Non-parametric significance tests

One of the fundamental principles of statistics is the distinction between different types of data. We have classified data as normal, ordinal and interval.

Data type	Description	Central Tendency	Dispersion
Nominal	Discrete, qualitative categories	Mode	None
Ordinal	Ranked values	Median	Interquartile Range
Interval	Measurable quantities with a uniform scale	Mean	Variance

There is a distinction between types of significance tests that roughly corresponds to the distinction between interval level data and the other types. Tests are classified into parametric and non-parametric tests. To use a parametric test one must have interval level data. (Sometimes data that is not strictly interval level data is treated as if it were interval level data. For example, IQ scores are strictly ordinal level data – they rank people according to ability on an IQ test – but IQ scores are usually treated with parametric tests. They are treated as quasi- or pseudo interval level data. Hence, to use a parametric test you must have interval or quasi-interval level data.)

There are further assumptions that need to be fulfilled before a parametric test can be applied:

1. Assumptions about the distribution of the population or the distribution of the sample mean. Generally, the distribution tested must be a normal distribution.

2. Assumptions about the variances of two samples. Variances of two samples are generally required to be similar. This is called the homogeneity of variance.

The specific assumptions are detailed for each test. Examples of parametric tests are:

1. Tests on the difference of two sample means using a standardised normal distribution.

2. Tests on a sample drawn from a normal distribution using a t-test.

3. Paired sample t-test.

Parametric tests are chosen in preference to non-parametric tests. This is because interval level data contains more information than other kinds of data. For instance, compare position in a race (ordinal data) with time taken to complete the race (interval data). Clearly, the latter data gives you more information. Consequently, the parametric test is more "powerful" – it

will enable one to draw conclusion that non-parametric tests would miss. However, ordinal and nominal level data are still important sources of information, and consequently it is important to develop tests for dealing with them.

Indicators that a non-parametric test will be appropriate are any (and possibly all) of the following:

1.   The data is not interval data and not quasi-interval either.

2.   You are making inferences about medians, not means.

3.   It is not possible to construe the background distribution as in any way normally distributed (even when the central limit theorem is taken into account).

4.   When two samples are involved it is obvious that the sample variances are wildly different.

Non-parametric tests are called "non-parametric" because they do not make any assumption about a population parameter. In other words, when we apply a non-parametric test we do not have to make assumptions about mean of a population, its variance or background probability distribution. Thus, whilst non-parametric tests are not as powerful as parametric tests they are of more general application and are available when the parametric tests fail.