W

Wald–Wolfowitz run test– A **nonparametric test** for testing the **null hypothesis** that **the distribution functions** of two continuous **populations** are the same. The **observations** from two **independent samples** taken from respective populations are arranged in increasing order of magnitude, irrespective of the population from which they came. Each value is then replaced by 1 or 2, depending on the sample to which it originally belonged. The total number of **runs,** say *U*, of like elements, i.e., 1s or 2s, is then counted and used as the **test statistic.** If the two populations differ among themselves, elements of one type (1s or 2s) would be expected to cluster together, tending to make *U* small, whereas if the populations are identical, the arrangement of 1s or 2s should be **random,** tending to make *U* large. Thus, small values of *U* do not support the **hypothesis** and the appropriate ***p* value** is a left-tailed **probability.** The test has a very low **power;** its **asymptotic relative efficiency** compared to the traditional ***t* test** for equal **variances** is zero. Furthermore, it has the least power compared to other nonparametric tests applied to the same **data.** See also *Kolmogorov–Smirnov two-sample test.*

washout period– In a **crossover study,** the time interval allowed between the two consecutive **treatments** in order to control for the effect of the treatments given in one period to be carried over to the next period. It helps to reduce the **treatment period interactions** so that the effect of the second period can be assessed without being contaminated by the effect of the first period.

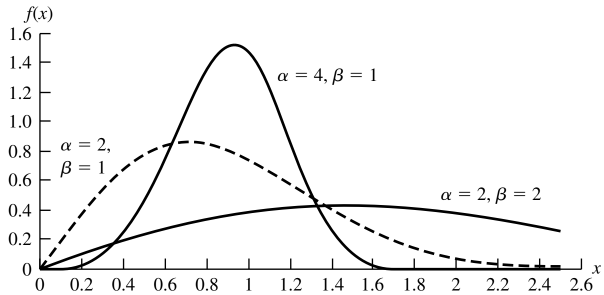
Weibull distribution– A **distribution** having the general **probability density function** given by

$$f(x) = \begin{cases} \dfrac{\alpha}{\beta}\left(\dfrac{x-\gamma}{\beta}\right)^{\alpha-1} \exp\left[-\left(\dfrac{x-\gamma}{\beta}\right)^{\alpha}\right] & x > \gamma, \alpha > 0,\ \beta > 0 \\ 0 & \text{elsewhere} \end{cases}$$

is known as a Weibull distribution. The **parameters** γ, α, and β determine the **location, shape,** and **scale,** respectively, of the distribution. The above distribution is the so-called three-parameter Weibull distribution. The two-parameter Weibull distribution has location at the origin, i.e., $\gamma = 0$, and its probability density function is given by

$$f(x) = \begin{cases} \dfrac{\alpha}{\beta^{\alpha}} x^{\alpha-1} \exp[-(x/\beta)^{\alpha}] & x > 0, \alpha > 0, \ \beta > 0 \\ 0 & \text{elsewhere} \end{cases}$$

The distribution was originally proposed to describe **data** from life testing. It can be used to model data involving a wide variety of shapes including both left- and right-skewed data sets.



Probability density curves for Weibull distributions for various values of α and β

weighted average– An **average** formed by multiplying each number in a set of numbers by a value called a weight and then adding the resulting products and dividing it by the sum of the weights. In a **grouped frequency distribution,** the individual values are very often weighted by their respective **frequencies.** Weighted averages are frequently used for combining the **means** of two or more groups of different sizes to take into account the sizes of the groups in computing the overall or grouped mean. In many economic applications, weighted averages are frequently employed in the construction of **index numbers.** Price and quantity index numbers are examples of weighted averages.

weighted kappa statistic– A modified version of the **kappa statistic** that allows for the assignment of weight to the difference in the degrees of disagreement between the raters. The main difficulty in applying the weighted kappa lies in the determination of, and the justification for, a set of weights.

weighted least squares estimation– A general method of estimation in which **estimates** are obtained by minimizing a weighted sum of squares of the differences between the observed value and its predicted value in terms of the **statistical model** of interest. The weights employed are generally taken as the reciprocals of the **variances.** See also *least absolute deviation estimation, least squares estimation.*

weighted mean– Compare *unweighted mean.* Same as *weighted average.*

Welch's analysis of variance test– Same as *Welch's test.*

Welch's test– The **test procedure** used for testing the equality of a set of **treatment means** having unequal **population variances.** The **test statistic** is a generalization of the **two-sample *t* statistic** with unequal population variances. The test has been found to perform rather well, although it is little less robust to the **ANOVA *F* test** to departures from **normality.** A number of parametric alternatives to Welch's test have also been proposed. However, if the underlying **assumptions** of **ANOVA** are seriously violated, one should consider the possibility of a **nonparametric analysis** instead of either Welch or other parametric procedures.

Wilcoxon matched-pair signed rank test– Same as *Wilcoxon signed rank test.*

Wilcoxon rank-sum test– A **nonparametric test** used for detecting differences between two **location parameters** based on the analysis of two **independent samples.** The **test statistic** is formed by combining the two **samples, ranking** the **observations** in the combined sample, and summing the **ranks** of the observations belonging to one of the samples. It is used in place of the **two-sample *t* test** either because **scores** are ordinal in nature or because the **normality** or **homogeneity** assumptions cannot be satisfied. The test is equivalent to the **Mann–Whitney *U* test.** See also *normal scores test.*

Wilcoxon signed-rank test– A **nonparametric test** for detecting differences between two **location parameters** based on the analysis of two **matched** or **paired samples.** This procedure is used to compare two **correlated samples** of **scores** that cannot be compared by means of a **paired *t* test** either because the scores are ordinal in nature or because the **normality** and **homogeneity** assumptions cannot be met. The **test statistic** is formed by **ranking** the **absolute values** of the pairwise differences of two **samples** and summing the **ranks** with either the positive sign or negative sign (whichever sum is smaller).

Wilk's lambda– See *multivariate analysis of variance.*

Wishart distribution– A **multivariate distribution** of **variances** and **covariances** in a **sample** of given size from a **multivariate normal distribution.** For a **univariate distribution,** Wishart distribution reduces to that of a **chi-square distribution.** It also follows many of the properties of **chi-square variables.**

within-group mean square– Same as *mean square within groups.*

within-group sum of squares– Same as *sum of squares within groups.*

within-patient trial– Same as *crossover trial.*

within-sample sum of squares– Same as *sum of squares within groups.*

Woolfs' estimator– In a **stratified analysis** involving a series of **2 × 2 tables,** an **estimator** of the common **odds ratio** obtained as the **weighted average** of the odds ratio estimators from each individual table where the weights are inversely proportional to the **variances** of the individual estimators. It is calculated by the formula

$$\frac{\sum_{i=1}^{k} w_i \mathrm{OR}_i}{\sum_{i=1}^{k} w_i}$$

where $\mathrm{OR}_i = a_i d_i / b_i c_i$, $w_i = (1/a_i + 1/b_i + 1/c_i + 1/d_i)$; a_i, b_i, c_i, d_i are four **cell counts** in the ith table; and k is the number of 2×2 tables.