in fact had a touch screen in September 2007, so $X_{mt} = 1$ for that model and date. On the same date, the iPod Shuffle did not have a touch screen, so $X_{mt} = 0$ for the Shuffle.) Similarly, an indicator variable for time periods where music downloads were DRM-free would take the value 1 during such periods, and zero otherwise.

45. The adjective "linear" refers to the maintained assumption that in a given dataset that records values of P and X, the relationship between P and the multiple X's is linear. Then P_{mt} may be expressed as a linear combination of the X's:

(1) $$P_{mt} = X^1{}_{mt}B^1 + X^2{}_{mt}B^2 + X^3{}_{mt}B^3 + \ldots + X^K{}_{mt}B^K + U_{mt}$$

In equation (1) the parameters $B^j\ j=1,2,\ldots,K$ are unknown constants that represent how much P changes when a particular X^j increases by one unit, holding constant all the other X^i for $i \neq j$. For example, if "all else equal" the addition of a touch screen ($X^1{}_{mt}$ increases from $X^1{}_{mt} = 0$ to $X^1{}_{mt} = 1$) was associated with a \$50 increase in price, then $B^1 = \$50$. And so on.

46. In addition to the linear combination of observed and measurable variables X^j, the right side of equation (1) includes a "residual" quantity U_{mt}, which represents the portion of P_{mt} that cannot be represented by the linear combination of Xs that are included in the model. In general, the most useful way to think about U_{mt} is that it represents all of the "left out" factors that affect P but were not included in the model, either because the person constructing the model chose not to include them or because they are "unobserved" (i.e., not recorded in the available data).

47. Given the model (1) for the relation between X and P, there are well-known regression techniques available to estimate the unknown parameters $B^j\ j=1,\ldots K$. The most basic of these techniques is called "ordinary least squares" (OLS), and that is the technique Professor Noll used in the hedonic regression model reported in Exhibits 13.1 and 13.2 of his report.[61] Under very

[61] In his deposition, Professor Noll appears to be confused about the technique he used to produce the estimates in Exhibits 13.1 and 13.2. He claims that these exhibits show "generalized least squares" estimates with "robust" standard errors that have been adjusted for heteroskedasticity. This is incorrect. His Exhibits 13.1 and 13.2

specific assumptions, the OLS estimator b^j of the unknown parameter B^j has certain "nice" properties. One is that b^j is "unbiased," which means that while b^j is itself a random variable that will vary from one random sample to another, the expected value of b^j is equal to the unknown value of the parameter B^j. Put differently, if the OLS estimator is unbiased, then repeated samples from the same population will generate a number of OLS estimates, but these estimates will tend to cluster around the true value B^j.

48. When will the OLS estimator b^j of B^j have this "nice" property of being unbiased? The key assumption is that the elements of U—the "excluded" variables—are not correlated with the "included" variables X. The idea is quite simple and can be illustrated in the context of Professor Noll's regression. Suppose that iPod models that use the updated iTunes 7 also have higher resolution displays compared to earlier models, but resolution is not included among the explanatory variables, X. This means that display resolution is an omitted variable—in other words, it's in U. Then the estimated coefficient on iTunes 7 will "pick up" the effect of resolution on price, because the indicator for iTunes 7 and the omitted factors in U are correlated with one another. As a result, if the impact on price of higher resolution is positive and the impact of the [redacted] on price is zero, the estimated coefficient on the iTunes 7 indicator variable would be positive because it is "picking up" the effects of higher resolution. This is called "omitted variables bias," and it is, in fact, one of the many fatal flaws in Professor Noll's regression analysis.

49. I mentioned above that the least squares estimator b^j of the unknown parameter B^j is itself a random variable, with a mean and a standard deviation, which in the case of regression estimators is called the "standard error" of the estimator. The standard error SE^j of b^j is a measure of the precision of the estimator—the confidence we can have that the true value B^j is near the estimated value. SE^j can also be estimated from the data under appropriate assumptions. As explained below, Professor Noll's implicit assumptions in this regard are wildly at odds with the facts, which causes him to vastly overstate the precision and statistical significance of his results.

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report OLS results. Videotaped Deposition of Roger G. Noll, May 16, 2013, hereinafter "Noll deposition," p. 196:4-22. The Appendix to his report contains other exhibits in which standard errors have been adjusted for heteroskedasticity.

B. Hedonic Models of Prices for Products with Changing Quality

50. Economists have long recognized the difficulty of comparing prices over time for products with changing attributes. Computers provide a good illustration. In 2004, a personal computer with about 1 gigabyte (GB) of system memory, a 60 GB hard drive and a 15-inch cathode ray monitor could be had for about $1200. By 2010, the same $1200 expenditure would get a computer with 8 GB of memory, a 700 GB hard drive and 21-inch LCD monitor. The nominal price of a standard computer system had not changed, but technical progress in storage, memory and production made the 2010 model vastly superior. The "real" price of a standard computer had fallen dramatically, even though the nominal price had not changed.

51. Now consider iPods. In 2001, an original iPod Classic with 5 GB of storage capacity sold for $399. By 2005 the same $399 nominal price fetched a Classic with photo and video capabilities and 60 GB of storage, among other features. And by 2009, for a $249 nominal price a consumer could purchase a 160 GB iPod Classic with further product enhancements. Like computers, "real" prices of iPods were falling dramatically.

52. As these examples illustrate, an analysis of product pricing that ignores the evolution of product quality and features can be highly misleading. One way of dealing with this issue is to employ "hedonic" models of product pricing, in which products are explicitly viewed as bundles of changing attributes or characteristics.[62] A hedonic regression model is in the (basic) form of equation (1), above, where the X^J represent measures of product characteristics and the B^j represent the "relative valuation" of such characteristics or qualities.

V. PROFESSOR NOLL'S HEDONIC DAMAGE MODEL

53. Professor Noll's damages model is built on a hedonic regression model of iPod prices and certain product attributes.[63] The basic framework of this regression follows the form of equation (1) above: a particular measure of iPod prices (the natural logarithm of price, ln(*P*)) is regressed on a chosen set of product characteristics, *X*, and the estimated coefficients *b* are interpreted as

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[62] Griliches, Zvi, "Hedonic Price Indexes and the Measurement of Capital and Productivity: Some Historical Perspectives." *NBER Working Paper 2634* (June 1988).

[63] Noll declaration, pp. 71-72.

measuring "the relative valuation of such qualities."[64] Putting it differently, Professor Noll starts with the hedonic regression model described above and adds a set of indicators for the occurrence of certain events that, in his view, affected the nature of competition between Apple and other unspecified sellers of MP3 players. This set of "event" indicators is the centerpiece of Professor Noll's claim that he has measured the impact of Apple's challenged conduct.

54. Specifically, his model includes an indicator variable for the introduction of iTMS, which is meant to measure the impact of iTMS on iPod prices (the iTMS coefficient), an indicator variable for Harmony's introduction to measure its impact on iPod prices (Harmony coefficient), an indicator variable for iTunes 4.7 (Harmony blocked coefficient), an indicator variable for iTunes 7 (iTunes 7.0 coefficient), as well as indicator variables for when competing online music stores went DRM-free (competitors DRM free coefficient) and when iTMS went completely DRM-free (iTMS all DRM free coefficient). Professor Noll constrains his model so that the iTunes 7 variable estimates a single percentage overcharge on all iPod models sold after September 12, 2006, whether the iPod model included [redacted] or not. The regression makes no attempt to measure any impact of the reintroduction of Harmony, changes to iTunes or iTMS or the introduction of the [redacted].

55. [redacted] As I explain below, it is improper and invalid to interpret these unreliable empirical "results" as evidence of overcharge or damage from Apple's challenged conduct. Professor Noll's conclusions are unreliable and highly misleading.

A. How Professor Noll Constructs His Data

56. Professor Noll implements his pricing regression using a measure of the unit price of individual iPod models and some of their characteristics. His price measure is constructed from Apple's transactional databases for resellers and direct purchasers, for which he estimates separate damage models. For resellers, the data he uses for his regression encompass 2.14

[64] Griliches, Zvi, "Hedonic Price Indexes and the Measurement of Capital and Productivity: Some Historical Perspectives," *NBER Working Paper 2634* (June 1988), p. 1.

million multi-unit transactions that occurred between November 2001 and December 2010. (By multi-unit, I mean the sale of more than one iPod in a single purchase/sale transaction.) For direct purchasers the data he uses for his regression include 36.9 million transactions — many of which are multi-unit — that occurred between November 2001 and December 2010.[65]

57. "Price" is not directly reported in either of these databases; instead the data report the total number of units purchased and the amount paid in each individual transaction between Apple and the buyer. [redacted] He does this for every such transaction, for both resellers and direct purchasers. His reseller regression data are made up of 2.14 million actual multiunit transactions, but by counting each transaction hundreds or even thousands of times, he effectively pretends that his regression model is using 113 million *independent* price observations. This is a serious error. As I discuss below, by ignoring the fact that his observations are not independent, Professor Noll exaggerates the precision of his regression estimates and their statistical significance.

58. It is important to understand how to interpret the regression estimates when this is done. The dependent variable in his regression is the natural logarithm of the calculated price. A basic mathematical "fact" about natural logarithms is that a change in the natural logarithm of some quantity is approximately the percentage change in that quantity. [redacted] This fact is useful in interpreting Professor Noll's regression results — if a variable in his regression has a coefficient

[65] Noll declaration, Exhibits 13.1 and 13.2.

of .05, for example, this means that a unit (1.0) change in that variable is associated with (not "caused") a price that is about five percent higher.

59. Professor Noll's regression estimates are displayed in two of his exhibits—Exhibit 13.1 of his report shows his estimates for resellers, and Exhibit 13.2 shows his results for direct purchasers. For completeness, I include Professor Noll's Exhibits 13.1 and 13.2 as Exhibits 12a and 12b. The main results from my review of his regressions will also be summarized in two exhibits, Exhibit 13a for resellers and Exhibit 13b for direct purchasers. Unlike Professor Noll's tables, each of which reported results from only one regression, Exhibits 13a and 13b report results from many regressions that correct Professor Noll's errors. Because of this, for each regression model shown in Exhibits 13a and 13b, I report the estimates for only the most relevant variables in Professor Noll's model. Complete results for all the variables in every regression in my review are reported in Appendix D. (See Exhibits D1a and D1b].

60. For clarity of exposition, I will focus much of my discussion on Professor Noll's reseller regression results. Nearly identical arguments apply to his direct purchaser regression, which I will note along the way.

B. What Professor Noll Claims to Find

61. Exhibit 12a (Noll Exhibit 13.1) shows Professor Noll's reseller sales regression results. His estimate of "overcharge" is based on the coefficient on the "itunes7_0" indicator. [redacted] This is the overcharge percentage that Professor Noll uses in his Exhibit 14 to calculate damages on all reseller transactions.

62. Along with each coefficient estimate, Professor Noll also reports the standard error he calculates for that estimate. In general, the standard error (standard deviation) of a coefficient measures the precision with which the coefficient in question is estimated. When the standard error is very small, the estimate is correspondingly very precise. Economists are also typically

[66] Noll declaration, p. 81.

interested in expressing the degree of confidence they have that the estimated value of the coefficient did not arise by chance when the true effect of the variable in question is actually zero. This can be measured by taking the ratio of a coefficient estimate to its standard error, which is called the "t-ratio" or "t-statistic" for that estimate. Intuitively, the t-statistic measures the distance between the estimated value of the parameter in question and zero, measured in standard deviations. When the t-statistic is large, the estimated coefficient is "far" from (many standard deviations away from) zero, which increases our confidence that the true effect of that variable is not zero.

63. When sample sizes are sufficiently large, as they are in this case, a common benchmark for saying that an estimated coefficient is "statistically significant" is that it has a t-statistic that is 2.0 or larger ($t \geq 2.0$) so that the estimated coefficient is at least twice its standard error. A t-statistic of 2.0 corresponds to approximately a five percent ($p = .05$) probability that a coefficient estimate as large as the one obtained could have arisen by chance if the true value of that coefficient is zero. This would sometimes be referred to as "statistical significance at the five percent level." Larger values of the t-statistic correspond to rapidly declining probabilities that the true effect of the variable in question is zero. For example, a t-statistic of $t = 2.58$ corresponds to a 1-in-100 ($p=.01$) probability of arising by chance—"statistical significance at the 1 percent level." A t-statistic of $t = 4.9$ corresponds to a one-in-one million chance ($p = .000001$).

VI. PROFESSOR NOLL'S CLAIMS OF PRECISION AND STATISTICAL SIGNIFICANCE ARE INCORRECT

64. In his Exhibits 13.1 and 13.2, Professor Noll places three stars (***) next to each of his estimated coefficients, which he points out "Denotes statistical significance at the 1% level."[67] This means that all of his estimated t-statistics are greater than 2.58 in absolute value. As Professor Noll puts it: "The coefficients on indicators of market conditions all are highly significant."[68] They are so significant, in fact, that Professor Noll should have noticed that something is seriously wrong with his model—his claims of precision and statistical significance

[67] Noll declaration, Exhibits 13.1, 13.2.

[68] Noll declaration, p. 90.

cannot possibly be true in data such as these. In fact his claims are caused by a major error, as I now explain.

65. My point can be illustrated by Professor Noll's claimed precision in estimating his "overcharge," which is the coefficient on his itunes7_0 indicator. [redacted] In effect, Professor Noll has absolute confidence in the exact numeric value of his estimated "overcharge." But he should not — his claims of extreme precision and statistical significance are the result of grossly inaccurate assumptions regarding the statistical independence of the price observations he constructs.

66. The most obvious manifestation of Professor Noll's error is illustrated by the way he treats the multi-unit transactions that account for the large majority of his data. As I noted above, Professor Noll's measure of "price" is derived from these multi-unit transactions with purchasers. [redacted] But in his regression model he did not treat this single transaction with single price as a single observation. He treated it as 28,050 independent observations on price, all of which coincidently had exactly the same price.

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[69] This calculation itself illustrates the absurdity of Professor Noll's standard errors. In his report, Professor Noll presents his results rounded to three significant figures. However, when I examine this particular coefficient carried out to four significant figures, [redacted] In other words, his estimates are allegedly so precise that even the rounded value he uses has virtually no chance of being true.

67. In Exhibit 13.1 of his report (my Exhibit 12a), Professor Noll reports that his Reseller Sales regression is based on 2.14 million "observations," but this is highly misleading. An accurate statement is that his data contained 2.14 million multi-unit ***transactions***, each of which allowed him to calculate a single price, as in the example above. When he ran his regression, he "frequency weighted" each of these 2.14 million transactions by the number of identical iPods represented in each transaction. This is equivalent to treating a single transaction involving *N* iPods for which he calculated a single average price *P* as *N* ***independent*** observations, each of which coincidently had the same price *P*. [redacted] But of course there are not 28,050 independent observations; Professor Noll has simply counted the one piece of information from this single transaction 28,050 times. The result is that the regression procedure "thinks" it is dealing with far more than 2.14 million observations— in fact, Professor Noll's Reseller Sales regression output is calculated as if he had 113 million ***independent*** price observations, though he does not report that number in his declaration.[70]

68. In his deposition, Professor Noll was asked whether the 2.14 million observations reported in his Exhibit 13.1 was the number of observations used for his standard error calculations.

> Q: When you do the log regression, Exhibit 13.1, you report that you had 2.1 million observations.
>
> A: Yes.
>
> Q: Is that the number that you used for the denominator of your standard errors—for your standard error calculations?
>
> A: Probably, I mean, yes.
>
> Q: Is that an appropriate number to use?
>
> A: I mean, remember, it's not quite that simple, because the quantity went into regression, but yes, you know. These are heteroskedastic robust standard error estimates.
>
> Q: So what formula did you use?

[70] The numbers above refer to Professor Noll's reseller regression. He took a similar approach in calculating the standard errors in his regression of direct sales. In that case, Professor Noll had data on 36.9 million transactions. However, after frequency weighting, he calculated his standard errors as if he had 42.4 million independent observations. See Noll declaration, Exhibits 13.1 and 13.2; and Exhibits 13a and 13b to this report ("Den DF" line, column 1).

> A: It's a quantity weighted - it's - the observations are quantity weighted, so it doesn't - it's not 2.1 million. It's a quantity weighting of all the observations.[71]

69. This "quantity weighting" (or as it is more generally called, "frequency weighting") is a serious error. The user's guide for SAS, the statistical software package that Professor Noll used for his regression analysis, clearly explains the meaning of frequency weighting and its consequence for the assumed number of observations on which the model is based:

> When a FREQ statement appears, each observation in the input data set is assumed to represent *n* observations, where *n* is the value of the FREQ variable. The analysis produced when you use a FREQ statement is the same as an analysis produced by using a data set that contains *n* observations in place of each observation in the input data set. When the procedure determines degrees of freedom for significance tests, the total number of observations is considered to be equal to the sum of the values of the FREQ variable.[72]

An online Stata tutorial on "Choosing the Correct Weight Syntax" posted by the Carolina Population Center at the University of North Carolina at Chapel Hill contains a specific warning about the consequences of frequency weighting.[73] Referring to frequency weights, or "fweights," this tutorial specifically states:

> Do not use fweights to specify sampling weights. Your variance of estimates, p-values and standard errors will be computed incorrectly.[74]

70. My inspection of Professor Noll's computer code confirms that he did, indeed, use frequency weights as sampling weights in his regression analysis. This is a major error when, as here, the data consist of multi-unit aggregates in which each unit is an exact replica of the others. Then each of these price "observations" from a particular transaction is (by construction) perfectly correlated with the others. This matters because Professor Noll assumed exactly the

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[71] Noll deposition, p. 197:6-9. Professor Noll is also confused about what types of standard errors he actually reported in Exhibits 13.1 and 13.2. They are not "heteroskedastic robust standard errors." They are ordinary least squares standard errors, calculated under the assumption that the 113 million observations are independent and that their residuals have common variance. The footnotes to his report indicate that he also ran these regressions allowing for robust standard errors, but those are not the results reported in Exhibit 13.1. (See Noll declaration, notes 127 and 133.)

[72] SAS/STAT(R) 9.2 User's Guide, Second Edition, "FREQ Statement." Available at http://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer htm#statug_reg_sect011 htm.

[73] Stata is another one of the most prominent statistics and econometrics software packages.

[74] "Choosing the Correct Weight Syntax," Carolina Population Center at the University of North Carolina at Chapel Hill, http://www.cpc.unc.edu/research/tools/data_analysis/statatutorial/sample_surveys/weight_syntax (accessed June 20, 2013).

opposite in calculating "the variance of estimates, p-values and standard errors" for his model — he assumed that literally millions of identical price "observations" are statistically independent, when they clearly are not.

71. The fundamental problem is that Professor Noll assumes his "113 million" observations are statistically independent of one another, but they are not. Professor Noll appears to be confused about the concept of "independence" that is required to run his regression in the way that he did. He appears to believe that the independence of his *price* observations depends on whether buyers of iPods are making independent purchase decisions. Asked whether two consumers purchasing the same product from the same store at the same price on the same day provide independent observations on price, he responded: "The two consumers made their decisions independently whether to buy the iPod. The price they were charged were [sic] the same, but it doesn't mean the observation of the transaction is not independent." (Noll deposition pp. 211:7-10). This is the wrong concept. The question isn't whether the individuals made independent decisions about whether to purchase their iPods; it's whether Apple set the prices of those two iPods independently. This analysis is about the determination of prices. [redacted] Professor Noll's answer reveals that he has it backwards — he's thinking of the wrong decision-maker.

72. This erroneous assumption that the prices of 113 million iPods (in his reseller regression) are statistically independent causes Professor Noll to vastly exaggerate what the data can show and to totally misrepresent the accuracy and statistical significance of his results. In order to understand the issue, one must first understand the strict assumptions of the "ordinary least squares" (OLS) procedure he used to estimate his model. Estimates of standard errors in regression models depend critically on what one assumes about the "covariance structure" of the residuals, *U,* across observations—that is, what one assumes about how the residuals are correlated with each other. The key but unstated assumption made by Professor Noll is that the residuals in his data are independent of one another (uncorrelated), which in layman's terms means that if I knew that the residual (the portion of the price that cannot be represented by the explanatory variables) for one iPod was, say, five percent, that information would not help me

predict the residual for ***any*** other iPod in the data — my best guess would be zero, because that is the expected value and Professor Noll *assumes* the residuals are independent.

73. [redacted] They are ***not*** independent as Professor Noll assumed; they are perfectly correlated. As the saying goes: "If you've seen one, you've seen them all." The consequence is that Professor Noll is pretending to have much more information than he actually does. The technical consequence of this exaggeration is that his standard errors will be underestimated or, put the other way around, his claims about the precision and statistical significance of his results will be greatly overstated.

74. In the data analyzed by Professor Noll, the problem is deeper than the obvious (but ignored) fact that all the iPods in a single transaction have the same price. [redacted] By construction, the residuals will be highly correlated across transactions for a given buyer, but also across buyers. In the jargon of econometrics, this means that the price observations for an iPod model at a given point in time form a "cluster" within which the residuals are (highly) positively correlated both within and across transactions.

75. An econometrician who neglects to account for this clustering will underestimate the true standard errors of his results. That is what Professor Noll did when he ignored these facts and falsely assumed that the price observations he created were independent of one another. As Professors Joshua Angrist and Jorn-Steffen Pischke (2009) put it in their useful survey of modern econometric methods:

> A pillar of traditional cross section inference ….is the assumption that the data are independent. Each observation is treated as a random draw from the population, uncorrelated with the observation before or after. We understand today that this sampling model is unrealistic and potentially even foolhardy. …We call this correlation the clustering problem.[75]

76. The same warning appears in the most recent edition of the American Bar Association's reference volume *Proving Antitrust Damages: Legal and Economic Issues* (2010):

> There can be substantial consequences from estimating the standard errors for the coefficient estimates as if the errors were uncorrelated when they are in fact correlated. With positive correlation between the error terms, the incorrectly estimated standard errors generally will be biased downward, making the regression coefficients seem to be more precisely estimated than they really are. As a result, a statistical test on the coefficients may yield what appears to be a statistically significant result but is not.[76]

77. In his deposition Professor Noll was adamant that clustering is not an issue for his model, and he expressed some annoyance when he was asked about it:

> Q: Did you cluster standard errors?
>
> A: This is not something that requires a cluster analysis. Again, you're perpetuating an econometric mistake you've been making for two years. This is not a problem of clustering.
>
> …
>
> Q: Did you cluster standard errors?
>
> A: That would have been inappropriate. This is not a clustering problem.
>
> …

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[75] Angrist, Joshua and Jorn-Steffan Pischke, Mostly Harmless Econometrics: An Empiricist's Companion, Princeton University Press, Princeton, New Jersey, 2009, pp. 293-294. Professor Noll cites Chapter 8 of this book as one of the documents he considered in preparing his report, and Chapter 8 is the chapter from which this quotation was taken. Noll declaration, Documents Considered #944.

[76] ABA Section of Antitrust Law, *Proving Antitrust Damages: Legal and Economic Issues*, ABA Publishing, Second Edition, 2010, pp. 145-6. The citation notes that standard methods of allowing for clustering "produce consistent estimates of the standard errors even when there is no correlation among the error terms. In other words, they work well in both situations." (p. 147).

> A: I also didn't fly to the moon because it's not a fly-to-the-moon problem. It's inappropriate to do any cluster analysis on this data set, because it's not a clustering problem.
>
> …
>
> Q: So you didn't do a cluster analysis?
>
> A: There aren't any clusters to do the analysis of. How can you do an analysis of something that isn't there?[77]

78. Unfortunately, it is Professor Noll who is "perpetuating an econometric mistake." If it is in fact true that "there aren't any clusters to do the analysis of," he could easily have offered evidence to prove his point: He could simply have shown that the residuals generated by his model are uncorrelated and that clustering by, say, product family would not affect his standard errors. Indeed, the American Bar Association volume cited above notes that standard econometric methods of allowing for clustering, which are "used generally in practice" and available in the software package used by Professor Noll, "produce consistent estimates of the standard errors even when there is no correlation among the error terms. In other words, they work well in both situations."[78] But he would not have been able to show this. As the examples above illustrate, his assumption that the residuals in his model are independently distributed is untrue in the extreme: the existence of clusters is obvious. However, one need not take my word for it. One can demonstrate the existence of clusters directly from Professor Noll's regression.

79. I used the parameter estimates in Professor Noll's reseller regression reported in Exhibit 13.1 of his report (my Exhibit 12a) to calculate the estimated residual for each of the 113 million iPods in his reseller data. Then, within each product family and quarter, I divided the observations randomly into two equally-sized groups and calculated the average residual within each group. If Professor Noll's assumption that his observations are independent is correct, then these family-by-quarter clusters would be meaningless. In particular, the average residuals in each family-quarter-group would satisfy the assumptions Professor Noll used in estimating his model and standard errors. First, because the model assumes that the expected value of the residuals is zero, the average value of the residual in each group should be very close to zero.

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[77] Noll deposition, pp. 186:6-187:22.

[78] ABA Section of Antitrust Law, *Proving Antitrust Damages: Legal and Economic Issues*, ABA Publishing, Second Edition, 2010, p. 147.

Second, the Group-1 and Group-2 average residuals should be uncorrelated with one another — in other words, knowing the Group-1 average residual for iPod Classics in the first quarter of 2005 should not help me predict the Group-2 residual for that same model sold in that same quarter.

80. The results of this exercise are shown in Exhibit 14a, which graphs each value of a Group-1 average residual for a family-quarter cluster, measured on the horizontal axis, against the corresponding Group-2 average residual measured on the vertical axis. The exhibit demonstrates two important facts. First, the average within-cluster residuals are not closely distributed around zero — they range from -0.45 to more than 0.30. With regard to within-cluster correlation, if Professor Noll was correct we should find that the average residual for Group 1 of each cluster does not help to predict the value for Group 2. In other words, the relationship between them should have a slope of zero. But the exhibit shows exactly the opposite — the within-cluster average residuals for Group 1 and Group 2 lie very close to a 45-degree line. Put differently, if I know the Group-1 average residual within a family-quarter cluster, I can almost exactly predict the Group-2 average residual within that cluster. These facts are completely at odds with Professor Noll's assertion that "there aren't any clusters."[79] There are clusters, and he ignored them. The existence of these clusters explains why Professor Noll's implausible claims of statistical significance, and his corresponding claim that clustering is not appropriate in these data, are simply wrong.

81. The consequences of Professor Noll's mistake in calculating standard errors are shown in column (2) of Exhibits 13a and 13b. Consider the reseller sales regression in Exhibit 13a. Using standard and well-accepted econometric methods that are part of the regression package used by Professor Noll, I calculated the standard errors of his model allowing for "clusters" of non-independent price observations within product family and quarter. Because I have changed nothing about Professor Noll's regression or the variables in it, the coefficient estimates are exactly the same as in his model. [redacted] The only thing that changes here is the claim one can make about the precision of these estimates. The previous discussion indicates there is very

[79] Repeating this exercise for Professor Noll's direct sales regression leads to the same conclusions. (See Exhibit 14b.)

high correlation of residuals within product family and quarter as a consequence of Apple's pricing practices and the construction of the data. Once I correct for this clustering, the standard errors of his estimates are much larger than what Professor Noll claims and much more reasonable as estimates of precision.

82. This point is demonstrated by looking at the t-statistics associated with each of Professor Noll's coefficients. Recall that the t-statistic is the ratio of a coefficient to its standard error. [redacted] But the correct estimated standard error that accounts for non-independence is 0.04216, which is ***468 times*** greater than the standard error Professor Noll claims. [redacted] That is, it is not statistically distinguishable from zero, and thus there is no material or reliable evidence of an "overcharge," even in Professor Noll's otherwise incorrect model.

83. The same is true of Professor Noll's direct sales regression. [redacted] Again, Professor Noll's estimate of an "overcharge" is not statistically distinguishable from zero.

84. The bottom line is this: Professor Noll's standard error calculations, and hence his claims of "statistical significance," are indisputably wrong. This conclusion alone is enough to undermine his claims to have identified a meaningful "overcharge" associated with the challenged conduct. But this failure to correctly represent the precision of his estimates is only one of many mistakes that materially affect his results and claims.

A. Professor Noll's "Before and After" Experiment: The Wrong But-For World

85. The measured product characteristics in Professor Noll's regression, such as the storage capacity of a device or functionalities such as the ability to store and display photo or video files, are used to control for "other factors" that affect the price of iPods. His real interest centers on a

set of "event" variables that are meant to identify "market conditions" and the impact of Apple's challenged conduct on iPod prices. Specifically, Professor Noll views these variables as representing a "before and after" comparison of iPod prices. As he describes it: "The 'before-after' method compares the prices of the reference products (here, iPods) before and/or after the occurrence of the anticompetitive acts with prices in the damage period."[80] He goes on to explain that "[t]he initial period before iTS was created and the period after the launch of the iTS establish the 'before' period for measuring Apple's market power prior to the events surrounding the release of Harmony, the attempts to disable Harmony, and the movement to DRM-free files."[81] Though this explanation is a bit confusing, the specification of his model demonstrates that what Professor Noll is trying to say is that his "before" period — his "but-for" world benchmark — is a three-month period between the launch of Harmony in July 2004 and the release of iTunes 4.7 in late October of 2004.

86. I understand the court has determined that the relevant FairPlay technology contained in iTunes version 4.7 — which initially "blocked" Harmony for several months — is not anticompetitive. This means that Professor Noll's "before" but-for benchmark for measuring the impact of the allegedly anticompetitive introduction of the [redacted] in September 2006 is incorrect. Other flaws aside, the logic of Professor Noll's "before and after method" implies that the "before" period should be the period before September 2006, when the [redacted] did not exist, FairPlay technology was legal, and Harmony was capable of interoperating with all iPod models.

87. Professor Noll's reseller sales regression is a good template for illustrating how he claims to find an anticompetitive increase in iPod prices. Exhibit 15a is a timeline that shows the periods when each of his six "event" indicators is "on" — that is, when the relevant indicator takes a value of 1 instead of zero. On each line that indicates an event I also show Professor Noll's estimate of the impact that event had on iPod prices. The "omitted" time period is the period before the opening of the iTMS in April 2003.[82]

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[80] Noll declaration, p. 71.

[81] Noll declaration, p. 73.

[82] Exhibit 15b contains a similar timeline for the direct sales regression.

88. [redacted]

89. These "effects" of the iTMS and Harmony may be used to illustrate an important feature of the way in which Professor Noll constructed his indicators for "market conditions." Suppose that Professor Noll had turned off (set to zero) his indicator for the iTMS on the same day he turned on (set to 1) his indicator for the existence of Harmony. [redacted] By "turning off" the iTMS indicator on the day the Harmony indicator is turned on, however, the Harmony indicator would be forced to capture the "effects" of *both* Harmony *and* the iTMS, not the (hypothetically) true effect of Harmony alone. Compared to its "true" value, the estimated effect of the Harmony indicator is too large (in absolute value) because it is picking up the effect of the iTMS, which was improperly turned off. In the language of econometrics, the estimated impact of Harmony is "biased."

[83] It is difficult to take these estimates seriously in the context of Plaintiffs' theory. [redacted] Professor Noll does not comment on the inconsistency of these estimated effects, or how they reflect on Plaintiffs' claims.

90. The third indicator in the sequence of Professor Noll's "events" is the introduction of iTunes 4.7 in October 2004, which included FairPlay technology with which Harmony could not initially interoperate. Professor Noll refers to this event as "harmony_blocked," and in his deposition he refers to it as "4.7." He turns this indicator on in October 2004 and turns it off on September 12, 2006, the day iTunes 7 was introduced. This choice is conspicuous because, as shown in Exhibit 15a, "harmony_blocked/4.7" is the only one of his event indicators that is ever turned off—once turned on, all the others remain on until the end of the data. [redacted]

91. Exhibit 15a shows that the next indicator to turn on is for iTunes 7, on September 12, 2006. *On exactly the same day*, Professor Noll turns off his indicator for iTunes 4.7. [redacted]

92. Professor Noll's decision to turn off his "harmony_blocked/4.7" indicator when he turns on his iTunes 7 indicator is very important. Recall the example above, where I examined what Professor Noll's regression would show if we hypothetically turned off the iTMS indicator on the same day that the Harmony indicator turned on. In the example, by omitting the impact of the iTMS during the Harmony period, the Harmony indicator was forced to "pick up" the

[84] Noll declaration, p. 80.

omitted effect of the iTMS. This biased the estimated effect of Harmony, and as a result, its coefficient roughly doubled.

93. Precisely the same thing happens here: by turning off the iTunes 4.7 indicator during the period where the iTunes 7 indicator is on, Professor Noll forces the iTunes 7 indicator to pick up the omitted "effect" of iTunes 4.7. [redacted] In other words, Professor Noll's decision to turn off his indicator for the existence of iTunes 4.7 technology has the effect of doubling his estimate of impact and, therefore, damages, for the reseller class. Note that nothing else in his regression changes — the coefficient on every other variable would have been exactly the same had he left "on" the iTunes 4.7 indicator.

94. The exercise in the previous paragraph is not just arithmetic. Professor Noll's decision to turn off the iTunes 4.7 indicator on September 12, 2006 precisely defines the "but-for" world that he assumes would have existed in the absence of the challenged conduct. Specifically, by turning off the iTunes 4.7 indicator he assumes that the FairPlay technology included in iTunes 4.7 through iTunes 6 would not exist in the but-for world, even though this was the legal technology in use immediately prior to the introduction of iTunes 7. Instead, Professor Noll's but-for world is a very brief period immediately ***before*** the release of iTunes 4.7, i.e., it is the 3-month period between July 26, 2004, when Harmony was first announced, and October 26, 2004, when iTunes 4.7 was introduced. He does not explain why this is the appropriate but-for world for measuring the incremental effect of the challenged [redacted], or iTunes 7, or for anything else relevant to this case. But this choice doubles his estimated impact of the [redacted] feature of iTunes 7 on resellers.

95. In his Second Supplemental Declaration on Class Certification Professor Noll attempted to explain his decision to turn off his iTunes 4.7 indicator upon the release of iTunes 7.[85] He

[85] Second Supplemental Declaration of Roger G. Noll on Class Certification, September 23, 2011, p. 10,

said: "The iTunes 7.0 release replaced the prior version of iTunes software and contained new code for disabling Harmony. If the iTunes 4.7 release was not anticompetitive, but the iTunes 7.0 release was anticompetitive, as plaintiffs allege, then the appropriate specification is for the indicator variable for iTunes 4.7 to be reset to zero when it is replaced by iTunes 7.0." While this is nothing more than an assertion, the assertion itself is incorrect. Putting aside the other problems with his model, the logically correct "before-and-after" experiment would compare the level of iPod prices during the period of challenged conduct to the level of prices prior to that conduct, when Apple's practices were legal. This is the period prior to September 12, 2006, when iTunes 4.7 through 6 were operative. Technically, in a regression this *incremental* effect on prices is found by leaving on the iTunes 4.7 indicator, which then captures the level of prices before September 2006, in which case the coefficient on the iTunes 7.0 indicator will measure the difference between average prices before and after the introduction of iTunes 7. As I explained above, Professor Noll's incorrect procedure compares prices after the introduction of iTunes 7 to those in a three-month window *in 2004*, which was two years earlier. But 2004 (or any earlier period) cannot be the but-for world of Plaintiffs' theory if technology and prices in 2005 and 2006 were legal.

96. [redacted]

In other words, by turning off the "harmony_blocked/4.7" indicator in his direct sales regression, Professor Noll overstates the claimed incremental effect of the [redacted] feature of iTunes 7 by a factor of more than six. And of course his reported damages are overstated by this factor as well.

97. The points just discussed are formally presented in column (3) of Exhibits 13a (for resellers) and 13b (for direct purchasers). As indicated, the incremental effect of iTunes 7 in Professor Noll's model can be found by leaving "on" the indictor for "harmony_blocked/4.7," just as other indicators are left on. [redacted]

[redacted]

B. Professor Noll's Confusion about the "Log of Time"

98. As described by Professor Noll, "Moore's Law" is an empirical regularity regarding technical progress: "the amount of functionality that can be placed on a semiconductor of a given size doubles every 18 months."[86] This is one of the reasons "prices for consumer electronics generally fall through time."[87] To capture this effect in his model, Professor Noll includes a variable he refers to as "the log of time" in his log price regressions. Professor Noll also offers the negative estimated coefficient on "the log of time" in his regression as a test of his model's validity.

99. Based on his discussions of this "log of time" variable in his report and in his deposition, one can only conclude that Professor Noll is confused both about the use and meaning of logarithmic variables in regression analyses and about their connection to economic theory. While it is quite common in empirical research to control for the impact of technical progress and other time-related factors by including a time trend, in nearly 40 years as an empirical researcher and journal editor I have ***never*** seen an economist use the "log of time" in any regression. Not even once. There is good reason for this: the "log of time" makes absolutely no sense as an economic control variable. And as it turns out, had Professor Noll used more conventional and widely accepted methods to control for technical progress, his results would have been quite different and his "damage" estimates much smaller. These points require some technical explanation.

100. Consider Moore's Law — as Professor Noll describes it in his report this "law" says the functionality that can be placed on a given size semiconductor doubles every 18 months. Turned into a prediction for prices of electronic goods, this means that each increment of time of a given size — say a month or a year — should reduce costs and prices of an electronic device with given functionality by a constant percentage amount. For example, if between 2002 and 2003 prices fall by 20 percent due to this form technical progress, then the constant pace of such

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[86] Noll declaration, p. 18.

[87] Noll declaration, p. 80.

progress implies that prices should fall by 20 percent between 2003 and 2004 or between 2007 and 2008. ***Each additional year reduces price by a constant percentage amount.*** Recalling that the change in the logarithm of a given quantity is approximately the percentage change in that quantity, this constant-percentage-change relationship between price and the passage of time may be represented mathematically as $\ln(P) = C + At$. In this equation, "*t*" is a measure of time such as the number of months from a given starting point—t = 1, 2, 3, … — and "A" is the constant percentage amount by which price changes between one month and the next. For example, if A = -0.02 then price falls at a rate of 2 percent per month. In other words, the proper representation of technical progress that causes prices to fall at roughly a constant rate — as implied by Moore's Law — is a ***linear*** relationship between the logarithm of price and ***time*** counted in integer units, not "the log of time".

101. What would be the meaning of using the "log of time" — as advocated by Professor Noll — rather than simply "time" to describe technical progress? The mathematical relationship would be $\ln(P) = C + B\ln(t)$, which would mean that each ***percentage*** increment of "time" causes the same (B) percentage change in price. So suppose we start time at *t=1* in November of 2001 as Professor Noll does in his data set. The change in ln(t) between month 1 (November) and month 2 (December) of 2001 is ln(2) - ln(1) = .693. [redacted] In other words, Professor Noll's use of "the log of time" to represent unmeasured technical progress actually constrains his model so that the effect of such progress is effectively zero during most of the period of interest, and particularly during the period in which iTunes 7 is relevant.

103. In his deposition Professor Noll was asked about this odd choice to use "the log of time" in his regression. His explanation was exactly backwards — there is no other way to put it. Apparently thinking that he is offering a technical defense for why the "log of time" is an appropriate explanatory variable, he actually explains why it is not appropriate. Here is his answer, with emphasis added:

> Q: And why did you decide to use the log of time rather than time in levels?
>
> A: Because the — if you — there's no reason to believe that you have an exponentially increasing price in time. That the — if you, if you, you know if you think about if you use level, if the dependent variable's a log of price, and you're measuring time by, you know, the first - the first month is month one and the second month is month two. When you go from one to two you're doubling it. That's a hundred percent increase, all right. ***When you're going from the hundredth month to the hundred-and-first month that's a one percent increase.***
>
> ***One would not expect that the – the effect of time would be such that going from 100 to 101 was one percent of going from one to two. The only – the way you get that to be a constant rate of increase is to take the logarithm of time.***[88]

104. As I explained above, I completely agree that one would not expect "the effect of time would be such that going from 100 to 101 was one percent of going from one to two." But that is precisely what Professor Noll forces his model to do when he uses the "log of time" as a control for technical progress. His statement "The only way you get that to be a constant rate of increase is to take the logarithm of time" is flatly wrong. He has it backwards. Using the logarithm of time forces a non-constant rate of change, which, as I showed above, rapidly approaches zero. The mathematical truth is that "the only way you get that to be a constant rate" is to measure time in levels, not in logarithms. In response to further questions about "the log of time" Professor Noll demonstrates complete confusion, cogently explaining why what he did is exactly wrong.

> Q: Why do you say that the choice of the starting time period is arbitrary?
>
> A: Well, I could - I could start my – my first period could be 1842, and I could measure time by every month since January 1842, all right. ***And in principle, that shouldn't affect anything***. ***I mean what I pick as the starting date shouldn't matter,*** because what I'm interested in is the effect of technological change during the period of the data.[89]

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[88] Noll deposition, pp. 24:17-25:9, emphasis added.

[89] Noll deposition, p. 27:4-12, emphasis added.

105. Professor Noll's reasoning is correct—choosing January of 1842 as the starting date from which time is measured "shouldn't affect anything." And it wouldn't if he had measured time in levels instead of logs. To be precise, had he chosen January 1842 as the starting date, then November 2001 (the first month in his data) would be month 1919 instead of month 1, and December 2001 would be month 1920. The ***level*** of time would change by one month between November and December, and this would be true no matter what starting year was used. In contrast, if time is measured from January of 1842 the passage of one calendar month between November and December of 2001 changes "the log of time" by ln(1920) - ln(1919) = 0.0005, which is vanishingly small. However, if time is measured from November of 2001 the exact same passage of one calendar month changes "the log of time" by ln(2) - ln(1) = 0.693, which is 1330 times larger.

106. Professor Noll correctly offers that "what I pick as a starting date shouldn't matter." If time is measured in levels, the arbitrary choice of starting date will ***not*** matter. However, if one uses his "log of time" variable the arbitrary choice of a starting date matters enormously. In other words, Professor Noll's deposition testimony is a clear acknowledgement that his reliance on "the log of time" is indisputably wrong. At another point in this exchange Professor Noll offers "that's why you – you always use the log of time in a logarithmic equation."[90] As I noted earlier, in nearly 40 years as a professional economist I have never seen a research paper that uses "the log of time in a logarithmic equation," because it would be wrong. Professor Noll's remark would have been correct had he said "never" instead of "always."

107. Correcting this error in Professor Noll's reasoning and model is easy — all one needs to do is use time measured in levels (months) instead of the "log of time" in his regression. The effect of doing so is shown in column (4) of Exhibits 13a and 13b. [redacted]

[90] Noll deposition, p. 26:15-17.

C. Additional Features and the "Quality" of Professor Noll's Regression

108. At page 80 of his report Professor Noll offers a way to "test" the quality of a regression: "Another test of the quality of a regression is whether the estimated coefficients are consistent with expectations derived from economic theory." He then offers an example: "For example, prices for consumer electronics generally fall through time due to the presence of ubiquitous learning by doing and Moore's Law. The positive coefficient on the logarithm of time bears out this expectation." [redacted] In any case, we have already established that the "logarithm of time" is a meaningless construct for measuring Moore's Law and technical progress, or for any other purpose.

109. Professor Noll neglects to mention other, equally important estimates from his regression that are ***not*** "consistent with expectations derived from economic theory." [redacted] Further, if Professor Noll's standard errors are to be believed (and they are not — see discussion above), then these estimates are highly statistically significant. [redacted] But there can be little doubt that these features are valuable to users, which is why Apple puts them in iPods. He similarly "finds" that the number of downloads available from the iTMS reduces iPod prices. According to Professor Noll's view of economic theory these effects should be positive, not negative as Professor Noll confidently estimates. If consistency with theory is a test of a model's quality, then these results indicate that Professor Noll's regressions fail multiple tests, and by a very wide margin.

110. These "tests" reject the conceptual foundation of Professor Noll's model, which is that it should be consistent with theory — especially the Plaintiffs' theory. But the conceptual foundation of Professor Noll's "before-and-after" experiment is incorrect in other ways as well.

Most prominently, he fails to recognize that the challenged conduct is not the introduction of iTunes 7 itself, but rather the introduction of a specific feature of iTunes 7. iTunes 7 had many additions and enhancements that were unrelated to the challenged conduct.[91] (See Exhibit 6.) In addition, iTunes 7 was introduced at the same time as new iPod models that were upgrades to previous versions, with enhanced functionalities.[92] At best, his iTunes_7 indicator is a catch-all for any and all things relevant to iPod pricing that are correlated with the time period in which iTunes 7 or later versions existed, but that are not among the (very) limited product characteristics he chose to include in his regression. Professor Noll does not explain why an indicator for the mere existence of iTunes 7 would measure and identify the impact of the allegedly anticompetitive [redacted] as opposed to the array of other features and functionalities of both the iTunes 7 software itself and the hardware devices with which it operated.

111. This raises the obvious question of why Professor Noll chose to include some product attributes in his model and to exclude others. Beyond the short list of attributes that Professor Noll included, Apple's data contain information on many other measurable attributes of iPod models that an economist would reasonably expect to affect pricing. For example, as indicated in Exhibit 10, the data indicate whether a particular model and generation of iPod could be attached by FireWire or USB, its weight, its battery life, the size of its display, its display resolution, and the number of hours required to charge its battery. To the extent that any or all of these measurable features are valuable — and why would they not be? — they should have been included in Professor Noll's model of iPod pricing. But they were not.[93]

112. Column (5) of Exhibits 13a and 13b takes this step, adding additional controls for measurable (and presumably valuable) features of iPods that Professor Noll chose to omit.[94] In

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[91] See Exhibit 2 for a list of iTunes features included in each version and Exhibit 6 for a list of those in iTunes 7.

[92] See Exhibit 3 for a description of the evolution of iPod features in successive models.

[93] Professor Noll apparently was aware of the fact that he had failed to consider a number of characteristics – See Expert Report of Dr. Michelle M. Burtis in Apple Inc.'s Opposition to Plaintiffs' Motion to Exclude, May 2, 2011, ¶¶16-17; Noll January 18, 2011 declaration, pp. 39, 76-78, 81-82, and Exhibits 1-6; Noll April 7, 2011 deposition, pp. 87:18-88:1.

[94] In choosing these characteristics, I used the following approach. I asked my staff to create a list of all iPod models (classified by MPN) that Apple had introduced between 2001 and December 2010 (the latest date for which I have usable price data). (Note: MPN stands for "Marketing Part Number" and is the most detailed level at which information on iPod characteristics is available. "Marketing Part Number," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Marketing_part_number (accessed June 14, 2013).) I then asked my

both cases the data indicate these features should not have been excluded from the model – tests of their joint significance solidly reject excluding these features from the regressions for both resellers and direct purchasers. Just as importantly, including these features leads to results that completely undermine any notion that iTunes 7 caused or allowed Apple to raise prices. [redacted]

D. Professor Noll's Regression Produces Implausible Results That Are Inconsistent With The Basic Economics Of Plaintiffs' Theory.

113. The issue for damages is how and *when* the [redacted] might have affected consumers' willingness to pay for new iPods and ultimately the prices that Apple would have charged for them. Exhibit 16 shows the way in which the [redacted] affected the interoperability of each new iPod model as of September 12, 2006 when the [redacted] was introduced. Professor Noll forces his regression to find that the challenged update would have had an immediate impact on prices of all iPods on the same date the update was introduced. This is contrary to his and Plaintiffs' theory, in which the update would cause the incremental degree of "lock-in" would rise over time as iPod owners accumulated more iTMS music relative to RMS.

114. Any "lock in" created by the [redacted] would play out over time. For example, consider an individual who purchased an iPod Nano 2nd Generation on September 12, 2006. The effect of the [redacted] was zero on September 12, 2006, because the owner's accumulated stock of iTMS music had not changed. When this owner goes to ***replace*** that Nano at some ***future*** date and assuming that that same owner had more iTMS music relative other music on her Nano, her

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staff to compile available information on the characteristics of each of these models. In doing this search, they reviewed information from Apple.com and Everymac.com. They also reviewed Apple press releases and Apple price committee documents that were produced as part of the discovery in this case. When information was not available or needed corroboration, they searched a variety of other websites. (For a list of the websites used and a description of the process by which the search was conducted, see Appendix C.) Ultimately they collected information on 39 different characteristics from which I selected for the regression those that logically appear to be relevant for the explanation of prices and would not generate perfect collinearity with other variables already included in the model.

stock of DRM-protected music would be less portable than it otherwise would have been, which might increase the likelihood of purchasing a new iPod instead of some other MP3 player. But notice how distant in time this effect would be — the "lock-in" of some new owners of a [redacted] device affects their ***next*** purchase of an MP3 player.

115. So even under Professor Noll's theory, the September 2006 update would not have raised iPod prices at that time. Indeed, Professor Noll notes that MP3 players are replaced roughly every 18 months to two years, on average.[95] It is therefore implausible that there would be a material effect of [redacted]-induced "lock-in" on or soon after the introduction of iTunes 7 and the [redacted]. And even in a vaguely defined "long run," if the incremental "lock-in" is to increase the prices that Apple charges, then it must offset the reduced demand for iPods by other buyers who, in Plaintiffs' theory, would have preferred the option of purchasing music from RMS.

E. Professor Noll's Regression Improperly Estimates A Single Average Overcharge Across All Models

116. Professor Noll improperly constrains his model by using a single variable for iTunes 7 that he has "on" for each model. Consequently, his model is forced to estimate a single average percentage overcharge across all iPod models and generations of models, including models and generations that never included the challenged update. His regression thus assumes that the [redacted] would not only cause overcharges on all other models, but also that the percentage overcharge would be exactly the same regardless of their feature sets or customer bases or ability to interoperate with Harmony. Estimating a single average percentage overcharge will mask the fact that certain models might have been impacted while others were not. It also hides the fact that his model does not include products that were sold before and after iTunes 7. The iPod Touch, for example, was not sold in the "before" period. This means that his regression cannot estimate the impact of iTunes 7 on the Touch by comparing its prices before and after the introduction of iTunes 7, for the simple reason that the Touch did not exist before iTunes 7. To overcome this, Professor Noll's assumes that the iPod Touch must have been impacted by the exact same percentage "overcharge" as models that were sold before and after the introduction of iTunes 7, including models that were and were not

[95] Noll declaration, pp. 4, 18.

affected by the [redacted]. For example, he assumes that the iPod Touch was impacted by the same percentage overcharge as [redacted] two models that existed (in different generations and with changing functionalities) before and after iTunes 7. [redacted] This issue was recognized by Professor Noll at the time of class certification, but he has done nothing to address it.[97]

117. [redacted]

118. [redacted]

[96] Internal Apple Presentations from the Price Committee, March 2001 to February 2009.

[97] Noll April 7, 2011 deposition, pp. 125:7-126:9.

[98] Dr. Martin was aware of these facts at the time he filed his April 3, 2013, report. Martin report, p. 34. However, Professor Noll seems to have had only a partial understanding by the time of his deposition on May 16, 2013. [redacted]

[redacted]

120. At deposition, Professor Noll suggested that he may change his regression to fix this problem by interacting the iTunes 7.0 variable with product-specific dummy variables, which would allow for separate "effects" on each model. [redacted]

121. [redacted] As explained above, if Plaintiffs are correct that use of Harmony and the RMS were valuable to prospective iPod buyers, then models that maintained interoperability would

[99] Noll deposition, pp. 85:12-87:24.

[redacted] Finally, a model with product specific effects of iTunes 7 cannot estimate an effect on the price of the iPod Touch, because the Touch did not exist prior to the introduction of iTunes 7.

122. These flaws aside, and to demonstrate the extreme sensitivity of Professor Noll's model, column (6) of Exhibits 13a and 13b take the additional step of allowing for separate effects of iTunes 7 on each iPod model other than the Touch, for which no such estimate is possible. [redacted] Again, this pattern is the opposite of Plaintiffs' damage claim.

F. The Impact of DRM-Free Music on the Price of iPods

123. Throughout this case, Professor Noll has made much of the fact that the widespread availability of DRM-free music would dramatically limit Apple's ability to lock in its iPod customers.[100] And, of course, once the iTMS began to offer DRM-free music, there could be no additional lock in. Earlier, in the class certification portion of this case, he recognized that Apple announced on January 6, 2009 that effectively immediately, eight million of the ten million songs in the iTMS would be available without DRM protection and that "by April 1, 2009, all digital audio files sold through iTMS could be purchased without FairPlay DRM."[101] In deposition Professor Noll was asked: "Do you think that as of the time Apple was selling 80

[100] See, e.g., Declaration of Roger Noll, July 15, 2008, p. 41; Reply Declaration of Roger Noll, October 19, 2009, p. 44; Noll January 18, 2011 declaration, p. 59.

[101] Noll January 18, 2011 declaration, p. 13; see also Reply Declaration of Roger Noll, October 19, 2009, p. 44 (citing Apple Press Release, "Changes Coming to iTunes Store," January 6, 2009, http://www.apple.com/pr/library/2009/01/06Changes-Coming-to-the-iTunes-Store html (accessed July 19, 2013)).

percent of its music from its music store DRM-Free, that that had any impact on iPod demand?" he answered: "Of course."[102] When asked where that impact would show up, he said:

> It won't show up. It won't show up. What it will do is just reduce the magnitude to the pre DRM-Free effect of 7.0, because the 7.0 effect would be less in the last few days of the period, and so the overall effect on the coefficient would be to reduce it to reduce the magnitude of the damages.
>
> So – you have – because the 7.0 period is really long compared to the DRM-Free, it's not going to have much of an effect, but the effect will be to suppress the coefficient on – on 7.0.[103]

124. Professor Noll's conjecture is wrong—notwithstanding the many other flaws of his regression and its interpretation, corrections to his "competitive market conditions" indicators for the availability of DRM-free music have a large impact on his estimated "overcharges." To show this, I have reproduced the analyses in 13a and 13b, but instead of setting the indicator variable for the iTMS being DRM-free to equal 1 as of April 1, 2009, I have set it to equal 1 three months earlier, as of January 6, 2009, when 80 percent of iTMS music went DRM-free.[104] The results of these sensitivity tests are reported in Appendix D. [See Exhibits D2a through D2c and D3a through D3c.] The key finding is that, again, these corrections uniformly reduce the estimated "effect" of iTunes 7.

VII. PROFESSOR NOLL'S DAMAGE CALCULATIONS

125. Each of the changes above has an effect on Professor Noll's estimate of the coefficient on his iTunes 7 indicator and thus on his estimate of damages. Although none of the estimated effects from Professor Noll's model are statistically significant, I have nonetheless used these coefficients to re-estimate "damages" in order to show the sensitivity of his damage estimates. The results of this exercise are shown in Exhibit 13c. As the exhibit shows, Professor Noll's damage estimates quickly vanish once his errors and omissions are corrected — and, in the end, "damages" are negative because the estimated "effect" of iTunes 7 is negative. This is further

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[102] Noll deposition, p. 117:7-10.

[103] Noll deposition, pp. 118:17-119:1.

[104] To make sure that these results are robust, I tested these changes individually, and I find that each of them has the effect of lowering Professor Noll's coefficients across the board. See Appendix D, Exhibits D4a1 through D4c3.

evidence that Professor Noll's approach to estimating impact and damages in this case is not scientifically valid, accurate or reliable.

VIII. SOME FINAL POINTS: PROFESSOR NOLL'S REGRESSION HAS NO CONNECTION TO THE CHALLENGED CONDUCT, PLAINTIFFS' THEORY, OR APPLE'S PRICING PRACTICES

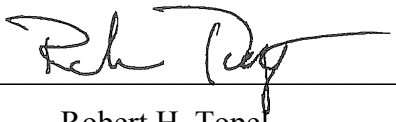
126. The fact remains that for all of these alternative specifications of Professor Noll's model, and for any others one can imagine, the entire exercise is futile. As explained above, any connection between the [redacted] and Plaintiffs' theory of "lock-in" depends on owners of affected iPods purchasing less music from the RMS after the introduction of the [redacted] than they would have had the [redacted] not been introduced, an effect that (if it exists at all) would accumulate slowly over time and might affect future purchase decisions. But Plaintiffs have provided no evidence that iPod owners ever purchased enough music from RMS to have a material impact on iPod prices, and have certainly provided no evidence that the [redacted] had a material incremental impact on whatever purchases there might have been. Prior to the introduction of the [redacted] the RMS accounted for only about three percent of protected music downloads overall, and this proportion would have been lower among iPod owners. With the introduction of the [redacted], the Plaintiffs' theory suggests that the most intense users of Harmony would be "locked out" from playing their music on new iPod models affected by the [redacted] and thus would be unlikely to purchase an affected new iPod. Thus Plaintiffs' entire case rests on a small and unobserved population of iPod owners who had not used Harmony much in the past, but allegedly would in the future. It is implausible that this unobserved and unmeasured group had a material impact on the price of iPods, even in the long run.

127. Professor Noll's method for estimating damages is also inconsistent with the way in which Apple set its prices. [redacted]

[105] Videotaped Deposition of Mark Donnelly, December 20, 2010 ("Donnelly deposition"), pp. 46:1-47:2.

[redacted]

128. As a result of the above analysis, my opinion is that there is no credible evidence that class members were damaged by Apple's challenged conduct.



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[106] Donnelly deposition, p. 20:5-23.

[107] Donnelly deposition, pp. 46:5-47:21, 49:21-50:12.

[108] Donnelly deposition, pp. 72:2-74:7.

Exhibit 1
Apple Timeline

Date	Events
January 9, 2001	iTunes introduced for Mac
October 23, 2001	Original iPod: 5GB Memory; holds 1000 songs
July 17, 2002	Second-generation iPod (touch-sensitive scroll wheel) PC-based iPods
April 28, 2003	Third-generation iPod, 30GB model holds up to 7500 songs iTunes Music Store opens for Mac users; downloads cost 99 cents
October 16, 2003	iTunes and iTunes Music Store introduced for PC users
January 6, 2004	iPod Mini; in five colors
July 17, 2004	Fourth-generation iPod introduced
July 25, 2004	RealNetworks announces that Harmony software is compatible with the iPod
October 27, 2004	iTunes 4.7 released; update is optional
January 11, 2005	iPod Shuffle introduced; no screen or wheel
March 21, 2005	iTunes 4.7 update is now mandatory for all users who want to buy from iTMS
April 26, 2005	RealNetworks announces that Harmony software is once again compatible with the iPod
September 7, 2005	iPod Nano replaces Mini
October 12, 2005	Fifth-generation "video" iPod Classic iTunes store to sell music videos and TV shows iTunes 6.0 released
September 12, 2006	Second-generation iPod Nano released: smaller with color and aluminum skin iTunes store begins to sell movies Enhanced video capabilities available as update to iPod Classic 5th Generation Second-generation Shuffle: size of a postage stamp [redacted]
March 21, 2007	Apple TV: connects iTunes and Internet to television
April 2, 2007	iTunes store begins to sell music from EMI without DRM
June 29, 2007	iPhone introduced: touch-screen iPod, Internet navigator, and phone all in one
September 6, 2007	iPod Nano 3rd Generation Released, iPod Classic 6th Generation, and iPod Touch 1st Generation released [redacted]
January 6, 2009	Apple announces that 80% of music at the iTMS is now DRM-free
March 31, 2009	iTunes store begins to sell all music without DRM
September 9, 2009	iTunes 9.0 released; adds GeniusMixes, HomeSharing, iTunes LPs and iTunes
March 30, 2010	iTunes 9.1 released; adds support for iPad
April 3, 2010	iPad released
September 1, 2010	iTunes 10 released; adds support for iPod Shuffle 4G, iPod Nano 6G, iPod Touch 4G, and Apple TV
June 6, 2011	iTunes 10.3 released; adds support for iCloud (Beta)
October 12, 2011	iCloud released

Sources:

http://www.apple.com/pr/library/2001/01/09Apple-Introduces-iTunes-Worlds-Best-and-Easiest-To-Use-Jukebox-Software.html
http://www.apple.com/pr/library/2001/10/23Apple-Presents-iPod.html
http://www.apple.com/pr/library/2002/07/17Apple-Unveils-New-iPods.html
http://www.apple.com/pr/library/2003/04/28Apple-Introduces-New-iPods.html
http://www.apple.com/pr/library/2003/04/28Apple-Launches-the-iTunes-Music-Store.html
http://www.apple.com/pr/library/2003/10/16Apple-Launches-iTunes-for-Windows.html
http://www.apple.com/pr/library/2003/10/16Apple-Updates-iPod.html
http://www.apple.com/pr/library/2004/01/06Apple-Introduces-iPod-mini.html
http://www.apple.com/pr/library/2004/07/19Apple-Introduces-the-New-iPod.html
http://www.apple.com/pr/library/2005/09/07Apple-Introduces-iPod-nano.html
http://www.apple.com/pr/library/2005/10/12Apple-Unveils-the-New-iPod.html
http://www.apple.com/pr/library/2005/10/12Apple-Announces-iTunes-6-With-2-000-Music-Videos-Pixar-Short-Films-Hit-TV-Shows.html
http://www.apple.com/pr/library/2006/09/12Apple-Announces-iTunes-7-with-Amazing-New-Features.html
http://www.apple.com/pr/library/2006/09/12Apple-Introduces-the-New-iPod-nano.html
http://www.apple.com/pr/library/2006/09/12Apple-Unveils-the-New-iPod-shuffle.html
http://www.apple.com/pr/library/2006/09/12Apple-Introduces-the-New-iPod.html
http://www.apple.com/pr/library/2007/03/21Apple-TV-Now-Shipping.html

Exhibit 1

Sources (cont):

http://www.apple.com/pr/library/2007/04/02Apple-Unveils-Higher-Quality-DRM-Free-Music-on-the-iTunes-Store.html
http://www.apple.com/pr/library/2007/06/28iPhone-Premieres-This-Friday-Night-at-Apple-Retail-Stores.html
http://www.apple.com/pr/library/2007/09/05Apple-Introduces-All-New-iPod-nano.html
http://www.apple.com/pr/library/2007/09/05Apple-Unveils-iPod-touch.html
http://www.apple.com/pr/library/2007/09/05Apple-Unveils-iPod-touch.html
http://www.apple.com/pr/library/2009/09/09Apple-Premieres-iTunes-9.html
http://www.apple.com/pr/library/2010/03/29iPad-Arrives-This-Saturday.html
http://www.apple.com/pr/library/2010/09/01Apple-Introduces-iTunes-10-With-Ping.html
http://www.apple.com/pr/library/2011/10/04Apple-to-Launch-iCloud-on-October-12.html
http://en.wikipedia.org/wiki/Ipod
http://en.wikipedia.org/wiki/Itunes
http://en.wikipedia.org/wiki/ITunes_Store
http://en.wikipedia.org/wiki/Apple_TV
http://www.wired.com/science/discoveries/news/2004/07/64341
http://news.cnet.com/RealNetworks-rekindles-iPod-tech-tussle/2100-1027_3-5685286.html
http://www.pcworld.com/article/115553/article.html
http://en.wikipedia.org/wiki/ITunes_version_history
http://en.wikipedia.org/wiki/IPad
http://en.wikipedia.org/wiki/Icloud

Exhibit 2
iTunes Update History

iTunes Version Update	Release Date	Major changes
1.0	1/9/2001	Original release based on SoundJam MP code
1.1	2/22/2001	External burners, improved visual effects, more supported CD burners
2.0	10/23/2001	Adds support for newly introduced iPod, CD burning improvements, equalizer/cross-fader/sound enhancer added
3.0	7/17/2002	Smart playlists, more song list categories (including the My Rating column)
4.0	4/28/2003	Adds support for new iTunes Music Store, AAC audio codec, DVD burning, music sharing, GUI improvements
4.1	10/16/2003	Music store/CD burning improvements, Windows support added, voice notes, on-the-go playlists.
4.2	12/18/2003	AOL accounts with music store, GUI, and performance improvements
4.5	4/28/2004	iMix, party shuffle, CD insert printing, music store improvements, WMA to AAC conversion (Windows only), Apple Lossless audio codec
4.6	6/9/2004	AirTunes support, minor improvements.
4.7	10/27/2004	Copying photos to iPod Photo, GUI/performance improvements, Windows taskbar minimizing, updated FairPlay in effort to block hacking of music from the iTMS
4.8	5/9/2005	Video support, international music stores supported, security enhancements
4.9	6/28/2005	Podcasting, Motorola ROKR E1 mobile phone support added
5.0	9/7/2005	GUI refined, search bar improvements, parental controls, smart shuffle, iPod Nano support
6.0	10/12/2005	GUI/music store changes, blocks DRM remover utilities, transfer videos to 5th generation iPod classic, included a complete redesign of FairPlay
7.0	9/12/2006	Video playback/purchasing improvements, iPod games, Major GUI changes, gapless playback and album, sync purchased content from iPod to computer, Cover Flow added, support [redacted]
7.1	3/4/2007	Apple TV support, additional 2G shuffle support, GUI improvements, fixes Windows Vista issues, enhanced sorting options, full-screen Cover Flow
7.2	5/29/2007	Fully supports Vista, iTunes Plus introduced with 256 kbit/s DRM-free music tracks, iTunes U introduced which offers free content from some of the top universities around the United States. Also included GUI Update for Windows Vista
7.3	6/29/2007	Support for iPhone activation/synching, GUI changes/fixes. Changes sorting pattern
7.4	9/6/2007	Support for iPod Touch, Classic (6G), Nano (3G), and adds interface art for new iPod Shuffle colors. GUI improvements; [redacted]
7.5	11/5/2007	Allows activation of iPhones outside of the United States wherever activation is available, (e.g. United Kingdom and Germany) as well as security and stability fixes. Also included is a GUI update for Leopard, and the ability to add custom ringtones for free. Includes support for iPod game Phase. Shows iPod battery level in source list (iPod Nano 3G, iPod Classic, iPod Touch, and iPhone with 1.1.2 software)
7.6	1/15/2008	Rent movies from the iTunes Store. Transfer Apple TV purchases to your computer. Allows manual management of music on iPhones. Added support for Windows Vista 64-bit
7.7	7/10/2008	Support for iPhone 3G, iOS 2.0 and the new App Store which features application downloads for the iPhone and iPod Touch as well as enabling the two products to act as remotes for wireless iTunes control
8.0	9/9/2008	Genius Sidebar and playlists, Grid View, HD TV shows, Shows capacity of Apps on iPhone/iPod Touch on device summary tab, new default visualizer, more flexible podcast options and support for second generation iPod Touch and 4th generation iPod Nano

Exhibit 2

iTunes Version Update	Release Date	Major changes
8.1	3/11/2009	Support for the third generation iPod Shuffle, speed improvements for browsing large libraries and the iTunes Store, as well as 'preparing to sync' and 'optimizing photos' for syncing to iPods and iPhones, Party Shuffle has been replaced by iTunes DJ which now has the ability to receive requests for songs, the ability to import/convert files and CDs to iTunes Plus format, better performance when downloading iTunes Plus songs, accessibility improvements, Genius has been expanded to cover TV shows and movies, refined parental controls and refined auto-fill options. Supports Multi-touch gestures
8.2	6/1/2009	Supports iPhone 3GS and iOS 3.0 Software Update for the iPhone and iPod Touch. Includes many accessibility improvements and bug fixes
9.0	9/9/2009	New UI and redevelopment of the iTunes Store using WebKit. Genius Mixes were added, as were Home Sharing, iTunes LPs and iTunes Extras. Support for activation/syncing of iPod touch (late 2009). Music is automatically added to the library from a watched folder. 1-Click purchases.
9.1	3/30/2010	Adds support for iPad, adds the ability to sync and organize downloaded books between iPad and the iTunes library, and Genius Mixes can now be renamed, rearranged, or removed. "Applications" are renamed "Apps"
9.2	6/16/2010	Added ability to sync with iPhone 4. Also added ability to sync and read books with iPhone or iPod touch with iOS 4 and iBooks 1.1. Added ability to organize and sync PDF documents as books, and to read PDFs with iBooks 1.1 on iPad and any iPhone or iPod touch with iOS 4. Added option to organize your apps on iOS 4 home screens into folders using iTunes. Speed up back-ups while syncing an iPhone or iPod touch with iOS 4. Album artwork improvements make artwork appear more quickly when exploring your library
10.0	9/1/2010	Adds new social networking layer named "Ping". Adds support for iPod shuffle 4G, iPod nano 6G, iPod touch 4G, and Apple TV (late 2010). Renamed AirTunes to AirPlay. Adds visual improvements to list view. Improves performance. Adds additional support for VoiceOver Kit for iPod. New application icon.
10.1	11/12/2010	Bug fixes. Streaming to AirTunes speakers working again. Adds Twitter connectivity to Ping. Adds printing support and support for devices running iOS 4.2
10.2	4/18/2011	Adds support for iPad 2, and iOS 4.3. Improves Home Sharing, allowing browsing and playback of entire iTunes libraries on devices running iOS 4.3, and brings back the colored icons in the Preferences window
10.3	6/6/2011	Adds support for iTunes in the Cloud (beta), allowing automatic downloading of purchased content between iTunes and iOS devices, and downloading previously purchased music. Adds support for iBookstore on the iTunes Store
10.4	7/20/2011	Adds support for Mac OS X Lion. It now allows users to take advantage of the Full-Screen App capability. GUI slightly improved. Better integration with Windows Vista and Windows 7 (Aero effects support).
10.5	10/11/2011	Adds support for iPhone 4S, iCloud, iTunes in the Cloud, Wi-Fi Syncing, and iOS 5.
10.6	3/7/2012	Adds support for iPad (3rd generation). Adds the ability to play 1080p HD movies and TV shows from the iTunes Store. Higher bit rate songs can be converted to 128, 196, or 256 kbit/s when syncing to iOS devices or iPods. Improvements for iTunes Match. Bug fixes

Sources:

http://en.wikipedia.org/wiki/ITunes_version_history
http://www.apple.com/pr/library/2001/01/09Apple-Introduces-iTunes-Worlds-Best-and-Easiest-To-Use-Jukebox-Software.html
http://www.apple.com/pr/library/2001/10/23Apple-Announces-iTunes-2.html
http://www.apple.com/pr/library/2002/07/17Apple-Announces-iTunes-3.html

Exhibit 2

Sources (cont.):

http://www.apple.com/pr/library/2003/04/28Apple-Launches-the-iTunes-Music-Store.html
http://www.apple.com/pr/library/2003/10/16Apple-Updates-iPod.html
http://www.apple.com/pr/library/2004/10/26Apple-Introduces-iPod-Photo.html
http://www.oldapps.com/itunes.php?old_itunes+4#changelog
http://gigaom.com/2005/05/09/itunes-48-released
http://www.apple.com/pr/library/2005/06/28Apple-Takes-Podcasting-Mainstream.html
http://www.apple.com/pr/library/2005/09/07Apple-Introduces-iTunes-5.html
http://www.apple.com/pr/library/2005/10/12Apple-Announces-iTunes-6-With-2-000-Music-Videos-Pixar-Short-Films-Hit-TV-Shows.html
http://www.apple.com/pr/library/2006/09/12Apple-Announces-iTunes-7-with-Amazing-New-Features.html
http://appleinsider.com/articles/07/03/05/apple_releases_itunes_71_quicktime_715_more
http://www.apple.com/pr/library/2007/05/30Apple-Announces-iTunes-U-on-the-iTunes-Store.html
http://www.apple.com/pr/library/2007/05/30Apple-Announces-iTunes-U-on-the-iTunes-Store.html
http://appleinsider.com/articles/07/06/29/itunes_7_3_supports_iphone_adds_apple_tv_photo_streaming
http://www.apple.com/pr/library/2007/09/05Apple-Unveils-the-iTunes-Wi-Fi-Music-Store.html
http://www.apple.com/pr/library/2008/01/15Apple-Premieres-iTunes-Movie-Rentals-With-All-Major-Film-Studios.html
http://www.apple.com/pr/library/2003/10/16Apple-Updates-iPod.html
http://www.apple.com/pr/library/2008/09/09Apple-Announces-iTunes-8.html
http://www.macworld.com/article/1139330/itunes.html

Exhibit 3
Evolution of iPod Features

Model Update	Release Date	Major Changes
iPod Classic: Original iPod introduced October 23, 2001		
iPod P68 Oct01	10/23/2001	First iPod introduced; portable device design; large capacity; featured Auto-Sync technology Available capacity: 5GB
iPod P95 Mar02	3/21/2002	Added 10 GB model to the family; users now can personalize their iPods with the laser engraving Available capacity: 5GB, 10GB
iPod P68A/97 Jul02	7/17/2002	Introduced 20 GB model; compatible with Windows; 10GB model is physically smaller than the previous comparable models Available capacity: 10GB, 20GB
iPod Q14 Apr03	4/28/2003	Introduced 15 GB and 30 GB models; smaller and lighter than earlier iPods; prices are lower than previous comparable models Available capacity: 10GB, 15GB, 30GB
iPod Q14A Sep03	9/8/2003	Upgraded 15 GB and 30 GB models to 20 GB and 40 GB, respectively, while keeping the same introduction prices Available capacity: 10GB, 20GB, 40GB
iPod Q14A Sep03	1/6/2004	Added 15 GB back to the family; 15 GB model is smaller, lighter, and costs less than previous comparable models Available capacity: 10GB, 15GB, 20GB, 40GB
iPod Q21 Jul04	7/19/2004	New 20 GB and 40 GB models have longer battery life and are in smaller sizes than the previous comparable models Available capacity: 20GB, 40GB
iPod Photo P98 Oct04	10/26/2004	Allow photo browsing on the high-resolution color screeen; have more memory Available capacity: 40GB, 60GB
iPod Photo P98A Feb05	2/23/2005	Replaced the 40 GB model with the 30 GB model; longer battery life Available capacity: 30GB, 60GB
iPod Photo P98A Feb05	6/28/2005	Merged iPod and iPod photo lines; all iPods now equiped with color display Available capacity: 20GB, 60GB
iPod Video M25 Oct05	10/12/2005	Enhanced color display with larger screen and higher resolution; smaller and lighter; faster battery recharge; introduced at lower prices Available capacity: 30GB, 60GB
iPod Video M25B Sep06	9/12/2006	Upgraded 60 GB model to 80 GB while maintaining the same size; enhanced color display with larger screen and higher resolution; supported video playback; increased game support; longer battery life for the 30 GB model than the previous comparable models; lower introduction price Available capacity: 30GB, 80GB
iPod Classic N25 Sep07	9/5/2007	Introduced the 160 GB model; longer battery life for music, photo, and video playback while keeping the same introduction prices Available capacity: 80GB, 160GB
iPod Classic N25B Sep08	9/9/2008	Introduction at same price as 80 GB model of iPod Video M25B in Sep07 Available capacity: 120GB
iPod Classic N25C Sep09	9/9/2009	Greater capacity while keeping the introduction price the same as the 120 GB model of iPod Classic N25B Sep08 Available capacity: 160GB

Exhibit 3

Model Update	Release Date	Major Changes
iPod Mini: Introduced January 6, 2004		
iPod Mini Q22 Jan04	1/6/2004	Introduced iPod mini, smallest portable music player available; lightweight; new design in various colors; touch-sensitive click wheel controller; large capacity Available capacity: 4GB
iPod Mini Q22B Feb05	2/23/2005	Added 6GB model; lower introduction prices; longer battery life Available capacity: 4GB, 6GB
iPod Nano: Introduced September 7, 2005 to replace iPod Mini		
iPod Nano M26 Sep05	9/7/2005	Available in black and white for both Mac and Windows users; held 1000 songs; thinner than a standard #2 pencil; supported photo playback Available capacity: 2GB, 4GB
iPod Nano M26 Sep05	2/7/2006	Introduced the 1 GB model Available capacity: 1GB, 2GB, 4GB
iPod Nano N36 Sep06	9/12/2006	Introduced 8 GB model at same price as 4 GB model from the first generation Nano; longer battery life; improved screen resolution; aluminum body with click wheel; smaller and lighter; additional colors; lower prices for 2 GB and 4 GB models Available capacity: 2GB, 4GB, 8GB
iPod Nano N46 Sep07	9/5/2007	New design; enhanced video user interface; larger screen with higher resolution; supported video playback Available capacity: 4GB, 8GB
iPod Nano N58 Sep08	9/9/2008	Additional colors; new design with a curved aluminum and glass enclosure; incorporate "Genius" technology; lower introduction prices than previous comparable models Available capacity: 8GB, 16GB
iPod Nano N33 Sep09	9/9/2009	New design; built-in video camera; larger screen with higher resolution; lower introduction prices than previous comparable models Available capacity: 8GB, 16GB
iPod Nano N20 Sep10	9/1/2010	New design; multi-touch interface; smaller and lighter than previous comparable models at same introduction prices Available capacity: 8GB, 16GB
iPod Shuffle: Introduced January 11, 2005		
iPod Shuffle Q98 Jan05	1/11/2005	smaller and lighter than any other iPods; 512 MB model for under $100. Available capacity: 512MB, 1GB
iPod Shuffle N98 Sep06	9/12/2006	Built-in clip; smaller, lighter, and more affordable than previous comparable model Available capacity: 1GB
iPod Shuffle N98A Jan07	1/30/2007	Additional colors; built-in clip; smaller, lighter, and more affordable than the previous comparable model Available capacity: 1GB
iPod Shuffle N98C Sep07	9/5/2007	New colors Available capacity: 1GB
iPod Shuffle N98E Feb08	2/19/2008	New colors; higher capacity while maintaining the same size and weight at a lower introduction price than the 1 GB model of iPod Shuffle N98C Sep07; reduced price of 1 GB model Available capacity: 2GB
iPod Shuffle N98F Sep08	9/9/2008	New colors; lower prices Available capacity: 1GB, 2GB
iPod Shuffle D98 Mar09	3/11/2009	Greater capacity; smaller and lighter; faster battery recharge Available capacity: 4GB

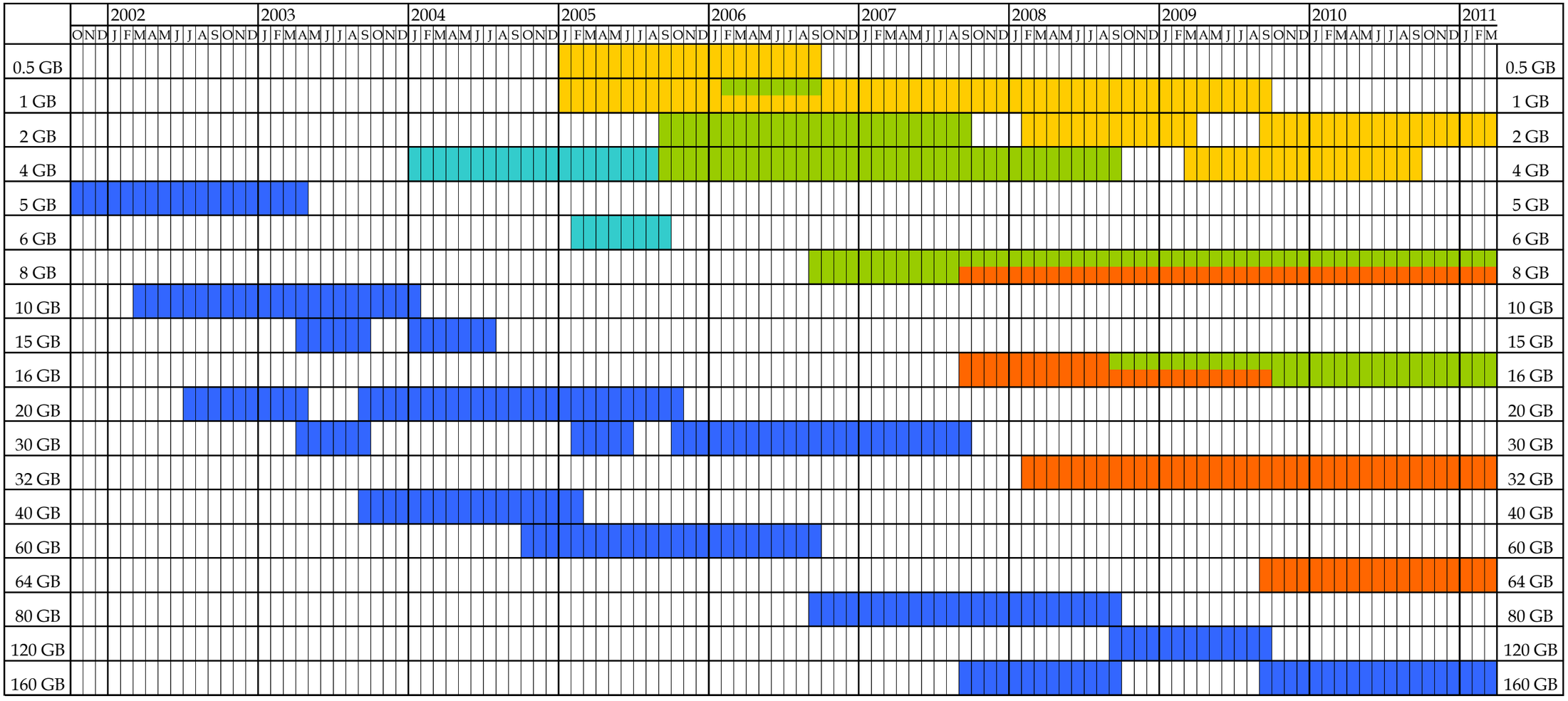
Exhibit 3

Model Update	Release Date	Major Changes
iPod Shuffle D55 Sep09/ iPod Shuffle D98A Sep09	9/9/2009	Lower price; button controller with voice over; in-ear headphones with remote Available capacity: 2GB, 4GB
iPod Shuffle N12 Sep10	9/1/2010	New design Available capacity: 2GB
iPod Touch: Introduced September 5, 2007		
iPod Touch N45 Sep07	9/5/2007	Multi-touch interface; built-in wifi wireless networking; 3.5-inch display; longer battery life for audio and video playback Available capacity: 8GB, 16GB
iPod Touch N45 Sep07	2/5/2008	Introduced 32 GB model Available capacity: 8GB, 16GB, 32GB
iPod Touch N72 Sep08	9/9/2008	New design; longer battery life for audio and video playback; lighter than previous comparable models Available capacity: 8GB, 16GB, 32GB
iPod Touch N18 Sep09/ iPod Touch N72B Sep09	9/9/2009	Introduced 64 GB model; new design; longer battery life for audio and video playback; lighter and lower introduction prices than the previous comparable models; greater memory and onboard RAM capacity for 32 GB and 64 GB models Available capacity: 8GB, 32GB, 64GB
iPod Touch N81 Sep10	9/1/2010	Higher screen resolution; included front-facing camera for FaceTime; longer battery life for audio and video playback; lighter and smaller than previous comparable models Available capacity: 8GB, 32GB, 64GB

Sources: iPod characteristics data in Murphy/Topel reports, Wikipedia and Apple press releases, including:

http://www.apple.com/pr/products/ipodhistory/
http://www.apple.com/pr/library/2002/07/17Apple-Unveils-New-iPods.html
http://www.apple.com/pr/library/2002/07/17Apple-Unveils-New-iPods.html
http://www.apple.com/pr/library/2003/04/28Apple-Introduces-New-iPods.html
http://www.apple.com/pr/library/2004/01/06Apple-Introduces-iPod-mini.html
http://www.apple.com/pr/library/2004/07/19Apple-Introduces-the-New-iPod.html
http://www.apple.com/pr/library/2004/10/26Apple-Introduces-iPod-Photo.html
http://www.apple.com/pr/library/2005/01/11Apple-Introduces-iPod-shuffle.html
http://www.apple.com/pr/library/2005/02/23Apple-Unveils-New-iPod-mini-Starting-at-Just-199.html
http://www.apple.com/pr/library/2005/06/28Apple-Merges-iPod-iPod-photo-Lines.html
http://www.apple.com/pr/library/2005/09/07Apple-Introduces-iPod-nano.html
http://www.apple.com/pr/library/2005/10/12Apple-Unveils-the-New-iPod.html
http://www.apple.com/pr/library/2006/05/23Nike-and-Apple-Team-Up-to-Launch-Nike-iPod.html
http://www.apple.com/pr/library/2006/09/12Apple-Introduces-the-New-iPod-nano.html
http://www.apple.com/pr/library/2006/09/12Apple-Unveils-the-New-iPod-shuffle.html
http://www.apple.com/pr/library/2006/09/12Apple-Introduces-the-New-iPod.html
http://www.apple.com/pr/library/2007/09/05Apple-Unveils-iPod-touch.html
http://www.apple.com/pr/library/2007/09/05Apple-Introduces-New-iPod-classic.html
http://www.apple.com/pr/library/2007/09/05Apple-Introduces-All-New-iPod-nano.html
http://www.apple.com/pr/library/2008/09/09Apple-Introduces-New-iPod-nano.html
http://www.apple.com/pr/library/2008/09/09Apple-Introduces-New-iPod-touch.html
http://www.apple.com/pr/library/2009/09/09Apple-Introduces-New-iPod-nano-With-Built-in-Video-Camera.html
http://www.apple.com/pr/library/2010/09/01Apple-Introduces-New-iPod-touch.html
http://www.apple.com/pr/library/2010/09/01Apple-Reinvents-iPod-nano-With-Multi-Touch-Interface.html

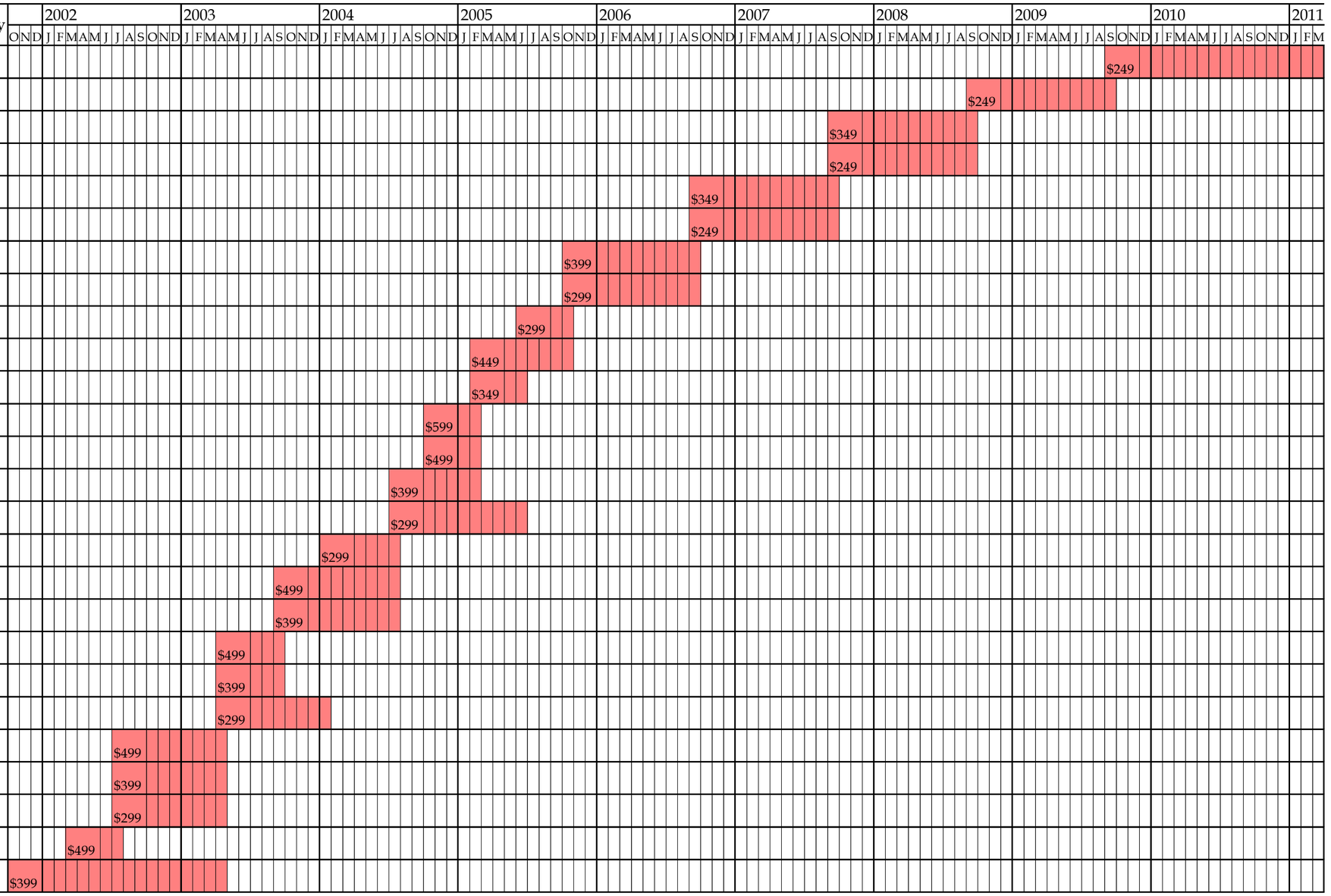
Exhibit 4
iPod Timeline by Memory Size



Note: Special editions of U2, Harry Potter, and Product Red are excluded from this exhibit.
Source: Price change data, Price Committee Documents, Apple Press Release, Direct Sales Data, Everymac.com.

Exhibit 5a
iPod Timeline of iPod Classic

Family	Start Date	Memory
IPOD CLASSIC N25C GOOD	9/9/2009	160
IPOD CLASSIC N25B GOOD	9/9/2008	120
IPOD CLASSIC N25 BETTER	9/5/2007	160
IPOD CLASSIC N25 GOOD	9/5/2007	80
IPOD VIDEO M25B BEST	9/12/2006	80
IPOD VIDEO M25B BETTER	9/12/2006	30
IPOD VIDEO M25 BEST	10/12/2005	60
IPOD VIDEO M25 BETTER	10/12/2005	30
IPOD PHOTO P98A GOOD	6/28/2005	20
IPOD PHOTO P98A BEST	2/23/2005	60
IPOD PHOTO P98A BETTER	2/23/2005	30
IPOD PHOTO P98 BEST	10/26/2004	60
IPOD PHOTO P98 BETTER	10/26/2004	40
IPOD Q21 BEST	7/19/2004	40
IPOD Q21 BETTER	7/19/2004	20
IPOD Q14B GOOD	1/6/2004	15
IPOD Q14A BEST	9/8/2003	40
IPOD Q14A BETTER	9/8/2003	20
IPOD Q14 BEST	4/28/2003	30
IPOD Q14 BETTER	4/28/2003	15
IPOD Q14 GOOD	4/28/2003	10
IPOD P97 BEST	7/17/2002	20
IPOD P97 BETTER	7/17/2002	10
IPOD P68A GOOD	7/17/2002	5
IPOD P95 BETTER	3/21/2002	10
IPOD P68 GOOD	10/23/2001	5



Note: Special editions of U2, Harry Potter, and Product Red are excluded from this exhibit.
Source: Price change data, Price Committee Documents, Apple Press Release, Direct Sales Data, Everymac.com.

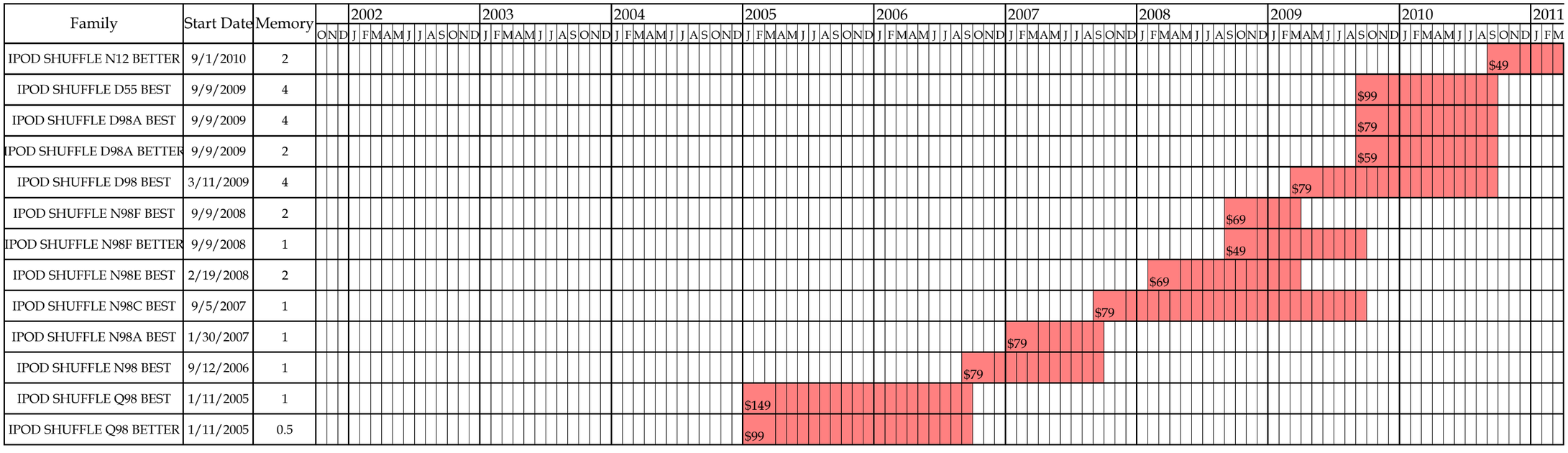
Exhibit 5b
iPod Timeline of iPod Mini

Family	Start Date	Memory	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
IPOD MINI Q22B BEST	2/23/2005	6				$249						
IPOD MINI Q22B BETTER	2/23/2005	4				$199						
IPOD MINI Q22 BEST	1/6/2004	4			$249							

Note: Special editions of U2, Harry Potter, and Product Red are excluded from this exhibit.
Source: Price change data, Price Committee Documents, Apple Press Release, Direct Sales Data, Everymac.com.

Exhibit 5c
iPod Timeline of iPod Shuffle

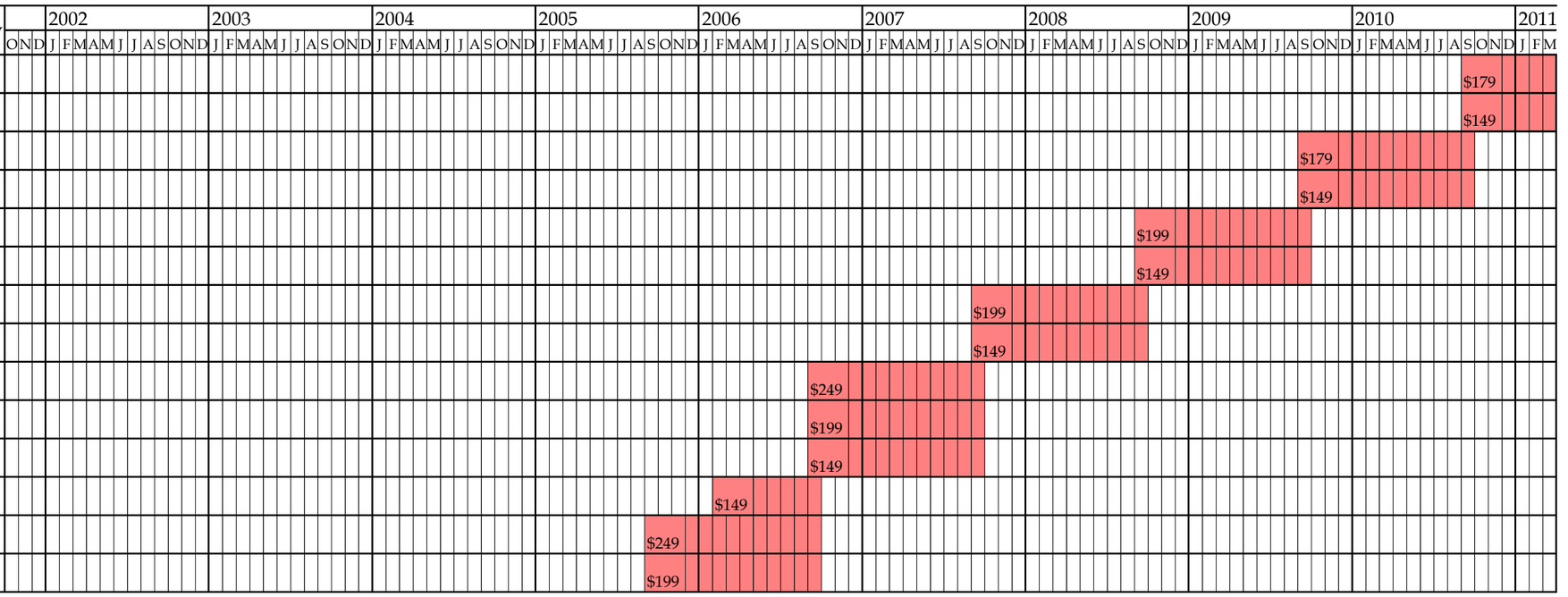
Family	Start Date	Memory
IPOD SHUFFLE N12 BETTER	9/1/2010	2
IPOD SHUFFLE D55 BEST	9/9/2009	4
IPOD SHUFFLE D98A BEST	9/9/2009	4
IPOD SHUFFLE D98A BETTER	9/9/2009	2
IPOD SHUFFLE D98 BEST	3/11/2009	4
IPOD SHUFFLE N98F BEST	9/9/2008	2
IPOD SHUFFLE N98F BETTER	9/9/2008	1
IPOD SHUFFLE N98E BEST	2/19/2008	2
IPOD SHUFFLE N98C BEST	9/5/2007	1
IPOD SHUFFLE N98A BEST	1/30/2007	1
IPOD SHUFFLE N98 BEST	9/12/2006	1
IPOD SHUFFLE Q98 BEST	1/11/2005	1
IPOD SHUFFLE Q98 BETTER	1/11/2005	0.5



Note: Special editions of U2, Harry Potter, and Product Red are excluded from this exhibit.
Source: Price change data, Price Committee Documents, Apple Press Release, Direct Sales Data, Everymac.com.

Exhibit 5d
iPod Timeline of iPod Nano

Family	Start Date	Memory
IPOD NANO N20 BEST	9/1/2010	16
IPOD NANO N20 BETTER	9/1/2010	8
IPOD NANO N33 BETTER	9/9/2009	16
IPOD NANO N33 GOOD	9/9/2009	8
IPOD NANO N58 ULTIMATE	9/9/2008	16
IPOD NANO N58 BEST	9/9/2008	8
IPOD NANO N46 BEST	9/5/2007	8
IPOD NANO N46 BETTER	9/5/2007	4
IPOD NANO N36 BEST	9/12/2006	8
IPOD NANO N36 BETTER	9/12/2006	4
IPOD NANO N36 GOOD	9/12/2006	2
IPOD NANO M26C GOOD	2/7/2006	1
IPOD NANO M26 BEST	9/7/2005	4
IPOD NANO M26 BETTER	9/7/2005	2



Note: Special editions of U2, Harry Potter, and Product Red are excluded from this exhibit.
Source: Price change data, Price Committee Documents, Apple Press Release, Direct Sales Data, Everymac.com.

Exhibit 5e
iPod Timeline of iPod Touch

Family	Start Date	Memory	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
			O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M
IPOD TOUCH N81 BEST	9/1/2010	64									$399	
IPOD TOUCH N81 BETTER	9/1/2010	32									$299	
IPOD TOUCH N81 GOOD	9/1/2010	8									$229	
IPOD TOUCH N18 BEST	9/9/2009	64								$399		
IPOD TOUCH N18 BETTER	9/9/2009	32								$299		
IPOD TOUCH N72B GOOD	9/9/2009	8								$199		
IPOD TOUCH N72 BEST	9/9/2008	32							$399			
IPOD TOUCH N72 BETTER	9/9/2008	16							$299			
IPOD TOUCH N72 GOOD	9/9/2008	8							$229			
IPOD TOUCH N45A BEST	2/5/2008	32							$499			
IPOD TOUCH N45 BETTER	9/5/2007	16						$399				
IPOD TOUCH N45 GOOD	9/5/2007	8						$299				

Note: Special editions of U2, Harry Potter, and Product Red are excluded from this exhibit.

Source: Price change data, Price Committee Documents, Apple Press Release, Direct Sales Data, Everymac.com.

Exhibit 6

iTunes 7.0 Features

- Released 9/12/2006
- First version of iTunes to sell movies (All of the first 75 movies from 4 studio of the Walt Disney Company)
- Movies will become available on the iTunes Store the same day they are released on DVD, with new releases priced at $12.99 when pre-ordered and during their first week of availability, and $14.99 thereafter, and library titles available for just $9.99 every day
- Delivers video near-DVD quality at a resolution of 640x480, 4 times higher than the previous version
- Redesigned layout to better organize and enjoy digital music and video
- New Cover Flow which lets you visually browse through your music and video by cover art
- iPod can now be used to transfer content to different computers
- The iTunes Store now also offers downloads of popular video games for fifth generation iPods (New iPod Classic only) available for $4.99 each
- Existing iPods can be updated with all features listed above
- [redacted]

Sources:

Apple_AIIA00974436
http://www.apple.com/pr/library/2006/09/12Apple-Announces-iTunes-7-with-Amazing-New-Features.html

Exhibit 7
Online Music Service Summary

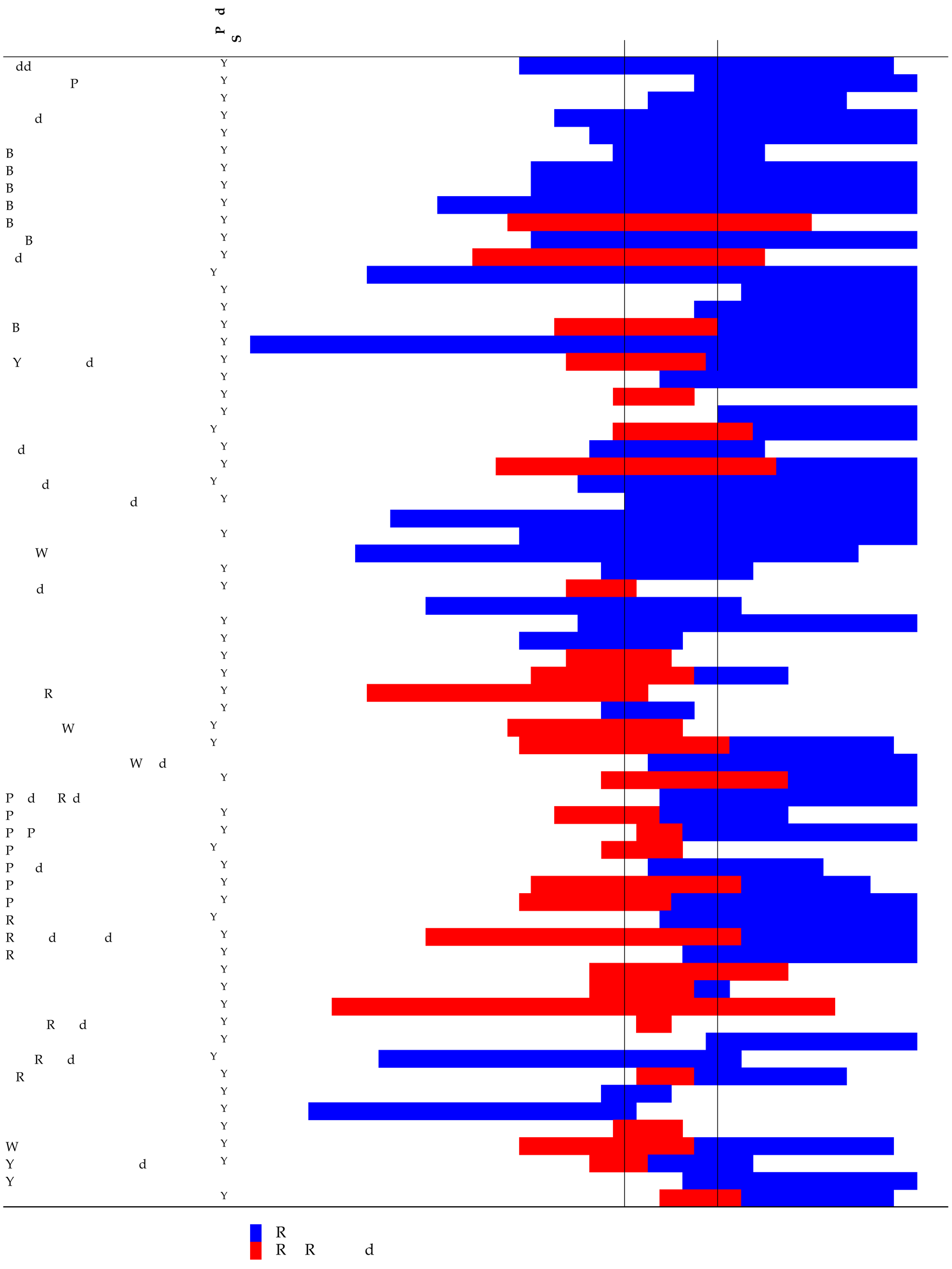


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Exhibit 7

Sources:	Source 1	Source 2	Source 3	Source 4
Addictech	http://www.trademarkia.com/addictech-76553281.html	http://www.gizmag.com/go/7269/		
Amazon MP3	http://en.wikipedia.org/wiki/Amazon_MP3			
Amie Street	http://en.wikipedia.org/wiki/Amie_Street			
Arkade	http://www.arkade.com/			
artistxite	http://artistxite.com/	http://musowiki.net/index.php/ArtistXite	http://website.informer.com/artistxite.com	
Batanga (eLatinMusic)	http://www.bizjournals.com/triad/stories/2006/11/06/story6.html?page=all	http://www.batanganetwork.com/batanga-inc-announces-seamless-music-purchase-experience-linked-directly-with-		
Beatport	http://en.wikipedia.org/wiki/Beatport	http://www.beatport.com/		
Bleep.com	http://en.wikipedia.org/wiki/Bleep.com			
Boomkat	http://www.boomkat.com/	http://www.webwiki.com/boomkat.com		
BuyMusic	http://en.wikipedia.org/wiki/BuyMusic	http://usatoday30.usatoday.com/tech/news/2003-07-28-buymusic_x.htm	http://www.underconsideration.com/speakup/archives/001534.html	
CDBaby	http://www.cdbaby.com/About	http://en.wikipedia.org/wiki/CD_Baby		
Cdigix	http://en.wikipedia.org/wiki/Cdigix			
Classical Archives	http://www.classicalarchives.com/about.html	http://en.wikipedia.org/wiki/Classical_Archives		
Digital-Tunes	http://www.digital-tunes.net/	http://www.prleap.com/pr/73840/		
Discogs	http://en.wikipedia.org/wiki/Discogs			
eBay Digital Music Center	http://news.cnet.com/eBay-plugs-into-digital-music-market/2100-1025_3-5270681.html	http://www.ebaychatter.com/the_chatter/2008/03/digital-downloa.html		
eMusic	http://en.wikipedia.org/wiki/Emusic	http://www.emusic.com/listen/#/		
FYE Download Zone	http://www.trademarkia.com/fye-download-zone-78763697.html	http://www.prnewswire.com/news-releases/trans-world-entertainment-announces-launch-of-fye-download-zone-74257247.html	http://www.billboard.biz/bbbiz/retail/trans-world-to-launch-digital-service-1003571570.story	
GoMusicNow	http://en.wikipedia.org/wiki/GoMusicNow	http://hardnews1.ansci.usu.edu/archive/dec2006/121306_15cents.html		
Grazemusic	http://www.billboard.biz/bbbiz/retail/trans-world-to-launch-digital-service-1003571570.story	http://news.minnesota.publicradio.org/features/2005/10/26_horwichj_graze/		
HDtracks	https://www.hdtracks.com	http://www.berkleegroove.com/2010/04/29/david-chesky-hd-tracks/	http://en.wikipedia.org/wiki/Chesky_Records	
iMesh	http://en.wikipedia.org/wiki/Imesh			
Indieburn	http://www.prweb.com/releases/2005/07/prweb258343.htm			
iTunes Music Store	http://en.wikipedia.org/wiki/ITunes_Store			
Jamendo	http://www.jamendo.com/en	http://en.wikipedia.org/wiki/Jamendo		
Juno / Juno Download	http://en.wikipedia.org/wiki/Juno_Records	http://www.junodownload.com/	http://www.junodownload.com/welcome_to_junodownload/	

Exhibit 7

Sources:	Source 1	Source 2	Source 3	Source 4
Kazaa	http://deadspin.com/titus-young-will-take-a-nap-in-your-at-t-store-496122722?utm_campaign=socialflow_deadspin_twitter&utm_source=deadspin_twitter&utm_medium=socialflow			
Lifeway Stores	http://www.baptiststandard.com/index.php?option=com_content&task=view&id=1249&Itemid=131			
LimeWire	http://en.wikipedia.org/wiki/LimeWire			
Misrolas	http://www.billboard.com/features/misrolas-com-shuts-download-store-1003844475.story#/features/misrolas-com-shuts-download-store-1003844475.story	http://www.theorchard.com/news/2005_08C.htm	http://www.billboard.com/features/misrolas-mobile-links-with-at-t-1003716969.story	
mMode Music Store	http://news.cnet.com/AT38T-Wireless-opens-mobile-music-store/2100-1027_3-5396072.html?tag=item	http://www.phonenews.com/cingular-to-shut-down-mmode-lbs-services-1117/	http://en.wikipedia.org/wiki/MMode	
Morpheus	http://en.wikipedia.org/wiki/Morpheus_(software)			
mp3tunes.com	http://www.mp3tunes.com/cb/about/	http://news.cnet.com/MP3tunes.com-shuns-digital-rights-management/2100-1027_3-5569293.html		
Mperia	http://en.wikipedia.org/wiki/BitPass			
MSN Music	http://en.wikipedia.org/wiki/MSN_Music	http://news.cnet.com/8301-10784_3-9926476-7.html		
Music Giants	http://www.stereophile.com/news/more_on_musicgiants/index.html	http://www.wired.com/listening_post/2007/09/musicgiants-a-h/		
Music Rebellion	http://keynet.blogs.com/networks/2004/01/psychology_schm.html	http://www.avsforum.com/t/365725/is-http-www-musicrebellion-com-legal-in-usa	http://web.archive.org/web/20060425071714/http://www.musicrebellion.com/	
Musica360	http://www.latinrapper.com/news_october25d.html	http://www.cnet.com/profile/Musica360.com/	http://web.archive.org/web/20070312054839/http://musica360.com/store/aboutus.php	
MusicNOW	http://www.internetretailer.com/2003/11/10/best-buy-music-now-launch-digital-music-store	http://news.cnet.com/aols-got-musicnow/2100-1027_3-5930749.html	http://www.pcworld.com/article/128520/aol_scraps_music_now_in_favor_of_napster.html	http://reviews.cnet.com/music-services/fullaudio-music-now/4505-9240_7-30974743-2.html
Napster 2.0	http://news.cnet.com/8301-17938_105-9945987-1.html	http://en.wikipedia.org/wiki/Napster_(pay_service)	http://techcrunch.com/2011/10/06/jon-irwin-on-why-rhapsody-bought-napster/	
National Geographic World Music	http://press.nationalgeographic.com/2006/08/03/worldmusicchanneldeliverssoundtrackoftheworldwithfreedownloads/	http://worldmusic.nationalgeographic.com/		
Optus Music Store	http://en.wikipedia.org/wiki/Optus_Music_Store			
Pandora Radio	http://www.tech-recipes.com/rx/1391/pandora_how_to_rip_save_music_mp3/	http://lifehacker.com/232533/download-of-the-day-pandora-downloader-windows	http://lifehacker.com/219114/download-of-the-day-pandoras-jar-windows?tag=softwarepandora	
Pass Along	http://en.wikipedia.org/wiki/PassAlong_Networks			
PayPlay.FM	http://en.wikipedia.org/wiki/PayPlay.FM			

Exhibit 7

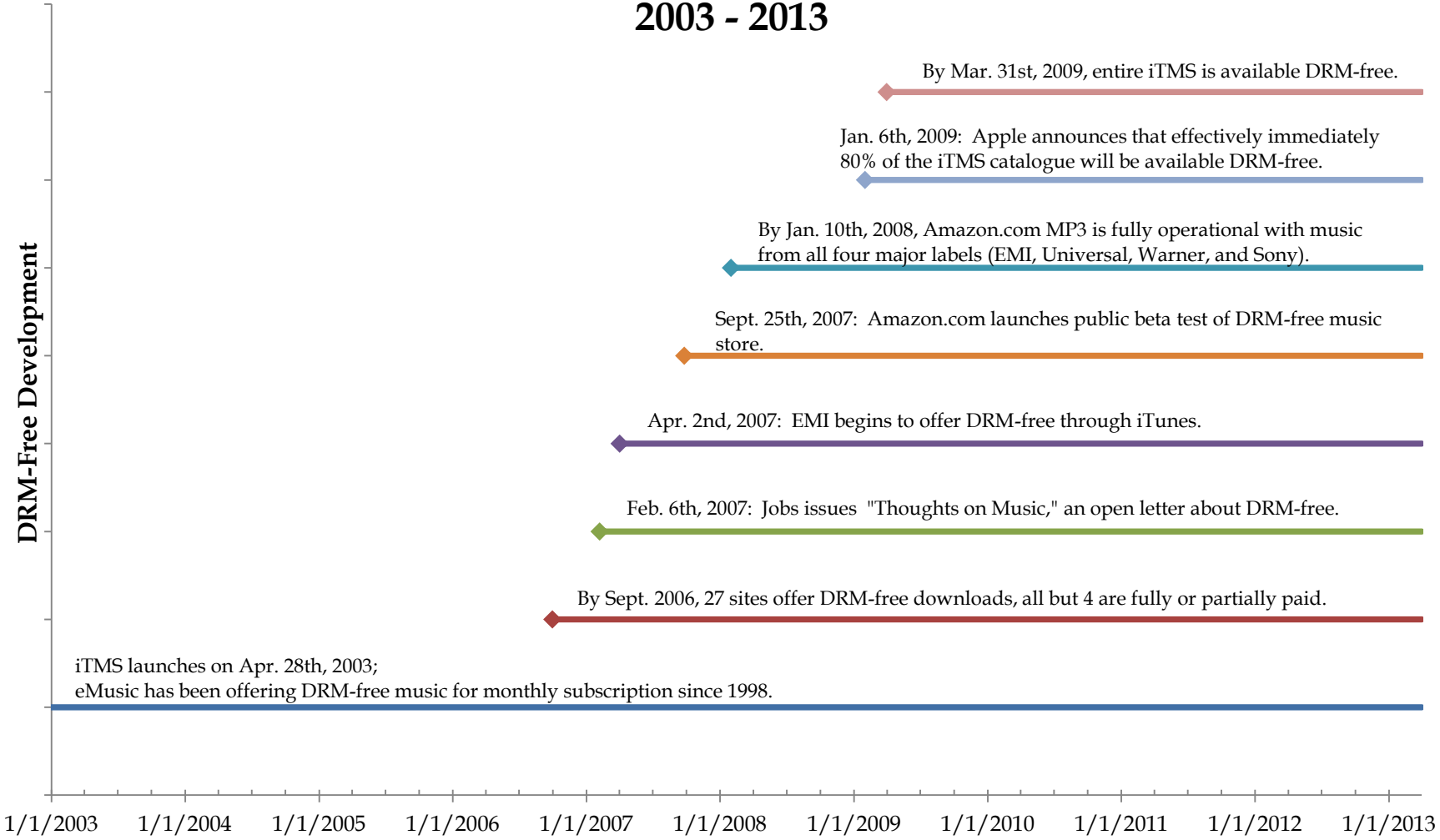
Sources:	Source 1	Source 2	Source 3	Source 4
Peer Impact	http://www.technologyreview.com/news/407000/p2p-from-internet-scourge-to-savior/	http://en.wikipedia.org/wiki/Peer_Impact	http://www.fatwallet.com/forums/off-topic/943427/	
Philadelphia Orchestra	http://www.philorch.org/recordings/	http://www.playbillarts.com/news/article/5262.html		
PlayNow	http://en.wikipedia.org/wiki/PlayNow_Arena	http://www.javamidlet.com/2007/11/09/playnow-music-download-service.html	http://news.cnet.com/8301-1023_3-10049186-93.html	
Puretracks	http://en.wikipedia.org/wiki/Puretracks	http://us.puretracks.com/content/viewer.aspx?cid=GlobalNav_Home		
RCN Music	http://music.rcn.net/	http://www.businesswire.com/news/home/20061117005100/en/RCN-Reaches-Enhance-Music-Game-Content-Choices		
Rhapsody (Started as Listen.com)	http://en.wikipedia.org/wiki/Rhapsody_(online_music_service)			
Rhino Entertainment	http://www.rhino.com/global/faq#restrictions_on_digital	http://www.allamericanpatriots.com/48735056_music_led_zeppelin_rocks_over_air_verizon_wireless		
Songtouch	http://www.songtouch.com/	http://christianmusic.about.com/od/top10songtouchsongs/tp/tpSTsgl41805.htm	http://www.gazette.com/articles/music-15226-christian-songtouch.html	
Sony Connect	http://en.wikipedia.org/wiki/Sony_Connect	http://downloadsquad.switched.com/2007/08/30/sony-kills-off-connect-online-music-store-atrac-format/		
Streamwaves	http://en.wikipedia.org/wiki/Streamwaves			
Tower Records Digital	http://www.ipodobserver.com/ipo/article/Tower_Records_Digital_Joins_Music_Download_Market/	http://www.dmwmedia.com/news/tag/tower_records		
Traxsource	http://www.traxsource.com/index.php?act=page&page_id=311			
TVT Records	http://en.wikipedia.org/wiki/TVT_Records			
URGE	http://en.wikipedia.org/wiki/URGE_(digital_music_service)	http://www.pcmag.com/article2/0,2817,2009421,00.asp	http://betanews.com/2007/07/24/drm-free-mp3s-coming-to-yahoo-urge/#comments	
Virgin Digital	http://en.wikipedia.org/wiki/Virgin_Digital			
Vitaminic Music Club	http://www.prnewswire.com/news-releases/epo-technology-announces-bundle-agreement-with-vitaminic-to-add-instant-music-access-to-the-vitaminic-music-club-76927317.html	http://www.vitaminic.co.uk/press-releases.html		
Voy Music	http://www.dmwmedia.com/news/2006/06/08/starmedia-voy-music-launch-latin-digital-music-service	http://www.hispanicbusiness.com/2005/11/21/voyr_announces_launch_of_voy_musictm.htm	http://www.dmwmedia.com/news/tag/voy	
Wal-Mart	http://www.macobserver.com/tmo/article/Inside_Wal-Marts_Online_Music_Store_Digital_Rights_Management/	http://arstechnica.com/business/2011/08/walmart-pulling-the-plug-on-its-mp3-store-but-not-its-drm-servers/	http://tech.fortune.cnn.com/2011/08/10/itunes-triumphant-walmart-kills-its-music-download-store/	
Yahoo! Music Unlimited	http://en.wikipedia.org/wiki/Yahoo!_Music_Unlimited	http://www.informationweek.com/news/191000022		

Exhibit 7

Sources:	Source 1	Source 2	Source 3	Source 4
YouTube	http://labnol.blogspot.com/2007/04/how-to-rip-audio-from-youtube-videos.html			
Zune Marketplace	http://en.wikipedia.org/wiki/Zune	http://www.zune.net/en-US/		

Exhibit 8

Timeline of DRM-Free Downloads
2003 - 2013



Sources: Apple press releases, Amazon press releases, EMI press releases, sources reflected in Exhibit 7, and Wikipedia.

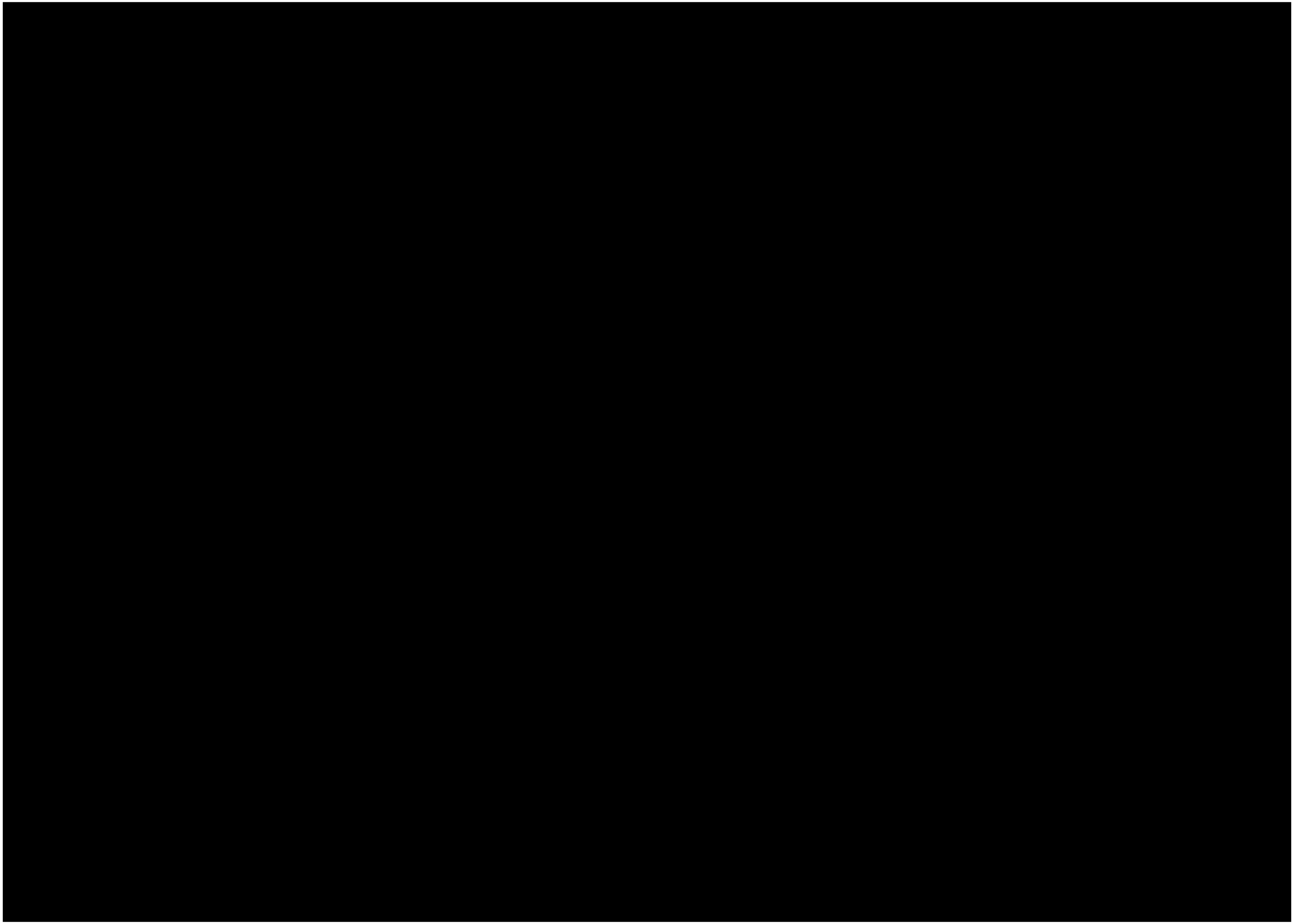


Exhibit 10
Attributes Considered and Attributes Ignored by Professor Noll

Attributes Considered by Professor Noll	Attributes Ignored by Professor Noll
Class	USB*
U2	Firewire*
Capacity (MB)	Weight (oz)*
Photo	Display (inches)*
Video and Photo	Resolution (pixels)*
Size (cubic inches)	Music Battery Hours*
Cost per Unit ($/Unit)	Recharge Hours
Reprice Sale	OEM sale (reseller regression only)*
End of Life Sale	
Quantity Sold	
Seasonality	
Number of Songs Available to Download	
Coupon (direct sales only)	

* Professor Noll's datasets contain this variable.
Sources: Declaration of Roger G. Noll on Liability and Damages and iPod Characterictics data in Murphy/Topel reports.

Exhibit 11

Exhibit 12a

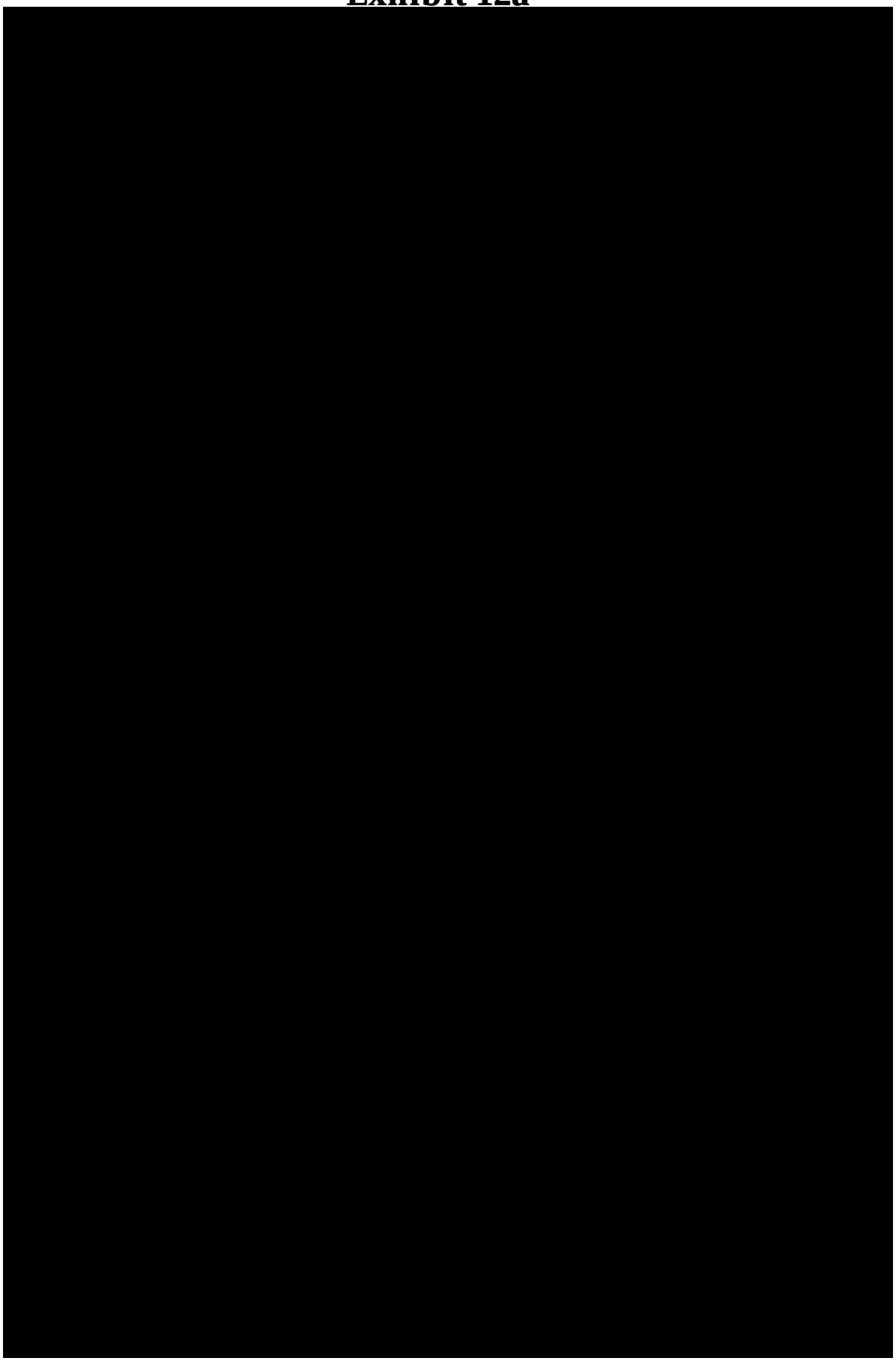


Exhibit 12a

Exhibit 13.1 Reseller Sales Log Regression Results

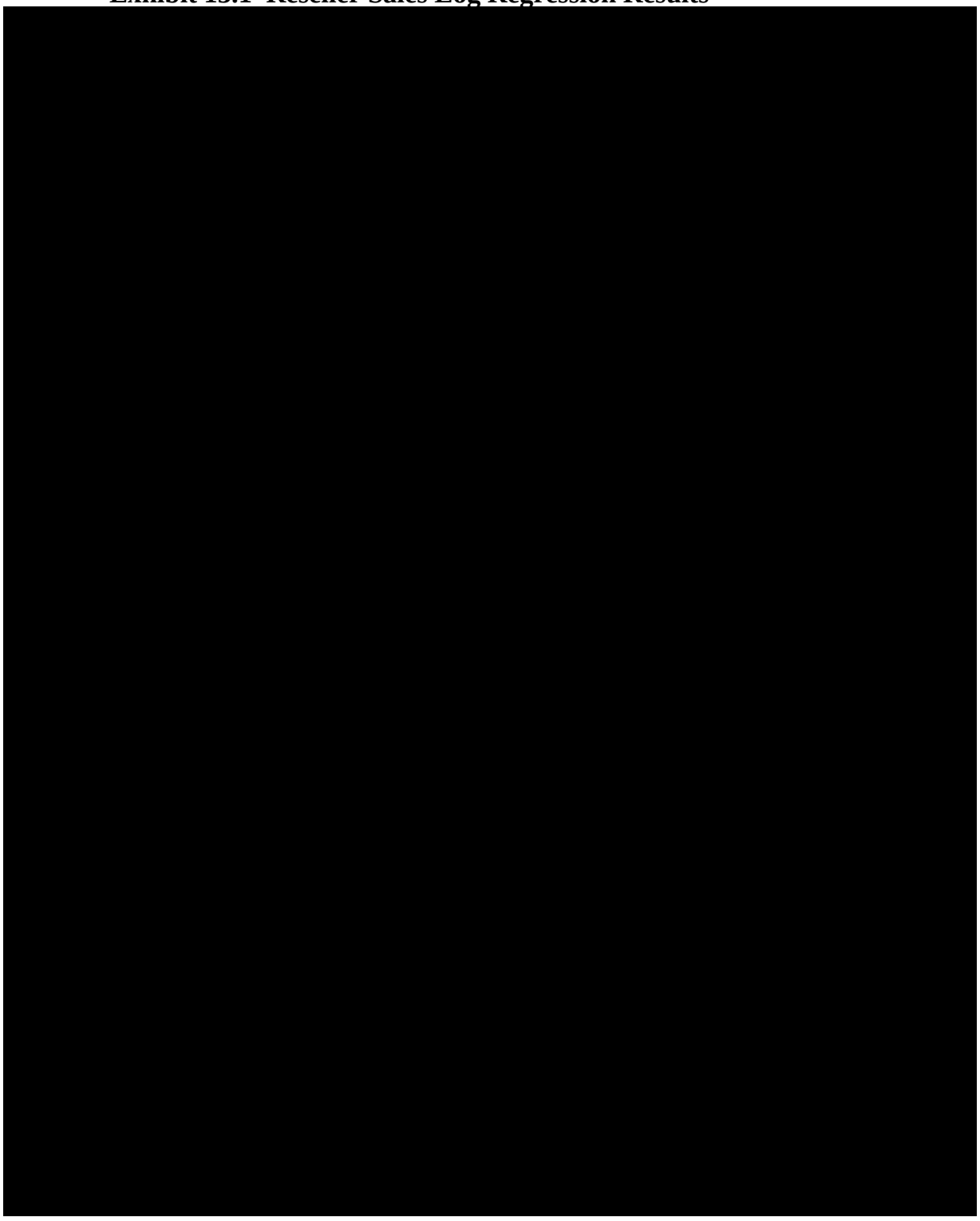


Exhibit 12b

Exhibit 13.2 Direct Sales Log Regression Results

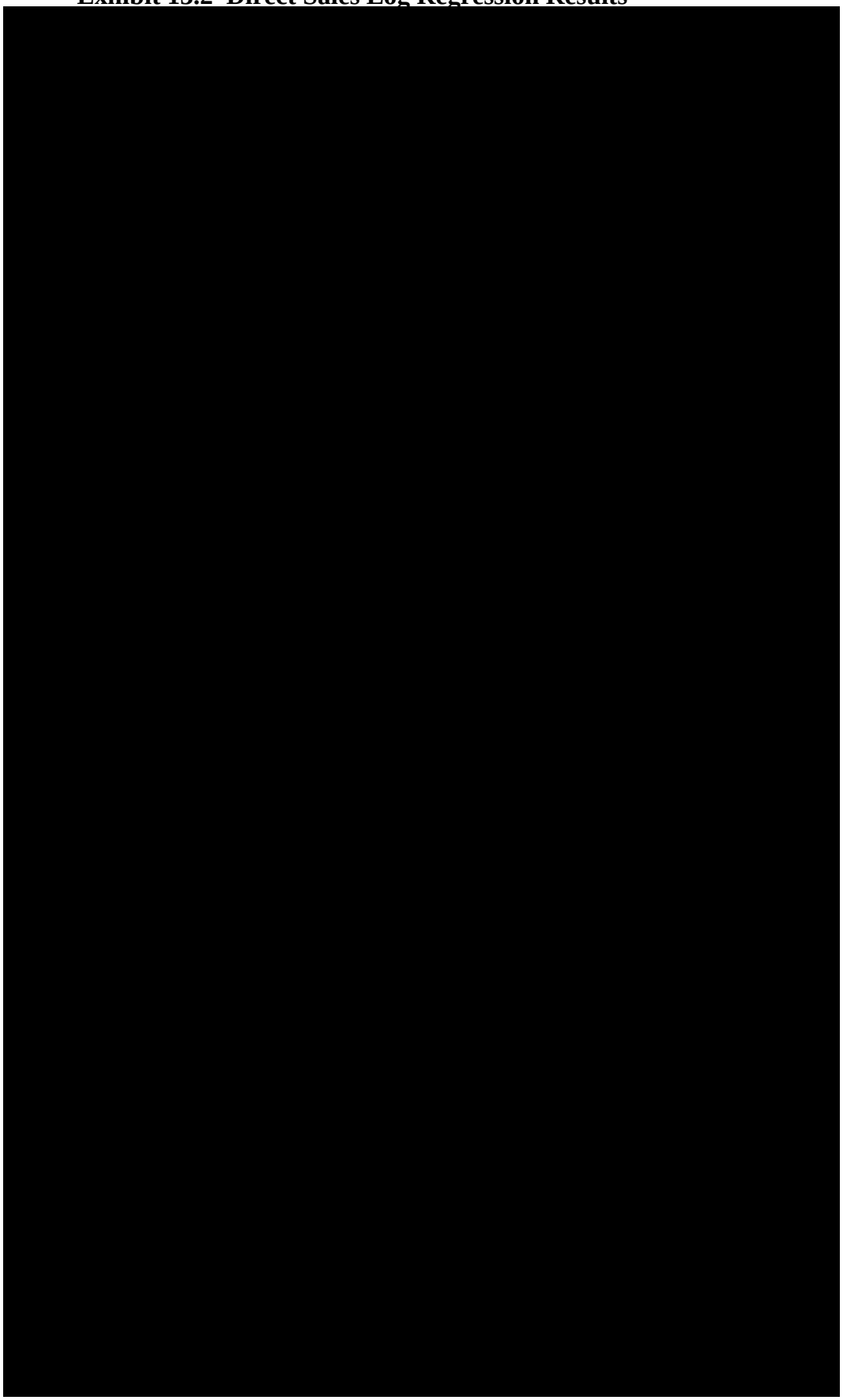


Exhibit 12b

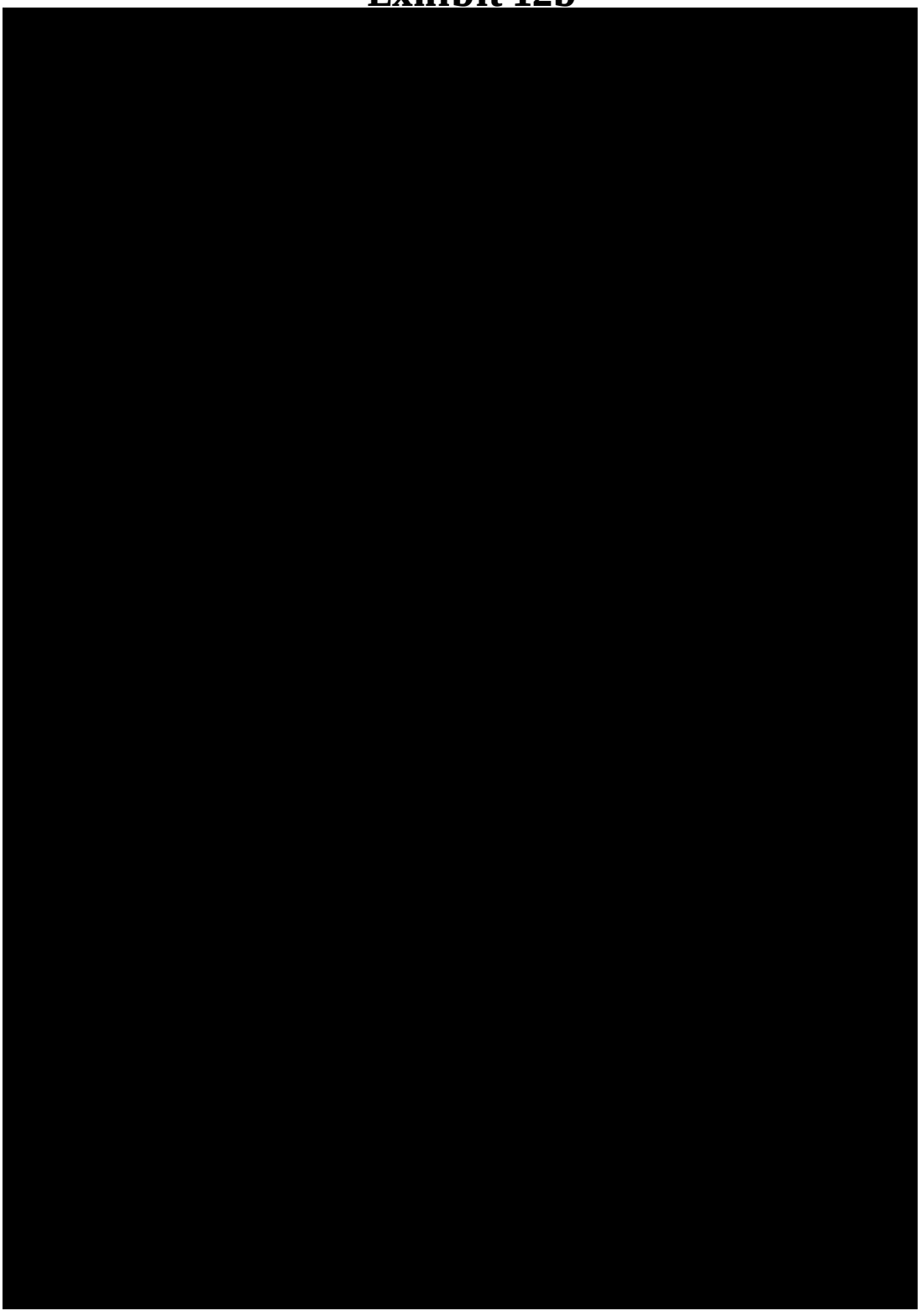


Exhibit 13a (Amended)
Summary of Resellers Data Regressions - Dependent Variable: Log Price (RPU)

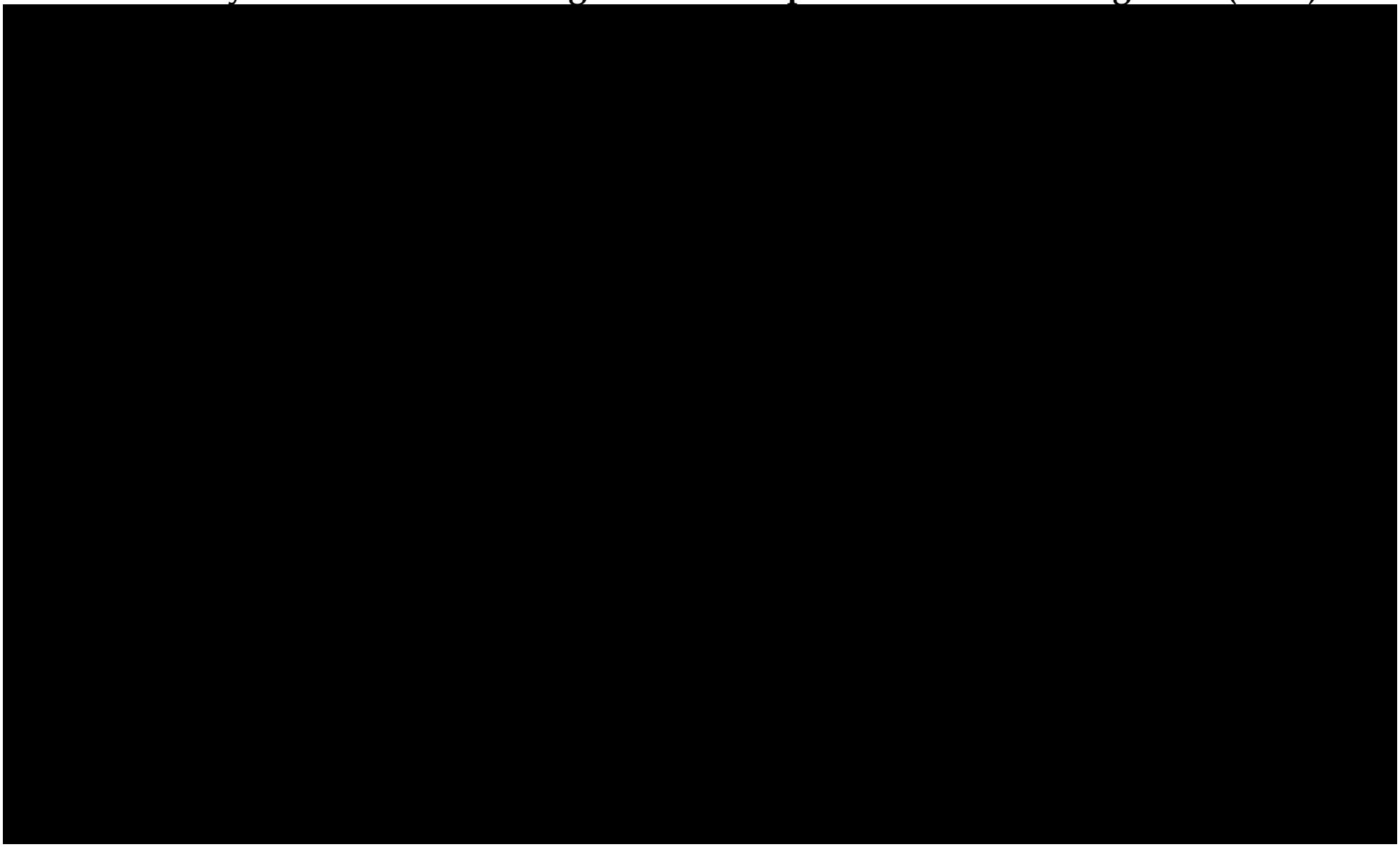


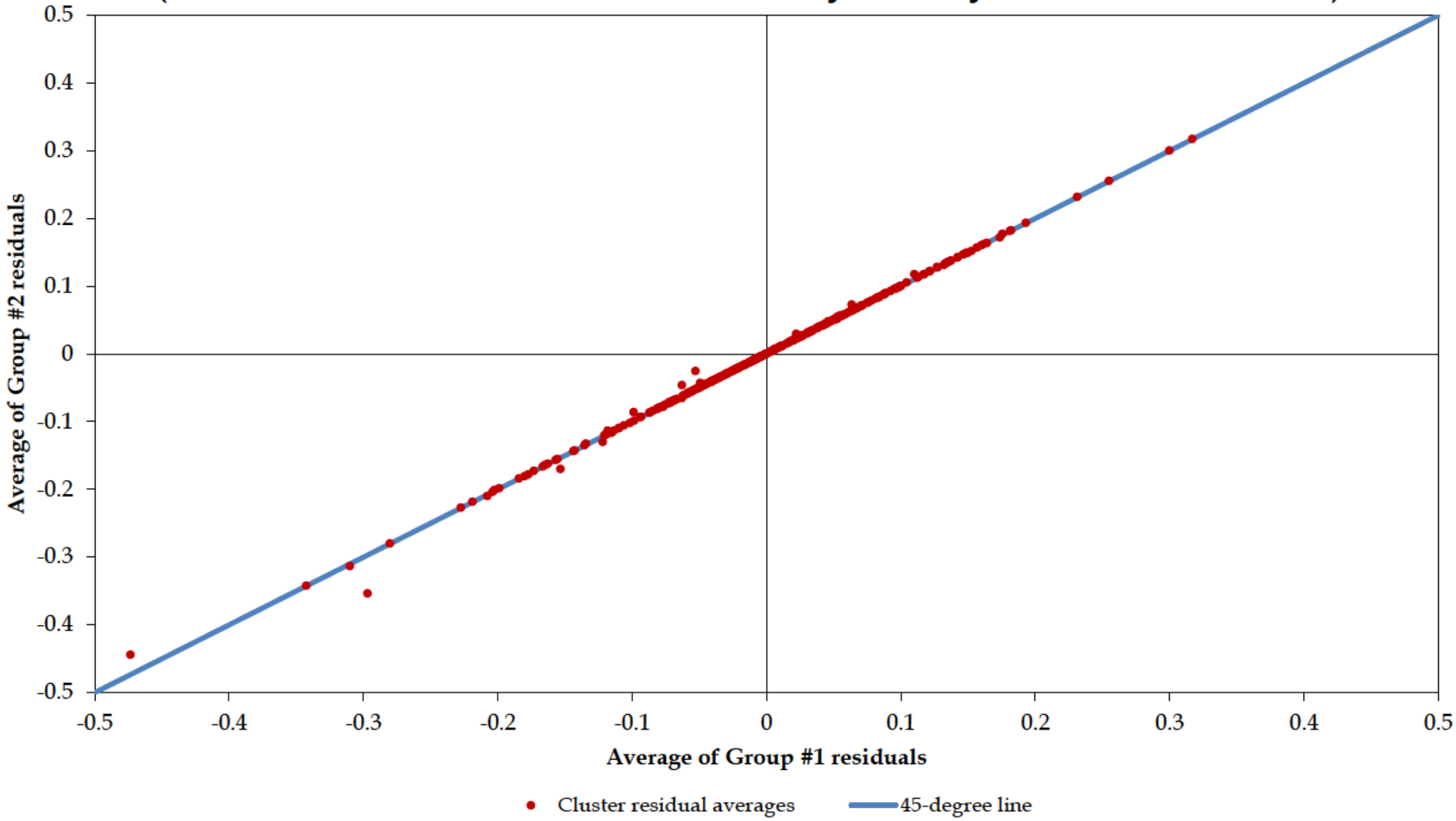
Exhibit 13b (Amended)
Summary of Direct Data Regressions - Dependent Variable: Log Price (RPU)

Exhibit 13c (Amended)

Effects of Correcting Professor Noll's Calculation of Damages

Exhibit 14a

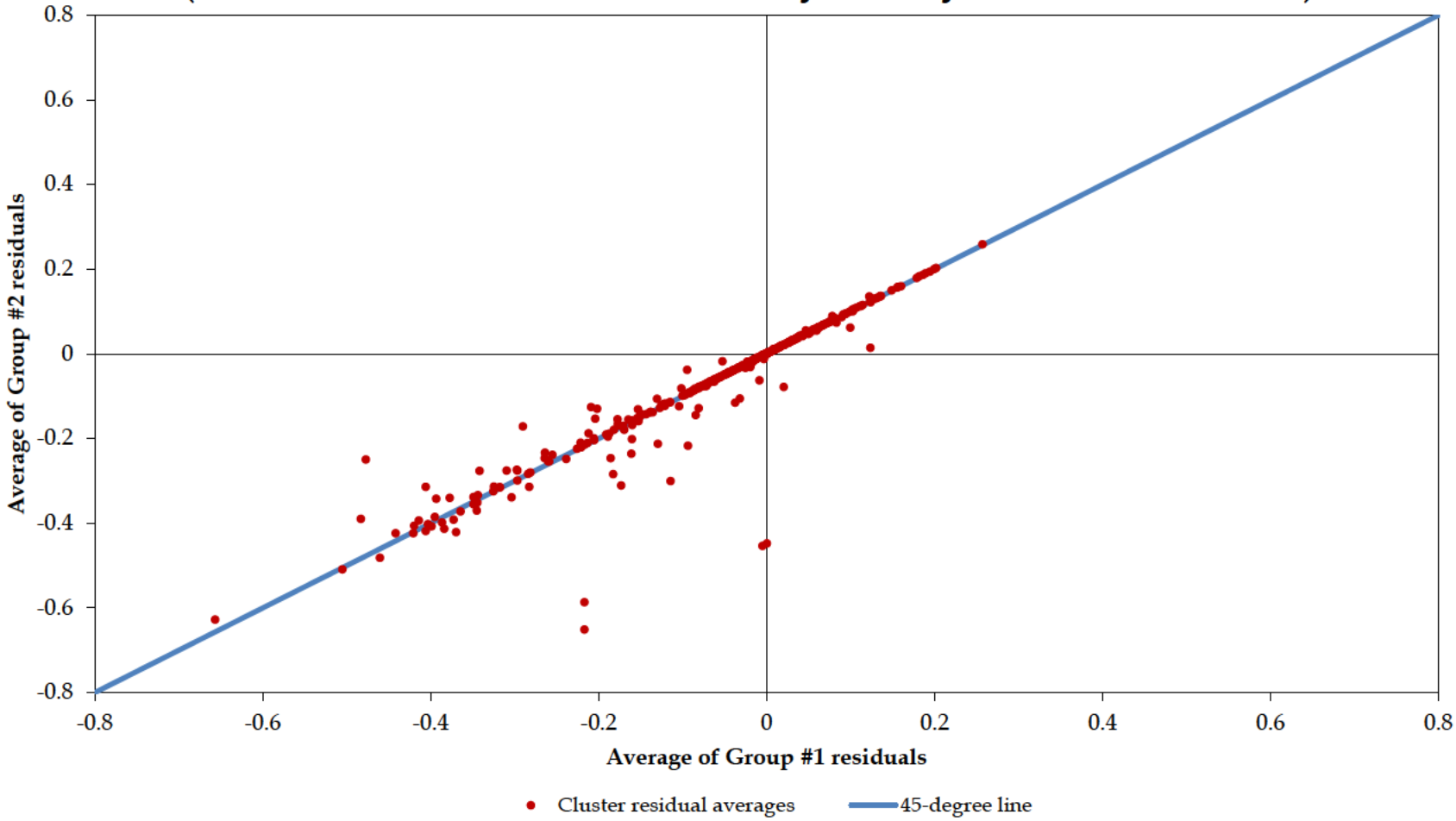
Average of Regression Residuals
Divided Randomly in Two Groups, by Cluster
(Resellers Sales, Clusters Defined by Family and Year-Quarter)



Sources: Apple iPod Sales Data

Exhibit 14b

Average of Regression Residuals
Divided Randomly in Two Groups, by Cluster
(Direct Sales, Clusters Defined by Family and Year-Quarter)



Sources: Apple iPod Sales Data

Exhibit 15a

Notes: [redacted]
2) Dates are as used in Professor Noll's latest declaration.
Sources: Declaration of Roger G. Noll on Liabilities and Damages, Apple Sales Data.

Exhibit 15b

Sources: Declaration of Roger G. Noll on Liabilities and Damages, Apple Sales Data.

Exhibit 16
Content Interoperability of New Digital Media Players

	Contents' Type of DRM		
	FairPlay (iTMS)	Helix (RMS)	DRM Free
Before Harmony (7/24/2004)			
iPods (all models)	Yes	**No**	Yes
Other portable media players	**No**	Yes	Yes
Between Harmony and iTunes 4.7 [harmony_blocked] (7/25/2004 - 10/26/2004)[1]			
iPods (all models)	Yes	Yes	Yes
Other portable media players	**No**	Yes	Yes
Between iTunes 4.7 [harmony_blocked] and Harmony2 (10/27/2004 - 4/25/2005)[1]			
iPods (all models)	Yes	**No**	Yes
Other portable media players	**No**	Yes	Yes
Between Harmony2 and iTunes 7 (4/26/2005 - 9/11/2006)[1]			
iPods (all models)	Yes	Yes	Yes
Other portable media players	**No**	Yes	Yes

[redacted]

Notes:
(1) Upgrading to iTunes 4.7 was optional until 3/21/2005 when it became mandatory for anyone who wished to buy from the iTMS.

Appendix A

Robert H. Topel

CURRICULUM VITAE
May, 2013

CURRENT POSITIONS

Isidore Brown and Gladys J. Brown Distinguished Service Professor of Economics, Booth School of Business, University of Chicago
Director, George J. Stigler Center for the Study of the Economy and the State
Co-Director, Energy Policy Institute at Chicago (EPIC)
Research Associate, National Bureau of Economic Research

EDUCATION

B.A. (with High Honors), University of California, Santa Barbara, 1974
Ph.D., University of California, Los Angeles, 1980

FIELDS OF SPECIALIZATION

Microeconomics, Labor Economics, Industrial Organization, Health Economics, Economic Policy, Energy Economics, National Security Economics

PREVIOUS ACADEMIC POSITIONS

Professor of Economics, Graduate School of Business, University of Chicago, 1986-93

Kirby Distinguished Visiting Professor of Economics, Texas A&M University, 2006
Professor of Economics, Department of Economics, University of California, Los Angeles, 1986
Associate Professor of Economics, Department of Economics, University of California, Los Angeles, 1985-86
Associate Professor of Economics, Graduate School of Business, University of Chicago, 1983-85
Assistant Professor of Economics, Department of Economics, University of Chicago, 1980-83

OTHER AFFILIATIONS

Research Associate, National Bureau of Economic Research, 1984—present
Senior Fellow, the Milken Institute, 1999—present

Faculty Member, MacLean Center for Clinical Medical Ethics, University of Chicago
Member, National Petroleum Council Taskforce on Transportation Fuels Supply and Infrastructure, 2010-2012
Fellow, Center for the Study of Poverty and Inequality, Stanford University, 2006-present
Member, Brookings Panel on Economic Activity, various years.
Visiting Scholar, Board of Governors of the Federal Reserve, 1990
Research Associate, Economics Research Center, NORC, 1980—1990
Consulting Economist, The Rand Corporation, 1982—1989
Research Associate, Center for the Study of the Economy and the State, 1980—present
Faculty Research Fellow, National Bureau of Economic Research, 1981-83
Research Economist, Unicon Corporation, 1981-88
Consultant, U.S. Department of Labor, 1985-90
Partner, Chicago Partners LLC 1994-2008
Principal & Managing Director, Navigant Economics, 2008-2013
Board of Directors, Ingalls Hospitals and Ingalls Health Service, 2000-2012
Director, WGA Evans Scholars Foundation, 2011-present
Senior Consultant, Charles River Associates, 2013-present

EDITORIAL POSITIONS

Editor, *Journal of Political Economy*, 1993-2003
Board of Editors, *American Economic Review*, 1992-94
Associate Editor, *Journal of Labor Economics*, 1982-92
Editorial Board, *International Journal of the Economics of Business*, 1993-present
Member of the Advisory Board, ERN Labor Journals, 1998-present

HONORS & AWARDS

Kenneth J. Arrow Award, International Health Economics Association, 2007
Kirby Distinguished Visiting Professor, Texas A&M University, 2006
Research America Eugene Garfield Prize for Medical and Health Research, 2005
Elected Fellow, Society of Labor Economists, 2004
Elected Member, Conference on Research in Income and Wealth
Elected Founding Member, National Academy of Social Insurance
William Ladany Research Scholar, University of Chicago, 1989-91
William Fishman Research Scholar, University of Chicago, 1986-87
Smith Richardson Dissertation Fellowship in Political Economy, 1978-79
Foundation for Research in Economics and Education Fellowships, 1975-79
Chancellor's Intern Fellow, University of California, Los Angeles, 1975-79
University Fellow, Northwestern University, 1975
General Electric Dissertation Fellowship, 1978

TEACHING EXPERIENCE

Graduate Economic Theory I, II, III
Law, Economics and Business

Competitive Strategy
Advanced Topics in Labor Economics
Advanced Topics in Microeconomics
Managing the Workplace
Industrial Organization/Antitrust
Price Theory

OTHER PROFESSIONAL ACTIVITIES

Thompson Lecture (Keynote Address), Midwest Economic Association, 2000
Nominating Committee, American Economic Association, 1996, 1997
Program Committee, American Economic Association, 2006-2007.
Organizer, Universities-NBER Research Conference: "Labor Markets in the 1990s," Cambridge, December 1989.
Program Chair, Labor Economics, Econometric Society Meetings, December 1989.
National Science Foundation Review Panel in Economics, 1998, 1999
Inaugural Keynote Lecture, Missouri Economics Conference, University of Missouri, 2001
Pihl Lecturer, Wayne State University, November, 2004
Keynote Address, Federal Reserve Bank of Cleveland Conference on Education and Economic Development, November, 2004
Kirby Lecturer, Texas A&M University, 2006
Huggins Lecturer, Department of Surgery Huggins Conference, University of Chicago, May, 2007
Keynote Address, Conference Board of Canada Conference on Medical Research, Montreal, January 2009
Keynote Address, Council on Competitiveness Conference on Energy Policy, Argonne National Laboratory, May 2009
Keynote Address, University of Chicago/RFF/University of Illinois Conference on *Energy Policy and the Economy*, Washington, D.C., January 2010
Keynote Address, Humana Health Economics Forum, Santa Fe Institute, 2011
Keynote Address, Toyota Sustainability Conference, La Jolla, 2011
Keynote Address, Conference on Health Policy, Arizona State University, 2013

UNIVERSITY SERVICE

Director, Undergraduate Program in Economics, 1980-83
Chairman, Graduate School of Business Curriculum Review, 1990-91
Committee on Graduate Education, 1992-94
Committee on Undergraduate Education, 1993-94
Council of the University Senate, 1992-94, 1995-97, 1999-2002, 2004-2007, 2010-
Committee of the Council of the University Senate, 2000-2002, 2006-2007
Graduate School of Business Policy Committee, 1995-97, 1999-2001
Member, Presidential Search Committee, 1999-2000
Board of Directors, University of Chicago Laboratory Schools, 1986-92, 1998-2007
Chairman, Director Search Committee, U of C Laboratory Schools, 2002-2003
Area Coordinator, PhD Program in Economics, 2002-2008

Director, George J. Stigler Center, 2007-present
Director, University of Chicago Energy Initiative, 2008-2010
Co-Director, Energy Policy Institute at Chicago, 2010-present

BIBLIOGRAPHY

Books:

The Welfare State in Transition, with Richard Freeman and Birgitta Swedenborg. Chicago: University of Chicago Press for NBER, 1997.

Labor Market Data and Measurement, with John Haltiwanger and Marilyn Manser. Chicago: University of Chicago Press for NBER, 1998.

Välfärdsstat i omvandling: Amerikanskt Perspectiv pä den Svenska Modelten, with Richard Freeman and Birgitta Swedenborg. Författarna och SNS Förlag, 1995.

Measuring the Gains from Medical Research: An Economic Approach, with Kevin M. Murphy. Chicago: University of Chicago Press (2003).

Reforming the Welfare State: Recovery and Beyond in Sweden, with Richard Freeman and Birgitta Swedenborg, Chicago, University of Chicago Press for NBER, 2009

Att Reformera Välfärdsstaten, with Richard Freeman and Birgitta Swedenborg, SNS Förlag, Stockholm, 2006

Distributional Aspects of Energy and Climate Policy, ed. with Mark Cohen and Don Fullerton, Special Issue of the BE Journal of Economic Analysis and Policy, Spring 2011. Also, Edward Elgar Publishing, Surrey, UK, 2013.

Articles and Monographs:

"Layoffs, Inventories, and the Demand for Labor," Ph.D. Dissertation, University of California, Los Angeles, December 1980.

"Unemployment Insurance: Survey and Extensions," *Economica* **47** (August 1980): 351-79 (with F. Welch)

"Inventory Adjustments, Industry Behavior, and the Business Cycle," presented at the NBER Conference on Inventories and Business Cycles, March 1980 (with A. Stockman)

"Inventories, Layoffs, and the Short-Run Demand for Labor," *American Economic Review* (September 1982): 769-87.

"Experience Rating of Unemployment Insurance and the Incidence of Unemployment," *Journal of Law and Economics* (April 1984): 61-90.

"On Layoffs and Unemployment Insurance," *American Economic Review* (September 1983): 541-59.

"Equilibrium Earnings, Turnover, and Unemployment: New Evidence," *Journal of Labor Economics* (October 1984): 500-22.

"Local Labor Markets," Presented at Hoover Institution Conference on Labor Markets, January 1983. *Journal of Political Economy* **94** (June 1986, part 2): 111-43.

"Estimation and Inference in 'Two-Step' Econometric Models," (with K. M. Murphy) *Journal of Business and Economic Statistics* **3** (October 1985): 370-80.

"Employment Risk, Sectoral Shifts, and Unemployment," (with G. Neumann), in *Studies in Search*, ed. N. M. Kiefer and G. R. Neumann. Oxford: Oxford University Press, 1989.

"Unemployment and Unemployment Insurance," *Research in Labor Economics* **7** (1985): 91-135.

"Efficient Labor Contracts with Employment Risk," (with F. Welch), *Rand Journal of Economics* **17** (Winter 1986): 490-507.

"Financing Unemployment Insurance: History, Incentives, and Reform," in *Unemployment Insurance: The Second Half Century*, ed. W. Lee Hansen and J. Byers. University of Wisconsin Press, 1990.

"Sectoral Uncertainty and Unemployment," UCLA Department of Economics Working Paper No. 384, September 1985 (with L. Weiss), in *Employment, Unemployment, and Labor Utilization*, ed. R. A. Hart. Boston: Allen & Unwin, 1988.

"The Housing Market in the United States" (with S. Rosen), *Journal of Political Economy* (August 1988): 718-40.

"What They Say or What They Do? The Use of Survey Data in Predicting Behavior" (with K. M. Murphy), Graduate School of Business, University of Chicago, March 1985.

"Unemployment, Risk and Earnings: Theory and Evidence from a Model of Equalizing Wage Differentials" (with K. M. Murphy), in *Unemployment and the Structure of Labor Markets*, ed. J. Leonard and K. Lang. London: Basil Blackwell, 1986, pp. 103-140.

"Job Mobility, Search, and Earnings Growth: A Reinterpretation of Human Capital Earnings Functions," *Research in Labor Economics* **8** (1986): 199-233. Reprinted in *Research in Labor Economics 35th Anniversary Retrospective, 2012, 401-435.*

"The Evolution of Unemployment in the United States: 1968-1985" (with K. M. Murphy), *The NBER Macroeconomics Annual*, vol. 2, 1987, pp. 7-58.

"The Impact of Immigration on the Labor Market," in *Immigration, Trade, and the Labor Market*, ed. R. Freeman. University of Chicago Press for NBER, 1988.

"Efficiency Wages Reconsidered: Theory and Evidence" (with K. M. Murphy), in *Advances in the Theory and Measurement of Unemployment*, pp. 204-40. Edited by Yoram Weiss and Gideon Fishelson. London: Macmillan, 1990.

"Labor Market Adjustments to Increased Immigration," (with R. LaLonde), in *Immigration, Trade, and the Labor Market*, ed. R. Freeman. University of Chicago Press for NBER, 1989.

"Job Mobility and the Careers of Young Men" (with M. P. Ward), *Quarterly Journal of Economics* 107 (May 1992): 441-79.

"Employment Risk, Diversification, and Unemployment," (with George Neumann) *Quarterly Journal of Economics* (November 1991): 1341-1365.

"Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority," *Journal of Political Economy* 99 (February 1991): 145-76. Reprinted in *Outstanding Contributions in Labor Economics*, ed. Orley Ashenfelter, Worth Publishers, 1999: 162-192.

"Specific Capital and Unemployment: Measuring the Costs and Consequences of Worker Displacement." *Carnegie-Rochester Series on Public Policy* 33 (1990): 181-214.

"The Assimilation of Immigrants in the United States: Immigrant Quality and the Changing Price of Skills," In *Immigration and the Work Force: Economic Consequences for the United States and Source Areas*, ed. G. Borjas and R. Freeman. Chicago: University of Chicago Press for NBER, 1992.

"Trends in the American Labor Market," *GSB Chicago*, vol. 12, no. 2, Winter 1990, pp. 11-16.

"Why Has the Natural Rate of Unemployment Increased over Time?" (with K. Murphy and C. Juhn), *Brookings Papers on Economic Activity* 2 (1991), pp. 75-142.

"Immigrant Quality and Assimilation in the American Labor Market" (with R. LaLonde), *American Economic Review*, 81 (May 1991): 297-302.

"Unemployment and Insurance," in *Proceedings of National Academy of Social Insurance*, 1992.

"Labor Markets and Economic Growth: Lessons from Korea's Industrialization, 1970-1990" (with D. Kim), *Differences and Changes in Wage Structures*, ed. Richard Freeman and Larry Katz (Chicago: University of Chicago Press for NBER, 1995.

"Wage Inequality and Regional Labor Market Performance in the United States," *Labour Market and Economic Performance: Europe, Japan, and the USA*, ed. Toshiaki Tachibanaki (New York: St. Martin's Press, 1994).

"Discretion and Bias in Performance Evaluation" (with C. Prendergast), *European Economic Review* 36 (June 1993): 355-65.

"What Have We Learned from Empirical Studies of Unemployment and Turnover?" *American Economic Review*, 83 (May 1993): 110-115.

"Regional Labor Markets and the Determinants of Wage Inequality," *American Economic Review*, 84 (May 1994): 17-22.

"Ekonomiska problem i Sveriges välfärdsstat -- inledning, sammanfattning och slutsatser," with Richard B. Freeman and Birgitta Swedenborg. In *Välfärdsstat i omvandling: Amerikanskt Perspectiv pä den Svenska Modelten*, with Richard Freeman and Birgitta Swedenborg. Författarna och SNS Förlag, 1995.

"Lönepolitik och strukturomvandling," with Per-Anders Edin. In *Välfärdsstat i omvandling: Amerikanskt Perspectiv pä den Svenska Modelten*, with Richard Freeman and Birgitta Swedenborg. Författarna och SNS Förlag, 1995.

"Favoritism in Organizations" (with C. Prendergast), *Journal of Political Economy* **104** (October 1996): 958-78.

"In Celebration of Armen Alchian's 80th Birthday: Living and Breathing Economics", (with Armen A. Alchian, James M. Buchanan, Harold Demsetz, Axel Leijonhufvud, John R. Lott, Jr., and William F. Sharpe), *Economic Inquiry*, Vol. XXXIV, July 1996, 412-426.

"Another Look at Look Labor Market Adjustments to Increased Immigration" (with J. Hojvat-Gallin and R. LaLonde), 1996.

"Economic Impact of International Migration and the Economic Performance of Migrants," (with R. LaLonde), in *Handbook of Population and Family Economics*, ed. Mark R. Rosenzweig and Oded Stark (Amsterdam: North-Holland, 1997), pp. 799-850.

"Economic Troubles in Sweden's Welfare State," in *The Welfare State in Transition*, ed. Richard Freeman, Robert Topel, and Birgitta Swedenborg. Chicago: University of Chicago Press for NBER, 1997.

"Wage Policy and Restructuring: The Swedish Labor Market Since 1960" (with Per-Anders Edin), in *The Welfare State in Transition*, ed. Richard Freeman, Robert Topel, and Birgitta Swedenborg. Chicago: University of Chicago Press for NBER, 1997.

"Unemployment and Nonemployment" (with Kevin M. Murphy), *American Economic Review* 87 (May 1997): 295-300.

"Factor Proportions and Relative Wages: The Supply Side Determinants of Wage Inequality," *Journal of Economic Perspectives* 11 (Spring 1997): 55-74.

"Empirical Knowledge in Labor Economics," in *Labor Market Data and Measurement*, ed. John Haltiwanger, Marilyn Manser, and Robert Topel. Chicago: University of Chicago Press for NBER, 1998.

"Labor Markets and Economic Growth," in *Handbook of Labor Economics*, ed. Orley Ashenfelter and David Card. Amsterdam: Elsevier Science B.V., 1999, pp. 2943-2984.

"Medical Research: What's It Worth?" (with K. M. Murphy), *Milken Institute Review: A Journal of Economic Policy* (First Quarter 2000): 23-30.

"Entry, Product Design, and Pricing in an Initially Monopolized Market" (with S. Davis and K. M. Murphy), University of Chicago GSB, September 2001, revised January, 2003. *Journal of Political Economy*, vol. 112 no. 1, pt. 2, February, 2004, pp188-225.

"Adverse Price Effects of Entry in Markets with Few Firms" (with Steven J. Davis and Kevin M. Murphy), Working Paper, University of Chicago, April 2001.

"The Economic Value of Medical Research" (with Kevin M. Murphy), in *Measuring the Gains from Medical Research: An Economic Approach*, edited by Kevin M. Murphy and Robert H. Topel. Chicago: University of Chicago Press, 2003, pp 41-73.

"Current Unemployment, Historically Contemplated" (with Kevin M. Murphy and Chinhui Juhn), *Brookings Papers on Economic Activity* 1. Washington, D.C.: The Brookings Institution, 2002.

"Estimation and Inference in Two-Step Econometric Models" (with K.M. Murphy), *Journal of Business and Economic Statistics*, 20, issue 1, 2002: 88-97 (reprint: 20th Anniversary issue of the most important contributions published in *JBES*).

"Labor Markets in the United States and Korea: Factor Proportions, Inequality, and Unemployment" in *Macroeconomic Implications of Post-Crisis Structural Change*, L.J. Cho, D. Cho and Y.H. Kim, KDI press, 2005, pp 131-60.

"Diminishing Returns? Evidence on the Costs and Benefits of Improving Health" (with K.M. Murphy) November 2002, *Perspectives in Biology and Medicine*, volume 46, no. 3, (Summer, 2003): pp108-128.

"War vs. Containment" (with S.J. Davis and K.M. Murphy), March 2003; presented at *NBER* Conference on National Security Economics, November 2003.

"Black-White Differences in the Economic Value of Improving Health" (with K. M. Murphy). Presented at the National Institutes of Health Conference on Racial Disparities in Health Outcomes, December 2001. *Perspectives in Biology and Medicine*, Summer, 2004.

"The Value of Health and Longevity" (with K.M. Murphy), Revised March, 2005, *NBER Working Paper #11405,* June 2005. *Journal of Political Economy*, October 2006, pp 871-904. Winner of the 2005 *Eugene Garfield Economic Impact of Medical Research*

Award, given by Research America. Winner of the 2007 *Kenneth J. Arrow Award*, given by the International Health Economics Association for the best paper in health economics published in 2006.

"The Private and Social Benefits of Education", (with Fabian Lange), *Handbook of the Economics of Education,* North-Holland, 2006

"The Social Value of Education", *Keynote Address, Federal Reserve Bank of Cleveland Conference on Education and Economic Development, November 2004,* in *Education and Economic Development*, Federal Reserve Bank of Cleveland Economic Review, 2004, pp 47-58.

"On Human Capital and Economic Growth" (with Fabian Lange), Working Paper, University of Chicago, September, 2005.

"Återhämtning och terstaende problem I den svenska valfardsstaten—inlendning, sammanfattning och slutsatser" in *Att Reformera Välfärdsstaten,* with Richard Freeman and Birgitta Swedenborg, SNS Förlag, Stockholm, 2006, 9-34.

"Forandrade forutsattningar for svensk lonebildning" (with Peter Fredriksson), in *Att Reformera Välfärdsstaten,* with Richard Freeman and Birgitta Swedenborg, SNS Förlag, Stockholm, 2006, 65-82.

"War in Iraq versus Containment" (with Steven J. Davis and Kevin M. Murphy), for CESifo Conference "*Guns and Butter: The Economic Causes and Consequences of Conflict"*, Munich, December 2005, February, 2006.

"Social Value and the Speed of Innovation" (with Kevin M. Murphy), *American Economic Review,* May, 2007.

"Unemployment", *The New Palgrave of Economics*, 2008

"Critical Loss Analysis in the Whole Foods Case", *Global Competition Policy*, March, 2008, @ http://www.globalcompetitionpolicy.org/index.php?&id=949&action=907.

"Wage Determination and Employment in Sweden Since 1990", (with Peter Fredricksson), Working Paper, University of Chicago and Uppsala University, August, 2006, revised December, 2008, in *Recovery and Beyond: Reforming the Welfare State in Sweden*, Richard Freeman, Birgitta Swedenborg and Robert Topel, eds., University of Chicago Press for NBER, 2009

"Reforming the Welfare State: Recovery and Beyond in Sweden" (with Richard Freeman and Birgitta Swedenborg), in *Recovery and Beyond: Reforming the Welfare State in Sweden*, Richard Freeman, Birgitta Swedenborg and Robert Topel, eds., University of Chicago Press for NBER, 2009

"On the Economics of Climate Policy", (with Gary S. Becker and Kevin M. Murphy), *BE Journal of Economic Analysis and Policy,* April, 2011

"Introduction to 'Job Mobility Search and Earnings Growth, A Reinterpretation of Human Capital Earnings Functions", *Research in Labor Economics 35th Anniversary Retrospective,* Emerald Group Publishing 2012, 397-400.

"Some Basic Economics of National Security" (with Kevin M. Murphy), *American Economic Review,* May 2013

"Competitive Discounts and Antitrust Policy" (with Kevin. M. Murphy and Edward A. Snyder), Oxford Handbook of Antitrust Economics, 2013 (forthcoming)

Selected Congressional Testimony and Presentations:

"Unemployment and Insurance," Testimony before the U.S. Senate Committee on Finance, April 23, 1991.

"The Economic Value of Medical Research," Testimony before the U.S. Senate Committee on Health, Education, Labor, and Pensions, May 10, 2001.

"The Value of Improvements in Health and Longevity", Presentation for Congressional Staff and the American Cancer Society, Washington, July, 2005.

Selected Reports:

"Unemployment Insurance Financing and Unemployment: Empirical Investigation of Adverse Incentives," Final Report, U.S. Department of Labor Contract No. B9M22046, November 1982.

"Unemployment and Unemployment Insurance," Final Report, U.S. Department of Labor, ETA, May 1984.

"Local Labor Markets," Final Report, U.S. Department of Labor, Office of the Assistant Secretary for Policy, March 1984.

"The Use of Survey Data in Predicting Behavior: The Case of Enlistment Intentions," Final Report, U.S. Department of Defense, May 1985.

"Equalizing Wage Differences," Final Report, U.S. Department of Labor, Office of the Assistant Secretary for Policy, August 1985.

"Sectoral Change and Worker Displacement," Final Report, U.S. Department of Labor, Office of the Assistant Secretary for Policy, March 1990.

Book Reviews:

Employment Hazards by W. Kip Viscusi. In *Journal of Economic Literature*, March 1982.

Handbook of Labor Economics, ed. O. Ashenfelter and R. Layard. In *Journal of Economic Literature*, 1988.

Selected Comments:

"Comment on 'Some Recent Developments in Labor Economics and Their Implications for Macroeconomics'," *Journal of Money, Credit and Banking* **20** (August 1988, part 2).

"Comment on 'Industry Rents: Evidence and Implications'," (by Lawrence Summers and Lawrence Katz) *Brookings Papers on Economic Activity*, Brookings Institution, Washington, D.C., 1989.

"Comment on 'Wage Dispersion between and within U.S. Manufacturing Plants', *Brookings Papers on Economic Activity*, 1991.

"Comment on 'Why Is the U.S. Unemployment Rate So Much Lower?'" *NBER Macroeconomics Annual*, 1998, pp. 67-72.

"Comment on 'Does Immigration Grease the Wheels of the Labor Market?'" by George J. Borjas. *Brookings Papers on Economic Activity*. edited by William C. Brainard and George L. Perry. Washington, D.C. Brookings Institution, 2001.

"Comment on 'Where did the Productivity Growth Go? Inflation Dynamics and the Distribution of Income'" by Ian Dew-Becker and Robert J. Gordon. *Brookings Papers on Economic Activity*. edited by William C. Brainard and George L. Perry. Washington, D.C. Brookings Institution, 2005, 135-44.

Recent Cases, Reports and Testimony

Roderick Arnold et al. v. Cargill, Inc. in the U.S. District Court for the District of Minnesota Third Division. No. 01-CV-2086 DWF/AJB. Expert on behalf of Cargill in racial discrimination class action. Expert Report, June 29, 2004.

Applied Medical v. Ethicon, Inc., et. al. in the Central District of California. No. SACV 03-1329. Expert on behalf of Johnson & Johnson (Ethicon) in antitrust litigation. Expert Report, May 24, 2005. Deposition, November 7, 2005. Trial Testimony, August 18, 2006.

Conmed Corp. v. Johnson & Johnson, United States District Court, Southern District of New York 03-CV8800. Expert on behalf of Johnson and Johnson in antitrust litigation. Expert Report, August 1, 2005.

Daryal T. Nelson, et. al. v. Wal-Mart Stores Inc. and Wal-Mart Transportation LLC., Eastern District of Arkansas Helena Division, N). 2:05 CV-00134-WRW. Expert on behalf of Wal-Mart in racial discrimination class action. Expert Report, April 12, 2006. Deposition, May 2, 2006. Expert Report, July 28, 2008. Rebuttal Expert Report, September 12, 2008. Deposition, September 23 2008. Declaration, October 2, 2008.

Sulfuric Acid Antitrust Litigation, In the US District Court for the Northern District of Illinois Eastern Division, No. 03-C-4576. Expert on behalf of Marsulex and Chemtrade in antitrust class action. Expert Report, February 3, 2006. Deposition March 2006.

Amy Velez, et. al. v. Novartis Corporation, Novartis Pharmaceuticals Corporation, and Thomas Ebeling, US District Court, Southern District of New York, 04 Civ. 09194. Economic (compensation practices) expert on behalf of Novartis Pharmaceuticals in class action gender discrimination case. Expert Report, November 9, 2006.

Peter P. Jonites, et. al. v. Exelon Corporation, et. al., United States District Court, Northern District of Illinois, No. 05CV04234. Expert on behalf of Exelon in class action labor case. Expert Report, April 16, 2007, Amended Expert Report, June 14, 2007.

Clifford L. Whitaker, et. al. v. 3M Company, United States District Court for the Second Judicial District of Minnesota Civ.C4-04-012239. Expert on behalf of 3M in class action discrimination case. Expert Report, July 25, 2007. Deposition, August 21, 2007.

Pinkowski et al,. v. 3M Company, United States District Court, District of New Jersey, No. 205CV05668. Expert on behalf of 3M in class action age discrimination case. Expert Report January 29, 2007. Deposition, March 2007. Trial Testimony, May 8, 2010.

Sun Microsystems, Inc., et al. v. Hynix Semiconductor, Inc., et al. (Consolidated), Unisys Corporation v. Hynix Semiconductor, Inc., et al., Jaco Electronics, Inc. v. Hynix Semiconductor, Inc., et al., Edge Electronics, Inc. v. Hynix Semiconductor, Inc., et al., All American Semiconductor, Inc., et al., v. Hynix Semiconductor, Inc. et al., DRAM Claims Liquidation Trust, by its Trustee Wells Fargo Bank, NA v. Hynix Semiconductor, et al., United States District Court for the Northern District of California San Francisco Division. Expert on behalf of Hynix Semiconductor, Inc. and Hynix Semiconductor America, Inc. in antitrust class action. Expert Report, March 7, 2008. Deposition, April 25, 2008. Declaration, April 16, 2009.

Katherine Puffer, on behalf of herself and all others similarly situated, v. Allstate Insurance Company in the U.S. District Court for the Northern District of Illinois Eastern Division. Expert on behalf of Allstate Insurance Company in class action gender discrimination case. Expert Report, April 1, 2008. Declaration, October 20, 2008.

William Syverson, Patrick Boone, Lee Deshler, Robert Flowers, Barry Gerard, Tina Gleisner, Thomas Gomez, Edwin "Dana" Goodloe, Rolf Marsh, Daniel Moczan, James Payne, and Antonio Rivera, individually and on behalf of others similarly situated, v. International Business Machines Corporation in the U.S. District Court for the Northern District of California San Jose Division. Expert on behalf of IBM in class action age discrimination case. Expert Report, August 19, 2008. Deposition, September 9, 2008. Declaration in support of IBM, December 19, 2008.

The United States of America v. Canada, in support of the United States' request for arbitration regarding Canadian softwood lumber subsidies. Expert on behalf of the United States and US Dept. of Justice in softwood lumber international trade arbitration. Expert Report, November 21, 2008. Expert Response Report, March 23, 2009. Expert Rejoinder Report, June 19, 2009. Trial Testimony, July 20, 2009. Expert Report for the Tribunal, June 15, 2010.

Valassis Communications, Inc. v. News America Incorporated, a/k/a News America Marketing Group, News America FSI, Inc. a/k/a News America Marketing FSI, LLC and News America Marketing In-Store Services, Inc. a/a/a News American Marketing In-Store Services, LLC in the United States District Court for the Eastern District of Michigan Southern Division, No. 06-10240. Expert on behalf of New America in antitrust litigation. Expert Report, November 21, 2008. Rebuttal Expert Report, December 26, 2008. Deposition, January 22, 2009. Supplemental Expert Report,

December 21, 2009. Supplemental Rebuttal Expert Report, January 14, 2010. Deposition, January 25, 2010.

Valassis Communications, Inc., v. News America Incorporated, No. 07-706645-CZ. Expert on behalf of News America in antitrust litigation. Expert Report, November 21, 2008. Rebuttal Expert Report, December 26, 2008. Deposition, January 22, 2009. Trial Testimony, July 15-16, 2009.

EBay Seller Antitrust Litigation in the U.S. District Court for the Northern District of California San Jose Division. Expert on behalf of Ebay Inc.'s opposition to plaintiffs' motion for class certification in antitrust case. Declaration, August 14, 2009. Deposition, August 28, 2009 and September 18, 2009.

Payment Card Interchange Fee and Merchant Discount Antitrust Litigation, in the U.S. District Court for the Eastern District of New York. Expert on behalf of card issuing banks, Visa and Mastercard in class action antitrust litigation. Expert Report, December 14, 2009. Deposition, April 20, 2010.

Applied Medical Resources Corp., and Applied Medical Distribution Corp. v. Ethicon Endo-Surgery, Inc. in the United States District Court for the Central Division of California Southern Division, No. CV09-3605-RSWL (VBKx). Expert Report, March 19, 2010. Deposition, April 15, 2010.

Wallace Bolden, et al. vs. Walsh Group, et.al in the U.S. District Court Northern District of Illinois, Eastern Division, No. 06cv104. Expert on behalf of Walsh Group in class action race discrimination case. Expert Report, December 22, 2010. Deposition, February 18, 2011.

Jones, et al. vs. Wells Fargo Bank N.A., Wells Fargo Home Mortgage, Inc. in the Superior Court of California, County of Los Angeles, BC337821. Expert on behalf of Wells Fargo Bank in class action lending discrimination case. Expert Report & Deposition. Trial Testimony, December 21, 2010.

Peterson v. Seagate U.S. LLC, 534 F.Supp.2d 996, 2008 WL398968. Expert on behalf of Seagate Corporation in class action age discrimination case. Expert Report, October 25, 2010. Deposition, February 15, 2011.

NRLC and Railroad Employees, National Mediation Board Case Nos. A-13569; A-13570; A-13572; A-13573; A-13574; A-13575; A-13592. Expert on behalf of major US railroads in labor mediation. Expert Report, October 10, 2011. Testimony December, 2011.

Toyota Motor Corporation Hybrid Brake Marketing Sales Practices and Products Liability Litigation in the United States District Court Central District of California Southern Division, No. 8:10-ML-02172-CJC-RNB. Expert on behalf of Toyota in class

action product liability (hybrid brakes) case. Expert Report, May 28, 2012. Deposition, July 19, 2012.

Text Messaging Antitrust Litigation in the United States District Court Northern District of Illinois Eastern Division, No. 08 C 7082. Expert on behalf of wireless providers in antitrust litigation. Expert Report, July 3, 2013.

Appendix B: List of Materials Relied Upon

Court Documents

1. DECLARATION OF ROGER G. NOLL ON LIABILITY AND DAMAGES – April 3, 2013 (and sources and documents considered, cited or relied upon therein)
2. CORRECTIONS TO DECLARATION OF ROGER G. NOLL ON LIABILITY AND DAMAGES – May 31, 2013 (and sources and documents considered, cited or relied upon therein)
3. EXPERT REPORT OF DAVID M. MARTIN – April 8, 2013 (and sources and documents considered, cited or relied upon therein)
4. DEPOSITION OF JEFFREY L. ROBBIN – December 3, 2010 (and sources and documents considered, cited or relied upon therein)
5. DEPOSITION OF ROGER G. NOLL – September 19, 2008 (and sources and documents considered, cited or relied upon therein)
6. DEPOSITION OF ROGER G. NOLL - April 7, 2011 (and sources and documents considered, cited or relied upon therein)
7. DEPOSITION OF ROGER G. NOLL - May 16, 2013 (and sources and documents considered, cited or relied upon therein)
8. DECLARATION OF ROGER G. NOLL – January 18, 2011 (and sources and documents considered, cited or relied upon therein)
9. SUPPLEMENTAL DECLARATION OF ROGER G. NOLL - July 18, 2011 (and sources and documents considered, cited or relied upon therein)
10. SECOND SUPPLEMENTAL DECLARATION OF ROGER G. NOLL – September 23, 2011 (and sources and documents considered, cited or relied upon therein)
11. SECOND SUPPLEMENTAL REPORT OF DR. MICHELLE M. BURTIS – November 14, 2011 (and sources and documents considered, cited or relied upon therein)
12. DECLARATION OF DR. JOHN P. J. KELLY - April 18, 2011 (and sources and documents considered, cited or relied upon therein)
13. See Expert Report of Dr. John P. J. Kelly - July 19, 2013 (and sources and documents considered, cited or relied upon therein)
14. DEPOSITION OF AUGUSTIN J. FARRUGIA - December 8, 2010 (and sources and documents considered, cited or relied upon therein)
15. DECLARATION OF AUGUSTIN FARRUGIA – January 18, 2011 (and sources and documents considered, cited or relied upon therein)
16. SUPPLEMENTAL DECLARATION OF AUGUSTIN FARRUGIA - July 2, 2013 (and sources and documents considered, cited or relied upon therein)
17. DEPOSITION OF JOHN P.J. KELLY, Ph.D. - February 22, 2011 (and sources and documents considered, cited or relied upon therein)
18. DECLARATION OF DAVID F. MARTIN – February 28, 2011 (and sources and documents considered, cited or relied upon therein)
19. DEPOSITION OF DAVID M. MARTIN, JR., PH.D. - May 9, 2013 (and sources and documents considered, cited or relied upon therein)

20. DEFENDANT APPLE INC.'S RESPONSES TO PLAINTIFF'S FIRST SET OF INTERROGATORIES August 29, 2008 (and sources and documents considered, cited or relied upon therein)
21. DECLARATION OF BONNY E. SWEENEY – January 18, 2011 (and sources and documents considered, cited or relied upon therein)
22. DECLARATION OF DAVID KIERNAN - January 18, 2011 (and sources and documents considered, cited or relied upon therein)
23. DECLARATION OF BONNY E. SWEENEY – February 28, 2011 (and sources and documents considered, cited or relied upon therein)
24. DECLARATION OF DAVID KIERNAN - February 28, 2011 (and sources and documents considered, cited or relied upon therein)
25. DECLARATION OF MICHAEL SCOTT – June 6, 2006 (and sources and documents considered, cited or relied upon therein)
26. Deposition of Michelle Burtis – September 30, 2009 (and sources and documents considered, cited or relied upon therein)
27. Deposition of David K. Heller – December 15, 2010 (and sources and documents considered, cited or relied upon therein)
28. Deposition of Arthur Rangel – December 17, 2010 (and sources and documents considered, cited or relied upon therein)
29. Deposition of Eddy Cue – December 17, 2010 (and sources and documents considered, cited or relied upon therein)
30. APPLE'S MOTION FOR SUMMARY JUDGMENT - April 18, 2011 (and sources and documents considered, cited or relied upon therein)
31. AMENDED CONSOLIDATED COMPLAINT FOR VIOLATIONS OF SHERMAN ANTITRUST ACT, CLAYTON ACT, CARTWRIGHT ACT, CALIFORNIA UNFAIR COMPETITION LAW, CONSUMERS LEGAL REMEDIES ACT, AND CALIFORNIA COMMON LAW OF MONOPOLIZATION – January 25, 2010 (and sources and documents considered, cited or relied upon therein)
32. ORDER GRANTING IN PART AND DENYING IN PART DEFENDANT'S MOTION FOR SUMMARY JUDGMENT; DENYING AS PREMATURE PLAINTIFFS' MOTION FOR CLASS CERTIFICATION – May 19, 2011 (and sources and documents considered, cited or relied upon therein)
33. UNREDACTED MEMORANDUM IN OPPOSITION TO MOTION FOR CLASS CERTIFICATION (December 15, 2008)
34. Plaintiffs' Rule 30(b)(6) Notice of Videotaped Deposition of Corporate Designees (2010-11-17)
35. SFI_658005_1_AIIA_ Responses to Data Questions 12.23.10
36. Plaintiffs' Notice of Motion and Renewed Motion for Class Certification and Appointment of Lead Class Counsel Under Seal (April 18, 2011)
37. SFI_658005_3_Responses to Data Questions 12.23.10
38. SFI_658269_4_Responses to Reseller Transaction Data Questions 2011-01-28
39. SFI_658573_3_Updated answers to 1.6.11 Follow Up Data Questions
40. SFI_658573_4_Responses to 1.7.2011 Data Questions
41. SVI_88493_7_Responses to iPod BOM and Gross Margin Reports 2011-02-04
42. PLAINTIFFS' MEMORANDUM IN OPPOSITION TO APPLE'S MOTION FOR SUMMARY JUDGMENT - April 18, 2011

43. DECLARATION OF BONNY E. SWEENEY IN SUPPORT OF PLAINTIFFS' MEMORANDUM IN OPPOSITION TO APPLE'S MOTION FOR SUMMARY JUDGMENT - April 18, 2011
44. EXPERT REPORT OF DR. MICHELLE M. BURTIS - April 18, 2011 (and sources and documents considered, cited or relied upon therein)
45. APPLE'S OPPOSITION TO RENEWED MOTION FOR CLASS CERTIFICATION - April 18, 2011
46. APPLE'S REPLY IN SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT - April 18, 2011
47. DECLARATION OF MICHAEL T. SCOTT IN SUPPORT OF APPLE'S REPLY IN SUPPORT OF ITS MOTION FOR SUMMARY JUDGMENT - April 18, 2011
48. DECLARATION OF CARMEN A. MEDICI IN SUPPORT OF REPLY MEMORANDUM IN SUPPORT OF PLAINTIFFS' RENEWED MOTION FOR CLASS CERTIFICATION - April 18, 2011
49. REPLY MEMORANDUM IN SUPPORT OF PLAINTIFFS' RENEWED MOTION FOR CLASS CERTIFICATION - April 18, 2011
50. Reply Declaration of Roger G. Noll 2011-03-28
51. SFI_662507_4_AIIA_ APPLE'S OPPOSITION TO RENEWED MOTION FOR CLASS CERTIFICATION 2011-04-11
52. ORDER GRANTING IN PART AND DENYING IN PART DEFENDANT'S MOTION FOR SUMMARY JUDGMENT; DENYING AS PREMATURE PLAINTIFFS' MOTION FOR CLASS CERTIFICATION 2011-05-19
53. SUPPLEMENTAL REPORT OF DR. MICHELLE M. BURTIS 2011-07-26
54. Exhibit 1 to DECLARATION OF DAVID C. KIERNAN IN SUPPORT OF APPLE'S RESPONSE TO PROFESSOR NOLL'S JULY 18 DECLARATION 2011-01-26
55. Exhibit 2 to DECLARATION OF DAVID C. KIERNAN IN SUPPORT OF APPLE'S RESPONSE TO PROFESSOR NOLL'S JULY 18 DECLARATION 2011-01-26
56. DECLARATION OF DAVID C. KIERNAN IN SUPPORT OF APPLE'S RESPONSE TO PROFESSOR NOLL'S JULY 18 DECLARATION
57. APPLE'S RESPONSE TO PROFESSOR NOLL'S JULY 18 DECLARATION
58. ORDER GRANTING PLAINTIFFS' MOTION FOR CLASS CERTIFICATION 2011-11-22
59. ORDER REGARDING SCHEDULE 2013-01-28
60. Class Certification Report Backups for Michelle Burtis
61. DECLARATION OF JEFFREY ROBBIN IN SUPPORT OF DEFENDANT'S RENEWED MOTION FOR SUMMARY JUDGEMENT - January 18, 2011

Bates Numbered Documents

62. Internal Apple iTMS Surveys
63. Internal Apple iPod Surveys
64. Apple_AIIA00178491
65. Apple_AIIA00178737
66. iTunes Surveys Mac customers (Aug '03) Windows customers (Dec '03) Windows Prospects (Dec '03) December 2003
67. Apple_AIIA00323221
68. Apple_AIIA00477469
69. Final Report 2005 CYQ3 iTMS Tracker Program October 2005
70. Apple_AIIA00355775
71. Apple_AIIA00526882
72. Apple_AIIA00178867

73. iTunes Store Tracker Program Final Report—2006 CYQ4 January 2007
74. Apple_AIIA00193099
75. iTunes Store Tracker Survey CYQ4 2008 – Apple Market Research & Analysis March 2009
76. iTunes Store Tracker Survey CYQ1 2010 – June 2010
77. Apple_AIIA00331445
78. Apple_AIIA00389307 - Wave 4
79. Apple_AIIA00331431 - Forrester – Apple iTunes Jump-Starts Windows Digital Music
80. Apple_AIIA00455825 - iPod and iPod mini Buyer Survey January 2005
81. Apple_AIIA00493743 - iPod Buyer Survey — Wave 1 July 2005
82. iPod Owner Survey - Wave 2 January 2006
83. iPod Buyer Survey FY09 – Q2
84. iPod Owner Survey - Wave 3 June 2006
85. W5 iPod/iPhone Buyer Survey - Nov 2007 Apple Confidential Internal Use Only
86. Apple_AIIA00002914
87. Apple_AIIA00115845
88. Apple_AIIA00135089
89. Apple_AIIA00178888
90. Apple_AIIA00180903
91. Apple_AIIA00195126
92. Apple_AIIA00199264
93. Apple_AIIA00199280
94. Apple_AIIA00319774
95. Apple_AIIA00320223
96. Apple_AIIA00331431
97. Apple_AIIA00331434
98. Apple_AIIA00333439
99. Apple_AIIA03335100
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104. Apple_AIIA004489705
105. Apple_AIIA00458544
106. Apple_AIIA00481550
107. Apple_AIIA00481589
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109. Apple_AIIA00549197
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115. Apple_AIIA00573587
116. Apple_AIIA00575626
117. Apple_AIIA00576776

118. Apple_AIIA00577214
119. Apple_AIIA00093860
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121. Apple_AIIA00945600
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125. Apple_AIIA00948381
126. Apple_AIIA00948413
127. Apple_AIIA00948739
128. Apple_AIIA00948960
129. Apple_AIIA00948962
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133. Apple_AIIA00954126
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154. Apple_AIIA00964990
155. Apple_AIIA00969312
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174. Apple_AIIA00974519
175. Apple_AIIA00974641
176. Apple_AIIA00974932
177. Apple_AIIA00093477
178. Apple_AIIA00974824
179. Apple_AIIA00974776
180. Apple_AIIA00974577
181. Apple_AIIA00974782
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195. Apple_AIIA00291156
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239. Apple_AIIA00511572
240. Apple_AIIA00511549
241. Apple_AIIA00511499
242. Apple_AIIA00511544
243. Apple_AIIA00511540
244. Apple_AIIA00362516
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247. Apple_AIIA00511467
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250. Apple_AIIA00586940
251. Apple_AIIA00589630
252. Apple_AIIA00586761

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254. Apple_AIIA00586947
255. Apple_AIIA005587043
256. Apple_AIIA00587053
257. Apple_AIIA00586847
258. Apple_AIIA00586841
259. Apple_AIIA00586961
260. Apple_AIIA00587018
261. Apple_AIIA00586956
262. Apple_AIIA00586928
263. Apple_AIIA00826100
264. Apple_AIIA00826134
265. Apple_AIIA00826069
266. Apple_AIIA00826063
267. Apple_AIIA00826053
268. Apple_AIIA00826010
269. Apple_AIIA00708248
270. Apple_AIIA00708205
271. Apple_AIIA00708163
272. Apple_AIIA00724232
273. Apple_AIIA00193955
274. Apple_AIIA00947706
275. Apple_AIIA00947643
276. Apple_AIIA01383219
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279. Apple_AIIA01218377
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281. Apple_AIIA01362603
282. Apple_AIIA01218253
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284. Apple_AIIA00448231
285. Apple_AIIA00448356
286. Apple_AIIA00583911
287. Apple_AIIA00319724
288. Apple_AIIA00350916
289. Apple_AIIA00953526
290. Apple_AIIA00361480
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293. Apple_AIIA00544957
294. Apple_AIIA00554643
295. Apple_AIIA00961911
296. Apple_AIIA01038556
297. Apple_AIIA01239186

298. Apple_AIIA00318980
299. Apple_AIIA00463988
300. Apple_AIIA00811549
301. Apple_AIIA01024886
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303. Apple_AIIA01035239
304. Apple_AIIA00949979
305. Apple_AIIA00795191
306. Apple_AIIA00959232
307. Apple_AIIA00960451
308. Apple_AIIA00127056
309. Apple_AIIA00319983
310. Apple_AIIA00106919
311. Apple_AIIA00337602
312. Apple_AIIA00106989
313. Apple_AIIA00949715
314. Apple_AIIA00949772
315. Apple_AIIA00954873
316. Apple_AIIA00467172
317. Apple_AIIA00180654
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320. Apple_AIIA00954724
321. Apple_AIIA00960055
322. Apple_AIIA01383038
323. Apple_AIIA00960073
324. Apple_AIIA00135124
325. Apple_AIIA00963542
326. Apple_AIIA00963282
327. Apple_AIIA00963298
328. Apple_AIIA00708319
329. Apple_AIIA01383386
330. Apple_AIIA01358855
331. Apple_AIIA00974863
332. Apple_AIIA00090447
333. Apple_AIIA00098417
334. Apple_AIIA00099100
335. Apple_AIIA00974436
336. Apple_AIIA00105851

Price Committee Documents

337. Apple_AIIA01278611 - 2001-03-11 iPod March line-up Decision
338. Apple_AIIA01276219 - 2004-06-30 iPod Decision
339. Apple_AIIA01278395 - 2004-10 iBook, Xserve RAID, iPod Decision

340. Apple_AIIA01278345 - 2005-01 iPod, Xserve, Displays, Keyboard & Mouse, Q97, Q88, PowerBook Decision
341. Apple_AIIA01277415 - 2005-06 iPod Decision
342. Apple_AIIA01277431 - 2005-06-09 iPod Decision
343. Apple_AIIA01384542 - 2005-08-15 PowerBook, iPod, Xserve RAID Decision
344. Apple_AIIA01277614 - 2006-01-18 iPod Decision
345. Apple_AIIA01278341 - 2006-01-18 PCM Back-up iPod Decision
346. Apple_AIIA01277439 - 2006-01-19 iPod Decision
347. Apple_AIIA01277541 - 2006-01-20 iPod Decision
348. Apple_AIIA01277329 - 2006-09 iPod Presentation
349. Apple_AIIA01276233 - 2007-04 iPod Presentation
350. Apple_AIIA01276249 - 2007-08 iPod, iPod nano Decision
351. Apple_AIIA01276307 - 2007-08 iPod, iPod nano, iPod shuffle Decision
352. Apple_AIIA01276342 - 2007-08-16 iPod, iPod nano, iPod shuffle Decision
353. Apple_AIIA01276402 - 2007-09 iPod Presentation
354. Apple_AIIA01276439 - 2007-10 iPod touch, app bundle pricing Decision
355. Apple_AIIA01276447 - 2007-10 iPod touch, software bundle Decision
356. Apple_AIIA01276570 - 2007-10 iPod touch, software bundle, iPhone Decision
357. Apple_AIIA01276584 - 2007-11 iPod touch, software bundle, iPhone Decision
358. Apple_AIIA01276598 - 2007-12-03 iPod touch, iPhone Decision
359. Apple_AIIA01276612 - 2008-01 iPod touch, iPhone Decision
360. Apple_AIIA01278046 - 2008-02-01 iPod shuffle Decision
361. Apple_AIIA01276714 - 2008-03-01 iPod shuffle, iPod touch Decision
362. Apple_AIIA01276791 - 2008-08 iPod touch, iPod classic, iPod nano Decision
363. Apple_AIIA01276935 - 2008-12 iPod shuffle Decision
364. Apple_AIIA01277156 - 2009-02 iPod shuffle Decision

Data

365. Upgrades by month (version 1).xlsb - For US Units and Revenue for Upgardes by month Since January,2009 to 17th October,2010
366. AIIA_US iPod Sales_Family Level_Direct-Indirect-OEM.xlsx
367. US Sales_iPods_Direct_Indirect_OEM_FY02-FY10
368. NPD_DigitalOnlyJuly06_Dec11.xlsx
369. NPD_PhysicalandDigital_July06_Dec11.xlsx
370. NPDMP3Aug07Update.xls
371. NPDMP3October2005Update.xls
372. NPDUSMP3April2009.xls
373. NPDUSMP3July2010.xls
374. NPDUSMP3June08Update.xls
375. NPDUSMP3PriceBandJuly2010.xls
376. BDF percentages to apply to reseller data.csv
377. rslr_rc_data.sas7bdat
378. IpodClassic2002Q1v3.txt
379. IpodClassic2002Q2v3.txt
380. IpodClassic2002Q3v3.txt

381.IpodClassic2002Q4v3.txt
382.IpodClassic2003Q1v3.txt
383.IpodClassic2003Q2v3.txt
384.IpodClassic2003Q3v3.txt
385.IpodClassic2003Q4v3.txt
386.IpodClassic2004Q1v3.txt
387.IpodClassic2004Q2v3.txt
388.IpodClassic2004Q3v3.txt
389.IpodClassic2004Q4v3.txt
390.IpodMINI2004Q2v3.txt
391.IpodMINI2004Q3v3.txt
392.IpodMINI2004Q4v3.txt
393.RecordCheck_Ipod Sales.xlsx
394.IpodMini2005Q1.txt
395.IpodMini2005Q2.txt
396.IpodMini2005Q3.txt
397.IpodMini2005Q4.txt
398.IpodMini2006to2011Q1.txt
399.IpodShuffle2005.txt
400.IpodShuffle2006.txt
401.IpodShuffle2007Q1.txt
402.IpodShuffle2007Q2.txt
403.IpodShuffle2007Q3.txt
404.IpodShuffle2007Q4.txt
405.IpodShuffle2008Q1.txt
406.IpodShuffle2008Q2.txt
407.IpodShuffle2008Q3.txt
408.IpodShuffle2008Q4.txt
409.IpodNano2005.txt
410.IpodNano2006Q1SC2.txt
411.IpodNano2006Q1SR3.txt
412.IpodNano2006Q2.txt
413.IpodNano2006Q3.txt
414.IpodNano2006Q4.txt
415.IpodNano2007Q1SC2.txt
416.IpodNano2007Q1SR3.txt
417.IpodNano2007Q2.txt
418.IpodNano2007Q3.txt
419.IpodNano2007Q4.txt
420.IpodNano2008Q1SC2.txt
421.IpodNano2008Q1SR3.txt
422.IpodNano2008Q2.txt
423.IpodNano2008Q3.txt
424.IpodNano2008Q4.txt
425.RecordCheck2 - Copy.xls

426.RecordCheck2.xlsx
427.IpodShuffle2009.txt
428.IpodShuffle2010.txt
429.IpodShuffle2011.txt
430.IpodTouch2008Q1.txt
431.IpodTouch2008Q2.txt
432.IpodTouch2008Q3.txt
433.IpodTouch2008Q4.txt
434.IpodTouch2009Q1.txt
435.IpodTouch2009Q2.txt
436.IpodTouch2009Q3.txt
437.IpodTouch2009Q4.txt
438.IpodTouch2010Q1.txt
439.IpodTouch2010Q2.txt
440.IpodTouch2010Q3.txt
441.IpodTouch2010Q4.txt
442.IpodTouch2011Q1.txt
443.IpodTouch2011Q2.txt
444.IpodTouch2011Q3.txt
445.IpodTouch2011Q4.txt
446.IpodClassic2011Q3V2.txt
447.IpodNano2011Q3V2.txt
448.IpodShuffle2011Q3V2.txt
449.IpodTouch2011Q3V2.txt
450.price_group_MISC.csv
451.price_group_1.csv
452.price_group_7.csv
453.price_overirde_12.csv
454.price_overirde_code14.csv
455.SFI_791971_1_PriceOverrideReasonDesc.xls
456.AppleDataExtract_iPod BDF Accruals from 2001 to 2011.csv
457.RetailerCodeNames.csv
458.RetailerCodeNames_2.csv
459.2002_Ipod_Sales
460.2003_Ipod_Sales
461.2004_Ipod_Sales
462.2005_Ipod_Sales
463.2006_Ipod_Sales
464.2007_Ipod_Sales
465.2008_Ipod_Sales
466.2009_Ipod_Sales
467.2010_Ipod_Sales
468.2011_Ipod_Sales
469.2002-2004_Ipod_Sales
470.2005_Ipod_Sales

471. 2006_Ipod_Sales
472. 2007_Ipod_Sales
473. 2008_Ipod_Sales
474. 2009_Ipod_Sales
475. 2010_Ipod_Sales
476. 2011_Ipod_Sales
477. AppleDataExtract_iPod BDF Accruals from 2001 to 2011.xls
478. AIIA_iPod-OEM_HP.xls
479. RetailerCodeNames.xls
480. NPDUSMP3May2009.xls
481. NPDUSMP3July2010.xls
482. 2000-2007 (NPD data).xls
483. ~5844701.xls
484. BDF percentages to apply to reseller data.csv
485. Merged iPod features and costs_direct sales.csv
486. Merged iPod features and costs_direct sales_CKD.csv
487. 2002_Ipod_Sales to 20011_Ipod_Sales
488. Merged iPod features and costs_CKD.csv
489. AIIA - US iTS P&Ls_Q3FY03-Q4FY10
490. iTunes Music Store P&L Data

NPD Monthly Trend Reports

491. Apple_AIIA00109997
492. Apple_AIIA00485090
493. Apple_AIIA00489689
494. Apple_AIIA 00127123
495. Apple_AIIA00129531
496. Apple_AIIA00135174
497. Apple_AIIA00358751
498. Apple_AIIA00358724
499. Apple_AIIA00358776
500. Apple_AIIA00358791
501. Apple_AIIA00358816
502. Apple_AIIA00358856
503. Apple_AIIA00358883
504. Apple_AIIA00431268
505. Apple_AIIA00485090
506. Apple_AIIA00489689
507. Apple_AIIA00505446
508. Apple_AIIA00511004
509. Apple_AIIA00536766
510. Apple_AIIA00555045
511. Apple_AIIA00559475
512. Apple_AIIA00621881
513. Apple_AIIA00625999

514. Apple_AIIA00630064
515. Apple_AIIA01085453
516. Apple_AIIA 00649138
517. Apple_AIIA00733250
518. Apple_AIIA00743040
519. Apple_AIIA00972703
520. Apple_AIIA01061216
521. Apple_AIIA01083128
522. Apple_AIIA01083366
523. Apple_AIIA01110277
524. Apple_AIIA 01121207
525. Apple_AIIA01121373
526. Apple_AIIA01279027
527. Apple_AIIA01326081
528. Apple_AIIA01326098
529. Apple_AIIA01326113
530. Apple_AIIA01326130
531. Apple_AIIA01326147
532. Apple_AIIA01326164
533. Apple_AIIA01326181
534. Apple_AIIA01326198
535. Apple_AIIA01326300
536. Apple_AIIA01326266
537. Apple_AIIA01358885
538. Apple_AIIA01358902
539. Apple_AIIA01358919
540. Apple_AIIA01358970
541. Apple_AIIA01358987
542. Apple_AIIA01358953
543. Apple_AIIA01358963
544. Apple_AIIA01359004

NPD Music Retail Shares

545. Apple_AIIA00167793
546. Apple_AIIA00187687
547. Apple_AIIA00188105
548. Apple_AIIA00189930
549. Apple_AIIA00327772
550. Apple_AIIA00429468
551. Apple_AIIA00662062
552. Apple_AIIA00678009
553. Apple_AIIA00725368
554. Apple_AIIA00946216
555. Apple_AIIA00946224
556. Apple_AIIA00946391

557. Apple_AIIA00946640
558. Apple_AIIA00946649
559. Apple_AIIA00946675
560. Apple_AIIA00960247
561. Apple_AIIA00960296
562. Apple_AIIA00960300
563. Apple_AIIA00960340
564. Apple_AIIA00962442
565. Apple_AIIA00965666
566. Apple_AIIA00965893
567. Apple_AIIA00966687
568. Apple_AIIA00967103
569. Apple_AIIA00968523
570. Apple_AIIA00968532
571. Apple_AIIA00968691
572. Apple_AIIA00968757
573. Apple_AIIA01205535
574. Apple_AIIA01205543
575. Apple_AIIA01205576
576. Apple_AIIA01205585
577. Apple_AIIA01205587
578. Apple_AIIA01205590
579. Apple_AIIA01205610
580. Apple_AIIA01205623
581. Apple_AIIA01206292
582. Apple_AIIA01206330
583. Apple_AIIA01208708
584. Apple_AIIA01208710
585. Apple_AIIA01208997
586. Apple_AIIA01233725

NPD Surveys

587. Apple_AIIA01309399
588. Apple_AIIA00178974
589. Apple_AIIA01309615
590. Apple_AIIA00945746
591. Apple_AIIA00964631
592. Apple_AIIA00178967
593. Apple_AIIA01217873
594. Apple_AIIA00968565
595. Apple_AIIA01309456
596. Apple_AIIA00952642
597. Apple_AIIA00481774
598. Apple_AIIA00945746
599. Apple_AIIA00948134

600. Apple_AIIA00952622
601. Apple_AIIA00957936
602. Apple_AIIA01214028
603. Apple_AIIA01215207
604. Apple_AIIA01215317

Apple Marketing Requirements Documents (MRDs)

605. Apple_AIIA01333844
606. Apple_AIIA00989705
607. Apple_AIIA00989713
608. Apple_AIIA01052191
609. Apple_AIIA01054705
610. Apple_AIIA00982117
611. Apple_AIIA00989717
612. Apple_AIIA00114451
613. Apple_AIIA00984872
614. Apple_AIIA01055013
615. Apple_AIIA00115742
616. Apple_AIIA01337461
617. Apple_AIIA_B_001604
618. Apple_AIIA01068163
619. Apple_AIIA01064431
620. Apple_AIIA01067923
621. Apple_AIIA01337470
622. Apple_AIIA01063781
623. Apple_AIIA01068809
624. Apple_AIIA01057554
625. Apple_AIIA01066740

Public Books and Articles

626. Apple Press Releases relating to iPod, iTunes, iTunes Music Store or iTunes Store, iPad, Apple TV, & iPhone
627. Joshua D. Angrist and Jörn-Steffen Pischke, Mostly Harmless Econometrics: An Empiricist's Companion. March 2008
628. Jobs, Steve, "Thoughts on Music", February 6, 2007
629. Brad Stone, "Want to Copy iTunes Music? Go Ahead, Apple Says." New York Times. January 7, 2009
630. Mitchell Hall, "Apple iTunes going DRM-free." The National Business Review. January 7, 2009
631. Smith, Tony, "Apple plugs PyMusique iTunes 'hole.'" The Register. March 22, 2005, http://www.theregister.co.uk/2005/03/22/apple_blocks_pymusique/ (accessed May 30, 2013)
632. "Apple cuts iTunes pricing, eases copy protection." NBCNews.com. January 6, 2009
633. Brent Schlender, "How Big Can Apple Get?" Fortune Magazine. February 21, 2005
634. Tony Smith, "Downloading digital music - Majors and minors, players and platforms, lawsuits and licenses." The Register. December 24, 2004

635. "FairPlay – QTFairUse,", Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/FairPlay, (accessed May 28, 2013).
636. "FireWire vs. USB 2.0." Q Imagining Technical Note
637. "Apple iPod shuffle 2nd Gen (Silver) 1 GB Specs." EveryiPod.com. Accessed: May 28, 2013
638. "iPod: Not Just iCandy." PCMag.com Accessed: May 28, 2013 http://www.pcmag.com/article2/0,2817,19362,00.asp
639. "iTunes strips songs' copy protection." Boston.com January 7, 2009 Accessed: May 28, 2013 www.boston.com/business/technology/articles/2009/01/07/itunes_strips_songs_copy_protection/#
640. Levy, Steven, The Perfect Thing: How the iPod Shuffles Commerce, Culture and Coolness. Simon & Schuster Paperbacks. New York, NY 2006
641. Katie Dean, "Listen Up: Songs Now 79 Cents." The New Yorker. May 28, 2003
642. Richtel, Matt, "TECHNOLOGY; Apple Introduces What It Calls an Easier to Use Portable Music Player," NY Times, October 24, 2001, http://www.nytimes.com/2001/10/24/business/technology-apple-introduces-what-it-calls-an-easier-to-use-portable-music-player.html (accessed 9/25/2012)
643. "New & Noteworthy: New Apple retail stores to open; LCD rackmounts; Apple slams Microsoft proposal; more" CNET News November 28, 2001
644. Copeland, Michael V., "Unlocking the iPod: If you want to buy content for Apple's iPod, you have to go through iTunes. Navio Systems is hoping to change that.," Business 2.0 Magazine (downloaded from CNN Money.com), May 22, 2006. http://money.cnn.com/2006/05/22/technology/business2_launchpad0522/ (accessed May 28, 2013)
645. Bell, Ian , "RealNetworks Snaps Apple's iPod Exclusivity", Digital Trends, July 26, 2004, http://www.digitaltrends.com/gadgets/realnetworks-snaps-apples-ipod-exclusivity/ (accessed accessed May 28, 2013).
646. "Publication 946, How to Depreciate Property." Internal Revenue Service. 2012
647. Tony Smith, "Real '49c a song' promo pushes downloads to 3m." The Register. September 9, 2004
648. Peter Cohen, "RealNetworks' Harmony promises iPod compatibility." PCWorld. July 26, 2004 http://www.macworld.com/article/1035237/harmony.html (accessed May 28, 2013)
649. Borland, John, "iTunes hack disabled by Apple." CNET News. March 21, 2005, http://news.cnet.com/Apple-disables-iTunes-hack/2100-1027_3-5628616.html#addcomm (accessed May 30, 2013)
650. "The SURVEYREG Procedure: Syntax." SAS/STAT(R) 9.22 User's Guide Accessed: June 19, 2013 support.sas.com/documentation/cdl/en/statug/63347/HTML/default/viewer.htm#statug_surveyreg_sect006.htm
651. SAS/STAT(R) 9.2 User's Guide, Second Edition, "FREQ Statement"., Available at http://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer.htm#statug_reg_sect011.htm
652. Tim Lambert, "Why You Need to Correct for Clustering - Deltoid." Science Blogs. September 10, 2003 scienceblogs.com/deltoid/2003/09/10/cluster/
653. Tony Smith, "Sony opens US music download store." The Register. May 4, 2004 Accessed: May 29 2013 http://www.theregister.co.uk/2004/05/04/sony_connect_us/

654. Mariano, Gwendolyn, "Listen.com to tune in new music service," CNET News, December 2, 2001, http://news.cnet.com/Listen.com-to-tune-in-new-music-service/2100-1023_3-276476.html (accessed July 16, 2013)
655. Benny Evangelista, "Music firms open online services, but will fans pay?" San Francisco Chronicle. December 3, 2001 Accessed: May 30, 2013
656. Evangelista, Benny, "Industry starting to endorse Net music / Listen.com to offer songs from all five major labels," Listen.com, July 1, 2002, http://www.sfgate.com/business/article/Industry-starting-to-endorse-Net-music-2801248.php (accessed July 16, 2013).
657. CNET Staff, "New & Noteworthy: CNET Reviews," November 28, 2001, http://reviews.cnet.com/8301-13727_7-1036303-263.html (accessed 9/25/2102).
658. Kahney, Leander "The Cult of iPod," San Francisco, CA: No Starch Press, Inc. (2005), p. 3
659. 2006 PC World Innovations Awards," PR Newswire, January 4, 2006, http://www.prnewswire.com/news-releases/2006-pc-world-innovations-awards-winners-unveiled-53127872.html (accessed July 16, 2013).
660. Bajarin, Ben, "Why Competing with Apple Is So Difficult,"Time Magazine. July 01, 2011Accessed: July 18, 2013 http://techland.time.com/2011/07/01/why-competing-with-apple-is-so-difficult/#ixzz2ZN8itJ6i
661. "iPod Mini," Wikipedia, The Free Enclyclopedia, https://en.wikipedia.org/wiki/IPod_Mini (accessed July 16, 2013)
662. Drew Turner, Daniel, "Apple hits $1 Billion in Profit for 2005," eWeek, October 10, 2011, http://www.eweek.com/c/a/Apple/Apple-Hits-1-Billion-in-Profit-for-2005/ (accessed July 16, 2013)
663. "Closed Platform," Wikipedia, The Free Enclyclopedia, http://en.wikipedia.org/wiki/Closed_platform (accessed July 17, 2013).
664. Bloomberg Businessweek, "RealPlayer: Master Music Manager," May 25, 2005, http://www.businessweek.com/stories/2005-05-25/realplayer-master-music-manager, (accessed May 28, 5/28/2013)
665.)"Managing Music with Windows Media Player," PCUG, http://www.pcug.org.au/pcug/training/upcd02dm01/dmLesson01Media%20Player.pdf, January 17, 2004 (accessed May 28, 2013)
666. Ku, Andrew, "Dell's Digital Jukebox 20 - Music, the Dell Way," AnandTech, June 20, 2004, http://www.anandtech.com/show/1354/9 (accessed June 4, 2013)
667. Boswell, Wendy, "Manage your music with Winamp," Lifehacker, July 8, 2007, http://lifehacker.com/276000/manage-your-music-with-winamp (accessed May 28, 2013)
668. Sauners, Gareth J M, "Anapod - transfer files to your iPod via Explorer," November 19, 2007, http://blog.garethjmsaunders.co.uk/archives/2007/11/19/anapod-transfer-files-to-your-ipod-via-explorer/ (accessed May 28, 2013)
669. Ulrich, Adrian, "Gnupod; Manage your iPod," GNU, last updated September 20, 2007, http://www.gnu.org/software/gnupod/gnupod.html (accessed May 28, 2013)
670. "How to Use the EphPod IPod Manager," eHow, http://www.ehow.com/how_2145859_use-ephpod-ipod-manager.html (accessed May 28, 2013)
671. "Napster," Wikipedia, The Free Enclyclopedia, http://en.wikipedia.org/wiki/Napster (accessed July 16, 2013)
672. Kravitz, David, "Dec. 7, 1999: RIAA Sues Napster," Wired, December 7, 2009, http://www.wired.com/thisdayintech/2009/12/1207riaa-sues-napster/ (accessed July 16, 2013)

673. Tyson, Dan, "The 25 Worst Tech Products of all Time," PCWorld, May 26, 2006, http://www.pcworld.com/article/125772/worst_products_ever.html (accessed July 16, 2013)
674. "iTunes Store," Wikipedia, The Free Enclyclopedia, http://en.wikipedia.org/wiki/ITunes_Store (accessed July 16, 2013)
675. Lewis, Peter, "Product of The Year Apple iTunes Music Store," Fortune Magazine (downloaded from CNN Money), December 22, 2003, http://money.cnn.com/magazines/fortune/fortune_archive/2003/12/22/356108/ (accessed July 16, 2013)
676. U.S. Department of Justice, Interoperability Between Antitrust and Intellectual Property, Thomas O. Barnett Presentation to the George Mason School of Law Symposium Managing Antitrust Issues In a Global Marketplace, Washington, D.C., September 13, 2006, http://www.usdoj.gov/atr/public/speeches/218316.htm (accessed July 16, 2013)
677. CNET News, "Real offers new tech, song store,." January 7, 2004, http://news.cnet.com/2100-1027-5136275.html (accessed July 16, 2013)
678. ArsTechnica, "Amazon's MP3 store brings more DRM-free music at lower prices than iTunes Store." September 25, 2007
679. "Amazon to Sell Warner Music Minus Copy Protection." NY Times. December 28, 2007
680. "Sony Joins Other Labels on Amazon MP3 Store." NY Times. January 11, 2008
681. Antone Gonsalves, "Amazon Adds Fourth Major Record Label To DRM-Free Music Store," Information Week, January 10, 2008
682. "Application Store," The Free Encyclopedia, http://en.wikipedia.org/wiki/Application_store (accessed July 16, 2013)
683. Dalrymple, Jim, "iPod DRM faces another reverse-engineering challenge," PCWorld, November 22, 2005, http://www.macworld.com/article/1048070/ipoddrm.html (accessed June 17, 2013)
684. Healey, Jon. "Napster and Rhapsody compete for headlines," Los Angeles Times. September 20, 2006 http://opinion.latimes.com/bitplayer/2006/09/ (accessed June 17, 2013)
685. Bernoff, Josh, "Apple iTunes Jump-Starts Windows Digital Music," Forrester Research, Inc., October 17, 2003
686. Leonard, Devin, "Songs In The Key Of Steve Steve Jobs may have just created the first great legal online music service. That's got the record biz singing his praises." Fortune Magazine, downloaded from CNNMoney.com, May 12, 2003 http://money.cnn.com/magazines/fortune/fortune_archive/2003/05/12/342289/ (accessed May 28, 2013).
687. John Berra, Walled Garden or Open Field?, Automation World, Feb. 2, 2012
688. Hee-Yeon Cho, Choon-Sung Nam, Dong-Ryeol Shin, 2010 International Conference on Electronics and Information Engineering (ICEIE 2010), pg. V2-141
689. Roland M. Müller, A Comparison of Inter-Organizational Business Models of Mobile App Stores: There is More than Open vs. Closed, Journal of Theoretical and Applied Electronic Commerce Research, Vol. 6, Issue 2 (Aug. 2011), pg. 72-73
690. Gobry, Pascal-Emmanuel, "How Amazon Makes Money From The Kindle," Business Insider, October 18, 2011, http://www.businessinsider.com/kindle-economics-2011-10 (accessed July 16, 2013)
691. Akasie, Jay, "With New Kindle, Bezos Proves Ecosystems Matter More Than Hardware," September 7, 2012 http://www.minyanville.com/sectors/technology/articles/amazon-new-kindle-amazon-kindle-family/9/7/2012/id/43794 (accessed July 16, 2013)

692. "Closed Platform," Wikipedia, The Free Enclyclopedia, http://en.wikipedia.org/wiki/Closed_platform (accessed July 17, 2013)
693. "MP3 Software Review", 10TopTenReviews, http://mp3-software-review.toptenreviews.com/ (accessed June 10, 2013)
694. "Music Management software," CNET, http://download.cnet.com/windows/music-management-software/ (accessed June 10, 2013)
695. Levine, Robert, "Unlocking the iPod; Jon Johansen became a geek hero by breaking the DVD code. Now he's liberating iTunes - whether Apple likes it or not." Fortune Magazine, downloaded from CNNMoney.com, October 23, 2006, http://money.cnn.com/magazines/fortune/fortune_archive/2006/10/30/8391726/ (accessed May 28, 2013)
696. Gannes, Liz, "DVD Jon Fairplays Apple," Gigaom.com, October 2, 2006, http://gigaom.com/2006/10/02/dvd-jon-fairplays-apple/ (accessed May 28, 2013).
697. "PyMusique," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/PyMusique (accessed May 28, 2013)
698. Borland, John, "RealNetworks rekindles iPod Tech Tussle," CNETNews, April 26, 2005, http://news.cnet.com/2100-1027_3-5685286.html (accessed May 28, 2013)
699. Brian S. Hall, "The Apple Walled Garden is Grounded in Old Fashioned Product Superiority," Techpinions.com. March 4th, 2013 http://techpinions.com/the-apple-walled-garden-is-grounded-in-old-fashioned-product-superiority/14796 (accessed July 18, 2013)
700. Graham, Jefferson, "Real says digital song sale doubled market share," USA Today, September 09, 2004, http://usatoday30.usatoday.com/tech/techinvestor/corporatenews/2004-09-08-real_x.htm (accessed July 2, 2013)
701. Jemima Kiss, "How Big Is the iPod Installed Base?" Guardian, September 9, 2009 (reporting discussion with executive at Forrester Research)
702. Larry Dignan, "Tablet Replacement Rates: More Like an MP3 Player than PC," ZDNet January 4, 2011 (reporting a Forrester Research study)
703. "Mobile Phone Lifecycles," GSM Association, 2006 (reporting that about half of phone sales are replacements and that the replacement rate is about 18 months)
704. "The Life Cycle of a Cell Phone," U.S. Environmental Protection Agency, 2005 (reporting cell phone replacement rate of 18 months)
705. John Paczkowski, "I Got a Fever, and the Only Prescription is… More iPhone!" All Things Digital, June 25, 1010 (reporting that the replacement cycle for iPhones is 14.7 months)
706. Victor H., "Americans Replace Their Cell Phones Every 2 Years, Finns – Every Six, a Study Claims," Phonearena.com, July 11, 2011
707. Griliches, Zvi, "Hedonic Price Indexes and the Measurement of Capital and Productivity: Some Historical Perspectives,." NBER Working Paper 2634 (June 1988)
708. "Choosing the Correct Weight Syntaxis," Carolina Population Center at the University of North Carolina at Chapel Hill, http://www.cpc.unc.edu/research/tools/data_analysis/statatutorial/sample_surveys/weight_syntax (accessed June 20, 2013)
709. William H. Greene, Econometric Analysis, 7th Edition, Prentice Hall, 2012, Chapter 11. See also Joshua Angrist and Jorn-Steffan Pischke, Mostly Harmless Econometrics, Princeton University Press, 2009, Chapter 8, "Clustering and Serial Correlation in Panels

710. "Proving Antitrust Damages: Legal and Economic Issues", ABA Publishing, Second Edition, 2010
711. "Apple offers variable pricing, more DRM-free music on iTunes," Los Angeles Times, Janaury 6, 2009, http://latimesblogs.latimes.com/technology/2009/01/apple-blinks-st.html (accessed June 28, 2013)
712. Burnette, Ed, "Apple iTunes goes all DRM free, with three price tiers," ZDNet.com, http://www.zdnet.com/blog/burnette/apple-itunes-goes-all-drm-free-with-three-price-tiers/702 (accessed June 28, 2013)
713. McLean, Prince, "iTunes Store goes DRM Free, offers over-the-air downloads," Apple Insider, January 6, 2009, http://appleinsider.com/articles/09/01/06/itunes_store_goes_drm_free (accessed June 28, 2013)
714. "iTunes Store and DRM-free music: What you need to know," MacWorld, http://www.macworld.com/article/1138000/drm_faq.html (accessed January 7, 2009)
715. Kennedy, Peter E., "Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations," The American Economic Review, Vol. 71, No.4 (Sep., 1981), 801.
716. "iTunes version history," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/ITunes_version_history (accessed June 25th, 2013)
717. Mook, Nate, "Apple Blocks iTunes DRM Hack." BetaNews. March 21, 2005 http://betanews.com/2005/03/21/apple-blocks-itunes-drm-hack/ (accessed July 18th, 2013)
718. "emusic," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Emusic (accessed May 28, 2013)
719. "Kazaa site becomes legal service," BBC News, http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/2/hi/technology/5220406.stm (accessed 5/28/2013)
720. "Encyclopedia: Kazaa," PCMag.com, http://www.pcmag.com/encyclopedia/term/45734/kazaa (accessed 5/28/2013)
721. "LimeWire," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Limewire (accessed 5/28/2013)
722. "Morpheus (software)," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Morpheus_(software) (accessed 5/28/2013)
723. "National Geographic unveils World Music downloads service," PC Pro.co.uk, http://www.pcpro.co.uk/news/90308/national-geographic-unveils-world-music-downloads-service (accessed 5/28/2013)
724. "iPod," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Ipod (accessed 5/28/2013)
725. "iTunes," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Itunes (accessed 5/28/2013)
726. "iTunes Store," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Itunes_Store (accessed 5/28/2013)
727. "Apple TV," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Apple_TV (accessed 5/28/2013)
728. Associated Press, "RealNetworks: Files Play on IPod," Wired Magazine. July 25, 2004 http://www.wired.com/science/discoveries/news/2004/07/64341 (accessed 7/17/2013)
729. Eric Dahl, "The Playlist: Legal Digital Tunes Go P2P," PCWorld, April 9, 2004 http://www.pcworld.com/article/115553/article.html (accessed 7/17/2013)

730. "iPad," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/iPad (accessed 5/28/2013)
731. "iCloud," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/iCloud (accessed 5/28/2013)
732. Haire, Meaghan, "A Brief History of the Walkman," Time Magazine. July 01, 2009 http://www.time.com/time/nation/article/0,8599,1907884,00.html (accessed 5/28/2013)
733. Simcoe, Robert J., "The Revolution in Your Pocket: FIFTY YEARS AGO A TRANSISTOR RADIO CALLED THE TR1 STARTED THE REMAKING OF THE WORLD BY SEMICONDUCTORS," Invention & Technology Magazine Fall 2004 Volume 20, Issue 2. http://web.archive.org/web/20081203130622/http://www.americanheritage.com/articles/magazine/it/2004/2/2004_2_12_print.shtml
734. Smith, Tony, "Ten years old: the world's first MP3 player. Who remembers the MPMan F10 now?" The Register. March 10, 2008 http://www.theregister.co.uk/2008/03/10/ft_first_mp3_player/ (accessed 7/17/2013)
735. Cohen, Peter, "PyMusique Author Hacks Apple's ITunes Fix," PCWorld. March 23, 2005 http://www.pcworld.com/article/120146/article.html (accessed 7/17/2013)
736. "Pandora Radio," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Pandora_Radio (accessed 5/28/2013)
737. Perez, Juan Carlos, "Sony Spins New Online Music Store," PCWorld. May 5, 2004 http://www.pcworld.com/article/115995/article.html (accessed 5/28/2013)
738. "Amazon.com Launches Public Beta of Amazon MP3, a Digital Music Store Offering Customers Earth's Biggest Selection of a la Carte DRM-Free MP3 Music Downloads," Business Wire. September 25, 2007 http://www.businesswire.com/portal/site/google/index.jsp?ndmViewId=news_view&newsId=20070925005710&newsLang=en (accessed 7/17/2013)
739. Stone, Brad, "Sony Joins Other Labels on Amazon MP3 Store," New York Times. January 11, 2008 http://www.nytimes.com/2008/01/11/technology/11sony.html?_r=1&adxnnl=1&ref=technology&adxnnlx=1366826676-ymmK7p9HEqdahXynzAiDzA& (accessed 7/17/2013)
740. "Old Version of iTunes," OldApps.com http://www.oldapps.com/itunes.php?old_itunes+4#changelog (accessed 7/17/2013)
741. Appleyard, David, "iTunes 4.8 Released," Gigaom. May. 9, 2005 http://gigaom.com/2005/05/09/itunes-48-released/ (accessed 7/17/2013)
742. AppleInsider Staff, "Apple releases iTunes 7.1, QuickTime 7.1.5, more," Apple Insider. March 5, 2007 http://appleinsider.com/articles/07/03/05/apple_releases_itunes_71_quicktime_715_more (accessed 7/17/2013)
743. AppleInsider Staff, "iTunes 7.3 supports iPhone, adds Apple TV photo streaming," Apple Insider. June 29, 2007 http://appleinsider.com/articles/07/06/29/itunes_7_3_supports_iphone_adds_apple_tv_photo_streaming (accessed 7/17/2013)
744. Dalrymple, Jim, "Apple releases iTunes 8.1 update," MacWorld. March 11, 2009 http://www.macworld.com/article/1139330/itunes.html (accessed 7/17/2013)
745. Hugh Hurt, "EMI's Last-Ditch Effort: DRM-Free Music." Wired. April 3, 2007 Accessed: May 28, 2013 http://www. wired.com/entertainment/music/news/2007 /04/emi_business0403

746. Richard MacManus, "EMI Music DRM-free: What It Means For The Online Music Industry." ReadWrite.com April 2, 2007 Accessed: May 28, 2013 http://readwrite.com/2007 /04/02/emi_music_drm_free
747. Candace Lombardi, "iTunes goes DRM-free with EMI." CNET News. May 30, 2007 Accessed: May 28, 2013 http://news.cnet.com/iTunes-goes-DRM-free-with-EMI/2100-1027_3-6187457.html
748. "EMI Music Launches DRM-Free Superior Sound Quality Downloads Across Its Entire Digital Repertoire." April 2, 2007 Accessed: May 28, 2013 http:/ /shaungroves.com/2007 /04/emi -drm-press-release/
749. "Apple to End Music Restrictions." BBC News. January 7 2009 Accessed: May 28, 2013 http://news.bbc.co.uk/2/hi/technology/7813527.stm
750. "SharpMusique." Wikipedia. Accessed: May 31, 2013 http://en.wikipedia.org/wiki/PyMusique
751. Eric Bleeker, "1 Acquisition Apple Doesn't Want to See: Samsung Buying Pandora." The MoHeyFool. March 3, 2013 Acessed: March 5, 2013 http://www.fool.com/investing/general/2013/03/03/1-acquisition-apple-doesnt-want-to-see-samsung-buy.aspx
752. "The History & Future of Real Networks," Internet Video Magazine. Accessed: May 11, 2013 http://internetvideomag.com/Articles-2004/022324Real.htm
753. Adrian Covert, "A decade of iTunes singles killed the music industry." Fortune Magazine. April 25, 2013 http://money.cnn.com/2013/04/25/technology/itunes-music-decline/index.html (accessed 7/17/2013)
754. John Borland, "Cell phones heading into iPod territory" CNET News. July 1, 2004 Accessed: April 23, 2013 news.cnet.com/Cell-phones-heading-into-iPod-territory/2100-1041_3-5254146.html
755. John Borland, "Cell phones take iPod challenge," CNET News. November 12, 2004 Accessed: April 23, 2013 news.cnet.com/Cell-phones-take-iPod-challenge/2100-1039_3-5449095.html
756. John Borland, "iTunes ushers in a year of change," CNET News. April 26, 2004 Accessed: April 23, 2013 news.cnet.com/iTunes-ushers-in-a-year-of-change/2100-1027_3-5199227.html
757. John Borland, "Music moguls trumped by Steve Jobs?" CNET News. April 15, 2005 Accessed: April 23, 2013 news.cnet.com/Music-moguls-trumped-by-Steve-Jobs---page-3/2100-1027_3-5671705-3.html
758. Ryan Naraine, "Music Store Embedded in New RealPlayer 10," InternetNews.com. January 07, 2004 Accessed: May 30, 2013 http://www.internetnews.com/ec-news/article.php/3296171/Music+Store+Embedded+in+New+RealPlayer+10.htm
759. Marc Ferranti, "RealNetworks Puts Harmony on any Player." IDG News Service. July 26, 2004 http://www.techhive.com/article/117062/article.html (accessed 7/17/2013)
760. Colin Cameron and Douglas L. Miller, "robust Inference with clustered Data," in Handook of Empirical Economics and Finance, edited by Aman Ullah and David E. A. Giles, CRC Press 2011
761. Kennedy, Peter, "A guide to Econometrics," Second Ed.
762. Daniel L. Rubinfeld, Quantitative Methods in Antitrust, in 1 ISSUES IN COMPETITION LAW AND POLICY 723 (ABA Section of Antitrust Law 2008)
763. "7 Digital About Us," http://about.7digital.com/ (accessed 7/17/2013)
764. "7digital," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/7digital (accessed 7/17/2013)
765. Clegg, Dean, "Addictech," http://www.trademarkia.com/addictech-76553281.html (accessed 7/17/2013)

766. Hanlon, Tim, "digiwax = DRM-free MP3 + Vinyl," Gizmag. May 15, 2007 http://www.gizmag.com/go/7269/ (accessed 7/17/2013)
767. "Amazon MP3," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Amazon_MP3 (accessed 7/19/2013)
768. "Amie Street," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Amie_Street (accessed 7/19/2013)
769. "Google Play," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Google_Play (accessed 7/19/2013)
770. "Arkade Overview," http://www.arkade.com/content/Bottom+Banner/Arkade+Overview (accessed 7/19/2013)
771. "Artistxite About Us," http://artistxite.com/us/magazine/staticabout/8280/About-Us.html (accessed 7/19/2013)
772. "ArtistXite," http://musowiki.net/index.php/ArtistXite (accessed 7/19/2013)
773. "WWW.ARTISTXITE.COM," http://website.informer.com/artistxite.com (accessed 7/19/2013)
774. "Bandcamp," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Bandcamp (accessed 7/19/2013)
775. "Bandcamp Terms of Use" http://bandcamp.com/terms_of_use (accessed 7/19/2013)
776. "Beatport," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Beatport (accessed 7/19/2013)
777. "Bleep.com" Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Bleep.com (accessed 7/19/2013)
778. "About Boomkat" http://www.boomkat.com/about/ (accessed 7/19/2013)
779. "Boomkat - Your independent music specialist," http://www.webwiki.com/boomkat.com (accessed 7/19/2013)
780. "BuyMusic," Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/BuyMusic (accessed 7/19/2013)
781. Graham, Jefferson, "BuyMusic's downloads strike a sour note,"USAToday. July 28, 2003 http://usatoday30.usatoday.com/tech/news/2003-07-28-buymusic_x.htm (accessed 7/19/2013)
782. "iTunes Music Store vs. BuyMusic.com," http://www.underconsideration.com/speakup/archives/001534.html (accessed 7/19/2013)
783. "CD Baby – About Us," http://www.cdbaby.com/About (accessed 7/19/2013)
784. "CD Baby," Wikipedia, The Free Encyclopedia http://en.wikipedia.org/wiki/CD_Baby (accessed 7/19/2013)
785. "Cdigix," Wikipedia, The Free Encyclopedia http://en.wikipedia.org/wiki/Cdigix (accessed 7/19/2013)
786. Young, Jeffrey R., " Cdigix Ceases Operations, Citing Poor Economy," The Chronicle of Higher Education. February 12, 2009 http://chronicle.com/blogs/wiredcampus/cdigix-ceases-operations-citing-poor-economy/4528
787. "About Classical Archives," http://www.classicalarchives.com/about.html (accessed 7/19/2013)
788. "Classical Archives ," Wikipedia, The Free Encyclopedia http://en.wikipedia.org/wiki/Classical_Archives (accessed 7/19/2013)
789. "Digital-tunes Homepage" http://www.digital-tunes.net/ (accessed 7/19/2013)
790. "Underground music service Digital Tunes launches! " PRLEAP.COM April 27, 2007 http://www.prleap.com/pr/73840/ (accessed 7/19/2013)

791. "Discogs," Wikipedia, The Free Encyclopedia http://en.wikipedia.org/wiki/Discogs (accessed 7/19/2013)
792. All documents and other information, including information from various websites, as listed or cited in the report or the footnotes, exhibits, and appendices thereto

Appendix C: Collection of iPod Characteristics

1. The iPod characteristics research was initiated based on the list of order numbers (also called "MPN" or "Product Identifier") provided in the direct sales and reseller sales transaction data from Professor Noll's latest declaration backup materials. The order numbers were then individually searched online, and the available characteristics from all sources consulted were collected. For example, by searching order number "M8737LL/A" online, we collected information from sources such as"support.apple.com", "everymac.com", and "amazon.com". The list of characteristic variables is a result of the union of the information collected from the different sources.

2. The full list of sources consulted includes Apple.com, Apple Price Documents (provided by client), Everymac.com (also known as "everyipod.com"), abt.com, amazon.com, bestbuy.com, brokerbin.com, buy.com, cdw.com, cnet.com, collegestoreonline.com, cowboom.com, ebay.com, facebook.com, falabella.com, flash-memory-store.com, ipodused.com, lowerpricestoday.com, milo.com, model spec, mp3-players.toptenreview.com, nexttag.com, onyougo.com, outlet.amazonwebstore.com, overstock.com, pacificgeek.com, partnumber.org, pcsuperstore.com, personafile.com, pricecheck.co.za, pricegrabber.com, reviewindex.net, shop.com, shop.neobits.com, techforless.com, Todoclon.com, toolowtogo.com, topperise.ch, warrantylife.com, wikipedia, youfindit.ca.

3. After the search of characteristics was completed for all order numbers, we compared and consolidated the information from various sources for each order number to obtain the order number level data. We first ranked the sources for a given order number depending on its reliability and the completeness of its information (referred to as "the ranking process" below). Reliability is determined by degree of consistency between the information reported by the source and Apple.com. Apple.com is considered the most reliable source, and all characteristics available on the Apple site were used for in constructing our characteristics dataset. However when information for certain characteristics or order numbers was not available on Apple.com (e.g., "discontinued dates"), we would refer to everymac.com as our second best source for characteristics since it has the most comprehensive technical specifications for most iPods, and its information is consistent with that on Apple.com when the latter is available. With these two

sources (apple.com and everymac.com), we were able to collect information on the characteristics for most models across all iPod families.

4. We further compared characteristics of the order numbers within the same iPod family to collapse the information from the order number level to the family level. Order numbers within the same family should have the same characteristics. Through comparison, we resolved differences in characteristics by cross-checking the information against the comparable iPod description in the corresponding Apple press release. For example, suppose "order No. 123" and "order No. 321" belong to the same iPod family. We checked their characteristics for internal consistency and also for consistency with the description on the Apple's product launch press for the respective family. If all sources agree, we use the characteristics for the family. If not, we adopt the information from the Apple press release when available. There are a few models for which some characteristics are not reported by Apple. In that case, we repeat the ranking process and use the information from the most reliable source. When using information from sources other than Apple.com, we verified the data by crosschecking multiple other sources. For example, if Apple.com does not report the battery life for iPod X and everymac.com reports 8 hours, we verified the data against a third reliable source such as "Amazon.com" or "CNET review," if possible.

5. Final results are compared with the characteristics provided in Professor Noll's latest declaration backup materials. The non-trivial differences between the two datasets are summarized in the table below. (In making this table, we exclude, for example, a difference in product width due to rounding – 2.43 inches vs. 2.4 inches.)

No.	VARIABLE	MODEL				COMPARISON	
		Class	family	u2	harrypotter	Murphy/Topel	Noll
1	1st Reprice - Month	IPOD CLASSIC	IPOD P68 GOOD	0	0	Jul 2002	Aug 2002
2	End of Life - Price	IPOD CLASSIC	IPOD PHOTO P98A BEST	0	0	349	249
3	End of Life - Price	IPOD CLASSIC	IPOD PHOTO P98A GOOD	0	0	349	249
4	End of Life - Price	IPOD SHUFFLE	IPOD SHUFFLE D98 BEST	0	0	79	69
5	End of Life - Price	IPOD SHUFFLE	IPOD SHUFFLE N98A BEST	0	0	79	49
6	End of Life - Month	IPOD SHUFFLE	IPOD SHUFFLE N98A BEST	0	0	Sep 2007	Feb 2008
7	End of Life - Month	IPOD SHUFFLE	IPOD SHUFFLE N98E BEST	0	0	Sep 2008	Mar 2009
8	End of Life - Year	IPOD SHUFFLE	IPOD SHUFFLE D98 BEST	0	0	2009	2010
9	End of Life - Year	IPOD SHUFFLE	IPOD SHUFFLE N98A BEST	0	0	2007	2008
10	End of Life - Year	IPOD SHUFFLE	IPOD SHUFFLE N98C BEST	0	0	2008	2009
11	End of Life - Year	IPOD SHUFFLE	IPOD SHUFFLE N98E BEST	0	0	2008	2009
12	Music Battery Hours	IPOD TOUCH	IPOD TOUCH N72 BEST	0	0	36	24
13	Music Battery Hours	IPOD TOUCH	IPOD TOUCH N72 BETTER	0	0	36	24
14	Music Battery Hours	IPOD TOUCH	IPOD TOUCH N72 GOOD	0	0	36	24
15	Size (cubic inches)	IPOD MINI	IPOD MINI Q22 BEST	0	0	3 89	3 60
16	Size (cubic inches)	IPOD CLASSIC	IPOD P68A GOOD	0	0	7 62	7 49
17	Size (cubic inches)	IPOD CLASSIC	IPOD P97 BEST MAC	0	0	8 21	8 06
18	Size (cubic inches)	IPOD CLASSIC	IPOD P97 BEST WIN	0	0	8 21	8 06
19	Size (cubic inches)	IPOD CLASSIC	IPOD P97 BETTER MAC	0	0	7 03	6 91
20	Size (cubic inches)	IPOD CLASSIC	IPOD P97 BETTER WIN	0	0	7 03	6 91
21	Weight (oz)	IPOD SHUFFLE	IPOD SHUFFLE D55 BEST	0	0	0 60	0 61
22	Onboard Ram (MB)	IPOD TOUCH	IPOD TOUCH N18 BEST	0	0	256	128
23	Onboard Ram (MB)	IPOD TOUCH	IPOD TOUCH N18 BETTER	0	0	256	128
24	Playback Support Formats	IPOD MINI	IPOD MINI Q22 BEST	0	0	doesn't include Apple lossless	includes Apple lossless
25	Playback Support Formats	IPOD NANO	IPOD NANO N20 BEST	0	0	includes Apple lossless	doesn't include Apple lossless
26	Playback Support Formats	IPOD NANO	IPOD NANO N20 BETTER	0	0	includes Apple lossless	doesn't include Apple lossless
27	Playback Support Formats	IPOD CLASSIC	IPOD PHOTO P98A BEST	0	0	includes Apple lossless	doesn't include Apple lossless
28	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE D98 BEST	0	0	doesn't include HE-AAC	includes HE-AAC
29	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE N98 BEST	0	0	includes audible	doesn't include audible
30	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE N98A BEST	0	0	includes audible	doesn't include audible
31	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE N98C BEST	0	0	includes audible	doesn't include audible
32	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE N98E BEST	0	0	includes audible	doesn't include audible
33	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE N98F BEST	0	0	includes audible	doesn't include audible
34	Playback Support Formats	IPOD SHUFFLE	IPOD SHUFFLE N98F BETTER	0	0	includes audible	doesn't include audible
35	Connectivity	IPOD CLASSIC	IPOD PHOTO P98 BEST	0	0	doesn't include firewire	includes firewire
36	Connectivity	IPOD CLASSIC	IPOD PHOTO P98 BETTER	0	0	doesn't include firewire	includes firewire
37	Connectivity	IPOD CLASSIC	IPOD PHOTO P98A BEST	0	0	doesn't include firewire	includes firewire
38	Connectivity	IPOD CLASSIC	IPOD PHOTO P98A BETTER	0	0	doesn't include firewire	includes firewire
39	Connectivity	IPOD CLASSIC	IPOD PHOTO P98A GOOD	0	0	doesn't include firewire	includes firewire
40	Connectivity	IPOD CLASSIC	IPOD PHOTO P98A GOOD	1	0	doesn't include firewire	includes firewire

Appendix D

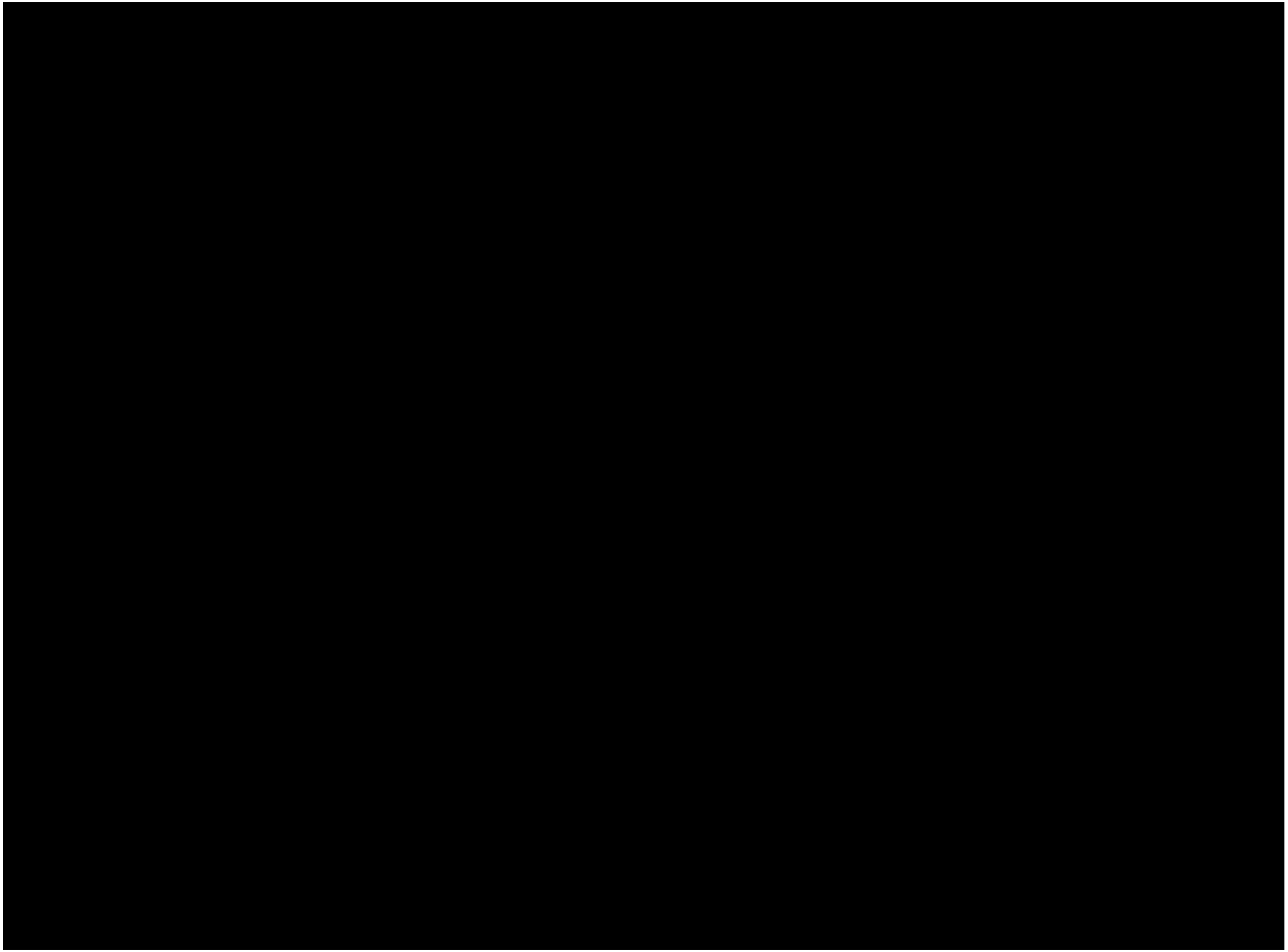
Additional Regression Results

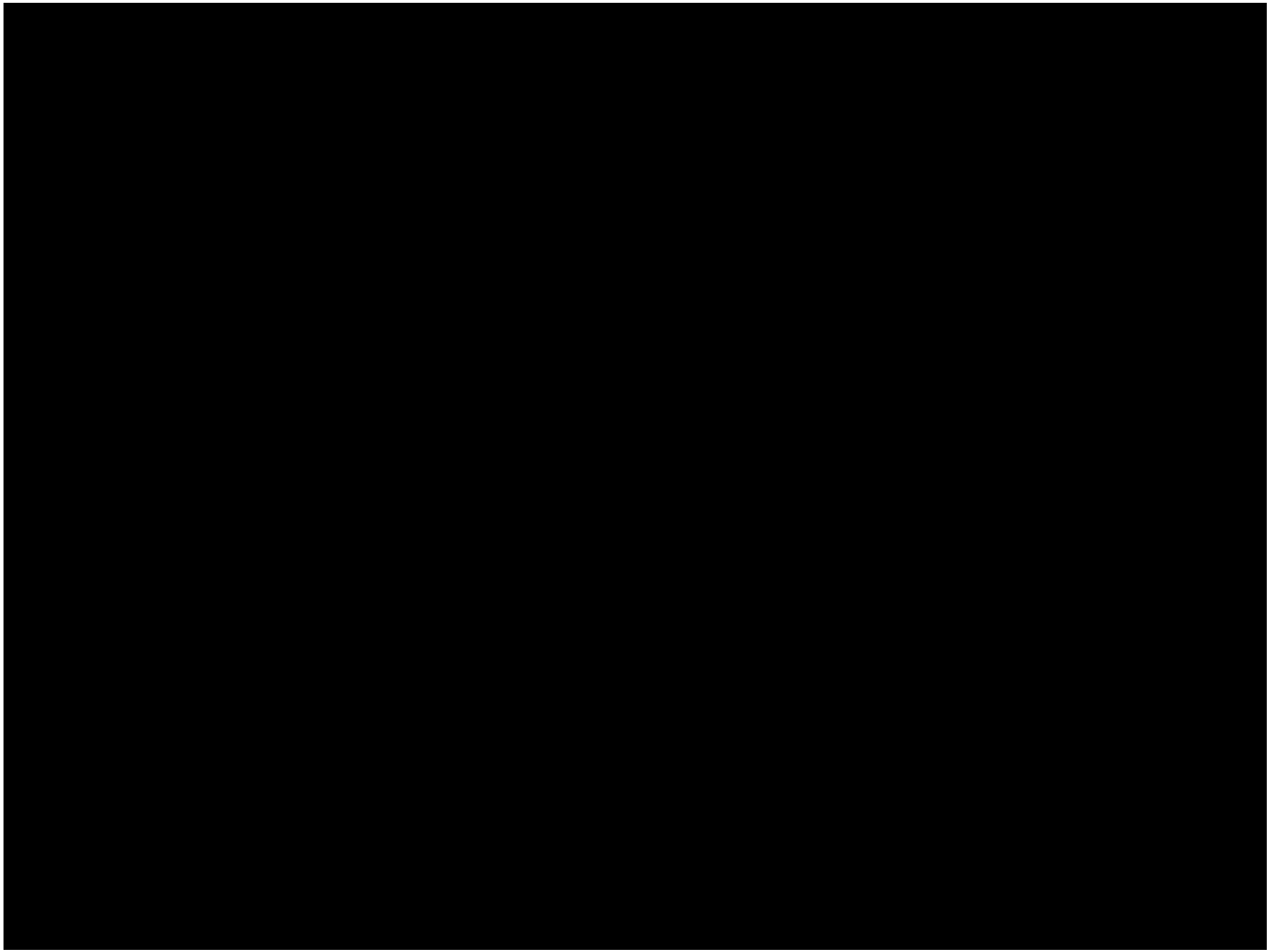
Exhibit D1a (Amended)

Exhibit D1a (Amended)

Exhibit D1a (Amended)

Exhibit D1a (Amended)





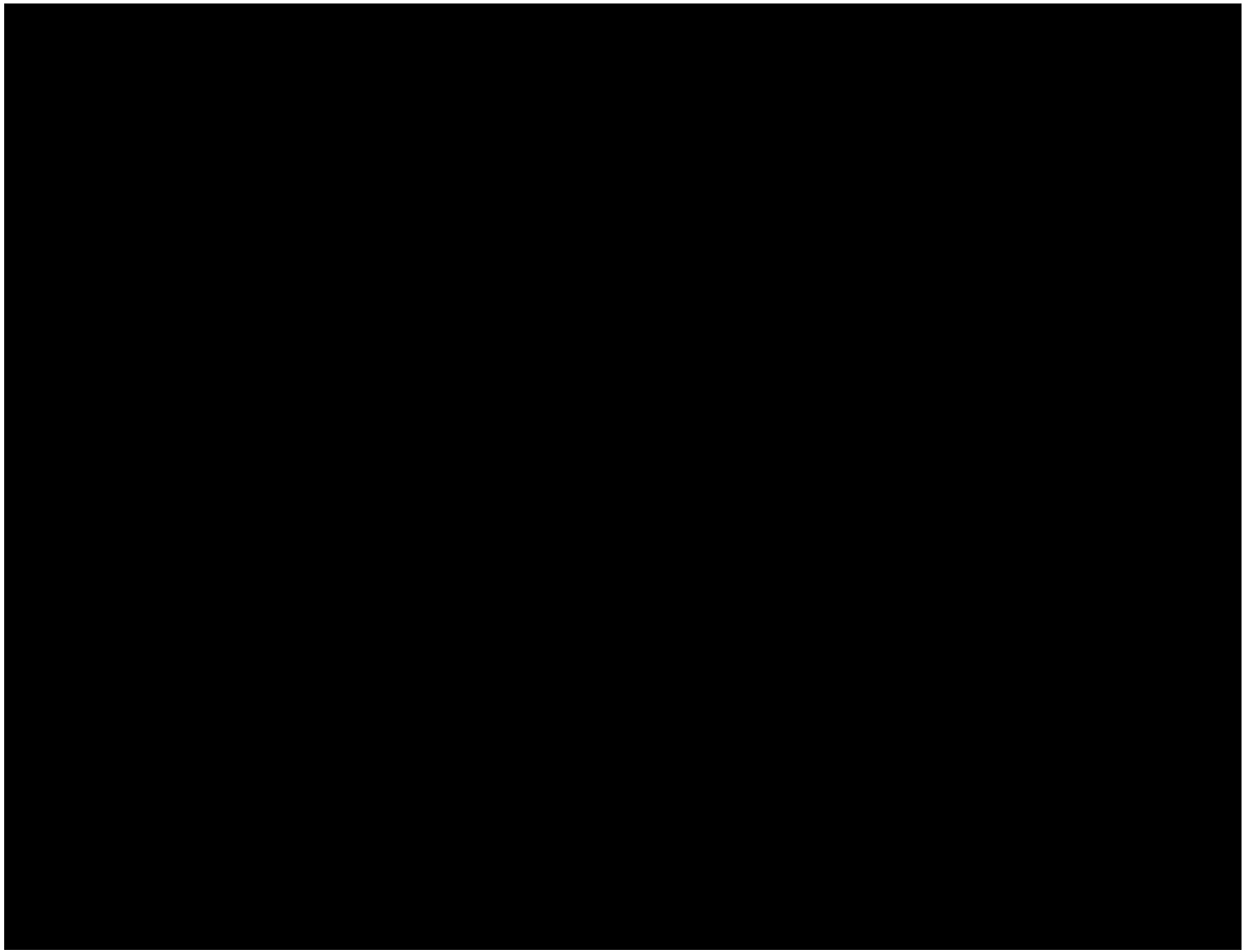


Exhibit D2a (Amended)

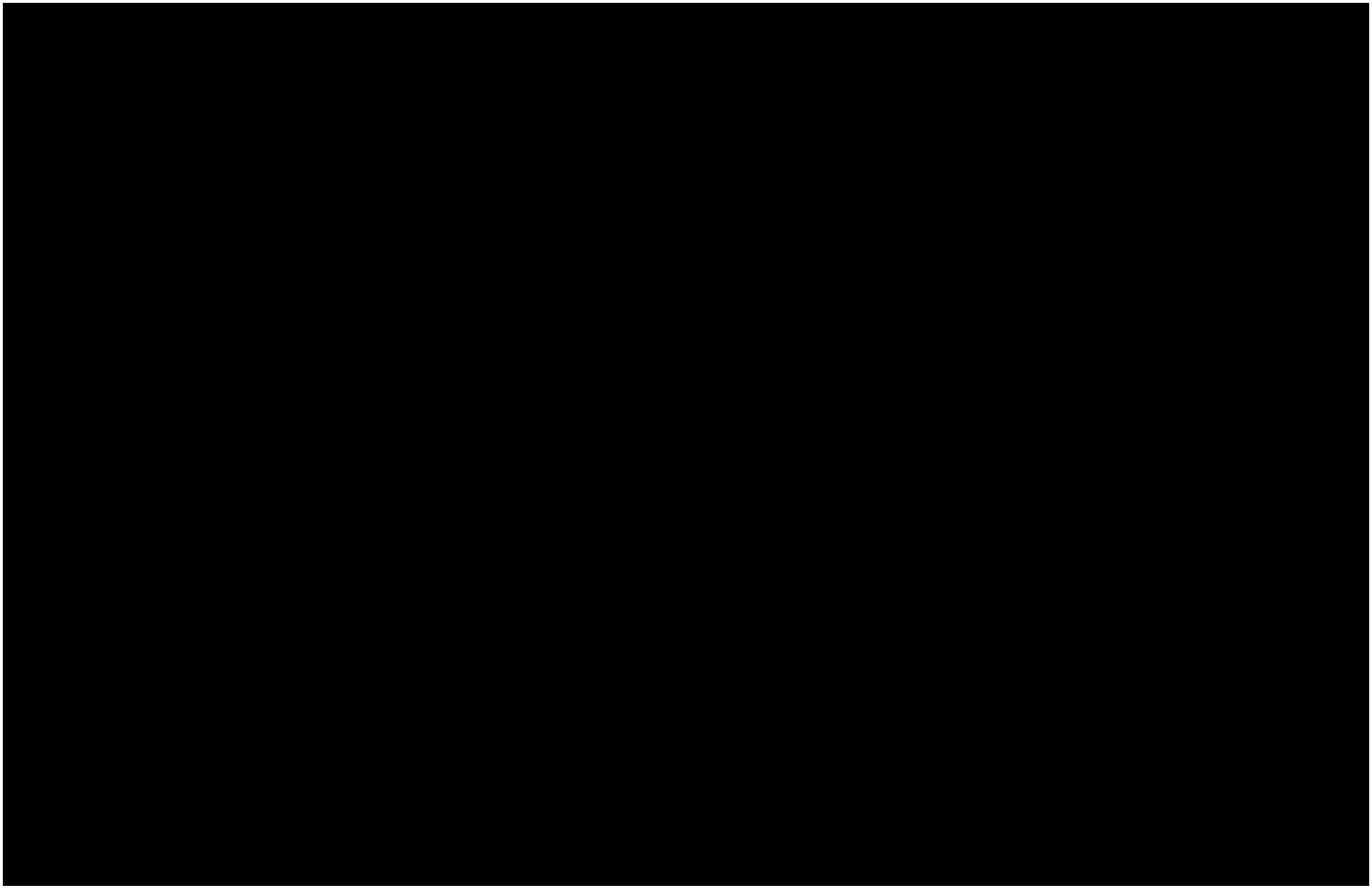


Exhibit D2a (Amended)

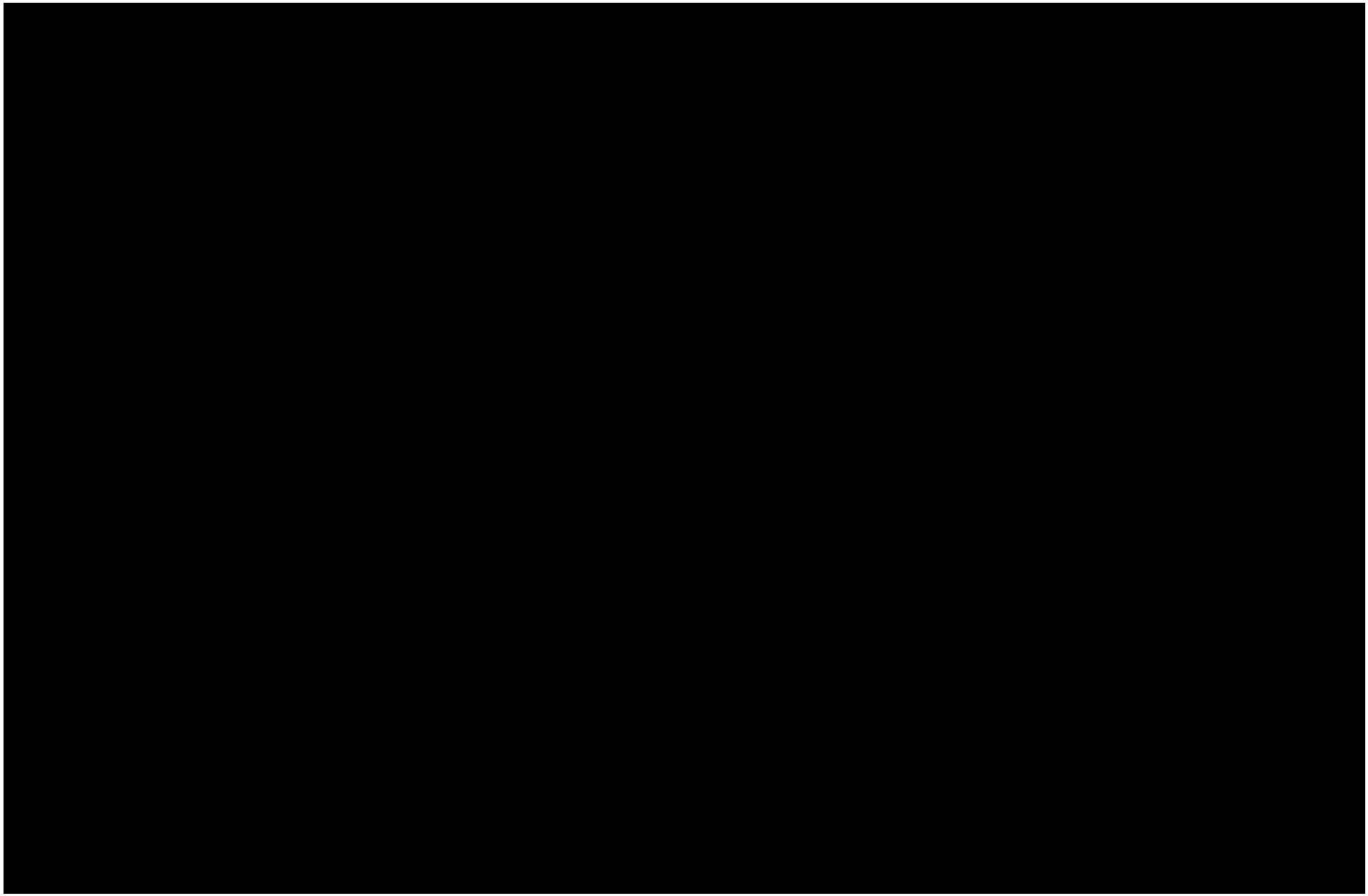


Exhibit D2a (Amended)

Exhibit D2a (Amended)

Exhibit D2b (Amended)

Exhibit D2b (Amended)

Exhibit D2b (Amended)

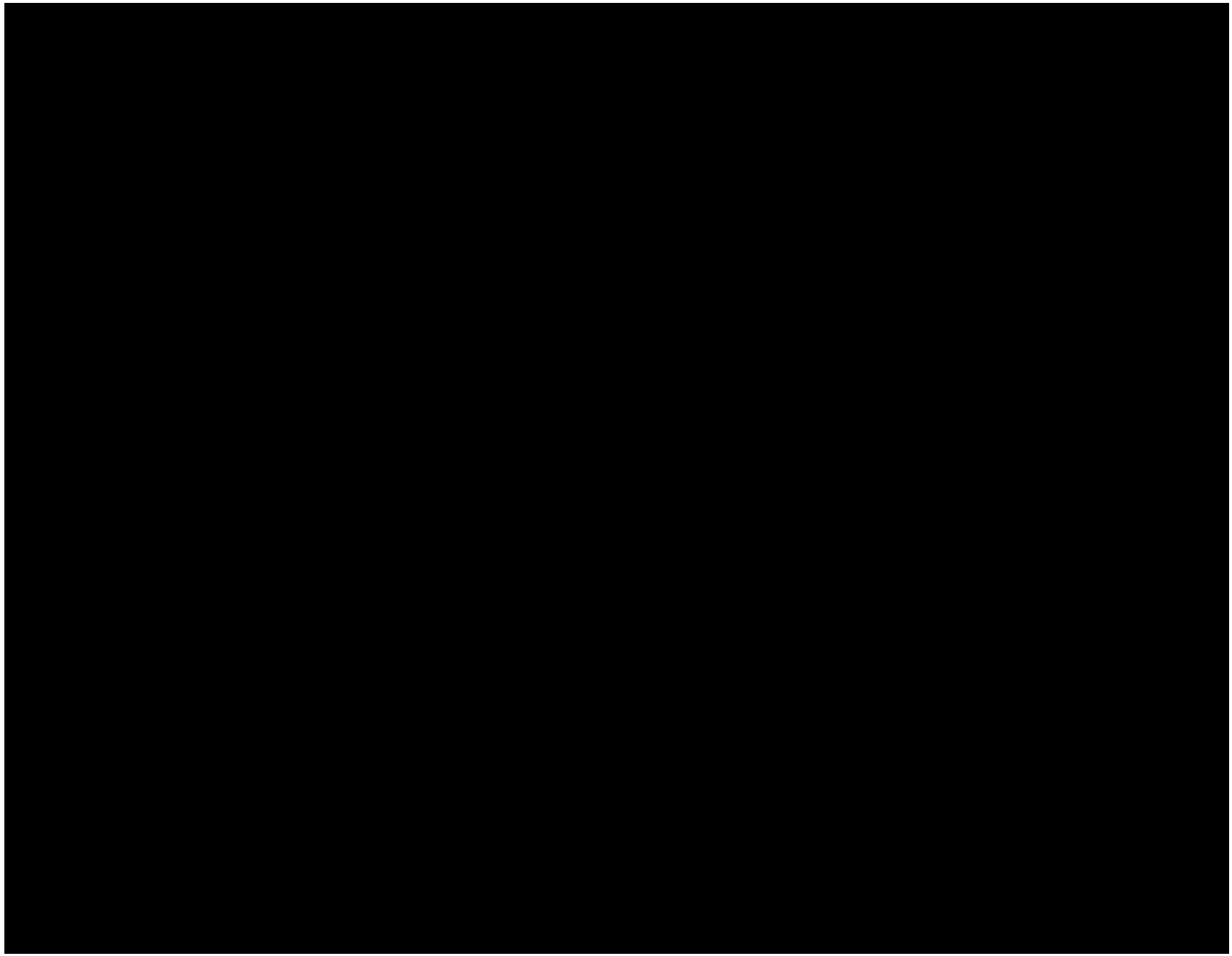


Exhibit D2b (Amended)

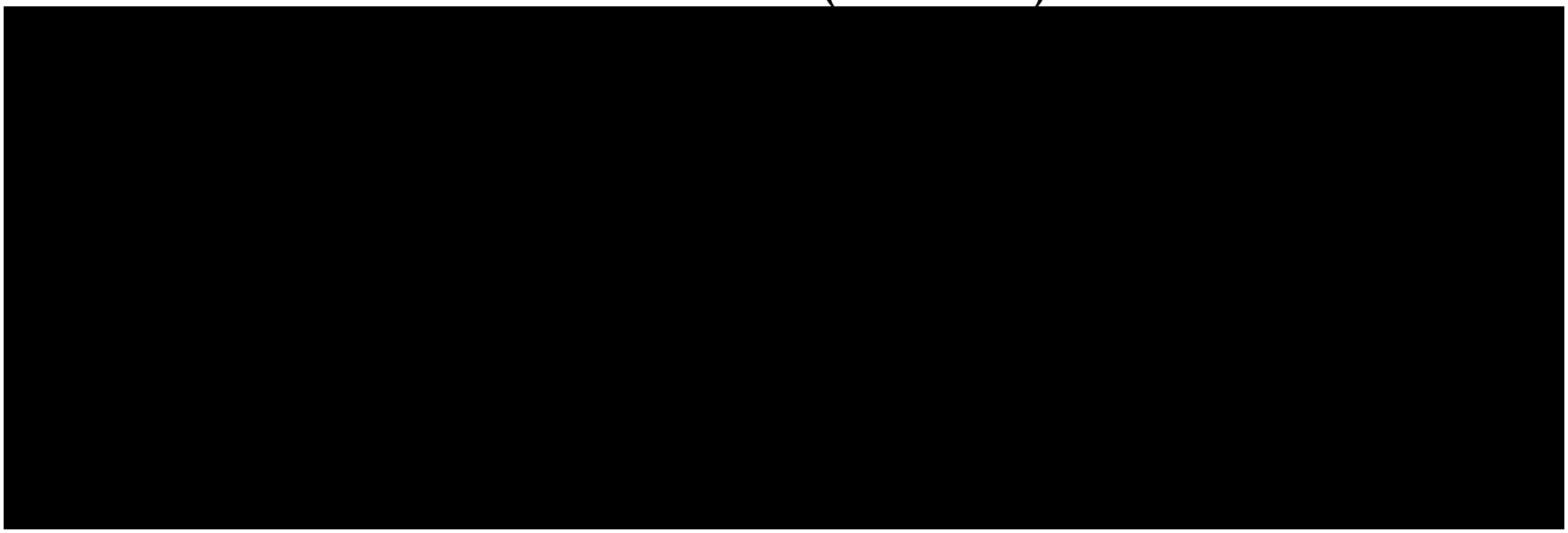
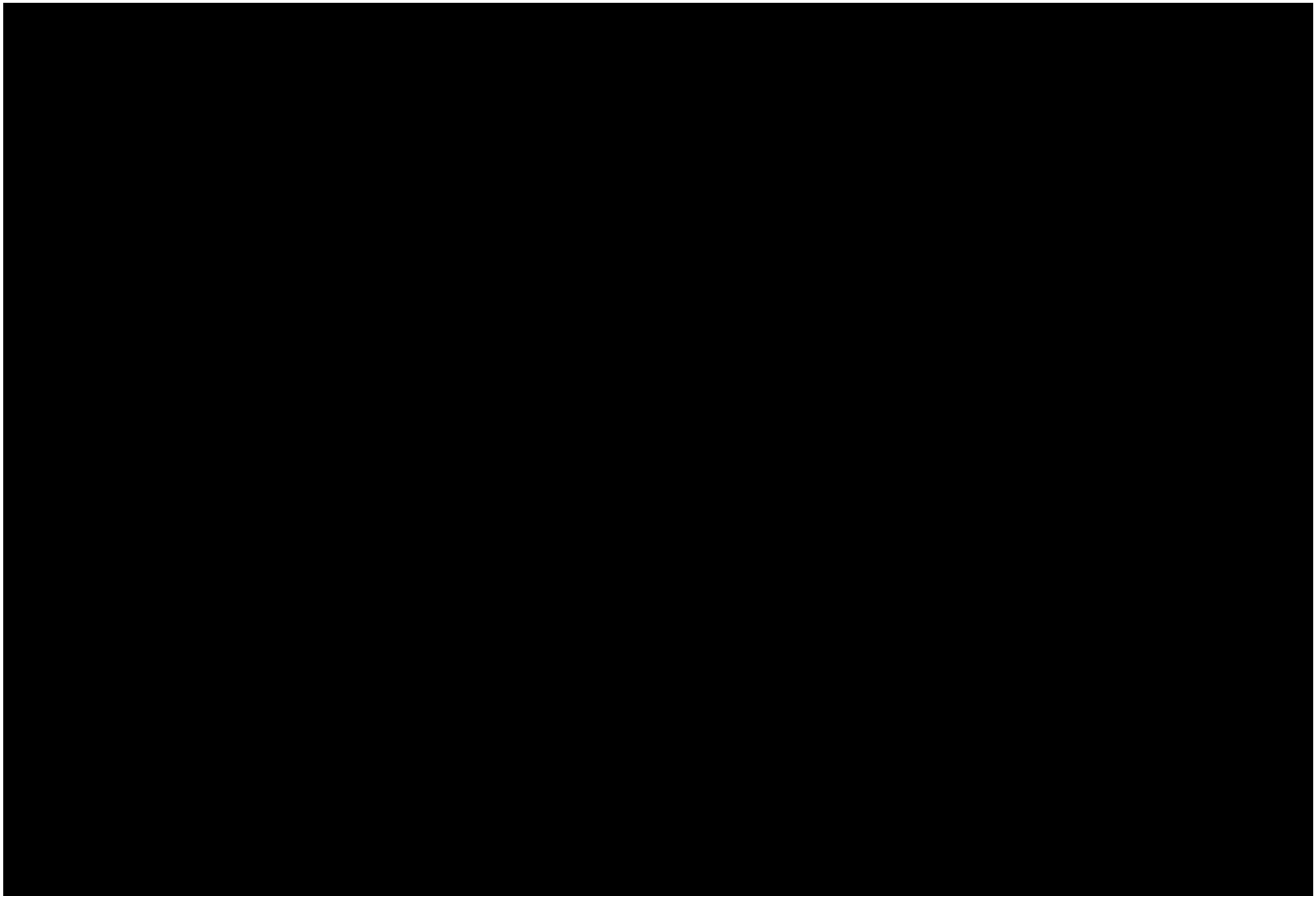
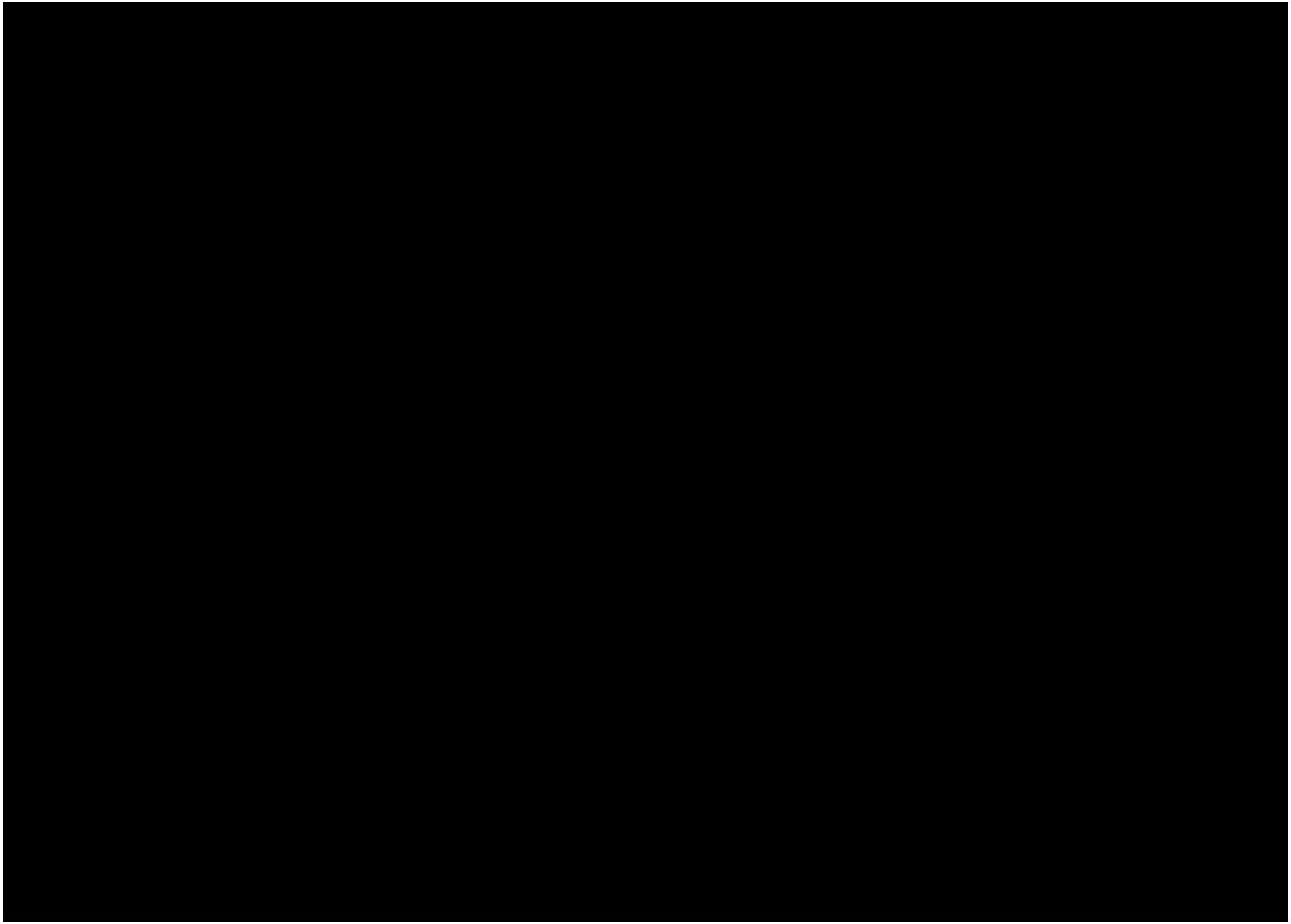
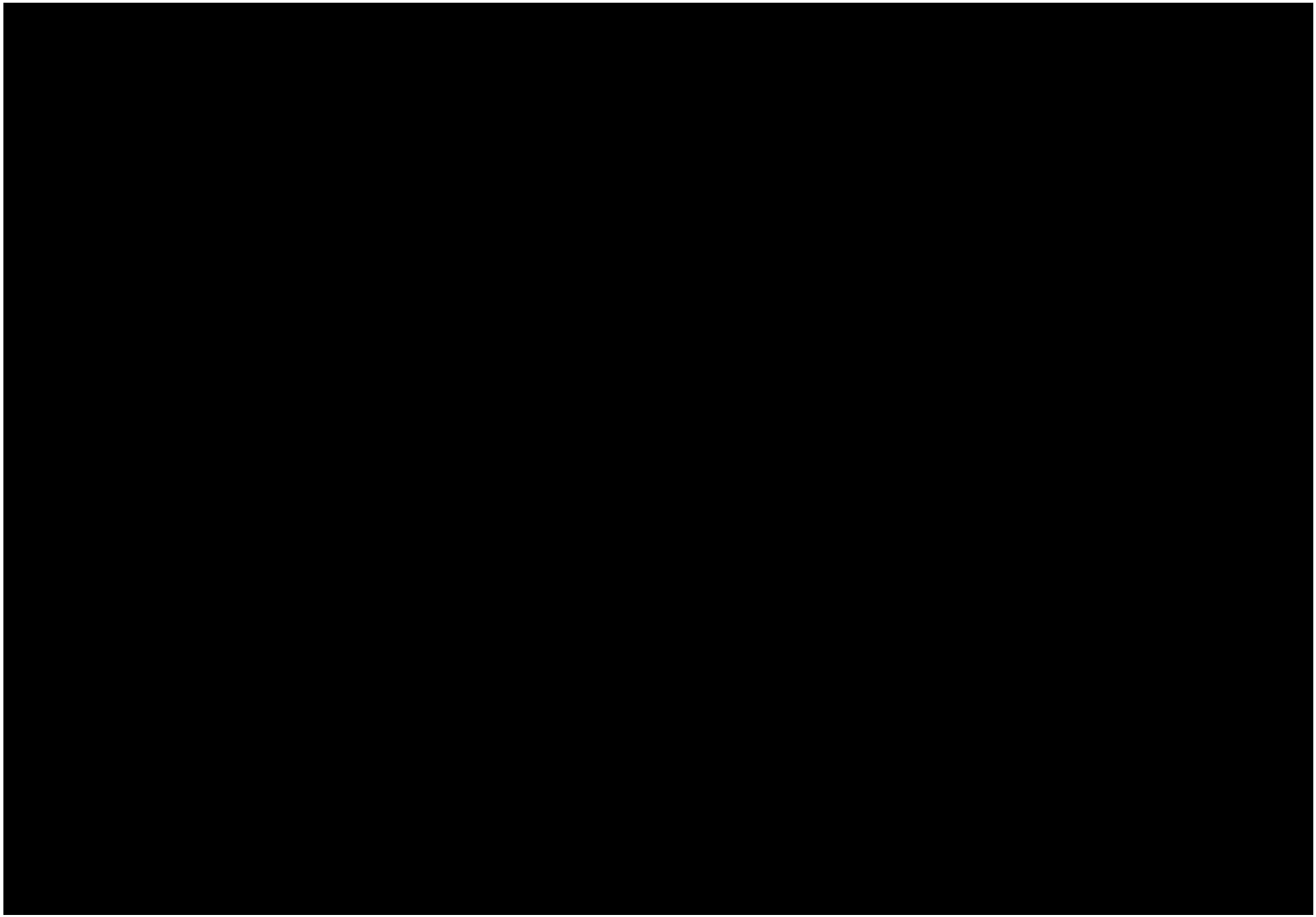


Exhibit D2c (Amended)

Note: Professor Noll's calculation of damages contains the following errors:
- Coefficients on iTunes 7 were calculated relative to the wrong but-for world.
- Standard errors were estimated incorrectly due to ignored clustering of residuals.
- Percentage Overchages were calculated using an incorrect formula.







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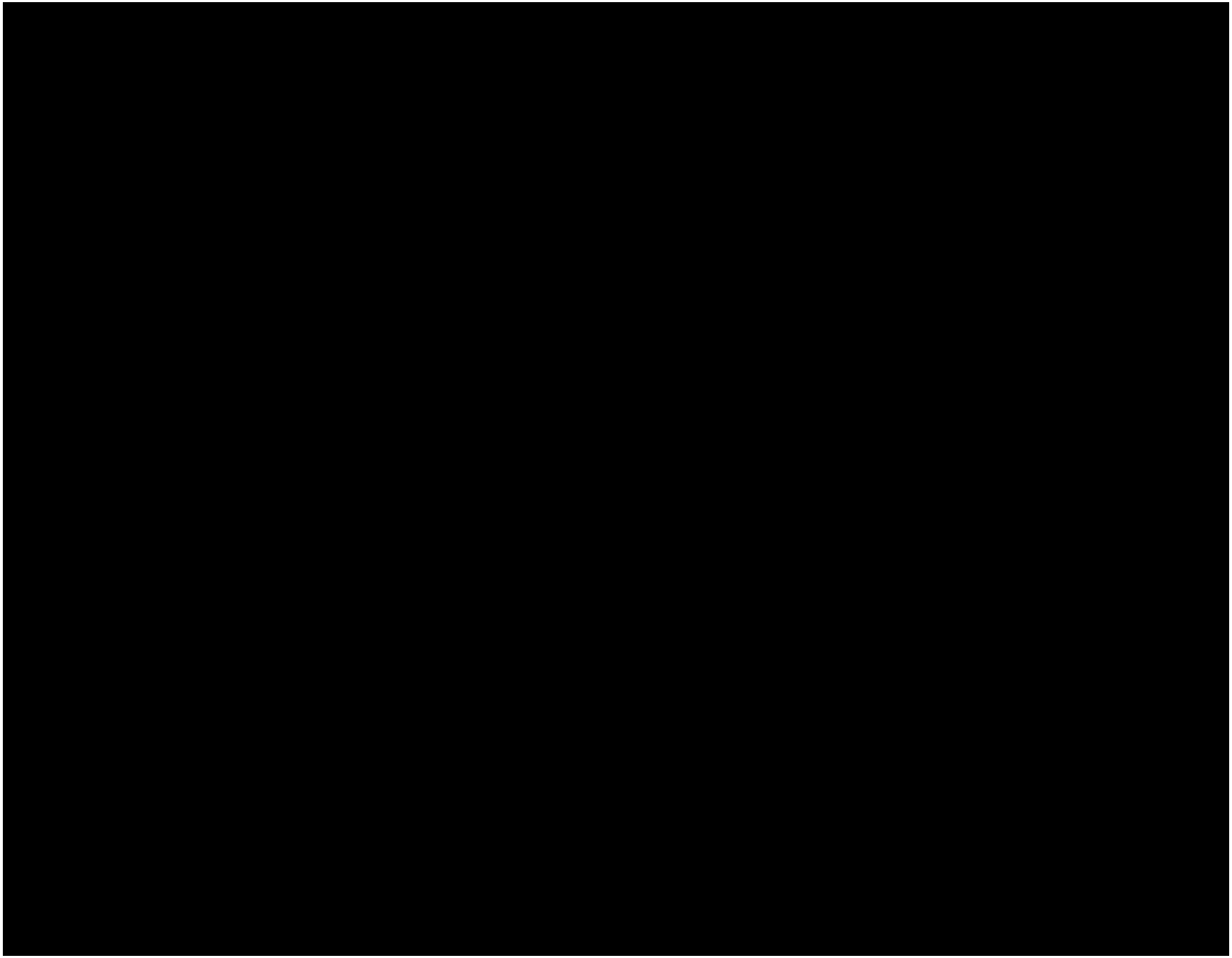

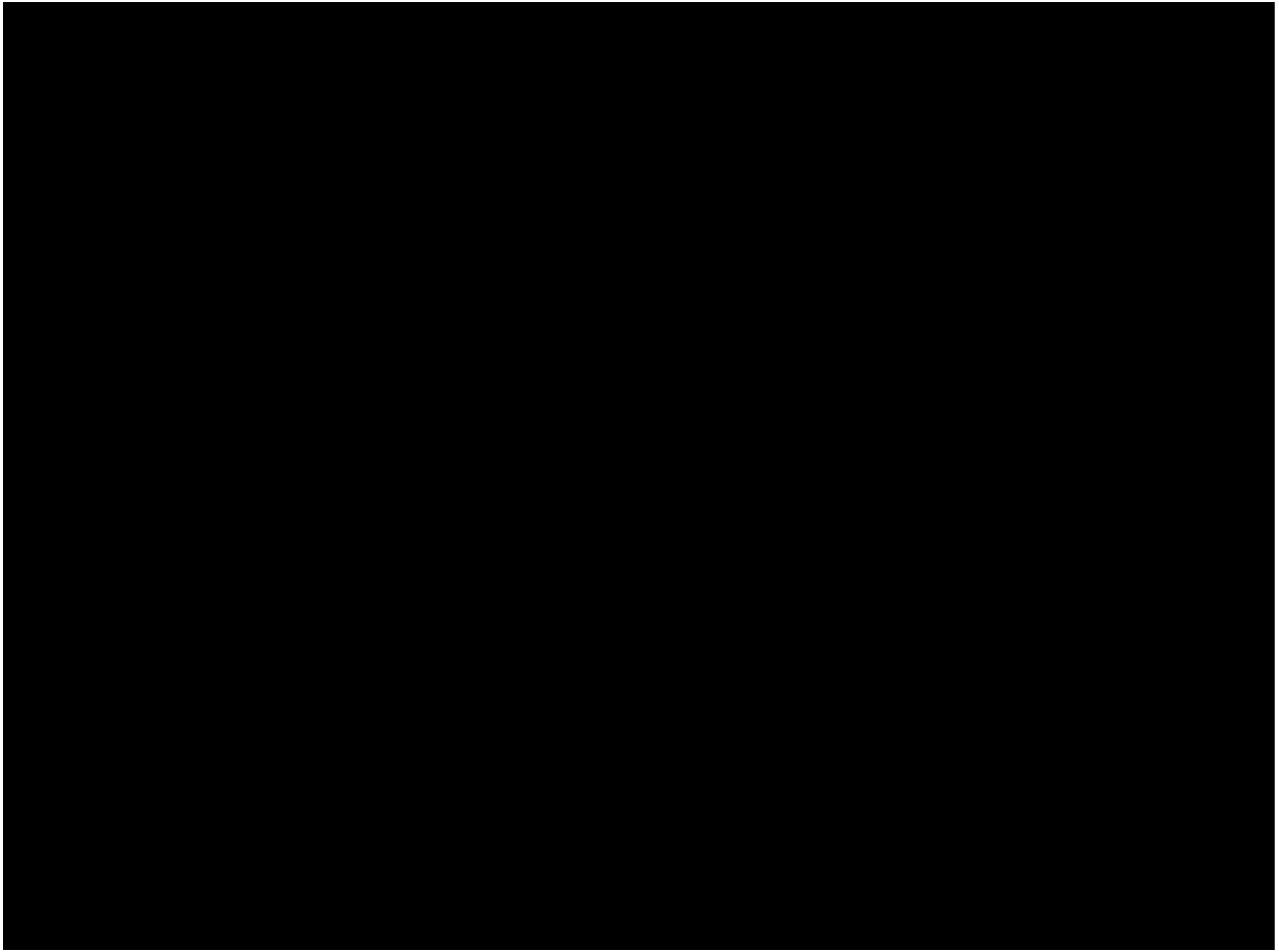

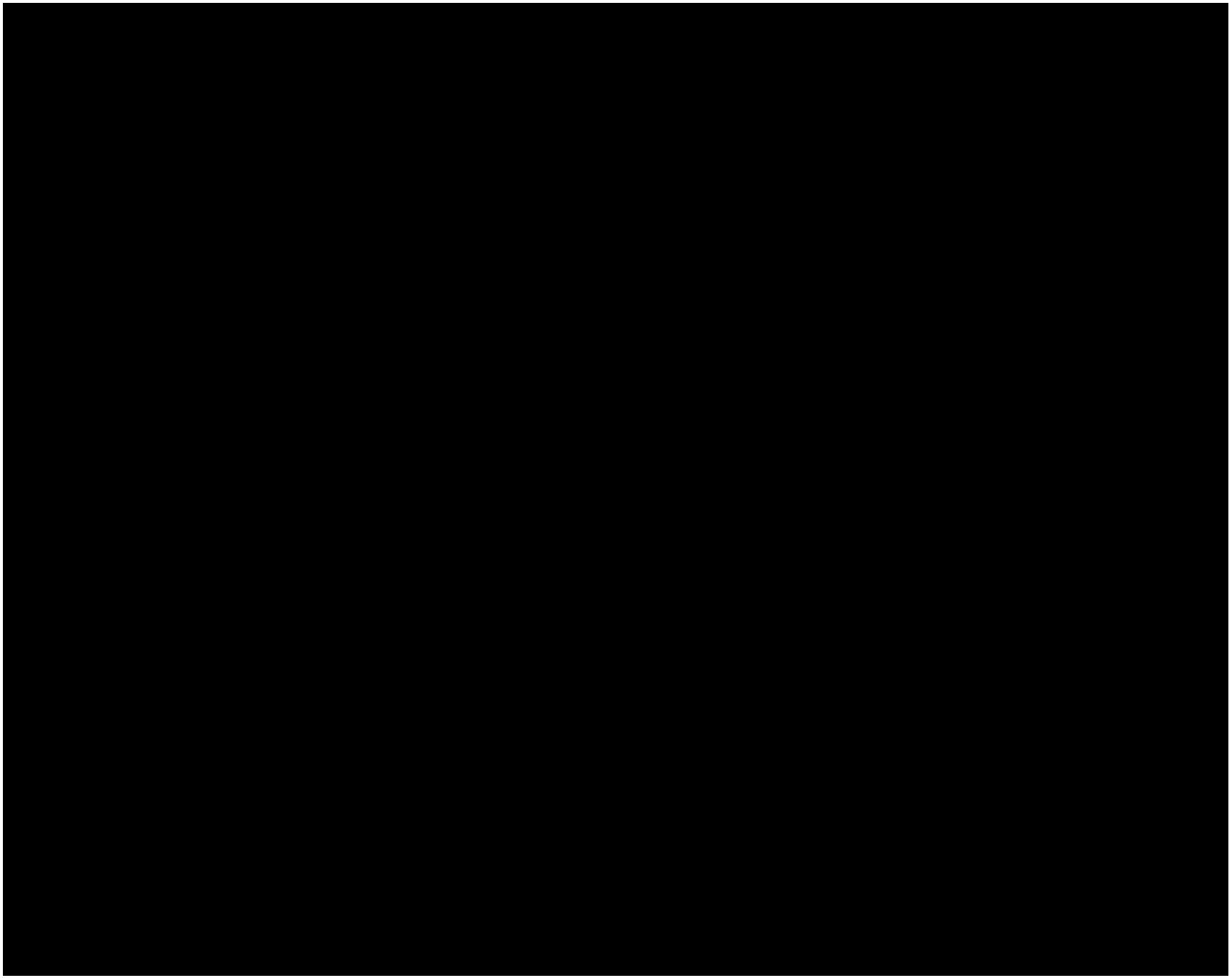

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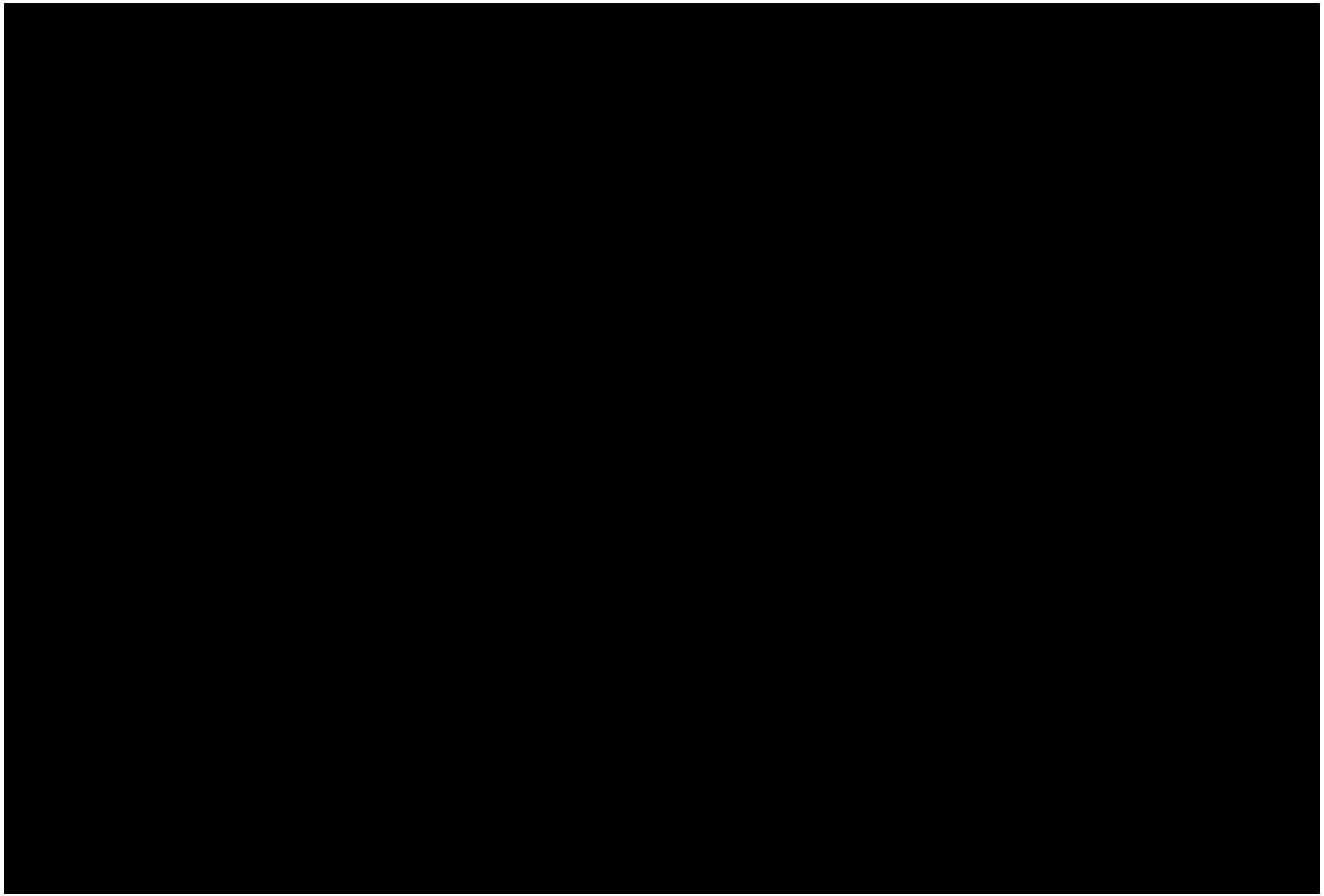

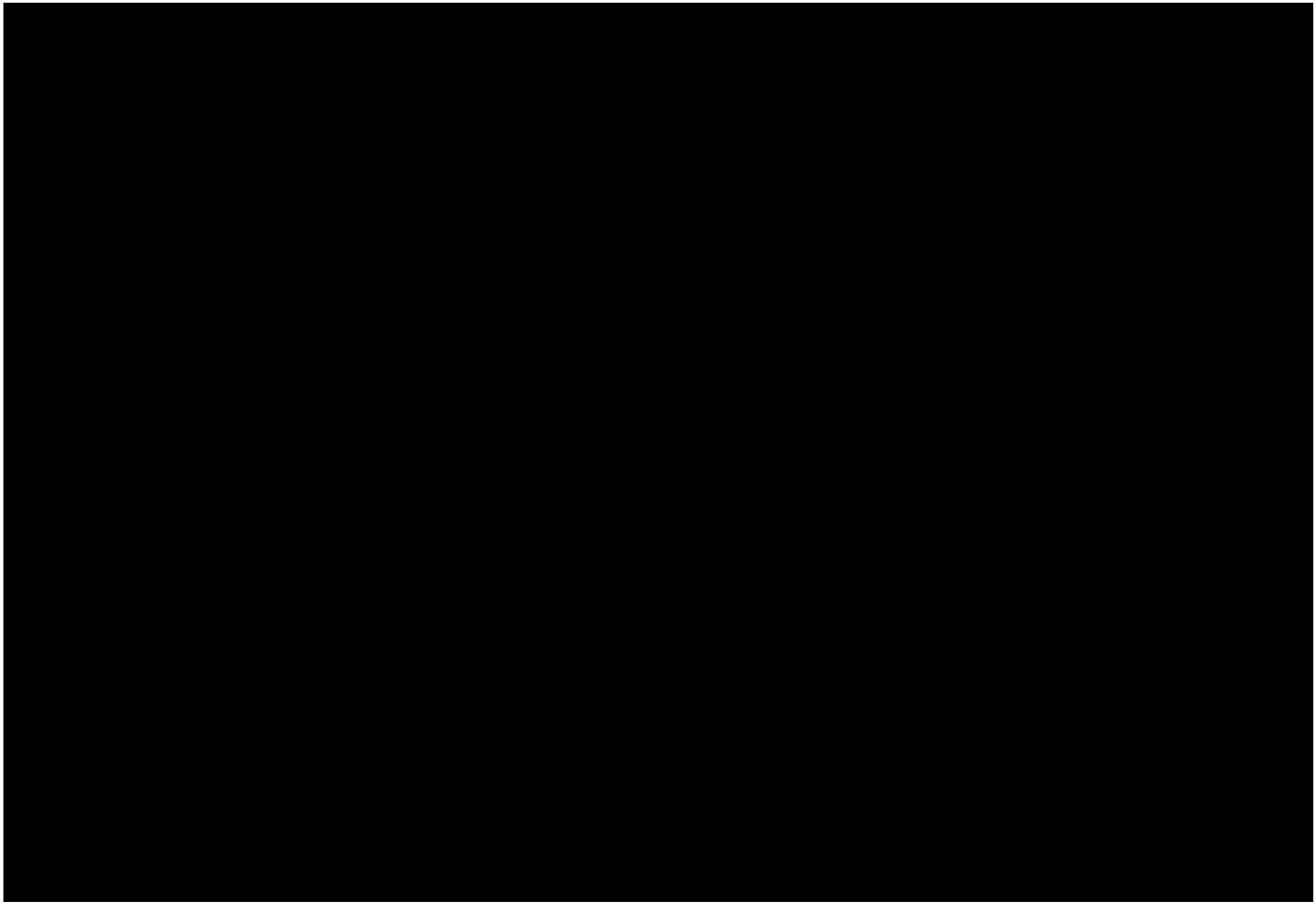

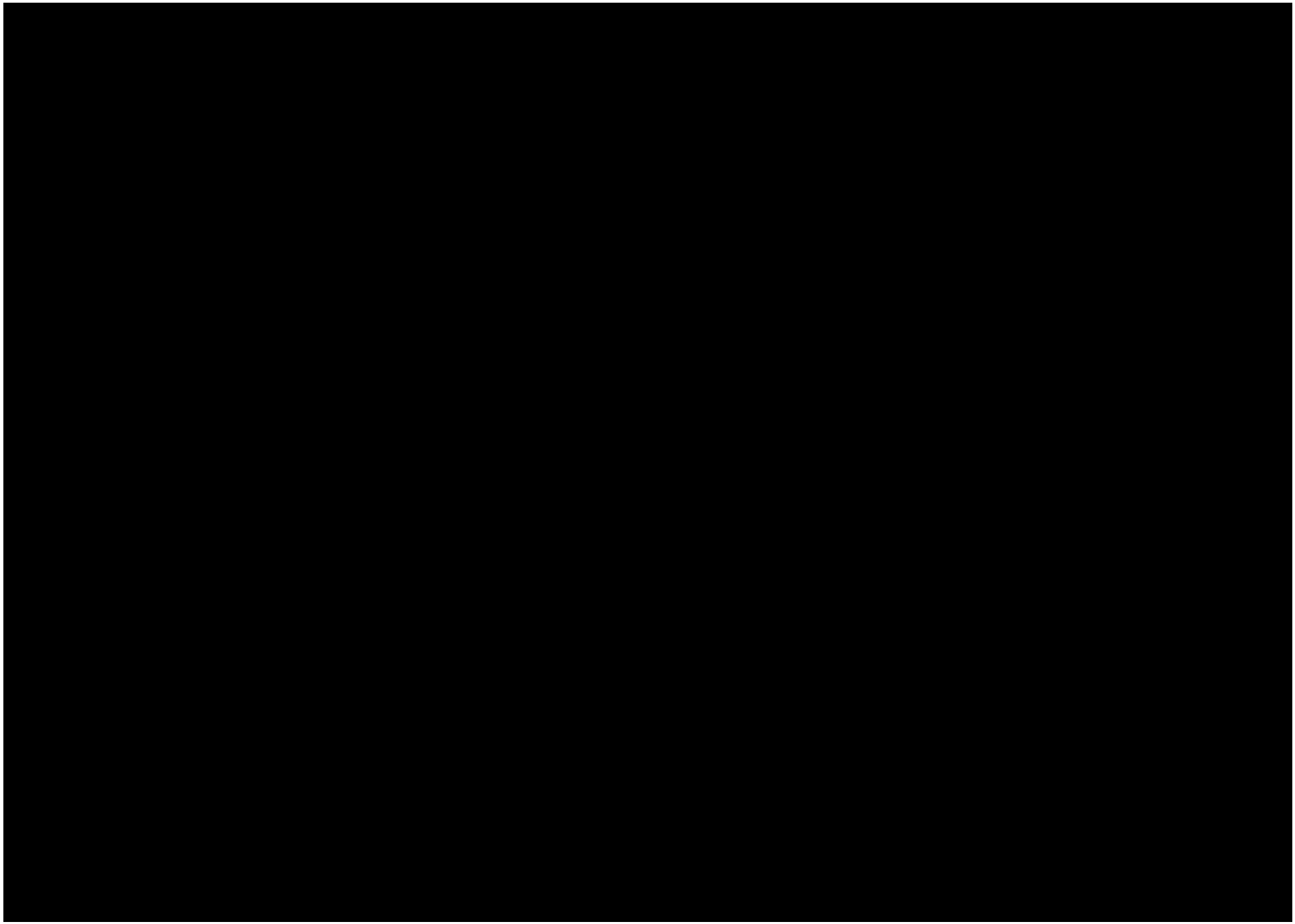

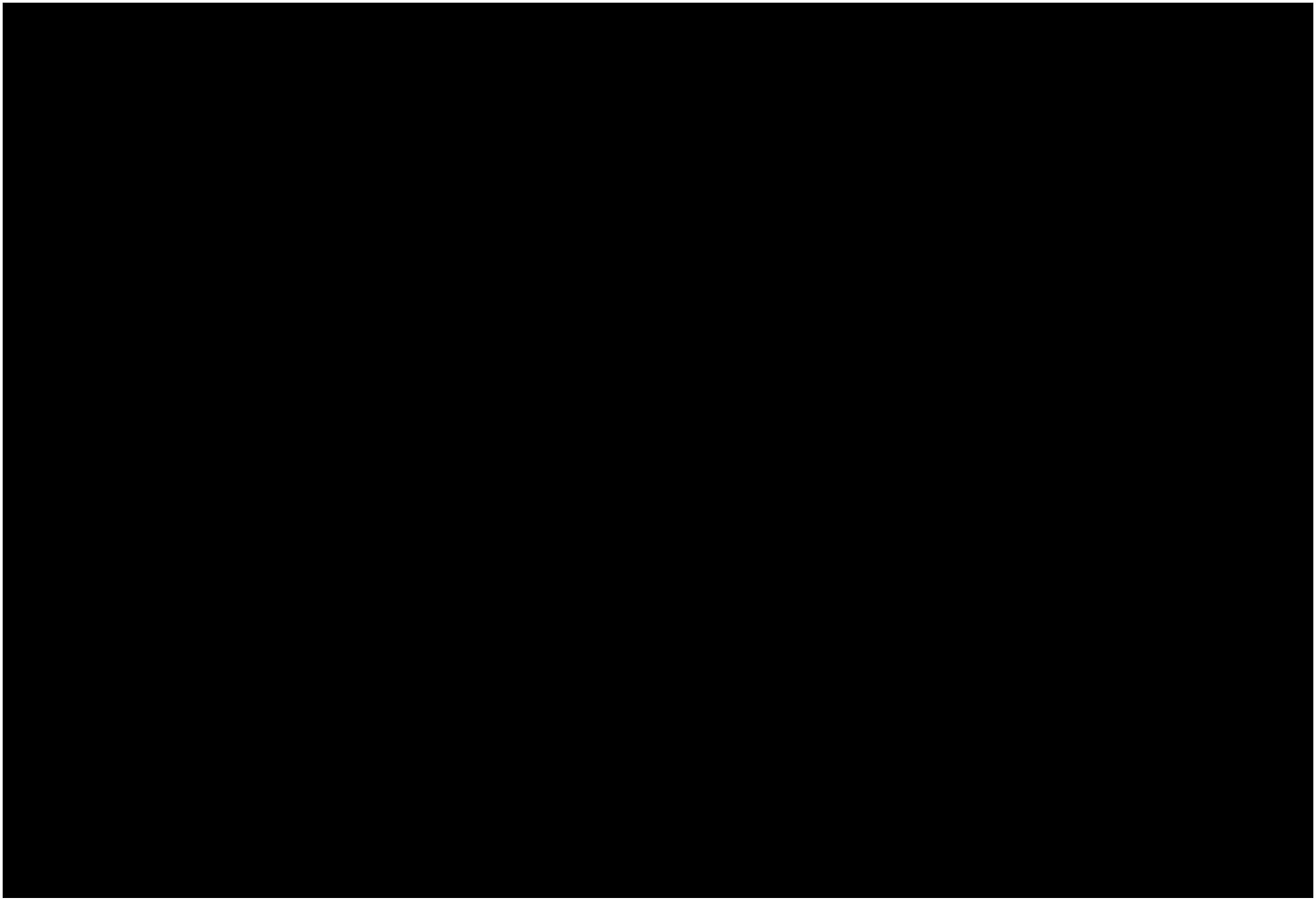

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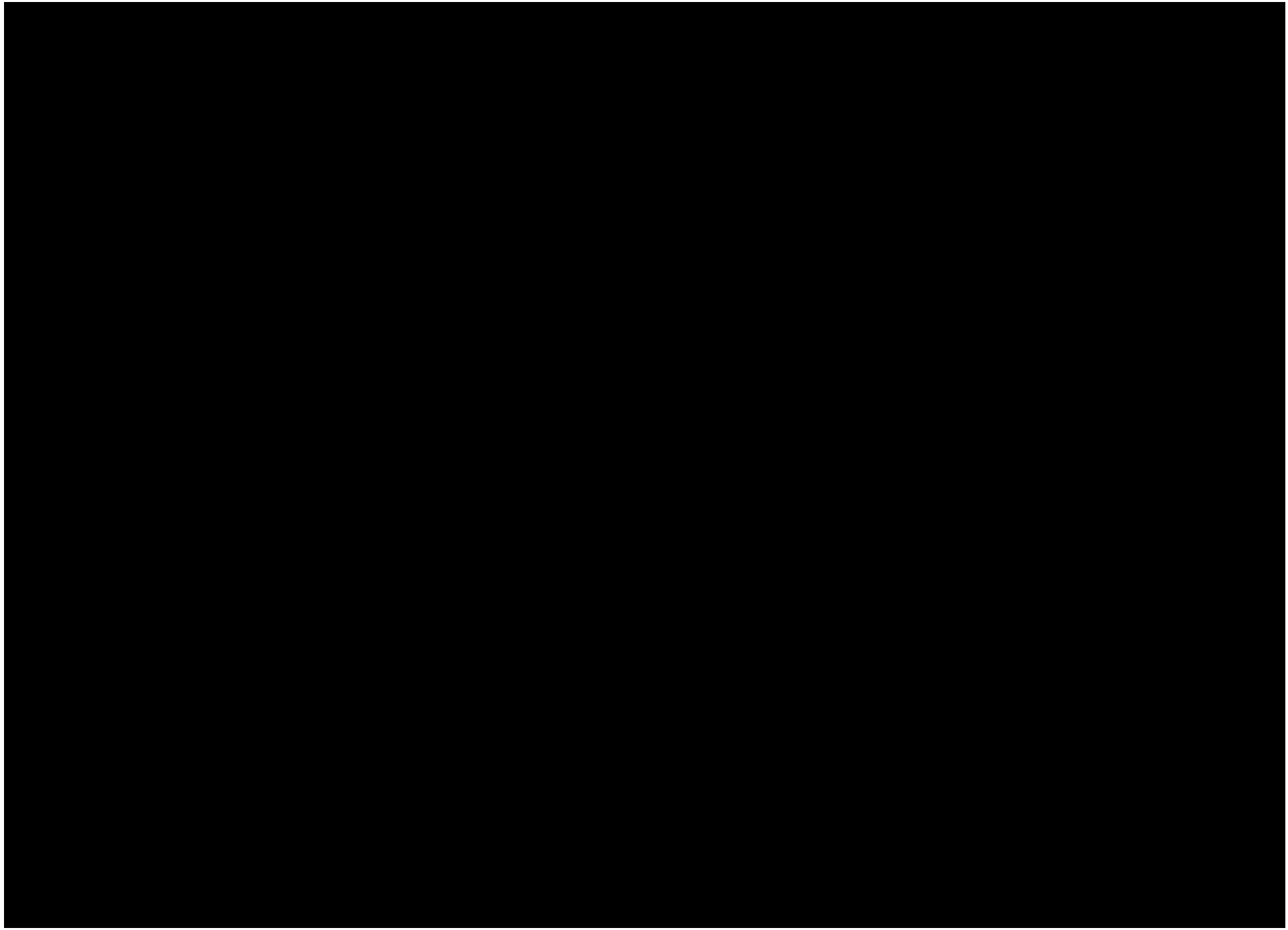

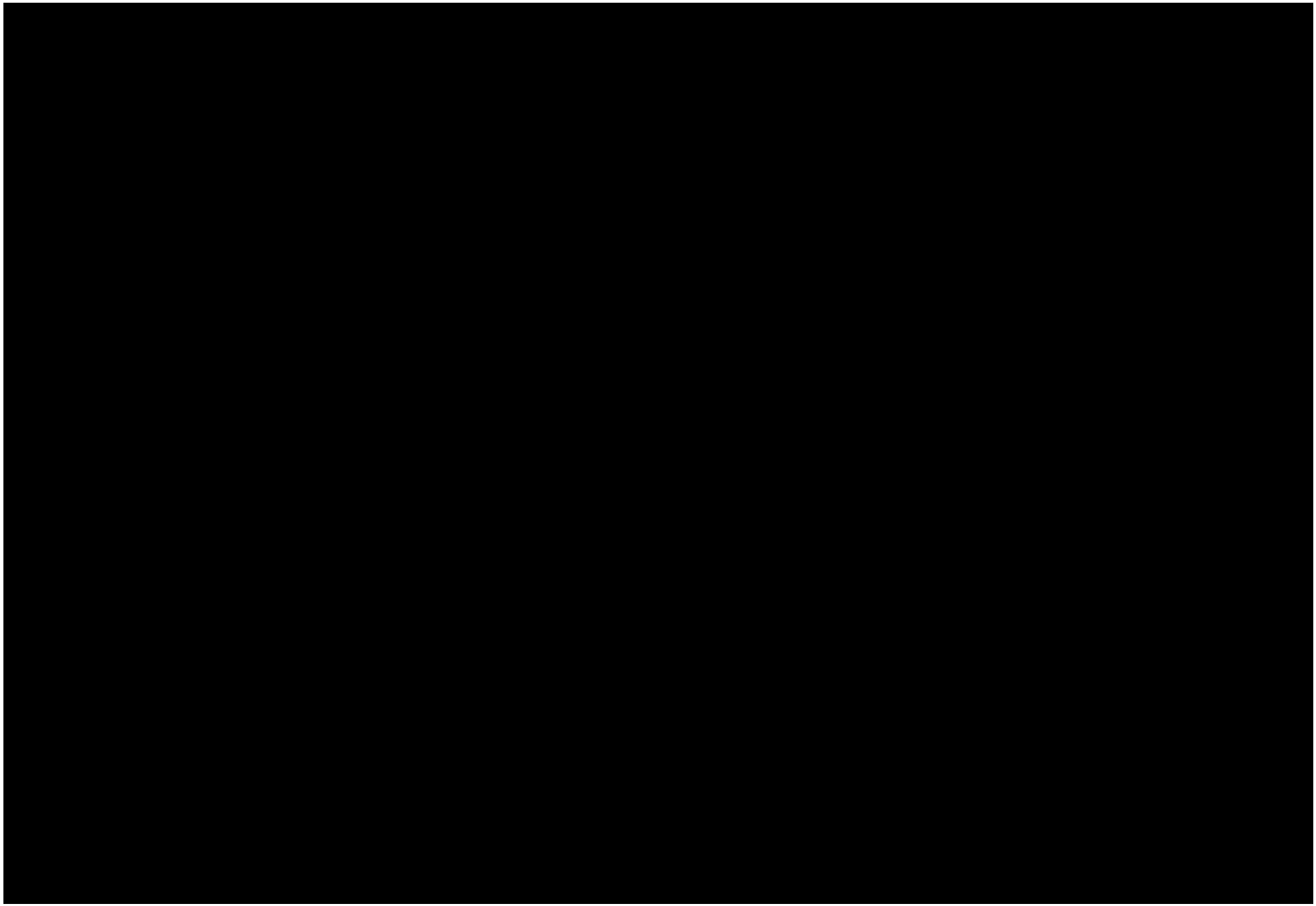

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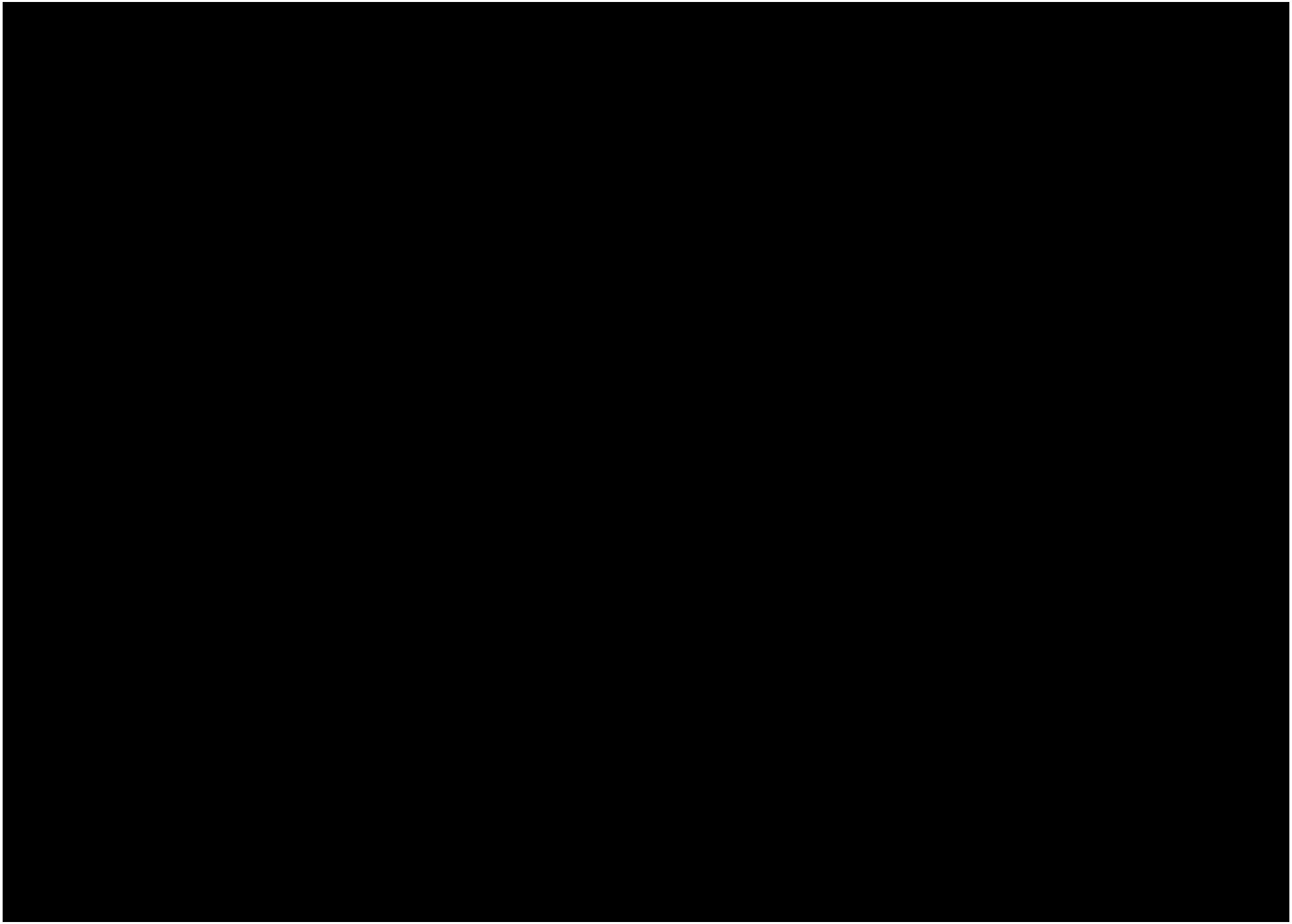

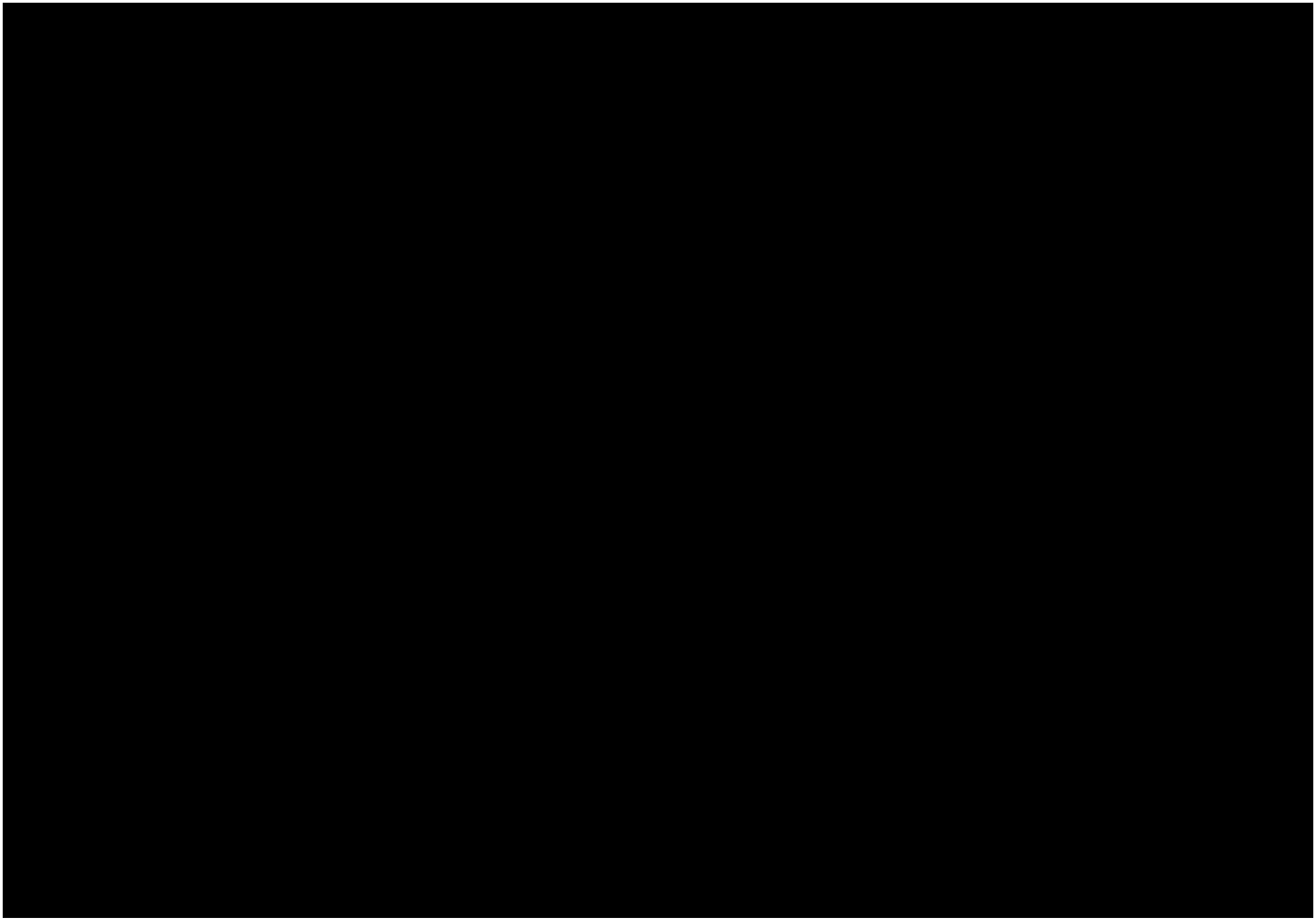

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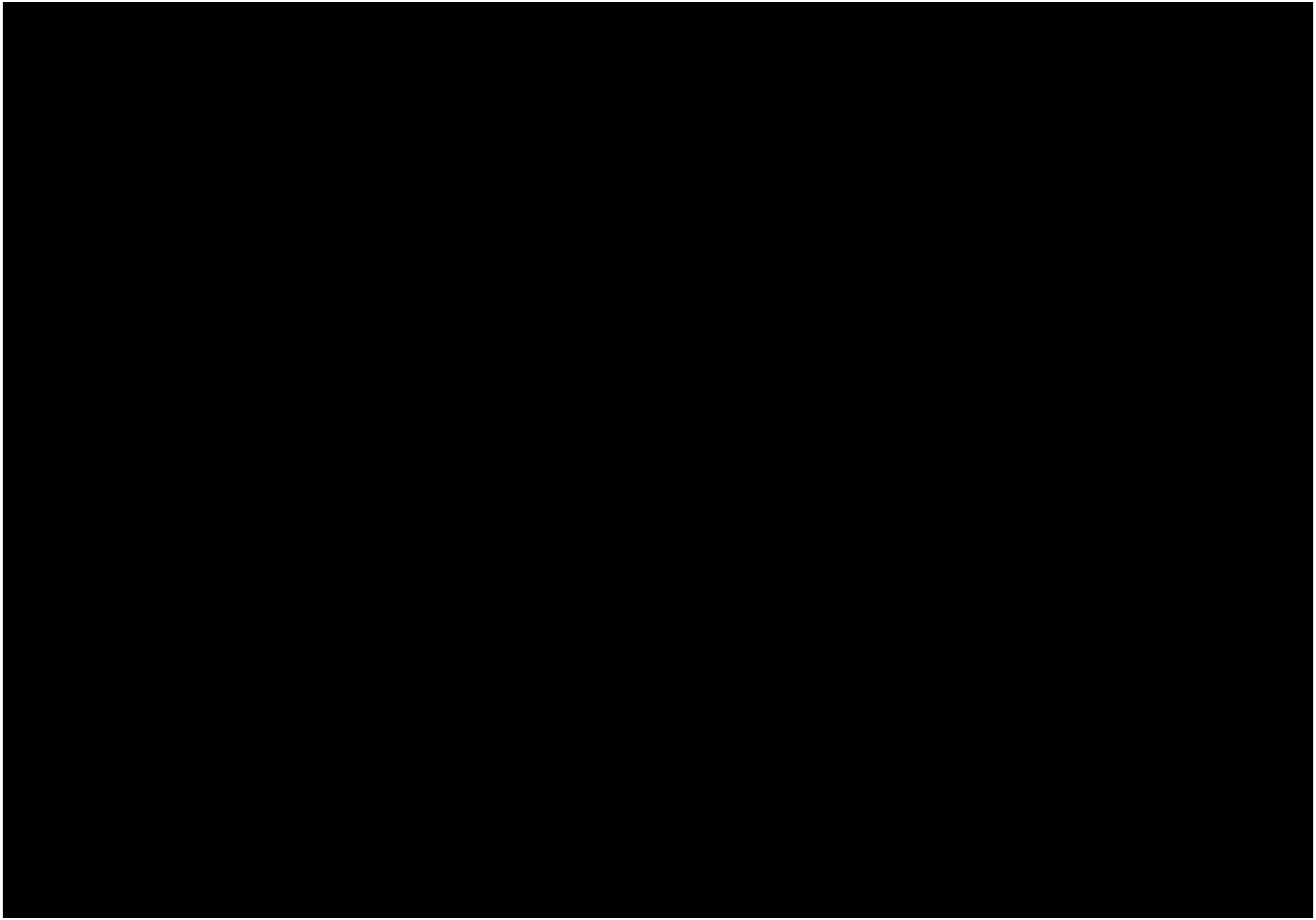

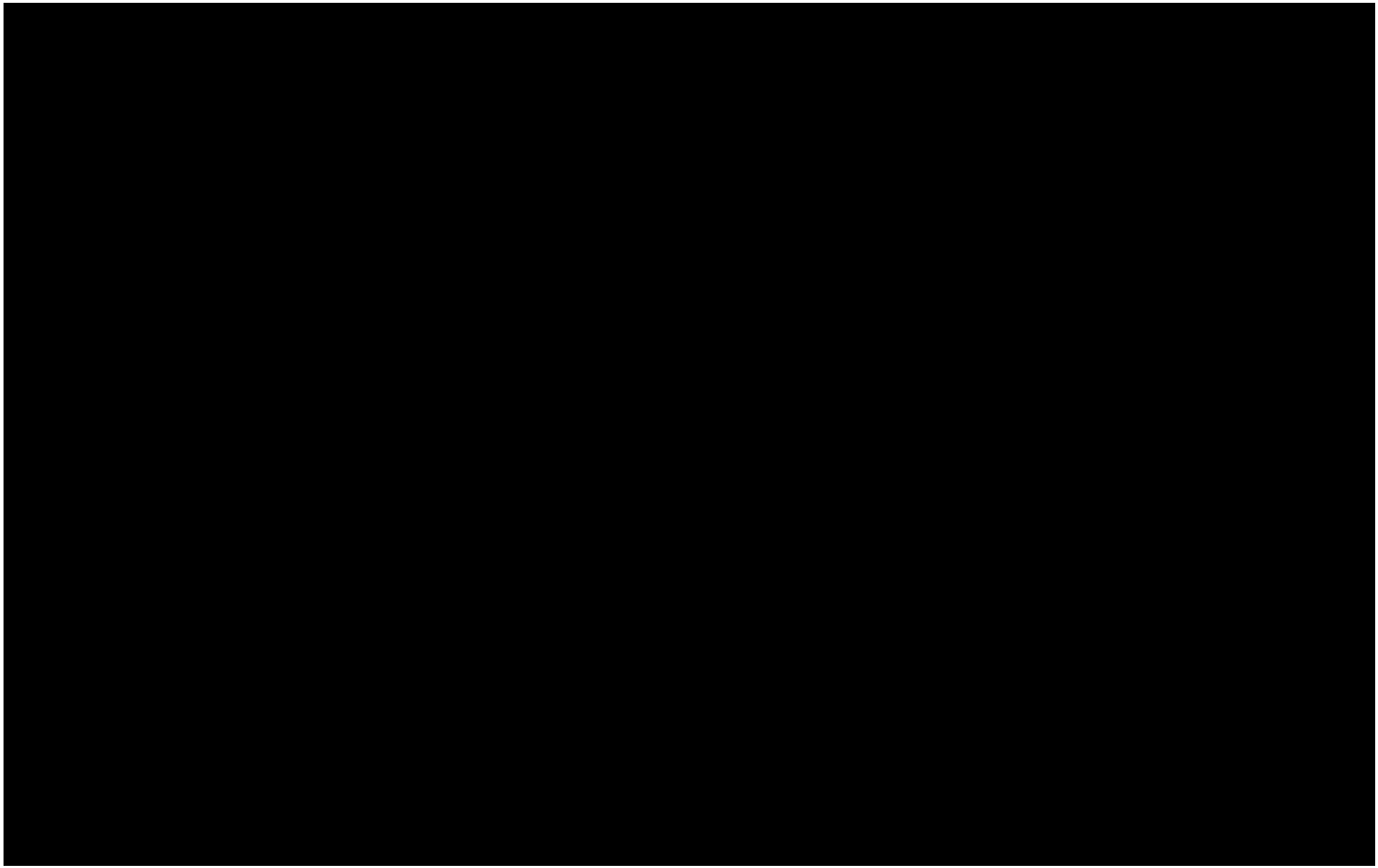

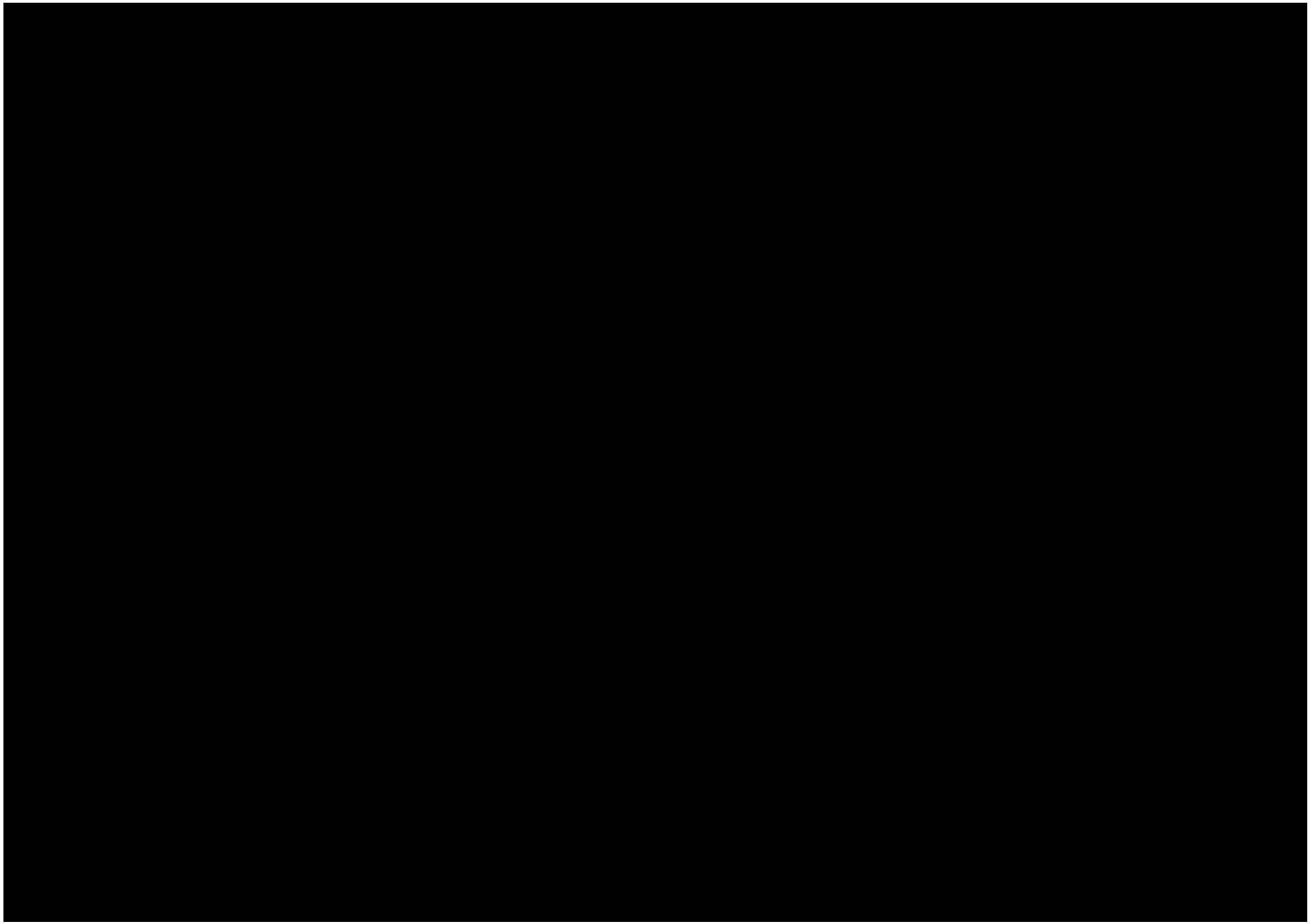

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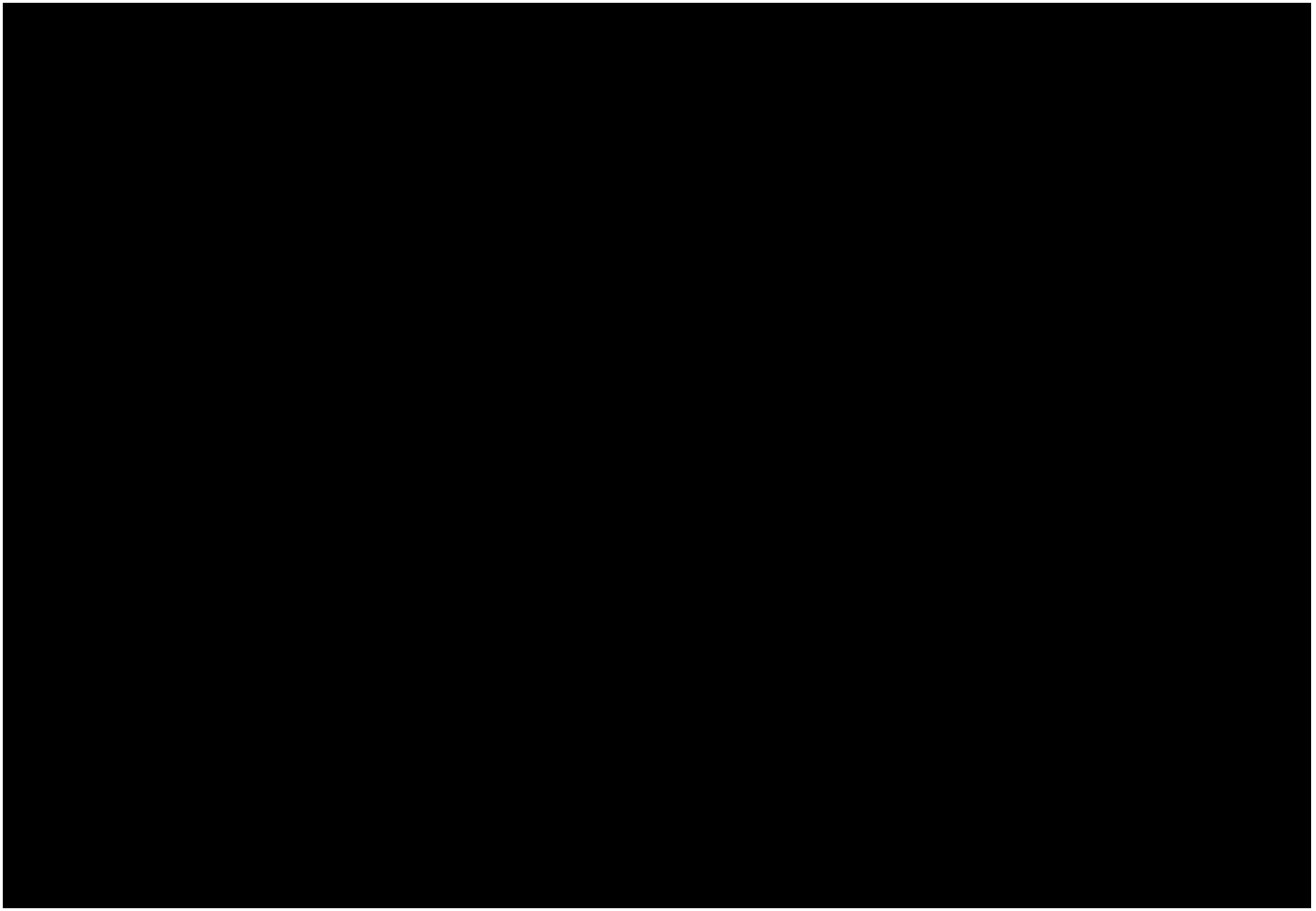

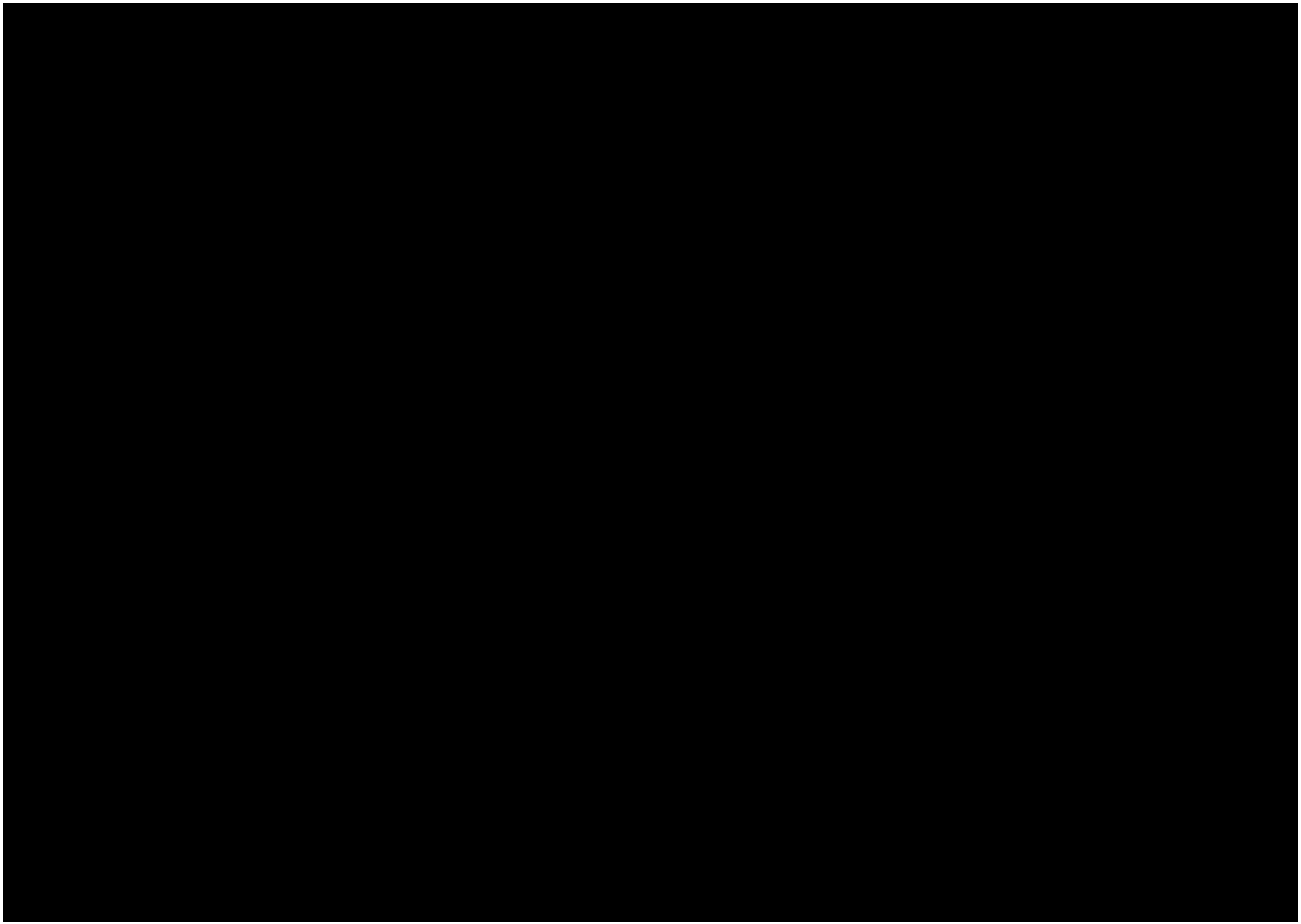

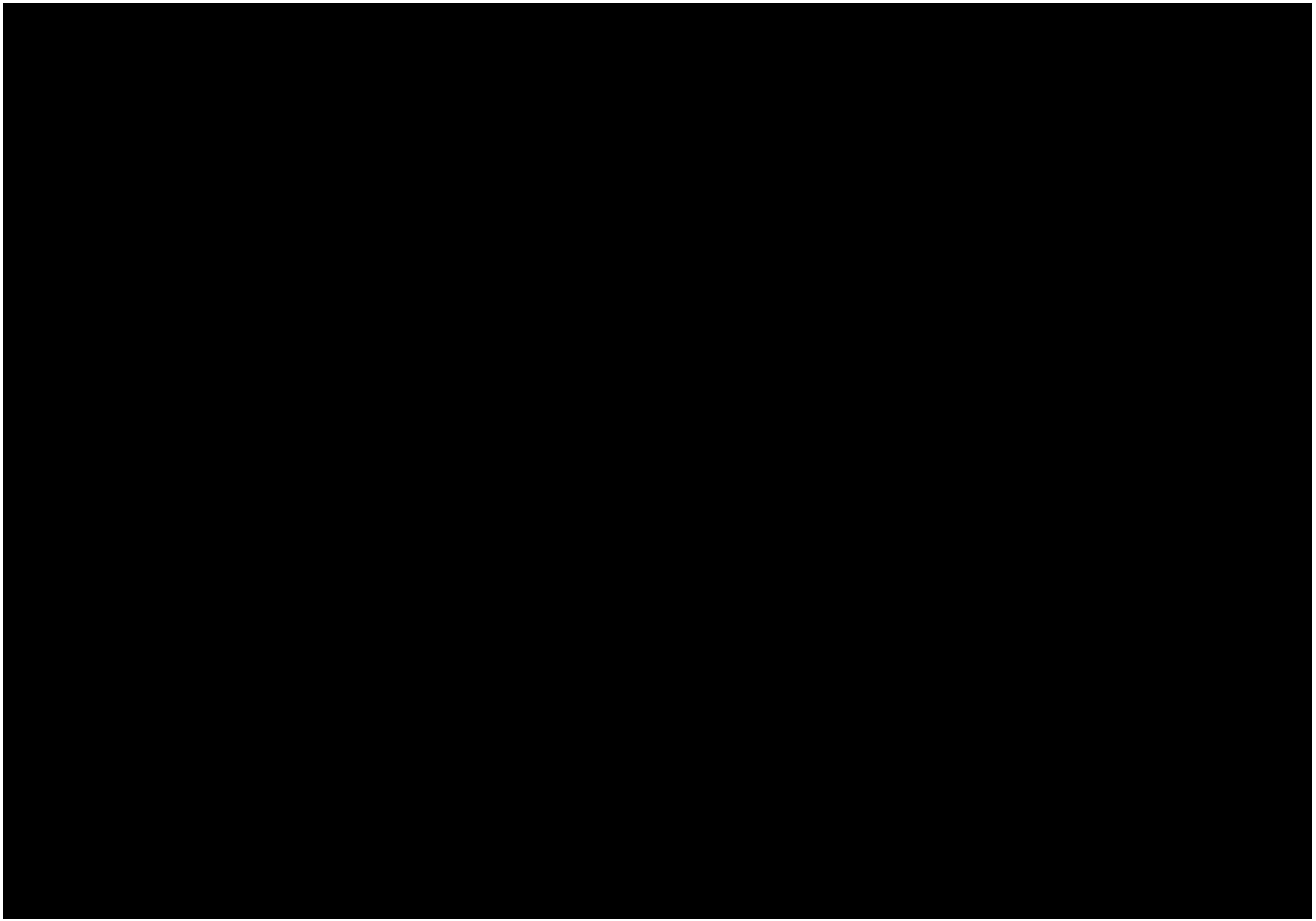

Exhibit D4b3 (Amended)

Exhibit D4c3 (Amended)
Effects of Correcting Professor Noll's Calculation of Damages

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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

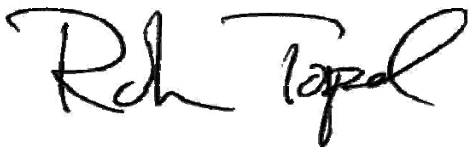
OAKLAND DIVISION

THE APPLE iPOD iTUNES ANTI-TRUST LITIGATION.	Case No. C 05-00037 (YGR) [CLASS ACTION] **DECLARATION OF DR. ROBERT TOPEL**

I, Robert H. Topel, Ph.D submitted my Amended Expert Report in the above-captioned matter on August 19, 2013, with supplemental exhibits served on November 8, 2013. The report and corrected exhibits are true and correct and based on my own personal knowledge.

I declare the forgoing is true and correct to the best of my knowledge and belief.

Executed this 19 day of December, 2013 in Payson, Arizona.



Robert H. Topel, Ph.D.

EXHIBIT 9
[Filed Under Seal]

The Apple iPod iTunes Anti-Trust Litigation

Videotaped Deposition of

ROBERT TOPEL, PH.D.

November 08, 2013

CONFIDENTIAL

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISION

THE APPLE iPOD iTUNES ANTI-TRUST LITIGATION

Lead Case No. C 05-00037

This Document Relates To:

ALL ACTIONS

CONFIDENTIAL - ATTORNEYS' EYES ONLY

VIDEOTAPED DEPOSITION OF ROBERT H. TOPEL, Ph.D.

Friday, November 8, 2013

San Francisco, California

Reported By:

Darcy J. Brokaw

RPR, CRR, CSR No. 12584

Job No. 10008160

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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISION

THE APPLE iPOD iTUNES ANTI-TRUST LITIGATION

Lead Case No. C 05-00037

This Document Relates To:

ALL ACTIONS

Videotaped Deposition of ROBERT H. TOPEL, Ph.D., taken on behalf of the Plaintiffs, at One Montgomery Street, Suite 1800, San Francisco, California, beginning at 8:10 a.m. and ending at 2:43 p.m., on Friday, November 8, 2013, before Darcy J. Brokaw, CSR No. 12584.

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ROBERT H. TOPEL, PH.D.

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EXPERT

ROBERT H. TOPEL, PH.D.

The Apple iPod iTunes Anti-Trust Litigation

Friday, November 8, 2013

Darcy J. Brokaw, RPR, CRR, CLR, CSR No. 12584

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Q. All right. Is it your understanding that the dataset that Professor Noll used in his regression constituted a sample of Apple's transaction data?

A. My understanding is that although there could be missing transactions in the translation that was given to Professor Noll, I don't believe there are. So it would be all the transactions.

Q. So it's a population consisting of the entire transactional database except for possibly a few data points that had to be discarded? Is that your view?

A. I don't know about "had to be discarded." It is what he got.

Q. Okay. Let me rephrase then.
So is it your understanding that Professor Noll relied on the complete Apple transaction database?

A. As complete as he got it.

Q. So it's not a sample of the transaction database?

A. You mean it's not a random draw from the transaction database?

Q. Well, let's start with that. Is it a random draw from the transaction database --

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A. No. As I understand it --

(Reporter admonishes.)

THE WITNESS: I'm sorry.

I think it -- I think it's the universe of what was handed over to me. He used every observation.

BY MS. SWEENEY:

Q. Now, how do you interpret the standard error when the data on which a regression is run are not a sample from the underlying population but, rather, constitute the whole population itself?

A. Your question is whether in the data as we get it the experiment could be replicated.

So like if the transaction database -- if all the transactions were running in, the data would be what they are in that circumstance.

Q. What do you mean when you're referring to "that circumstance"?

A. You might get a different set of outcomes from running the -- running the process again. So we've got all the data that came from one process of selling Apples -- selling iPods.

Q. So is there a difference when you're using a population versus a sample and you're determining the statistical significance of standard errors?

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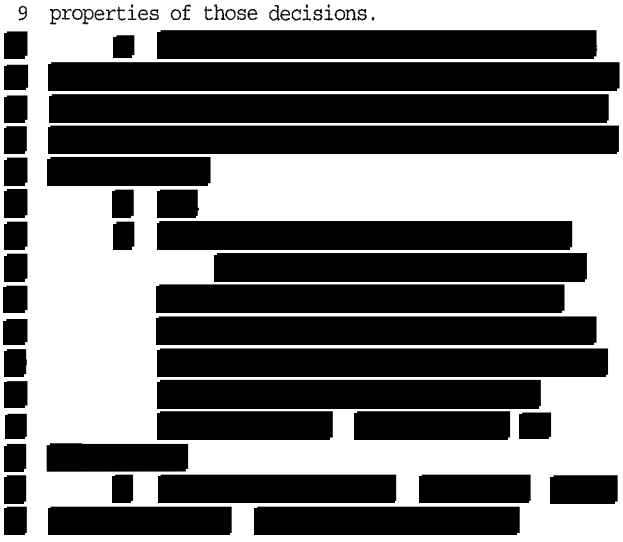
A. I don't understand your question, but for the purposes of this analysis, I don't think there is.

Q. And why don't you think there is a difference?

A. Because we're asking whether people are making independent pricing decisions, and we have to -- we have to think about the statistical properties of those decisions.



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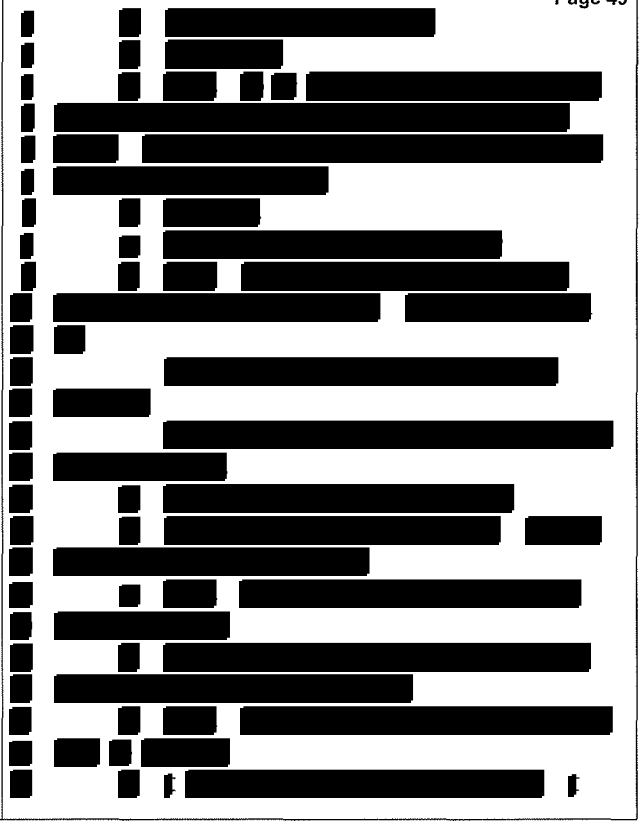


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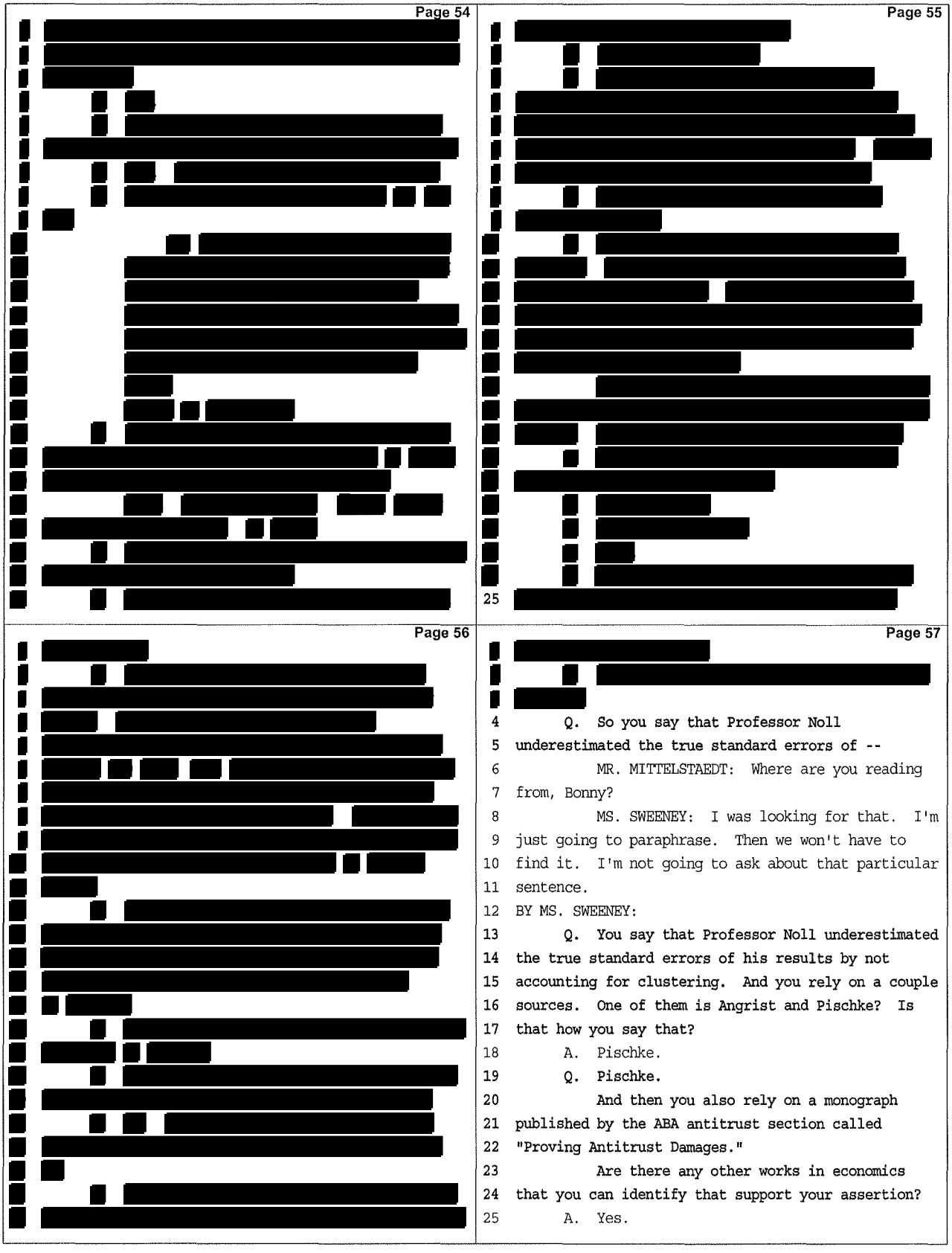

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Q. So you say that Professor Noll underestimated the true standard errors of --

MR. MITTELSTAEDT: Where are you reading from, Bonny?

MS. SWEENEY: I was looking for that. I'm just going to paraphrase. Then we won't have to find it. I'm not going to ask about that particular sentence.

BY MS. SWEENEY:

Q. You say that Professor Noll underestimated the true standard errors of his results by not accounting for clustering. And you rely on a couple sources. One of them is Angrist and Pischke? Is that how you say that?

A. Pischke.

Q. Pischke.

And then you also rely on a monograph published by the ABA antitrust section called "Proving Antitrust Damages."

Are there any other works in economics that you can identify that support your assertion?

A. Yes.

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apply a different clustering adjustment method to serially correlate residuals versus cross-sectional residuals?

A. It depends on whether one wants to assume some parametric form for serial correlation or not.

Q. I'm not sure I can understand that answer, so I'll just --

A. It's kind of a statistical question, so it's a statistical answer.

Q. So is a gross layperson way of describing your answer to say maybe?

A. There are different ways of dealing with serial correlation. And the clustering method, where you cluster within some group, is a robust way of doing that.

Others might decide, well, I have a particular form in which I think the serial correlation occurs. So they might parameterize the covariance matrix of the residuals in that way.

(Reporter inquires.)

THE WITNESS: The covariance matrix of the residuals in that way.

BY MS. SWEENEY:

Q. Okay. So it is possible to use different methodologies for serially correlated residuals

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versus cross-sectional residuals, correct?

A. Sure.

Q. You didn't do that here, right? You just used the same methodology for both kinds of residuals?

A. Ours are robust, yes. They're robust estimates, given the definition of the groups.

Q. So that's why you didn't use an alternative method; is that right?

A. Yes. As I said, this was sufficient to demonstrate my point.

Q. Are you familiar with the shortcomings that Professor Noll identified in the dataset that he used?

A. I read them.

Q. Did you do anything when you conducted your regression analyses to correct for those shortcomings?

A. The specific ones that he referred to?

Q. Yes.

A. No. We took the data, as he had analyzed, as a given, and we showed the flaws in his analysis.

Q. Did you ask Apple for any additional data?

A. Not that I recall. We got this data, I think -- as I indicated, we went out and looked for

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other attributes. That was collected from Apple's websites and the websites of others.

Q. Did you ask Apple for any further explanation of the observations of different aspects of the dataset that you received?

A. Well, if you define "you" there as my staff and me -- and my staff might have been trying to understand something that they didn't understand -- I can't tell you that, say, Ricardo didn't have a conversation with somebody. But it wasn't on my radar screen.

[redacted]

Q. So you just took the data as you received it from Professor Noll and applied your clustering

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adjustment, correct?

A. I believe that's a simplified way of putting it. I think that my staff went to the trouble of reconstructing the data in the way they thought it should be reconstructed and comparing it to Professor Noll, because I told them to go out and reproduce what Professor Noll had done. And they said the data came out pretty much the way Professor Noll had it, so we're going to go with that.

Q. Well, what do you mean by "reconstructed"?

A. We got the same files, as I recall, that Professor Noll got. And so he ran his regressions on a particular dataset. I think we were able to reproduce what Professor Noll did.

Q. But going to this point of what Professor Noll described as shortcomings in the data, you didn't do any further adjustments to account for the discounts or coupons, et cetera, correct?

A. I don't think I had those information.

Q. Did you ask for that information?

A. I physically didn't ask for it.

Q. Did you -- I'm sorry.

A. I think I asked somebody at some point, is

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those things that's statistically independent, then you're okay, statistically, assuming that the observations are independent.

BY MS. SWEENEY:

Q. So is it your view that Roger's regression analysis suffers from an omitted variable problem?

A. You're on another problem now. That's not the reason for the clustering analysis that we did.

Q. What is the reason for the clustering analysis that you did?

A. I think all the reasons I've given earlier today: that Professor Noll is pretending to have the data generate much more independent variation, vastly more independent variation than they actually do.

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BY MS. SWEENEY:

Q. When you say that a missing predicate is that people were in fact purchasing from the Real Music Store for usage on iPods in significant numbers, what do you mean when you say "significant numbers"?

A. Well, the question is how many for lockin is the incremental number --

(Reporter inquires.)

THE WITNESS: The question for lockin is

EXHIBIT 10

[Filed Under Seal]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISION

THE APPLE iPOD iTUNES ANTI-TRUST LITIGATION

Lead Case No. C 05-00037

This Document Relates To:

ALL ACTIONS

CONFIDENTIAL - ATTORNEYS' EYES ONLY

VIDEOTAPED DEPOSITION OF KEVIN M. MURPHY, PH.D.

Tuesday, November 12, 2013

San Francisco, California

Reported By:

Darcy J. Brokaw

RPR, CRR, CSR No. 12584

Job No. 10008261

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Q. And is it your practice to have your staff prepare portions of your report?

A. I think we work together. I mean, usually the way it works is I -- we have -- first, before we ever do anything on a report, we do some work, we figure out what we're doing and what the analysis is.

I think at some point you get to the point where you say, okay, we've done enough analysis to know the basic contours of the testimony.

At that point I usually individually -- or sit down with people -- and try to come up with an outline of how we'll structure the report, what topics to be covered. At that point you usually have basic opinions in mind based on the analysis you've done.

Then it becomes a matter of fleshing out that outline. And, you know, either I will take the first crack at fleshing out parts of the outline or the staff will. Most often I'll take the first crack at, you know, kind of the core parts of the report, the analysis of the economics, the empirical analysis and things like that. The staff's more likely to take the first stab at some of the background sections and things like that.

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And then -- but then I'll go over whatever they've done, and I'll ask them to look at whatever I've done, and then we go back and forth. And so it's really a back-and-forth process between myself and the staff.

But usually it starts with kind of an outline or structure that I either do myself or in a meeting or sitting down with staff.

Q. Now, in your Appendix 2 -- I'm sorry, Appendix B, where you identify all the materials that you specifically relied upon to reach your conclusions, did you personally review all those materials?

A. No.

Q. Did you review any of the materials in Exhibit B?

A. Oh, yes, many of them.

Q. And so how did you -- how was the knowledge that was gained by someone reviewing Appendix B? How was that passed on to you?

A. Usually it came about because we would be asking a particular issue. I'd ask, you know, I need to learn about this; can you look for documents or data or other things related to a specific topic?

And they would go out and look for that

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information, and they'd bring back what they found.

Usually that would spur more questions, and then they'd go back.

So it would be kind of an iterative process where they would do kind of searching based on my direction as to what kinds of issues we were interested in trying to understand.

Q. Did you ask Apple for an opportunity to interview any Apple employees?

A. Not that I recall. We've been working on this a long time, so -- but I don't recall any specific interviews in this case.

Q. How long have you been working on this case?

A. Several years, as I recall.

I know enough not to guess, because people are very bad at recalling how far back in time things are. So I wouldn't want to -- wouldn't want to offer a guess, but it's been quite a while.

Q. Did you ask for any data that were not among the materials supplied to you by Apple?

A. I believe we did. I think we've asked for data and we received data that we asked for.

Q. And what was the data that you asked for and received?

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A. I mean, I think we got some data on some consumer surveys that are talked about in -- customer surveys that are in our -- were talked about in the report. That's the one that comes to my mind. I'm sure there are others, but those are the ones that came to my mind.

I don't remember if we got the NPD data from them or how that came about. But there were a number of cases where we received data from Apple based on things we were interested in looking into.

Q. The transactional datasets that you used in your regression analyses, did you ask Apple for clarification about those datasets?

A. I didn't personally. I believe the staff did, but I can't -- I don't have a specific recollection of any questions that were there.

Q. Do you know who that would be on your staff?

A. Probably Ricardo Cossa, I would think, or Anita Garten would be the most likely people.

Q. And did you or your staff ask Apple for additional transactional data?

A. I don't know. I mean, we did talk to them about transactional data, but I don't know if we asked them for additional beyond what we got. That,

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I don't know.
Q. And did you use the same dataset that Professor Noll used?
A. I think we did. We tried to. I mean, I think we thought that would make it more simple for people to look at the results.
It's always more difficult if the two parties are using different data. Then it's harder to make comparisons, because some of the differences might be due to the data, some of the differences might be due to what you do with the data.
So we felt that working with the same data to the extent possible made sense.
Q. Now, can you explain what your clustering criticism is of Professor Noll?
A. Yeah. I mean, when you do statistical inference, you have to have a way of assessing the precision of your estimates, and the precision of your estimates depends on the amount of information that are contained in the data that you're analyzing.
And one of the key issues that comes up in analyses is whether different pieces of data are really independent, that is, they provide additional information above and beyond what's contained in

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other observations. And not just whether they have additional information, whether they have unique pieces of information that's distinct from the information in other observations.
And it's, you know, common in economics to then think about, well, is there a dependence among the different observations in your dataset?
So the outcome or what you see in one observation has information that's correlated with or similar to the information contained in other observations.
And Professor Noll ignores that in calculating his standard errors and doing his statistical inference. In this case, it's a rather egregious error.
If you look, comparing the standard errors once you correct for that dependence with the standard errors that he calculates, they were off by a factor of a hundred or more, which is pretty big. I mean, it's saying, you know, I think -- I'm saying the precision is within plus or minus 1, when actually it's plus or minus 100, I mean, or more.
And that failure, I think, really means that the statistical inference that he engages in is --

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THE REPORTER: I'm sorry. "And that failure, I think, really" --
(Reporter inquires.)
THE WITNESS: -- results in the statistical inference he engages in being completely inappropriate and misleading.
BY MS. SWEENEY:
Q. Now, did you serve as an expert in the High-Tech Employee case?
A. Yes, I did.
Q. And who were you retained by in that case, what defendant?
A. I was retained by a group of defendants, joint defense group.
Q. Including Apple?
A. Including Apple and a number of other -- Intel, Adobe, Intuit, Intel, Google, Pixar, Lucas Films.
Q. And you submitted an expert report in that case, correct?
A. Yes, I did.
Q. And did you submit a supplemental expert report in that case?
A. I believe I did, yes.
Q. And in that case, did you criticize

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plaintiffs' expert for engaging in a -- in a problem -- well, strike that.
Did you assert that plaintiffs' expert should have clustered the standard errors in his regression?
A. Yes, I did.
Q. And did the court accept your opinion on that issue?
MR. KIERNAN: Object to the form.
THE WITNESS: I don't know if they said it was -- I think in the original order, I think she said something along the lines of it was unclear whether he needed the cluster or not.
I think Professor Leamer, who was the expert on the other side, has subsequently agreed that his standard errors are not correct and that you do need to do something to account for clustering. And, in fact, the court's opinion also reflected that.
And the question is what method should be used to make a correction for his failure to do that analysis.
BY MS. SWEENEY:
Q. You said that the court -- the court's opinion also reflected that Professor Leamer needed

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to do something about clustering? Is that what you said?

A. No. He had to do something to address the correlation of the residuals. And Professor Leamer said there's more than one way to do that. Clustering is one method, there are other methods.

And so then the question is which method should be used. I think Professor Leamer has recognized that, in fact, his residuals were not independent, and therefore, something needed to be done, of which clustering is probably the most standard solution to that problem.

Q. But the court concluded, didn't it, that Dr. Leamer's failure to cluster the standard errors did not provide a sufficient basis to conclude that the regression at issue failed to provide a reliable methodology for class certification? Were you aware of that?

MR. KIERNAN: Object to the form.

THE WITNESS: I think that sounds like what the court said. Of course, they're not saying that he doesn't need to cluster and that's not a mistake. He's just saying -- I think the court is inferring that they still think they can use the regression based on other things.

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But it clearly -- and I think Professor Leamer ultimately has admitted that he does need to do something about his standard errors. His claim was that he would do something different. In fact, in his revised report, he did something different, which dramatically changed his standard errors.

BY MS. SWEENEY:

Q. Did you say -- or strike that.

Is it your view that a model's results need not necessarily be statistically significant to be reliable?

A. I think I have said things along those lines. What I'm referring to is the fact that you can think of statistical significance at the 5 percent level. And for large datasets, you can think about having a T statistic bigger than 2 as getting you past that 5 percent level.

What I'm saying is if your T statistic is 1.95 versus 2.05, you don't want to say those are somehow magically different because one's on one side of 2 and one's on the other side.

That's, I think, the fallacy that people fall into, thinking that there's a bright line there at 2.0 that says, if I'm less than 2, I've got nothing; if I'm more than 2, I have enough.

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I mean, the answer is 1.95 isn't very different than 2.05. And that was my testimony in that case, that was my testimony in every other case, is that you've just got to look at the results and say, how precise are they? Are they sufficiently precise that I can make a reasonable statement? And there's no bright line that says bigger than 2 is good and a little bit less than 2 is bad. And that's what I meant by that statement.

Q. So I think you alluded to this earlier, but so is it your view that there are methods for addressing nonindependence between observations other than adjusting the standard errors through clustering?

A. Yes, you can. You can aggregate up to a level such that your observations are independent, which is basically aggregate away the dependence. So you're saying -- you're actually recognizing --

THE REPORTER: "Aggregate away" --

THE WITNESS: -- the dependence.

So you're actually recognizing that you have fewer observations than the raw number of observations in your dataset.

BY MS. SWEENEY:

Q. Are there any other methods?

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A. Yeah, there are various other methods to try to estimate the degree of correlation. Actually put a parametric model on the correlation that you can try to do. That's another method that's common.

Those would probably be the three most common. I'd say clustering is currently the most common way that people address it.

Aggregation is a second method that can be helpful. In some cases, it's basically the same as clustering.

The other one is some kind of parametric model for the degree of dependence among observations, which is another somewhat common; probably less common than the clustering approach.

Q. So when you say that another method is the parametric model for the degree of dependence among observations, what do you mean by that?

A. You actually specify a model that tells you how and in what way different observations are not independent. So you allow specifically for correlation of a particular form between individual observations.

Q. Do you do that by including variables in the regression that explain some of the commonalities?

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for any particular reason, that much closer to the regression line.

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Q. Now, we talked earlier about your criticism that -- strike that.

We talked earlier about whether iPod