(Extract from Jim Ring's Statistical Notes to accompany the course: Section 9, pp31 -32)

Elaboration

Having discussed the relationship between two variables, we move on to investigate the effect of other variables on this relationship. This is the elaboration process.

References:

Loether & McTavish, Ch 8

Bowen & Weisberg, Ch 8

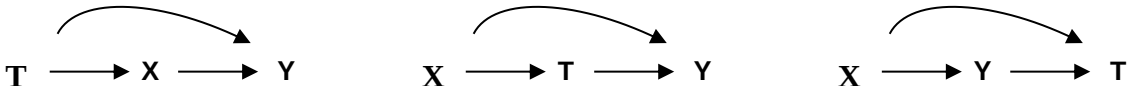
Blalock, Sect. 15.4 and Ch 20

Rosenberg M, The Logic of Survey Analysis

Moser & Kalton, Ch 17, Sect 4

9.1 The Control Variable

The additional variables used to investigate the original relationship are called control variables or test variables. The effect of a test variable T on the relationship between an independent variable X and a dependent variable Y can be represented diagrammatically as follows:



antecedent intervening consequent

Fig 9.1 Three models for one control variable

An antecedent model has the control variable as a causal factor for both X and Y; an intervening model has the control variable as a causative factor for the dependent variable Y, but is itself affected by the independent variable X; finally a consequent model has the control variable as an effect of both X and Y. The choice of model - antecedent, intervening or consequent - depends entirely on the nature of the underlying theory and the specific hypotheses you want to test. Statistical analysis cannot by itself determine which model is correct in any particular instance: it can only be used to investigate the form of the associations (or lack of associations) between variables once the model has been defined.

9.2 Conditional Tables

We obtain conditional tables by dividing the sample into two or more groups according to the value of the control variable. Each conditional table thus produces a description of the relationship between X and Y for each value of T. These three-variable tables are known as first order tables (one control variable) as distinct from the original two-variable tables which are known as zero-order tables (no control variable). If we introduce a second or even a third control variable, this produces second- or third-order tables and so on for as many test variables as are included in the model.

In addition to these conditional tables, it is also useful to examine the original (zero-order) associations between the test variable T and each of the original variables X and Y. We then have a

more or less complete picture of the whole model. This enables us to produce three kinds of measures of association (or PRE measures) as follows:

1 Original total association: between X and Y

2 Conditional associations: between X and Y for each value of T

3 Total associations with the control variable: between X and T and between Y and T

By comparing these different measures of association, and bearing in mind the model of the relationships between variables, we can then investigate in detail the effect of the test variable.

For example, three possible outcomes might be:

1 Spurious relationships: in an antecedent model when the original total association is strong, but the conditional associations are both weak. The total associations with the control variable will also have been strong.

2 *Independent causation*: in an intervening or an antecedent model, when the original total association is weak, the conditional associations are strong, and the total associations with the control variable are strong.

3 *Suppressor control* variable: in an intervening model, when the original total association is as strong as each of the conditional associations (i.e. they are all about the same), and the total associations with the control variable are weak for the independent variable X, but strong for the dependent variable Y.

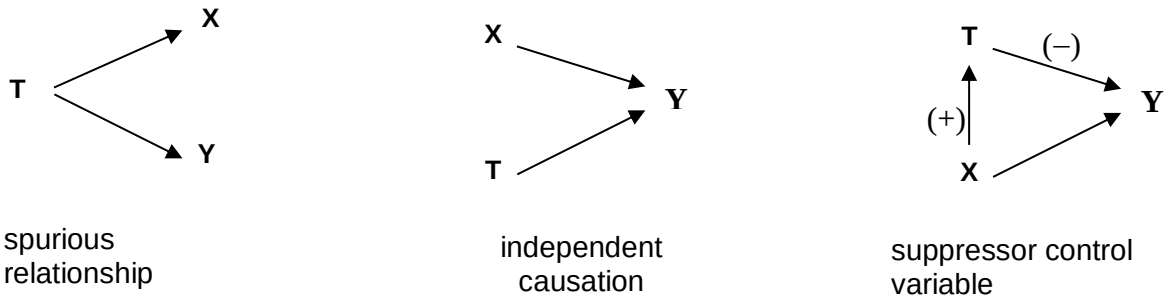


Fig 9.2 Examples of possible relationships

9.3 Partial Measures of Association

In many of the above examples, we are interested only in the summary of the conditional associations - i.e. we want an "average" of the conditional measures of association. This average is most often achieved by means of a partial coefficient of association or partial correlation coefficient. If the original conditional associations were PRE measures, then the partial coefficients are also usually PRE measures. As with conditional associations, we can also define zero-, first- etc. order partial correlations. For example SPSS produces partial gamma coefficients.

More often partial coefficients are used for interval dependent variables, especially when either or both of the independent and control variables are also interval. This type of coefficient, normally referred to as partial correlation, is particularly appropriate to regression analysis and analysis of variance.