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MULTIVARIATE DATA ANALYSIS

FIFTH
EDITION



HAIR ■ ANDERSON ■ TATHAM ■ BLACK

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without theoretical support. In those instances the researcher is running a much greater risk of finding results with little or no generalizability. Instead, in using these additional variables, the researcher must be guided by theory that is supported by empirical analysis. In this manner, both practical and statistical significance can hopefully be met.

Stage 3: Assumptions in Multiple Regression Analysis

We have shown how improvements in prediction of the dependent variable are possible by adding independent variables and even transforming them to represent aspects of the relationship that are not linear. But to do so we must make several assumptions about the relationships between the dependent and independent variables that affect the statistical procedure (least squares) used for multiple regression. In the following sections we discuss testing for the assumptions and corrective actions to take if violations occur.

Assessing Individual Variables versus the Variate

The assumptions underlying multiple regression analysis apply both to the individual variables (dependent and independent) and to the relationship as a whole. Chapter 2 examined the available methods for assessing the assumptions for individual variables. But in multiple regression, once the variate has been derived, it acts collectively in predicting the dependent variable. This necessitates assessing the assumptions not only for individual variables but also for the variate itself. This section focuses on examining the variate and its relationship with the dependent variable for meeting the assumptions of multiple regression. These analyses actually must be performed *after* the regression model has been estimated in stage four. Thus, testing for assumptions must occur not only in the initial phases of the regression, but also after the model has been estimated.

The basic issue is whether, in the course of calculating the regression coefficients and predicting the dependent variable, the assumptions of regression analysis have been met. Are the errors in prediction a result of an actual absence of a relationship among the variables, or are they caused by some characteristics of the data not accommodated by the regression model? The assumptions to be examined are as follows:

- Linearity of the phenomenon measured
- Constant variance of the error terms
- Independence of the error terms
- Normality of the error term distribution

The principal measure of prediction error for the variate is the **residual**—the difference between the observed and predicted values for the dependent variable. Plotting the residuals versus the independent or predicted variables is a basic method of identifying assumption violations for the overall relationship. When examining residuals, some form of standardization is recommended, as it makes the residuals directly comparable. (In their original form, larger predicted values naturally have larger residuals.) The most widely used is the **studentized resid-**