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Is a "Statistically Significant" Result Significant?

By William Choi, Ph. D. and Mark Dwyer,Ph D. at Econ One Los Angels

In many instances, experts often are required to undertake regression analysis to answer questions about the economic effect of an event, action or policy. For example, suppose an expert concludes that a defendant's latest advertising campaign (alleged to be false and disparaging against a plaintiff's product) caused the plaintiff's sales of the product to fall, and this conclusion is based on finding "statistical significance" between the amount spent on the advertising campaign by the defendant (explanatory variable) and the plaintiff's sales (dependent variable). If the expert relies solely on statistical significance to form this conclusion, then such an analysis is woefully incomplete. In this article, we offer three brief reminders about statistical significance.

Statistical Significance ≠ Causality

Statistical significance cannot prove causality. The explanatory variable's statistical significance only measures how precisely the degree of correlation or co-movement between the explanatory and dependent variables can be estimated. However, several reasons may exist as to why there is a statistically significant relationship. For instance, a decline in the plaintiff's market share, in favor of the defendant, may have given the defendant greater resources for advertising. If so, causality would run in the opposite direction. Alternatively, both plaintiff and defendant may have lost sales and increased advertising in response to a new entrant. In this case, there is no direct relationship between the defendant's advertising and the plaintiff's sales, even though there could be a statistically significant relationship between them. While considering factors such as the plaintiff's advertising expenditures or the state of the industry may make it possible to distinguish further between these alternative economic mechanisms using regression models, this example illustrates that judgments as to causality must include a "healthy dose of economic theory and common sense."[1] Conversely, the absence of statistical significance does not imply a lack of causality and can arise when there is insufficient data to precisely measure the effect.

Statistical Significance Is Influenced By Sample Size

It is important to remember how statistical significance is achieved. Virtually every independent variable will have some correlation, however small, with any dependent variable. Increasing the sample size increases the precision of the estimated effect of the independent variable, and eventually almost any estimate will be found to be significantly different from zero if the sample size is large enough. To compensate for such spurious significance, some researchers suggest using smaller significance levels as the sample size increases.[2] This is but one reason why the 5% significance level is not an absolute.

Statistical Significance ≠ Economic Significance

There is another form of significance that must be remembered when interpreting statistical analysis. This is economic significance, which is distinct from statistical significance. Economic significance relates to whether the explanatory variable has a meaningful and plausible influence on the dependent variable. Too much focus on statistical significance can lead to a false conclusion that an explanatory variable drives the dependent variable even though its estimated effect is trivial, has the wrong sign, or is implausibly large. Conversely, a statistically insignificant finding may cause one to overlook a variable with a meaningful (but imprecisely estimated) impact. McCloskey and Ziliak (1996) look carefully at a large number of empirical studies in economics and conclude that researchers don't seem to appreciate that statistical significance does not imply economic significance.[3]

1 Studenmund, A. H., Using Econometrics: A Practical Guide, 2nd Edition, 1992, HarperCollins, p. 6.

2 See Judge, G. G. et al., The Theory and Practice of Econometrics, 2nd Edition, 1985, Wiley, p. 131.

3 McCloskey, Deirdre N., and Stephen Ziliak. 1996. "The Standard Error of Regression." Journal of Economic Literature 34 (March): 97-114.