A

Aalen's linear regression model: A model for the *hazard function* of a set of survival times given by

$$\alpha(t; \mathbf{z}(t)) = \alpha_0(t) + \alpha_1(t)z_1(t) + \cdots + \alpha_p(t)z_p(t)$$

where $\alpha(t)$ is the hazard function at time t for an individual with covariates $\mathbf{z}(t)' = [z_1(t), \ldots, z_p(t)]$. The 'parameters' in the model are functions of time with $\alpha_0(t)$ the baseline hazard corresponding to $\mathbf{z}(t) = \mathbf{0}$ for all t, and $\alpha_q(t)$, the excess rate at time t per unit increase in $z_q(t)$. See also **Cox's proportional hazards model**. [*Statistics in Medicine*, 1989, **8**, 907–25.]

Abbot's formula: A formula for the proportion of animals (usually insects) dying in a toxicity trial that recognizes that some insects may die during the experiment even when they have not been exposed to the toxin, and among those who have been so exposed, some may die of natural causes. Explicitly the formula is

$$p_i^* = \pi + (1 - \pi)p_i$$

where p_i^* is the observable response proportion, p_i is the expected proportion dying at a given dose and π is the proportion of insects who respond naturally. [*Modelling Binary Data*, 1991, D. Collett, Chapman and Hall/CRC Press, London.]

ABC method: Abbreviation for **approximate bootstrap confidence method**.

Ability parameter: See **Rasch model**.

Absolute deviation: Synonym for **average deviation**.

Absolute risk: Synonym for **incidence**.

Absorbing barrier: See **random walk**.

Abundance matrices: Matrices that occur in ecological applications. They are essentially two-dimensional tables in which the classifications correspond to site and species. The value in the *ij*th cell gives the number of species *j* found at site *i*.

Accelerated failure time model: A general model for data consisting of survival times, in which explanatory variables measured on an individual are assumed to act multiplicatively on the time-scale, and so affect the rate at which an individual proceeds along the time axis. Consequently the model can be interpreted in terms of the speed of progression of a disease. In the simplest case of comparing two groups of patients, for example, those receiving treatment A and those receiving treatment B, this model assumes that the survival time of an individual on one treatment is a multiple of the survival time on the other treatment; as a result the probability that an individual on treatment A survives beyond time t is the probability that an individual on treatment B survives beyond time ϕt, where ϕ is an unknown positive constant. When the endpoint of interest is the death of a patient, values of ϕ less than one correspond to an acceleration in the time of death of an individual assigned to treatment A, and values

of ϕ greater than one indicate the reverse. The parameter ϕ is known as the *acceleration factor*. [*Modelling Survival Data in Medical Research*, 1994, D. Collett, Chapman and Hall/CRC Press, London.]

Acceleration factor: See **accelerated failure time model**.

Acceptable quality level: See **quality control procedures**.

Acceptable risk: The risk for which the benefits of a particular medical procedure are considered to outweigh the potential hazards.

Acceptance region: The set of values of a test statistic for which the null hypothesis is accepted.

Acceptance–rejection algorithm: An algorithm for generating random numbers from some probability distribution, $f(x)$, by first generating a random number from some other distribution, $g(x)$, where f and g are related by

$$f(x) \leq kg(x) \text{ for all } x$$

with k a constant. The algorithm works as follows:

- let r be a random number from $g(x)$;
- let s be a random number from a uniform distribution on the interval (0,1);
- calculate $c = ksg(r)$;
- if $c > f(r)$ reject r and return to the first step; if $c \leq f(r)$ accept r as a random number from f. [*Statistics in Civil Engineering*, 1997, A.V. Metcalfe, Edward Arnold, London.]

Acceptance sampling: A type of *quality control procedure* in which a sample is taken from a collection or batch of items, and the decision to accept the batch as satisfactory or reject them as unsatisfactory, is based on the proportion of defective items in the sample. [*Quality Control and Industrial Statistics*, 4th edition, 1974, A.J. Duncan, R.D. Irwin, Homewood, Illinois.]

Accidentally empty cells: Synonym for **sampling zeros**.

Accrual rate: The rate at which eligible patients are entered into a *clinical trial*, measured as persons per unit of time.

Accuracy: The degree of conformity to some recognized standard value. See also **bias**.

ACE: Abbreviation for **alternating conditional expectation**.

ACES: Abbreviation for **active control equivalence studies**.

ACF: Abbreviation for **autocorrelation function**.

ACORN: An acronym for 'A Classification of Residential Neighbourhoods'. It is a system for classifying households according to the demographic, employment and housing characteristics of their immediate neighbourhood. Derived by applying *cluster analysis* to 40 variables describing each neighbourhood including age, class, tenure, dwelling type and car ownership. [*Statistics in Society*, 1999, D. Dorling and S. Simpson eds., Arnold, London.]

Acquiescence bias: The bias produced by respondents in a survey who have the tendency to give positive responses, such as 'true', 'like', 'often' or 'yes' to a question. At its most extreme, the person responds in this way irrespective of the content of the item. Thus a person may respond 'true' to two items like 'I always take my medication on time'

and 'I often forget to take my pills'. See also **end-aversion bias**. [*Journal of Intellectual Disability Research*, 1995, **39**, 331–40.]

Action lines: See **quality control procedures.**

Active control equivalence studies (ACES): *Clinical trials* in which the object is simply to show that the new treatment is at least as good as the existing treatment. [*Statistical Issues in Drug Development*, 1997, S. Senn, Wiley, Chichester.]

Active control trials: *Clinical trials* in which the trial drug is compared with some other active compound rather than a placebo.

Active life expectancy (ALE): Defined for a given age as the expected remaining years free of disability. [*New England Journal of Medicine*, 1983, **309**, 1218–24.]

Activ Stats: A commercial computer-aided learning package for statistics. See also **statistics for the terrified**. [Interactive Learning Europe, 124 Cambridge Science Park, Milton Road, Cambridge CB4 4ZS.]

Actuarial estimator: An estimator of the *survival function*, $S(t)$, often used when the data are in grouped form. Given explicitly by

$$S(t) = \prod_{\substack{j\geq 0 \\ t_{(j+1)}\leq t}} \left[1 - \frac{d_j}{N_j - \frac{1}{2}w_j}\right]$$

where the ordered survival times are $0 < t_{(1)} < \cdots < t_{(n)}$, N_i is the number of people at risk at the start of the interval $t_{(i)}$, $t_{(i+1)}$, d_i is the observed number of deaths in the interval and w_i the number of censored observations in the interval. [*Survival Models and Data Analysis*, 1980, R.G. Elandt–Johnson and N.L. Johnson, Wiley, New York.]

Actuarial statistics: The statistics used by actuaries to evaluate risks, calculate liabilities and plan the financial course of insurance, pensions, etc. An example is *life expectancy* for people of various ages, occupations, etc. See also **life table**. [*American Society of Actuaries*, 1961, **13**, 116–20.]

Adaptive cluster sampling: A procedure in which an initial set of subjects is selected by some sampling procedure and, whenever the variable of interest of a selected subject satisfies a given criterion, additional subjects in the neighbourhood of that subject are added to the sample. [*Biometrika*, 1996, **84**, 209–19.]

Adaptive estimator: See **adaptive methods**.

Adaptive methods: Procedures that use various aspects of the sample data to select the most appropriate type of statistical method for analysis. An *adaptive estimator*, T, for the centre of a distribution, for example, might be

$$\begin{aligned} T &= \text{mid-range when } k \leq 2 \\ &= \text{arithmetic mean when } 2 < k < 5 \\ &= \text{median when } k \geq 5 \end{aligned}$$

where k is the sample *kurtosis*. So if the sample looks as if it arises from a short-tailed distribution, the average of the largest and smallest observations is used; if it looks like a long-tailed situation the median is used, otherwise the mean of the sample is calculated. [*Journal of the American Statistical Society*, 1967, **62**, 1179–86.]

Adaptive sampling design: A *sampling design* in which the procedure for selecting *sampling units* on which to make observations may depend on observed values of the variable of interest. In a survey for estimating the abundance of a natural resource, for example, additional sites (the sampling units in this case) in the vicinity of high observed abundance may be added to the sample during the survey. The main aim in such a design is to achieve gains in precision or efficiency compared to conventional designs of equivalent sample size by taking advantage of observed characteristics of the population. For this type of sampling design the probability of a given sample of units is conditioned on the set of values of the variable of interest in the population. [*Adaptive Sampling*, 1996, S.K. Thompson and G.A.F. Seber, Wiley, New York.]

Added variable plot: A graphical procedure used in all types of regression analysis for identifying whether or not a particular explanatory variable should be included in a model, in the presence of other explanatory variables. The variable that is the candidate for inclusion in the model may be new or it may simply be a higher power of one currently included. If the candidate variable is denoted x_i, then the *residuals* from the regression of the response variable on all the explanatory variables, save x_i, are plotted against the residuals from the regression of x_i on the remaining explanatory variables. A strong linear relationship in the plot indicates the need for x_i in the regression equation (Fig. 1). [*Regression Analysis*, Volume 2, 1993, edited by M.S. Lewis-Beck, Sage Publications, London.]

Addition rule for probabilities: For two events, A and B that are *mutually exclusive*, the probability of either event occurring is the sum of the individual probabilities, i.e.

$$\Pr(A \text{ or } B) = \Pr(A) + \Pr(B)$$

where $\Pr(A)$ denotes the probability of event A etc. For k mutually exclusive events $A_1, A_2, \ldots, A_k$, the more general rule is

$$\Pr(A_1 \text{ or } A_2 \ldots \text{ or } A_k) = \Pr(A_1) + \Pr(A_2) + \cdots + \Pr(A_k)$$

See also **multiplication rule for probabilities** and **Boole's inequality**. [KA1 Chapter 8.]

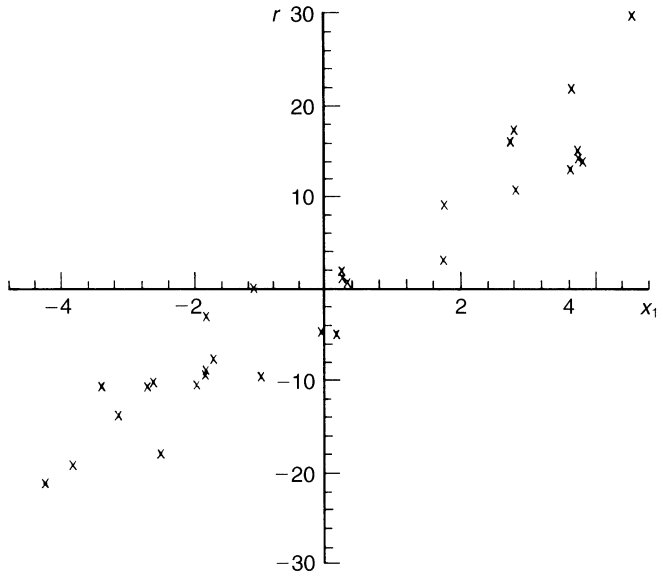

Fig. 1 Added variable plot indicating a variable that could be included in the model.

Additive clustering model: A model for *cluster analysis* which attempts to find the structure of a *similarity matrix* with elements s_{ij} by fitting a model of the form

$$s_{ij} = \sum_{k=1}^{K} w_k p_{ik} p_{jk} + \epsilon_{ij}$$

where K is the number of clusters and w_k is a weight representing the salience of the property corresponding to cluster k. If object i has the property of cluster k, then $p_{ik} = 1$ otherwise it is zero. [*Psychological Review*, 1979, **86**, 87–123.]

Additive effect: A term used when the effect of administering two treatments together is the sum of their separate effects. See also **additive model**.

Additive genetic variance: The variance of a trait due to the main effects of *genes*. Usually obtained by a factorial *analysis of variance* of trait values on the genes present at one or more loci. [*Statistics in Human Genetics*, 1998, P. Sham, Arnold, London.]

Additive model: A model in which the explanatory variables have an *additive effect* on the response variable. So, for example, if variable A has an effect of size a on some response measure and variable B one of size b on the same response, then in an assumed additive model for A and B their combined effect would be $a + b$.

Additive outlier: A term applied to an observation in a *time series* which is affected by a non-repetitive intervention such as a strike, a war, etc. Only the level of the particular observation is considered affected. In contrast an *innovational outlier* is one which corresponds to an extraordinary shock at some time point T which also influences subsequent observations in the series. [*Journal of the American Statistical Association*, 1996, **91**, 123–31.]

Additive tree: A connected, *undirected graph* where every pair of nodes is connected by a unique path and where the distances between the nodes are such that

$$d_{xy} + d_{uv} \leq \max[d_{xu} + d_{yv}, d_{xv} + d_{yu}] \text{ for all } x, y, u, \text{ and } v$$

An example of such a tree is shown in Fig. 2. See also **ultrametric tree**. [*Tree Models of Similarity and Association*, 1996, J.E. Corter, Sage University Papers 112, Sage Publications, Thousand Oaks.]

Adequate subset: A term used in regression analysis for a subset of the explanatory variables that is thought to contain as much information about the response variable as the complete set. See also **selection methods in regression**.

Adjacency matrix: A matrix with elements, x_{ij}, used to indicate the connections in a *directed graph*. If node i relates to node j, $x_{ij} = 1$, otherwise $x_{ij} = 0$.

Adjusted correlation matrix: A *correlation matrix* in which the diagonal elements are replaced by *communalities*. The basis of *principal factor analysis*.

Adjusted treatment means: Usually used for estimates of the treatment means in an *analysis of covariance*, after adjusting all treatments to the same mean level for the covariate(s), using the estimated relationship between the covariate(s) and the response variable. [*Biostatistics*, 1993, L.D. Fisher and G. Van Belle, Wiley, New York.]

Adjusting for baseline: The process of allowing for the effect of *baseline characteristics* on the response variable usually in the context of a *longitudinal study*. A number of methods might be used, for example, the analysis of simple *change scores*, the ana-

a. Dissimiliarities

	A	B	C	D	E
Worker A	--				
Worker B	15	--			
Worker C	20	25	--		
Worker D	18	23	6	--	
Worker E	20	25	20	18	--

b. Additive Tree

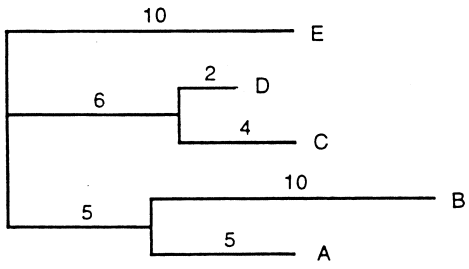

Fig. 2 An example of an additive tree. (Reproduced by permission of Sage Publications from *Tree Models of Similarity and Association*, 1996, J.E. Corter.)

lysis of percentage change, or, in some cases, the analysis of more complicated variables. In general it is preferable to use the adjusted variable that has least dependence on the baseline measure. For a longitudinal study in which the correlations between the repeated measures over time are moderate to large, then using the baseline values as covariates in an *analysis of covariance* is known to be more efficient than analysing change scores. See also **baseline balance.** [*Statistical Issues in Drug Development*, 1997, S. Senn, Wiley, Chichester.]

Admissibility: A very general concept that is applicable to any procedure of statistical inference. The underlying notion is that a procedure is admissible if and only if there does not exist within that class of procedures another one which performs uniformly at least as well as the procedure in question and performs better than it in at least one case. Here 'uniformly' means for all values of the parameters that determine the probability distribution of the random variables under investigation. [KA2 Chapter 31.]

Admixture in human populations: The inter-breeding between two or more populations that were previously isolated from each other for geographical or cultural reasons. Population admixture can be a source of spurious associations between diseases and *alleles* that are both more common in one ancestral population than the others. However, populations that have been admixed for several generations may be useful for mapping disease *genes*, because spurious associations tend to be dissipated more rapidly than true associations in successive generations of random mating. [*Statistics in Human Genetics*, 1998, P. Sham, Arnold, London.]

Aetiological fraction: Synonym for **attributable risk.**

Affine invariance: A term applied to statistical procedures which give identical results after the data has been subjected to an *affine transformation*. An example is *Hotelling's* T^2 *test*.

Affine transformation: The transformation, $\mathbf{Y} = \mathbf{AX} + \mathbf{b}$ where $\mathbf{A}$ is a nonsingular matrix and $\mathbf{b}$ is any vector of real numbers. Important in many areas of statistics particularly *multivariate analysis*.

Age-dependent birth and death process: A *birth and death process* where the birth rate and death rate are not constant over time, but change in a manner which is dependent on the age of the individual. [*Stochastic Modelling of Scientific Data*, 1995, P. Guttorp, CRC/Chapman and Hall, London.]

Age heaping: A term applied to the collection of data on ages when these are accurate only to the nearest year, half year or month. See also **coarse data.**

Age–period–cohort model: A model important in many *observational studies* when it is reasonable to suppose that age, number of years exposed to risk factor, and age when first exposed to risk factor, all contribute to disease risk. Unfortunately all three factors cannot be entered simultaneously into a model since this would result in *collinearity*, because 'age first exposed to risk factor' + 'years exposed to risk factor' is equal to 'age'. Various methods have been suggested for disentangling the dependence of the factors, although most commonly one of the factors is simply not included in the modelling process. See also **Lexis diagram** [*Statistics in Medicine*, 1984, **3**, 113–30.]

Age-specific death rates: Death rates calculated within a number of relatively narrow age bands. For example, for 20–30 year olds,

$$\mathrm{DR}_{20,30} = \frac{\text{number of deaths among 20–30 year olds in a year}}{\text{average population size in 20–30 year olds in the year}}$$

Calculating death rates in this way is usually necessary since such rates almost invariably differ widely with age, a variation not reflected in the *crude death rate*. See also **cause-specific death rates** and **standardized mortality ratio.** [*Biostatistics*, 1993, L.D. Fisher and G. Van Belle, Wiley, New York.]

Age-specific failure rate: A synonym for *hazard function* when the time scale is age.

Age-specific incidence rate: *Incidence rates* calculated within a number of relatively narrow age bands. See also **age-specific death rates.**

Agglomerative hierachical clustering methods: Methods of *cluster analysis* that begin with each individual in a separate cluster and then, in a series of steps, combine individuals and later, clusters, into new, larger clusters until a final stage is reached where all individuals are members of a single group. At each stage the individuals or clusters that are 'closest', according to some particular definition of distance are joined. The whole process can be summarized by a *dendrogram*. Solutions corresponding to particular numbers of clusters are found by 'cutting' the dendrogram at the appropriate level. See also **average linkage, complete linkage, single linkage, Ward's method, Mojena's test, K-means cluster analysis** and **divisive methods.** [MV2 Chapter 10.]

Agresti's α: A generalization of the *odds ratio* for *2×2 contingency tables* to larger *contingency tables* arising from data where there are different degrees of severity of a disease and differing amounts of exposure. [*Analysis of Ordinal Categorical Data*, 1984, A. Agresti, Wiley, New York.]

Agronomy trials: A general term for a variety of different types of agricultural field experiments including fertilizer studies, time, rate and density of planting, tillage studies,

and pest and weed control studies. Because the response to changes in the level of one factor is often conditioned by the levels of other factors it is almost essential that the treatments in such trials include combinations of multiple levels of two or more production factors. [*An Introduction to Statistical Science in Agriculture*, 4th edition, 1972, D.J. Finney, Blackwell, Oxford.]

AI: Abbreviation for **artificial intelligence.**

Aickin's measure of agreement: A chance-corrected measure of agreement which is similar to the *kappa coefficient* but based on a different definition of agreement by chance. [*Biometrics*, 1990, **46**, 293–302.]

AID: Abbreviation for **automatic interaction detector.**

Aitchison distributions: A broad class of distributions that includes the *Dirichlet distribution* and *logistic normal distributions* as special cases. [*Journal of the Royal Statistical Society, Series B*, 1985, **47**, 136–46.]

Aitken, Alexander Craig (1895–1967): Born in Dunedin, New Zealand, Aitken first studied classical languages at Otago University, but after service during the First World War he was given a scholarship to study mathematics in Edinburgh. After being awarded a D.Sc., Aitken became a member of the Mathematics Department in Edinburgh and in 1946 was given the Chair of Mathematics which he held until his retirement in 1965. The author of many papers on least squares and the fitting of polynomials, Aitken had a legendary ability at arithmetic and was reputed to be able to dictate rapidly the first 707 digits of π. He was a Fellow of the Royal Society and of the Royal Society of Literature. Aitken died on 3 November 1967 in Edinburgh.

Ajne's test: A *distribution free method* for testing the uniformity of a *circular distribution*. The test statistic A_n is defined as

$$A_n = \int_0^{2\pi} [N(\theta) - n/2]^2 \mathrm{d}\theta$$

where $N(\theta)$ is the number of sample observations that lie in the semicircle, θ to $\theta + \pi$. Values close to zero lead to acceptance of the hypothesis of uniformity. [*Scandinavian Audiology*, 1996, 201–6.]

Akaike's information criterion: An index used in a number of areas as an aid to choosing between competing models. It is defined as

$$-2L_m + 2m$$

where L_m is the maximized *log-likelihood* and m is the number of parameters in the model. The index takes into account both the statistical goodness of fit and the number of parameters that have to be estimated to achieve this particular degree of fit, by imposing a penalty for increasing the number of parameters. Lower values of the index indicate the preferred model, that is, the one with the fewest parameters that still provides an adequate fit to the data. See also **parsimony principle** and **Schwarz's criterion.** [MV2 Chapter 11.]

ALE: Abbreviation for **active life expectancy**.

Algorithm: A well-defined set of rules which, when routinely applied, lead to a solution of a particular class of mathematical or computational problem. [*Introduction to Algorithms*, 1989, T.H. Cormen, C.E. Leiserson, and R.L. Rivest, McGraw-Hill, New York.]

Alias: See **confounding.**

Allele: The DNA sequence that exists at a genetic location that shows sequence variation in a population. Sequence variation may take the form on insertion, deletion, substitution, or variable repeat length of a regular motif, for example, CACACA. [*Statistics in Human Genetics*, 1998, P. Sham, Arnold, London.]

Allocation ratio: Synonym for **treatment allocation ratio.**

Allocation rule: See **discriminant analysis.**

Allometry: The study of changes in shape as an organism grows. [MV1 Chapter 4.]

All subsets regression: A form of regression analysis in which all possible models are considered and the 'best' selected by comparing the values of some appropriate criterion, for example, *Mallow's C_k statistic*, calculated on each. If there are q explanatory variables, there are a total of $2^q - 1$ models to be examined. The *leaps-and-bounds algorithm* is generally used so that only a small fraction of the possible models have to be examined. See also **selection methods in regression.** [ARA Chapter 7.]

Almon lag technique: A method for estimating the coefficients, $\beta_0, \beta_1, \ldots, \beta_r$, in a model of the form

$$y_t = \beta_0 x_t + \cdots + \beta_r x_{t-r} + \epsilon_t$$

where y_t is the value of the dependent variable at time t, $x_t, \ldots, x_{t-r}$ are the values of the explanatory variable at times $t, t-1, \ldots, t-r$ and ϵ_t is a disturbance term at time t. If r is finite and less than the number of observations, the regression coefficients can be found by *least squares estimation*. However, because of the possible problem of a high degree of *multicollinearity* in the variables $x_t, \ldots, x_{t-r}$ the approach is to estimate the coefficients subject to the restriction that they lie on a polynomial of degree p, i.e. it is assumed that there exists parameters, $\lambda_0, \lambda_1, \ldots, \lambda_p$ such that

$$\beta_i = \lambda_0 + \lambda_1 i + \cdots + \lambda_p i^p, \quad i = 0, 1, \ldots, r, \quad p \leq r$$

This reduces the number of parameters from $r+1$ to $p+1$. When $r = p$ the technique is equivalent to least squares. In practice several different values of r and/or p need to be investigated. [*The American Statistician*, 1972, **26**, 32–5.]

Alpha(α): The probability of a type I error. See also **significance level.**

Alpha factoring: A method of *factor analysis* in which the variables are considered samples from a population of variables.

Alpha spending function: An approach to *interim analysis* in a *clinical trial* that allows the control of the type I error rate while giving flexibility in how many interim analyses are to be conducted and at what time. [*Statistics in Medicine*, 1996, **15**, 1739–46.]

Alpha(α)-trimmed mean: A method of estimating the mean of a population that is less affected by the presence of *outliers* than the usual estimator, namely the sample average. Calculating the statistic involves dropping a proportion α (approximately) of the observations from both ends of the sample before calculating the mean of the remainder. If $x_{(1)}, x_{(2)}, \ldots, x_{(n)}$ represent the ordered sample values then the measure is given by

$$\alpha_{\text{trimmed mean}} = \frac{1}{n-2k}\sum_{i=k+1}^{n-k} x_{(i)}$$

where k is the smallest integer greater than or equal to αn. See also **M-estimators.** [*Biostatistics*, 1993, L.D. Fisher and G. Van Belle, Wiley, New York.]

Alpha(α)-Winsorized mean: A method of estimating the mean of a population that is less affected by the presence of *outliers* than the usual estimator, namely the sample average. Essentially the k smallest and k largest observations, where k is the smallest integer greater than or equal to αn, are reduced in size to the next remaining observation and counted as though they had these values. Specifically given by

$$\alpha_{\text{Winsorized mean}} = \frac{1}{n}\left[(k+1)(x_{(k+1)} + x_{(n-k)}) + \sum_{i=k+2}^{n-k-1} x_{(i)}\right]$$

where $x_{(1)}, x_{(2)}, \ldots, x_{(n)}$ are the ordered sample values. See also **M-estimators.** [*Biostatistics*, 1993, L.D. Fisher and G. Van Belle, Wiley, New York.]

Alshuler's estimator: An estimator of the *survival function* given by

$$\prod_{j=1}^{k} \exp(-d_j/n_j)$$

where d_j is the number of deaths at time $t_{(j)}$, n_j the number of individuals alive just before $t_{(j)}$ and $t_{(1)} \leq t_{(2)} \leq \cdots \leq t_{(k)}$ are the ordered survival times. See also **product limit estimator.** [*Modelling Survival Data in Medical Research*, 1994, D. Collett, Chapman and Hall/CRC Press, London.]

Alternate allocations: A method of allocating patients to treatments in a *clinical trial* in which alternate patients are allocated to treatment A and treatment B. Not to be recommended since it is open to abuse. [SMR Chapter 15.]

Alternating conditional expectation (ACE): A procedure for estimating optimal transformations for regression analysis and correlation. Given explanatory variables $x_1, \ldots, x_q$ and response variable y, the method finds the transformations $g(y)$ and $s_1(x_1), \ldots, s_q(x_q)$ that maximize the correlation between y and its predicted value. The technique allows for arbitrary, smooth transformations of both response and explanatory variables. [*Biometrika*, 1995, **82**, 369–83.]

Alternating least squares: A method most often used in some methods of *multidimensional scaling*, where a goodness-of-fit measure for some configuration of points is minimized in a series of steps, each involving the application of least squares. [MV1 Chapter 8.]

Alternating logistic regression: A method of *logistic regression* used in the analysis of *longitudinal data* when the response variable is binary. Based on *generalized estimating equations*. [*Analysis of Longitudinal Data*, 1994, P.J. Diggle, K.-Y. Liang and S.L. Zeger, Oxford Science Publications, Oxford.]

Alternative hypothesis: The hypothesis against which the null hypothesis is tested.

Amersham model: A model used for *dose–response curves* in immunoassay and given by

$$y = 100(2(1-\beta_1)\beta_2)/(\beta_3 + \beta_2 + \beta_4 + x + [(\beta_3 - \beta_2 + \beta_4 + x)^2 + 4\beta_3\beta_2]^{\frac{1}{2}}) + \beta_1$$