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11 UNITED STATES DISTRICT COURT
 12 NORTHERN DISTRICT OF CALIFORNIA
 13 OAKLAND DIVISION

14 THE APPLE IPOD ITUNES ANTI-TRUST)	Lead Case No. C-05-00037-YGR
15 LITIGATION)	
16 _____)	<u>CLASS ACTION</u>
17 This Document Relates To:)	PLAINTIFFS' REPLY MEMORANDUM IN
18 ALL ACTIONS.)	SUPPORT OF <i>DAUBERT</i> MOTION TO
_____)	EXCLUDE CERTAIN OPINION
	TESTIMONY OF KEVIN M. MURPHY
	AND ROBERT H. TOPEL

19 DATE: TBD
 20 TIME: TBD
 21 CTRM: 5, 2nd Floor
 JUDGE: Hon. Yvonne Gonzalez Rogers

22 **UNREDACTED VERSION OF DOCUMENT SOUGHT TO BE SEALED IN ENTIRETY**

23 [APPLE'S PROPOSED REDACTIONS]

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1 **I. INTRODUCTION**

2 In their *Daubert* Motion to Exclude Certain Opinion Testimony of Kevin M. Murphy and
3 Robert H. Topel (“Plaintiffs’ *Daubert* Motion” or “Pltfs’ Mem.”), Plaintiffs demonstrated that
4 Apple’s experts’ clustering opinions should be excluded because they are not “sufficiently tied to the
5 facts of the case that will assist the jury in resolving a factual dispute.” *Daubert v. Merrell Dow*
6 *Pharms.*, 509 U.S. 579, 591, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993). Relying on the expert
7 opinions of Professors Noll and Wooldridge,¹ Plaintiffs showed that the “clustering adjustment” that
8 Murphy and Topel apply to Professor Noll’s regressions is both inappropriate and harmful.
9 Clustering grossly exaggerates the standard errors, leading to the incorrect conclusion that Professor
10 Noll’s regression results are not statistically significant.² Pltfs’ Mem. at 12; Sweeney *Daubert* Decl.,
11 Ex. 1 (Wooldridge Decl.) at 5; Sweeney Reply *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 1
12 26, 32-33.

13 In response, Apple merely repeats its experts’ discredited theories and attacks Professor
14 Wooldridge by distorting the record. But Apple cannot escape the fact that its experts’ litigation-
15 driven clustering opinions have no place in this case. As explained by Professors Noll and
16 Wooldridge in their supplemental reports and confirmed through theoretical calculations, statistical
17 tests and simulations, Murphy and Topel’s clustering adjustment is arbitrary, improperly distorts the
18 standard errors, and should be excluded. *See FTC v. Wellness Support Network, Inc.*, No. 10-cv-

19 ¹ Despite Apple’s contention to the contrary, Plaintiffs do not rely solely on Professor
20 Wooldridge. They also rely on Professor Noll’s opinions (*see, e.g.*, Pltfs’ Mem. at 2 n.3 (citing Noll
21 Rebuttal at 8); *id.* at 4 n.7 (citing Noll Rebuttal at 5-6); *id.* at 9 (citing Noll Rebuttal at 10); *id.* (citing
22 Noll Rebuttal at 9, 36-39); *id.* at 12 (citing Noll Rebuttal at 43-44, 47)) and undisputed factual
evidence about the data sets used in the regressions. *See* Pltfs’ Mem. at 8 n.11 (quoting Topel:
“The data came out pretty neat the way Professor Noll had it, so we’re going to go with that.”).

23 ² All references to (“Sweeney *Daubert* Decl.”) are to the Declaration of Bonny E. Sweeney in
24 Support of Plaintiffs’ *Daubert* Motion to Exclude Certain Opinion Testimony of Kevin M. Murphy
25 and Robert H. Topel, dated December 20, 2013; all references to (“Kiernan *Daubert* Decl.”) are to
26 the Declaration of David C. Kiernan in Support of Apple’s Opposition to Plaintiffs’ *Daubert*
27 Motion, dated January 13, 2014; all references to (“Sweeney Reply *Daubert* Decl.”) are to the
28 Declaration of Bonny E. Sweeney in Support of Plaintiffs’ Reply Memorandum in Support of
Daubert Motion to Exclude Certain Opinion Testimony of Kevin M. Murphy and Robert H. Topel,
filed concurrently herewith; and all references to (“Sweeney MSJ Opp. Decl.”) are to the
Declaration of Bonny E. Sweeney in Support of Plaintiffs’ Memorandum of Law in Opposition to
Defendant’s Motion for Summary Judgment and to Exclude Expert Testimony of Roger G. Noll,
dated January 13, 2014.

1 04879-JCS, 2013 U.S. Dist. LEXIS 144140, at *32 (N.D. Cal. Oct. 4, 2013) (excluding expert
2 testimony for lack of “fit”).

3 **II. CLUSTERING DOES NOT FIT THE FACTS OF THE CASE**

4 Despite Apple’s protestations, ample “real-world facts” and “real-world evidence” support
5 Plaintiffs’ claim that Apple’s disabling of Harmony through its 7.0 updates enhanced and maintained
6 Apple’s monopoly power and enabled Apple to sell iPods at supracompetitive prices. *See* Dkt. No.
7 751-3 (Plaintiffs’ Memorandum of Law in Opposition to Defendant’s Motion for Summary
8 Judgment and to Exclude Expert Testimony of Roger G. Noll) at 8-9. [REDACTED]

9 [REDACTED]
10 [REDACTED]
11 [REDACTED]

12 Recognizing that Professor Noll’s credentials and regression methodologies have been
13 widely accepted, Apple aims its principal attack at the statistical significance of Professor Noll’s
14 results, claiming that he should have clustered the standard errors. According to Apple, after
15 “correcting” for clustering, the statistical significance of Noll’s regressions disappears, and damages
16 – conveniently – are reduced to zero. But this argument has no basis in economics or the facts of
17 this case.

18 **A. There Is No Clustering Problem Among iPod Transactions**

19 As an initial matter, Apple’s claim that the data observations used in Professor Noll’s
20 regressions are not independent lacks merit. As Apple’s own expert concedes, if the transactional
21 data “were truly independent, then you wouldn’t have to cluster.” Sweeny MSJ Opp. Decl., Ex. 52
22 (1/8/14 Topel Dep.) at 242:5-7. That is exactly the situation here. Each transaction involved a
23 different buyer making an independent decision about whether to make a purchase and, if so, how
24 many units to buy. As a result, each is properly regarded as an independent event. Sweeney
25 *Daubert* Decl., Ex. 4 (Noll Rebuttal) at 9, 36; *id.*, Ex. 1 (Wooldridge Decl.) at 8 (“If one properly
26 views a transaction as a unit of observation, as is done by Professor Noll, the data need not be treated
27 as a cluster sample. In particular, the clustering procedure suggested by Professors Murphy and
28 Topel . . . is inappropriate.”)

1 Equally important, clustering is not appropriate here because Professor Noll analyzed the
2 *entire* population of Apple’s transactional data, not just a sample. Sweeney MSJ Opp. Decl., Ex. 3
3 (Noll Supp. Rebuttal) at 3. Clustering problems arise when dealing with data drawn from clustered
4 samples, not when dealing with a randomly-drawn sample or the whole population.³ *Id.*; Sweeney
5 *Daubert* Decl., Ex. 4 (Noll Rebuttal) at 10; Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at
6 3-7; Sweeney *Daubert* Decl., Ex. 1 (Wooldridge Decl.) at 10; Sweeney Reply *Daubert* Decl., Ex 1
7 (Wooldridge Supp. Decl.) at 11-27, 32-33.

8 **B. Apple’s Pricing Practices Do Not Give Rise to Correlation of the**
9 **Residuals**

10 [REDACTED]
11 [REDACTED]
12 [REDACTED]
13 [REDACTED]
14 [REDACTED]
15 [REDACTED]
16 [REDACTED]
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18 [REDACTED]
19 [REDACTED]
20 [REDACTED]
21 [REDACTED]
22 [REDACTED]
23 [REDACTED]
24 [REDACTED]

25 _____
26 ³ As described in Thompson (2012), a cluster sample is one in which a simple random sample
27 of primary units is taken from the population of primary units. Sweeney Reply *Daubert* Decl., Ex. 1
(Wooldridge Supp. Decl.) at 11. Without cluster samples there can be no clustering problems.

28 ⁴ See Def.’s Mem. at 9 n.12.

1 **C. Apple’s “Test” for Correlation of the Residuals Is Flawed**

2 Lacking any economic or factual support for its clustering adjustment, Apple claims Murphy
3 and Topel have demonstrated, using “standard tests,” that the residuals are “highly correlated” at the
4 family and quarter level. Def.’s Mem. at 10. But as Professor Noll concluded in his Supplemental
5 Report, those “tests” are “unreliable because the groups into which [Murphy and Topel] divide the
6 observations are artificially created.” Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 5.
7 To demonstrate this artifice, Professor Noll used Murphy and Topel’s testing method, but divided
8 the data by different time periods (family/month and family/week instead of family/quarter). The
9 results were “qualitatively identical,” demonstrating that the correlations that Murphy and Topel
10 allegedly identified are “not due to the standard problem of cluster samples . . . but are the expected
11 result of dividing the residual errors into a large number of arbitrarily selected groups.” Sweeney
12 MSJ Opp. Decl., Ex. 3 (Noll Supp. Report) at 6 & Exhibits 1a-b & 2a-b.⁵

13 Professor Wooldridge’s simulations confirm that Apple’s experts’ “exercise is entirely
14 predictable, and tells us nothing about whether clustering is needed.” Sweeney Reply *Daubert*
15 Decl., Ex. 1 (Wooldridge Supp. Decl.) at 25. Indeed, their test demonstrates why clustering is
16 inappropriate in this case and leads to artificial inflation of the standard errors:

17 Not only do Professors Murphy and Topel provide no useful evidence in
18 favor of clustering, their exercise actually supports the simulation evidence above
19 that clustering badly overestimates the true precision in the estimates. Ironically, by
20 extension, the Murphy-Topel analysis actually explains why their cluster-robust
21 standard errors in the iPod transactions are much too large.

22 . . . Given that the theoretical derivation in Section 4 and the simulation
23 evidence presented here completely support my earlier intuition, I am more strongly
24 convinced than ever that the “tests” used by Professors Murphy and Topel show
25 nothing of value when it comes to deciding whether standard errors need to be
26 clustered.

27 *Id.* at 26.

28 ⁵ In its Opposition, Apple tries to minimize its previous reliance on clustering by family and
quarter, stating that “even if the standard errors are clustered only by family and not by time period,
Noll’s results still are not statistically significant.” Def.’s Mem. at 18. But the same problems apply
to clustering by family. *See infra* at 8.

1 **D. Apple’s “Omitted Variables” Argument Does Not Support Clustering**

2 As Plaintiffs’ experts have explained, Apple’s “omitted variables” argument does not support
3 clustering. First, clustering is not required if the observation data are a random sample or an entire
4 population of data (as here), rather than a clustered sample.⁶ Sweeney Reply *Daubert* Decl., Ex. 1
5 (Wooldridge Supp. Decl.) at 1, 11-27, 32-33; Sweeney *Daubert* Decl., Ex. 1 (Wooldridge Decl.) at
6 10; Sweeny *Daubert* Decl., Ex. 4 (Noll Rebuttal) at 10; Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp.
7 Rebuttal) at 3-7. In his Supplemental Declaration, Professor Wooldridge cites several examples of
8 influential empirical studies that used large random samples but did not correct for clustering,
9 despite clear evidence of omitted variables. Sweeney Reply *Daubert* Decl., Ex. 1 (Wooldridge
10 Supp. Decl.) at 12-13. In those cases, “no clustering is needed to obtain the appropriate standard
11 errors. The usual heteroskedasticity-robust standard errors [which Noll used] are appropriate.” *Id.*

12 Indeed, Murphy’s own research has used large random samples with obvious omitted
13 variables, and yet Murphy made no clustering correction. *Id.* at 13-14. For example, in Juhn,
14 Murphy, and Pierce (1993), Murphy utilized 27 years worth of data from the Current Population
15 Survey (“CPS”) to study wage inequality, but did not cluster standard errors. *Id.* As Wooldridge
16 puts it: “It seems pretty clear that unobserved factors affecting wage can vary by state and year. Yet
17 there is no discussion of how omitted factors that vary by state and time cause the underlying errors
18 in their models to be correlated.” *Id.*

19 This same Murphy study also refutes Apple’s (unsupported) argument that Noll’s
20 standard errors are “unbelievably small” and the corresponding t-statistics⁷ unbelievably large.
21 Def.’s Mem. at 8. In his 1993 study, Murphy reports t-statistics well above 300 with only
22 approximately 50,000 observations. Here, with more than 600 times that number of
23 observations, Noll reports a t-statistic on the key variable of approximately 448. This is well

24 _____
25 ⁶ Wooldridge explained that in his First Declaration that the same calculations that can be
26 drawn about clustering random samples also apply to a whole population. Sweeney *Daubert* Decl.,
27 Ex. 1 (Wooldridge Decl.) at 5, 10-12; *see also* Sweeney Reply *Daubert* Decl., Ex. 1 (Wooldridge
28 Supp. Decl.) at 9-15.

⁷ A t-statistic is a ratio of the departure of an estimated parameter from its notional value and
its standard error. It is typically used in hypothesis testing.

1 within acceptable limits, as Professor Murphy’s own work attests. Sweeney Reply *Daubert*
2 Decl., Ex. 1 (Wooldridge Supp. Decl.) at 14.

3 Second, the “omitted variables” that Apple asserts should have been included in Noll’s
4 regressions cause multicollinearity. Given that Professor Noll’s regressions include a large number
5 of product characteristics that affect iPod prices, multicollinearity should be tested for and avoided –
6 even if the omitted variables purportedly add to the explanatory power of the regression. Sweeney
7 MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 8-9. Multicollinearity causes a reduction in the
8 precision of the estimated coefficients in the regression, making them less reliable. Sweeney
9 *Daubert* Decl., Ex. 4 (Noll Rebuttal) at 31; Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at
10 7.

11 Here, neither of Apple’s experts conducted any of the standard tests for multicollinearity or
12 provided support for their opinion. Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 7-10;
13 *id.*, Ex. 53 (1/8/14 Murphy Dep.) at 294:25-298:14. Had they done so, they would have discovered
14 that all but one of the omitted attributes generated a multicollinearity problem. Sweeney MSJ Opp.
15 Decl., Ex. 3 (Noll Supp. Rebuttal) at 10. Professor Noll utilized three separate tests (the adjusted R-
16 squared, condition number, and VIF) and each one unequivocally demonstrated multicollinearity
17 problems when adding the omitted variables to the regressions. *Id.* at 10-11.

18 Nor did Murphy and Topel provide any logical reason – based on economic theory or
19 econometrics – that would justify adding any of the omitted variables to the regression.⁸ *Id.* at 9-10;
20 *see, e.g., id.*, Ex. 53 (1/8/14 Murphy Dep.) at 285:17-22 (“I would say it’s basically based on
21 economics and the actual evidence on pricing. I – I don’t recall a specific document that talks about
22 the pricing of those. But it’s something economics would lead us to believe should be included.”).
23 Topel’s rationalization for adding the omitted variables is even more rudimentary: “my recollection
24 is that these were variables that were in the data that Professor Noll had, and he chose to omit them.

25 _____
26 ⁸ Contrary to Apple’s misrepresentations, Noll did not admit that his regression should include
27 variables where the “prices plausibly could be affected by it.” Def.’s Mem. at 10 (citing Noll
28 Supp. Rebuttal at 9). Instead, Noll stated that if an indicator variable is turned on, it means that that
particular variable should have affected the price of an iPod – not that it has to be turned on. Dkt.
No. 685 (Second Supplemental Declaration of Roger G. Noll on Class Certification) at 9.

1 So we simply said let's not omit them. Let's see what happens. They surely seem to be variable
2 characteristics." Sweeney MSJ Opp. Decl., Ex. 52 (1/8/14 Topel Dep.) at 216:17-22; *see also id.*,
3 Ex. 53 (1/8/14 Murphy Dep.) at 288:4-11 (haphazardly guessing that a "vast bulk of" the iPods
4 would be affected by one particular omitted variable). As Murphy admits, "if you thought there was
5 no economic reason to include those kinds of variables in a regression, then I don't think you'd want
6 to put them in." Sweeney MSJ Opp. Decl., Ex. 53 (1/8/14 Murphy Dep.) at 289:16-19. Because
7 neither Murphy nor Topel could provide any economic or econometric reason for including the
8 omitted variables, these variables rightly should be excluded from Professor Noll's regressions.

9 **E. Through the Construction of Arbitrary Clusters, Apple's Experts**
10 **Artificially Introduce Correlation into the Error Residuals**

11 Through the use of ex post clustering,⁹ Murphy and Topel effectively collapse the
12 transactions data for each class/generation/family of an iPod into a calendar quarter and thus into a
13 single observation, which works to reduce the number of transaction observations and the number of
14 degrees of freedom in the regression. Sweeney *Daubert* Decl., Ex. 4 (Noll Rebuttal) at 47. Murphy
15 and Topel's clustering analysis is unreliable because the groups into which they divide their
16 observations are artificially created.¹⁰ Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 5.
17 Murphy and Topel first divide the observations into families, using the premise that Apple's pricing
18 committee used common features within a family to set "uniform" prices. *Id.* As discussed above,
19 this assertion is contradicted by Apple's own admissions and the transactions data.

20 Next, Murphy and Topel further group these families of iPods by quarter, but provide no
21 logical basis for doing so. Sweeney *Daubert* Decl., Ex. 4 (Noll Rebuttal) at 44; Sweeney Reply

22 ⁹ Both Professor Noll and Professor Wooldridge refer to the idea of "ex post clustering." This
23 phrase is in reference to clustering where a random sample is drawn from a large population with the
24 observations subsequently grouped on the basis of an observed variable. Sweeney Reply *Daubert*
25 Decl., Ex. 1 (Wooldridge Supp. Decl.) at 11-12.

26 ¹⁰ Apple mischaracterizes Noll's testimony. Noll did not state that the "independence
27 assumption applies when using the entire population of transactions and that residuals could be
28 correlated within groups." Def.'s Mem. at 13. Noll argued that where the R-square is extremely
high (indicating a high explanatory power in the regression), you would not need to test the
residuals, particularly if you already have group identifiers. Here, it is unnecessary to perform a test
of the independence assumption because "there are no groups with outlying residual errors in the R-
squared spot. And by definition, the mean residual errors by group are going to be zero." Sweeney
MSJ Opp. Decl., Ex. 50 (12/18/13 Noll Dep.) at 46:6-9.

1 *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 4-5. Grouping the residual errors into families by
2 quarter only makes sense if there is an unobserved variable that affects iPod families differently in
3 different quarters. Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 5. Murphy and Topel
4 could have just as easily grouped the residuals by day, week, or year – the arbitrary nature of their
5 clustering by quarter is entirely ad hoc. When pressed, neither Murphy nor Topel could provide any
6 rationale for grouping the residuals by quarter. Murphy admitted that there is no evidence that Apple
7 evaluates its iPod pricing on a quarterly basis and that grouping by quarter was done as a
8 “compromise,” conceding that aggregating at other levels would also be “reasonable.” Sweeney
9 MSJ Opp. Decl., Ex. 53 (1/8/14 Murphy Dep.) at 264:11-265:15 (“I don’t think [Apple does]
10 anything that lines up precisely on quarter boundaries.”). Likewise, Topel acknowledged that Apple
11 “hold[s] prices constant across a couple of quarters.” *Id.*, Ex. 52 (1/8/14 Topel Dep.) at 206:13-
12 207:23.

13 The arbitrariness of Murphy and Topel’s clustering adjustment is underscored by the fact that
14 neither did any additional testing to determine the effect of aggregating the data for different time
15 periods. *Id.*, Ex. 53 (1/8/14 Murphy Dep.) at 265:17-266:5; *id.*, Ex. 52 (1/8/14 Topel Dep.) at 209:1-
16 15. If they had done so, they would have seen that the same results occur whether the data are
17 clustered by family/quarter, family/month, or family/week. Sweeney MSJ Opp. Decl., Ex. 3 (Noll
18 Supp. Rebuttal) at 6 & Exs. 1a-b, 2a-b. These results demonstrate that Murphy and Topel had no
19 basis for clustering the residuals into quarters; the supposed correlations of the residual errors are the
20 expected result of dividing the residual errors into a large number of arbitrarily selected groups.
21 Sweeney MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 6; Sweeney Reply *Daubert* Decl., Ex. 1
22 (Wooldridge Supp. Decl.) at 25-26 (Apple’s exercise is “predictable” and “tells us nothing about
23 whether clustering is needed.”)

24 Recognizing that clustering by quarter is inappropriate, Apple attempts to salvage Murphy
25 and Topel’s analysis by arguing that clustering the standard errors at the family level alone
26 demonstrates that Noll’s results are still not statistically significant. Def.’s Mem. at 18. But
27 clustering at the family level (without regard to time period) is still ex post clustering, so the
28 correlation of residuals that is observed has been introduced artificially (irrespective of the particular

1 ex post cluster chosen), and does not stem from a true cluster sampling problem that needs to be
2 “properly corrected.” Sweeney Reply *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 17-18.

3 **F. Clustering Where Unnecessary Is Harmful**

4 Both Murphy and Topel concede that making a clustering adjustment when it is not required
5 can bias the standard errors. Sweeney MSJ Opp. Decl., Ex. 52 (1/8/14 Topel Dep.) at 244:4-19; *id.*,
6 Ex. 53 (1/8/14 Murphy Dep.) at 279:3-7. In fact, as confirmed by Professor Wooldridge in his
7 Supplemental Declaration, clustering standard errors where, as here, the entire data population is
8 being used, can result in “severe upward biases” of the standard errors. Sweeney Reply *Daubert*
9 Decl., Ex. 1 (Wooldridge Supp. Decl.) at 19-20, 26; *see also* Sweeney *Daubert* Decl., Ex. 4 (Noll
10 Rebuttal) at 6. This is far from harmless.

11 In his Supplemental Declaration, Professor Wooldridge uses a theoretical calculation and
12 several simulations to demonstrate that clustering after random sampling (or, as in this case, after
13 observing an entire population) biases the standard errors upward. The theoretical calculation
14 “confirms the intuition” expressed in Professor Wooldridge’s first declaration: “If one starts with a
15 random sample, computes residuals, and then averages those residuals with arbitrarily created
16 clusters, the residuals will have means that are systematically different from zero. Therefore,
17 clustering artificially inflates the standard errors, perhaps by a substantial amount.” *Id.* at 18.
18 Professor Wooldridge concludes that “clustering after collecting a random sample is far from
19 harmless. The upward bias can be severe, and the situation gets worse as the sample size
20 grows” *Id.* at 19.

21 Professor Wooldridge’s simulations also demonstrate that clustering standard errors in a
22 population artificially inflates the standard errors:

23 These simulation results cast serious doubt on the practice of clustering when
24 the entire population is available. When we take a 10% random sample we know that
25 the proper standard error is, roughly, .049. Across the 1,000 simulations the largest of
26 the standard errors is about .051. In other words, the largest standard error we obtain
27 using 1,000 different 10% random samples is never close to the clustered standard
28 error using the entire population, .206. Thus, if we insist on clustering the population
standard errors, we have the perverse conclusion that virtually any 10% random
sample produces a much more precise estimate than using the entire population. By
contrast, if we use the usual standard error then this paradox disappears: the standard
error from the population, .016, is much smaller than any of the 1,000 standard errors
obtained from a 10% sample. (The smallest is about .049.)

1 Sweeney Reply *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 24.

2 **G. The Number of Observations Per Cluster Distorts the Standard Error**

3 As confirmed by Professor Wooldridge’s simulations, when the number of observations in a
4 cluster increases relative to the number of clusters, the standard error becomes distorted. Sweeney
5 Reply *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 20. Running a basic simulation, Professor
6 Wooldridge found that the usual standard errors work well when the total number of observations
7 were at 50. *Id.* However, when the number of observations increased to 5,000 – with an average of
8 1,000 observations per cluster – the mean cluster standard is approximately .709, which is close to
9 the predicted value of .707. *Id.* Calculating the ratio of the average cluster standard error to the
10 usual standard error is $.709/.033 = 21.5$ *Id.* This indicates that the clustered standard error is
11 expected to be about 21.5 times too large – confirming both Professor Noll and Professor
12 Wooldridge’s theory that clustering is very harmful and produces standard errors that are too
13 conservative. *Id.*

14 Further, Apple’s attack on Noll’s reliance on Angrist and Pischke’s book is misguided.
15 Apple argues that the relevant chapter demonstrates the opposite of Noll’s opinion – that clustering
16 should be performed when the number of observations per group and the amount of within-group
17 correlation increases because the standard error becomes “increasingly misleading.” Def.’s Mem. at
18 16. However, this chapter of Angrist and Pischke’s book is based on problems when one is already
19 dealing with cluster samples – not when one working is working with an entire population. Sweeney
20 MSJ Opp. Decl., Ex. 3 (Noll Supp. Rebuttal) at 4. When discussing the performance of standard
21 errors in relation to the number of clusters, the authors state that “[i]f 42 is enough for the standard
22 cluster adjustment to be reliable, and if less is too few, then what should you do when the cluster
23 count is low? *First best is to get more clusters by collecting more data.*” *Id.* This statement only
24 makes sense if the original number of clusters is less than the population of clusters, thereby
25 denoting the ability to obtain more clusters if necessary. *Id.*

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1 **III. APPLE’S ATTACKS ON PROFESSOR WOOLDRIDGE ARE**
2 **UNFOUNDED**

3 **A. Professor Wooldridge’s Opinions Are Supported by Generally**
4 **Accepted Econometrics and Wooldridge’s Own Peer-Reviewed**
5 **Publications and Research and Were Not Manufactured for This**
6 **Litigation**

7 All of Apple’s attacks on Professor Wooldridge fail to withstand scrutiny. First, Wooldridge
8 did not “custom-manufacture” his opinion for the purposes of this litigation.¹¹ Def.’s Mem. at 14-15.
9 Professor Wooldridge is on published record criticizing clustering in a context closely related to
10 random sampling: stratified sampling with large sample sizes within strata. Sweeney Reply *Daubert*
11 Decl., Ex. 1 (Wooldridge Supp. Decl.) at 27. With stratified sampling, one first partitions the
12 population, just as with cluster sampling. *Id.* But, rather than sample clusters, one obtains random
13 samples within each stratum. *Id.* In Wooldridge (2003, 2010, Section 20.3.4.), Professor
14 Wooldridge explains that treating stratified samples as cluster samples is likely to be too
15 conservative, which is the same issue here: the usual standard errors are correct and clustered
16 standard errors are too conservative. *Id.*

17 Apple also argues that Professor Wooldridge’s opinion that clustering with random samples
18 is unnecessary and perhaps harmful has no support in economic literature. Besides being incorrect
19 (Wooldridge’s own peer-reviewed publications provide such authority), this criticism actually
20 demonstrates that it is Murphy and Topel’s clustering opinions that lack support. As Professor
21 Wooldridge explains, econometrics literature does not warn against clustering a random sample
22 because “it is well known how to compute standard errors with random samples, and it does not
23 involve clustering.” *Id.* at 28, *see generally id.* at 28-29.

24 ¹¹ The authority Apple relies upon to exclude Professor Wooldridge’s declaration are
25 inapposite. In *Cabreara v. Cordis Corp.*, 134 F.3d 1418 (9th Cir. 1998), the expert in question could
26 not support his conclusions with any of his own research or any other known research – unlike here,
27 where Professor Wooldridge relied upon both econometric theory and simulations to support his
28 opinion. Similarly, in *Lust by & Through Lust v. Merrell Dow Pharms., Inc.*, 89 F.3d 594, 597 (9th
Cir. 1996), the origination of the expert’s opinion could only be traced to a point after he began
working as a professional plaintiff’s witness. Here, Professor Wooldridge began developing his
theory on clustering years before he was retained in this litigation and has stated that he has seen this
issue come up in other contexts. Kiernan *Daubert* Decl., Ex. 11 (1/6/14 Wooldridge Dep.) at 91:10-
16.

1 Apple also criticizes Professor Wooldridge for clustering in previous work when using the
2 entire population. Def.'s Mem. at 14. However, Professor Wooldridge's past work with clustering a
3 population data set are limited to particular circumstances not present here. Sweeney Reply *Daubert*
4 Decl., Ex. 1 (Wooldridge Supp. Decl.) at 30-31. The first circumstance occurs with panel data,
5 where one wants to group the data to control for unobserved effects that can cause bias in the
6 estimates. Clustering is even appropriate when dealing with a random sample of cross-section/time
7 period units here because of the need to control for unobserved factors that are constant over time.
8 *Id.* The second scenario where Professor Wooldridge clustered a population involved cross sectional
9 data, where there were many groups and relatively small group sizes. *Id.* Both of these examples of
10 clustering a population are narrow exceptions that have no parallels to the litigation at hand. *Id.*

11 Finally, it must be noted that if random sampling required the calculation of cluster-robust
12 standard errors, then numerous papers in empirical economics would have to be redone. Sweeney
13 Reply *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 12. Many influential studies, like Angrist
14 and Krueger (1991), Angrist and Evans (1998), and Angrist, Chernozhukov, and Fernandez-Val
15 (2006, *Econometrica*), use large random samples from the United States Census without using
16 clustering for standard errors. Sweeney Reply *Daubert* Decl., Ex. 1 (Wooldridge Supp. Decl.) at 11-
17 12.

18 **B. Plaintiffs Timely Disclosed Wooldridge**

19 This Court should reject Apple's argument that Wooldridge's declaration is untimely.¹²
20 First, Plaintiffs complied with the scheduling order when it timely served Professor Noll's reports in
21 April and November of 2013. Rule 26(a)(2) only requires the disclosure of "the identity of any
22 witness it may use at trial to present evidence." Fed. R. Civ. P. 26(a)(2).

23

24 ¹² All three of the out-of-circuit authorities Apple relies upon in support of its argument to
25 exclude Professor Wooldridge share a common theme, limiting their applicability. In *Reed v. Smith*
26 *& Nephew, Inc.*, 527 F. Supp. 2d 1336, 1348 (W.D. Okla. 2007), *Moore v. Napolitano*, 926
27 F. Supp. 2d 8, 25 n.12 (D. D.C. 2013), and *Jeffries v. Centre Life Ins. Co.*, No. 1:02-cv-351, 2004
28 U.S. Dist. LEXIS 30769, at *1 (S.D. Ohio Jan. 28, 2004), the court ultimately excluded the untimely
expert opinions because the objecting party never had a chance to depose the expert witness, unlike
here. Plaintiffs made Professor Wooldridge fully available for an entire day of deposition, of which
Apple took advantage. Def.'s Mem. at 12.

1 Professor Wooldridge is offering testimony on a narrow topic – clustering – in connection
2 with Plaintiffs’ *Daubert* motion. He is not Plaintiffs’ merits expert, and Plaintiffs had no obligation
3 to disclose him in April of 2013. Because Plaintiffs had no obligation to disclose Professor
4 Wooldridge prior to the merits expert disclosure deadlines, his expert report was not untimely. *See,*
5 *e.g., Nightlight Sys. v. Nitelites Franchise Sys.*, No. 1:04-CV-2112, 2007 U.S. Dist. LEXIS 95538, at
6 *24-*26 (N.D. Ga. May 11, 2007) (permitting the use of an undisclosed expert strictly at the
7 *Daubert* hearing and not at trial, noting that there was enough time for expert reports and depositions
8 prior to the expert hearing); *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 739 (3d Cir.
9 1994) (affirming district court’s decision to allow an undisclosed expert to testify at *Daubert*
10 hearing).

11 Second, under Rule 37(c)(1), even assuming the disclosure was untimely (which it was not),
12 a party may use a late-disclosed witness if the failure to disclose was “substantially justified or is
13 harmless.” Fed. R. Civ. P. 37(c)(1). Because Plaintiffs made Professor Wooldridge available for a
14 full day of deposition on January 6, 2014 (which availability Apple took complete advantage of –
15 using even less than the allotted amount of time agreed upon to complete the deposition), there was
16 no prejudice. Professor Wooldridge also fully responded to Apple’s document subpoena. Further,
17 Apple claims that the arguments proffered by Professor Wooldridge are largely similar to those put
18 forth by Professor Noll, thereby refuting Apple’s suggestion that it did not have enough time to
19 address Professor Wooldridge’s theories or opinions. Def.’s Mem. at 12. Courts regularly permit
20 expert testimony under similar circumstances.¹³ *See, e.g., Wendt v. Host Int’l*, 125 F.3d 806, 814
21 (9th Cir. 1997) (vacating district court’s preclusion of expert testimony because parties had time “to
22 begin the expert disclosure procedure anew”); *Baxter Healthcare Corp. v. Fresenius Med. Care*
23 *Holding, Inc.*, No. C 07-1359, 2009 U.S. Dist. LEXIS 32380, at *8 (N.D. Cal. Apr. 2,
24 2009) (denying motion to preclude evidence and witnesses introduced after fact discovery

25
26 ¹³ That Apple’s former expert (used for class certification only) raised clustering is irrelevant.
27 Plaintiffs successfully refuted those arguments, as demonstrated by the fact that Judge Ware ruled
28 that Plaintiffs had adequately demonstrated class-wide impact and damages based on Professor
Noll’s methodologies, while in turn rejecting Dr. Burtis’ opinion (which included her clustering
opinions). Dkt. No. 694 (Order Granting Plaintiffs’ Motion for Class Certification) at 6-7.

1 concluded, noting that the opposing party was able to depose the witness); *In re Enron Corp. Sec.,*
2 *Derivative & ERISA Litig.*, MDL No. 1446, 2007 U.S. Dist. LEXIS 98619, at *133-*134 (S.D. Tex.
3 Feb. 1, 2007) (untimely expert report permitted where the expert’s theory and data were already
4 available to the opposing party and thus there was no unfair surprise; court noted that there was
5 plenty of time to schedule depositions without disrupting the trial schedule).

6 **IV. CONCLUSION**

7 Clustering the error residuals in this case is both inappropriate and harmful, as confirmed
8 through Professor Noll’s Supplemental Rebuttal Report and Professor Wooldridge’s Supplemental
9 Declaration. Apple’s assertions to the contrary falter when analyzed against the facts of the case,
10 economic and econometric theory, and statistical analysis and simulations that Murphy and Topel’s
11 clustering opinion fails to fit the facts of this case and should be excluded from the summary
12 judgment record and at trial.

13 DATED: January 31, 2014

Respectfully submitted,

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