INFORMATION POINT:

Analysis of variance (ANOVA)

Analysis of Variance is a method used to compare the means of several groups of observations. An *F*-test is used to test the null hypothesis that the means of all the groups of observations are equal. In its simplest form, ANOVA is called one-way analysis of variance. For example, we might measure the height of 10-year-old girls in five different countries and wish to test whether the mean height of 10-year-old females is the same in all five countries. If we only compared two countries we could use a *t*-test to carry out this investigation, so one-way analysis of variance can be considered as an extension of the *t*-test to cope with the situation in which we need to compare more than two groups simultaneously.

The analysis is based upon the assumption that the samples come from normally distributed populations with the same standard deviation. That is, we must be able to assume that the variable of interest is normally distributed within each group and that each group has the same standard deviation for that variable. If the assumption that the samples are from normal distributions is not viable, then the non-parametric test called the Kruskal Wallis test could be used instead, this is the non-parametric equivalent of one way ANOVA. Altman (1991) gives more detailed information about one way ANOVA and its non-parametric equivalent.

There are a number of ways in which analysis of variance might be further extended, but the assumptions of normality and equal standard deviation still need to hold. First, perhaps the observations could be grouped according to two different categorical variables (or factors, as they are often called). The extension allowing for two factors is called two-way ANOVA. For example, in our study of height of 10-year-old females one factor is country and another might be whether or not they were breast-fed.

A second extension of one way ANOVA is when we have two dependant variables that we wish to compare simultaneously across two or more groups. This extension is called multivariate analysis of variance (MANOVA). This has been used in the above paper to simultaneously consider the mean scores of the eight constructs (so the means of eight dependant variables) across two groups (the diplomats and the graduates). MANOVA is discussed in more detail with an example in Polit (1996).

Further reading

Altman D.G. (1991) *Practical Statistics for Medical Research*. Chapman & Hall. London. pp. 205–215.

Polit D.F. (1996) *Data Analysis and Statistics for Nursing Research*. Appleton and Lange, Stamford, Connecticut. pp. 317–324.

NICOLA CRICHTON