

“How to Interpret Regression Coefficients and Calculate Adjustments for Differences in Property Productivity Features”

To the Editor

I have read “How to Interpret Regression Coefficients and Calculate Adjustments for Differences in Property Productivity Features” and feel compelled to point out that the suggested technique is not appropriate. First of all, the appraiser is using multiple regression analysis to estimate the value of property. This works fine as a check against the value in the appraisal. In using multiple regression analysis, the appraiser is essentially using a statistical model that says the land is worth x , changes in the market are worth y , and so forth. Then, he uses those factors (variable and coefficient) to calculate the adjustments. There are two problems with this. First, each appraisal would require 37 sales, as shown in the example, and then you still have the problem of whether the data set (sample size) is large enough. In addition, everyone knows that “correlation does not equate to causation,” so in a market a swimming pool may be considered a variable but it may not have any value, or in water-starved California it may have negative value.

In the example shown in the article, the indicated value is rounded to \$845,000 using multiple regression, and \$836,000 using the adjustments from multiple regression. At the same time, the average unadjusted price of the comparables is \$854,751, rounded to \$850,000. Why? Because statistical analysis does not reflect how the market values each attribute. Finally, there is a practical problem with this application. If you have to explain it to a judge and/or jury, I am willing to bet there is a 100% probability that an appraiser with a solid understanding of statistics will use a different set of data and discredit this analysis.

*Paul Walker, AI-GRS
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Author’s Response

My thanks to Paul Walker, AI-GRS, for his comments on my article, “How to Interpret Regression Coefficients and Calculate Adjustments for Differences in Property Productivity Features.” Mr. Walker states, “First of all, the appraiser is using multiple regression analysis to estimate the value of a property. This is fine as a check against the value in the appraisal.” It appears that Mr. Walker is confused about the purpose of the article, which should be clear from its title. The market value estimate derived by applying the multiple regression technique of the sales comparison approach may be the only stand-alone value reported in an appraisal report. The purpose of presenting the multiple regression analysis technique of the sales comparison approach is to show how the technique could be applied to derive the required adjustments for differences in property productivity attributes if, and only if, the direct sales comparison technique is applied in an analysis. My article referenced the fourteenth edition of *The Appraisal of Real Estate* for the use of statistical analysis to estimate adjustments.

Mr. Walker posits that there are two problems. “First, each appraisal would require 37 sales and then you still have the problem of whether the data set (sample size) is large enough.” To estimate the coefficients of a multivariate model using the ordinary least squares (OLS), all that is required is that the number of observations should exceed the number of explanatory variables by one for the sample regression model to be estimated successfully. However, the larger the sample size, the more stable are the parameter estimates and the lower are the standard errors of the coefficients. The more homogeneous the data set, the fewer the number of observations needed. The text *Appraising the Tough Ones* states as follows:

When faced with a lack of data in a particular market or under a particular set of circumstances, appraisers have

two options: they can go back in time in the same market or go out geographically to other, similar markets.¹

My article describes an appraisal I did for a bank client in 2016. I analyzed these 37 observations for the valuation. In my valuation practice, I typically apply multiple regression analysis as a stand-alone method to develop an opinion of a defined standard of value.

Mr. Walker also states, "In addition, everybody knows that 'correlation does not equate to causation,' so in a market a swimming pool may be considered a variable but it may not have any value, or in water-starved California it may have a negative value." For a given data set, a predictor variable may have little or no statistically significant ability to explain variation of the predicted variable. For the swimming pool variable example, it is very likely that it may not be statistically significant to explain variation in the predicted variable, depending on the features of the property appraised and value range of comparable properties. A priori, before estimating the regression model, an analyst may not know if the impact of a swimming pool on the expected selling price of a home is positive, negative, or statistically significant. In applying multiple regression based on a given data set, one can determine whether the impact is negative, positive, and/or statistically significant. It provides documentation that an appraiser is not just plucking numbers from thin air or saying "based on my experience" when concluding the impact is negative or positive.

Mr. Walker posits, "In the example shown in the article, the indicated value is rounded to \$845,000 using multiple regression, and \$836,000 using the adjustments derived from multiple regression. At the same time, the average unad-

justed price of the comparables is \$854,751, rounded to \$850,000. Why? Because statistical analysis does not reflect how the market values each attribute." For a given property type there are different categories of market participants. Some market participants may value a given class of property by using multiple regression analysis; for example, Fannie Mae and automated valuation models. Applying the direct sales comparison technique of the sales comparison approach is an attempt by the appraiser to mirror the behavior of market participants. Multiple regression analysis and the direct sales comparison analysis are both techniques of the sales comparison approach. The third technique is the basic statistical analysis. The three techniques rely on market data to estimate expected selling price.

Finally, Mr. Walker states, "there is practical problem with this application. If you have to explain it to a judge and/or jury I am willing to bet there is a 100% probability that an appraiser with a solid understanding of statistics will use a different set of data and discredit this analysis." Of course, based on two different sample data sets, the estimated models may be slightly different, even when the same relevant population is sampled. In a litigation situation, appraisal reports planned to be used in a trial are subject to discovery. The quality and quantity of the data sets, as well as methodology used in the respective reports, are items subject to critical examination at deposition and cross-examination during trial. For litigation purposes, I have developed an opinion of value based on multiple regression analysis and offered testimony based on the same appraisal report.

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1. Frank E. Harrison, *Appraising the Tough Ones: Creative Ways to Value Complex Residential Properties* (Chicago: Appraisal Institute, 1996), 41.