

EXHIBIT 3

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You will receive an incorrect R-squared value in the chart tool in Excel 2003

SUMMARY

The chart tool in Microsoft Excel permits you to fit a trend line and to display an R-squared value.

Additionally, if you click the **Set Intercept = 0** box, the R-squared value is always incorrect in any version of Excel. A workaround is provided in this article to obtain the correct R-Squared value.

MORE INFORMATION

The chart tool has its own linear regression routine separate from both LINEST in Excel and from the Analysis ToolPak (ATP) regression tool that calls LINEST. LINEST has been improved for Microsoft Office Excel 2003 (and the ATP regression tool has also been improved with the improvements to LINEST). Earlier versions of both LINEST and the ATP regression tool computed incorrect R-squared values in the case where the intercept was set to zero. For example, the R-squared values are not correct if one of the following cases is true:

- If the third argument to LINEST is set to FALSE rather than set to TRUE (or omitted).

-or-

- If the **Constant is Zero** check box is selected for the ATP regression tool.

R-squared values in other cases do not exhibit this problem.

The chart tool has not been improved for Office Excel 2003. Therefore, if you want a correct R-squared value for the trend line on a chart for any version of Excel, you must use the following workaround.

Example Usage

To illustrate the R-squared value problem, follow these steps:

1. Create a blank worksheet in Excel.
2. Copy the following table:

X's	Y's
1	11
2	12
3	13

3. Select cell A1 in your blank Excel worksheet, and then click **Paste** on the **Edit** menu so that the entries in the table below fill cells A1:B4 in your worksheet.
4. Select the cell range A1:B4.
5. On the **Insert** menu, click **Chart**.
6. On the **Standard Types** tab, click **XY (Scatter)**, and then click **Next**.
7. On the **Data Range** tab, click **Columns**, and then click **Next**.
8. Click **Finish** to complete the chart.
9. With the chart selected, click **Add Trendline** on the **Chart** menu.
10. On the **Type** tab, click **Linear**.
11. On the **Options** tab, follow these steps:
 - a. Click to select the **Set intercept =** check box, and then verify that the **Set intercept =** box is set to **0**.
 - b. Click to select the **Display R-squared value on chart** check box.
12. Click **OK** to close the **Add Trendline** dialog box.

The R-squared value of minus 20.429 appears, but it is not the correct square of a number. This problem arises from an incorrect formula for the total sum of squares.

Use one of the following methods to find the correct R-squared value in Office Excel 2003:

- Call LINEST on the same data (with the third argument equal to FALSE and the fourth argument equal to TRUE). Use the R-squared value that is in the third row, first column of the output table.

-or-

- Use the ATP regression tool (with the **Constant is Zero** check box selected). Use the R-squared value that is clearly shown in it's

output.

Unfortunately, for earlier versions of Excel, the methods that are mentioned to find the correct R-squared value will not work without you having to revise the results. If you have an earlier version of Excel, either call LINEST or use the ATP regression tool as suggested in the previous paragraph, and then observe the following results:

- If you called LINEST, the Residual sum of squares appears in the fifth row, second column of LINEST output. If you used the ATP regression tool, the Residual sum of squares is clearly labeled in the ANOVA table portion of the output.
- Compute total sum of squares as SUMSQ(known_y's). In the example, that's SUMSQ(B2:B4).
- Correct R-squared = (Total sum of squares - Residual sum of squares) / Total Sum of Squares.

Conclusions

An R-squared value that is inserted on a chart with a linear trend line is always incorrect in the case where the **Set Intercept = 0** box is selected. (Cases with non-linear trend lines or values other than zero for setting the intercept, or both, have not been investigated.)

A work around has been provided to find the correct R-squared value. If the **Set Intercept = 0** box is left unchecked (by far the more typical case in practice), there is no problem with the chart tool's value of R-squared.

APPLIES TO

- Microsoft Office Excel 2003

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