

APPENDIX 1

*Glossary of Terms**

- Aggregation.* Simplification of a system by gathering related entities into larger groups.
- Algorithm.* Set of steps leading to the solution of a problem.
- Analogue Computer.* Computer performing computations by physical processes (usually in electrical circuits) which are analogous to those involved in the problem under investigation, rather than by operating on their numerical equivalents.
- Analytic Function.* A function is analytic at a given point if it can be represented in the neighbourhood of that point by its Taylor series (named after B. Taylor, 1685–1731).
- Anemometer.* Instrument for measuring the speed (and often direction) of the wind.
- Aquifer.* Layer of permeable rock containing water, and capable of conducting it in recoverable quantity.
- Biochemical Oxygen Demand (BOD).* A measure of the rate of oxygen uptake by aqueous media, and hence of their decomposable organic matter.
- Biomass.* Mass of organic matter, living or dead, originating from an animal and/or plant population.
- Biome.* A biotic community covering a large geographic area and characterized by distinctive life forms.
- Black Box.* Colloquialism for a part of a system whose internal mechanisms are unknown or ignored, and in which only inputs and outputs are considered.
- Calibration [of a model].* The process of comparing model output with observed results, and modifying parameter estimates to provide a better fit.
- Cartesian Coordinates.* System of coordinates permitting the determination of the position of each point on a plane by its distances from two intersecting lines, usually perpendicular. Similarly, in space, a Cartesian system comprises a set of axes, usually mutually perpendicular, with a common origin (named after R. Descartes, 1596–1650).
- Catchment.* Area from which water runs off, for instance to a river system or reservoir.
- Conversational Mode.* Operating mode for communication between a computer and a terminal, in which each entry from the terminal elicits a response from the computer and vice versa.
- Covariance Matrix.* A set of numbers arranged in rows and columns to form a

*Several entries use descriptions based on those listed in *Chambers Dictionary of Science and Technology*, the *McGraw-Hill Dictionary of Scientific and Technical Terms*, and other scientific glossaries.

table, each number being a measure of the association between a pair of variables corresponding to that particular row and column.

Decision Maker. An official or group at some level of government, a private company, individual, or a whole population performing its management role by a popular vote.

Degrees of Freedom. The number of variables which may be specified independently to define the state of a system.

Delphi Process. Method seeking consensus amongst a panel of evaluators on questions that involve value judgments of relative worth.

Deterministic. Describes a system in which everything that occurs is determined by a chain of causation and in which, given the current state of the system and specified inputs, the future state and outputs are uniquely defined.

Differential Equation. An equation involving derivatives of unknown functions.

Digital Computer. Computer performing arithmetical and logical processes on numerical or other data expressed in a notation using digits.

Dominant Modes. Primary characteristics of the observed response of a system to a perturbation.

Dynamic Programming. Mathematical technique for solving multistage optimization problems, wherein an optimal decision has to be made at each stage of a process, and the decisions interact.

Dynamic Storage. Computer storage of information where allocation of space is constantly changed in accordance with varying requirements.

Ecosystem. A set of living organisms which coexist, interact, and exchange material, together with the inorganic factors affecting them.

Environmental Impact. The net change (good or bad) in man's health and well-being (including the well-being of the ecosystems on which human survival depends) that results from a process set in motion or accelerated by man's actions.

Eutrophication (literally, 'good nourishment'). Process by which the concentration of nutrients in a body of water is gradually increased over moderately long periods of time.

Evapotranspiration. Loss of water vapour from soil surface and vegetation combined.

Feedback. An interaction within a system whereby a change in a variable tends to cause an increase or decrease in the subsequent rate of change of that same variable.

Flow-Chart. Detailed graphic representation of a sequence of operations.

FORTTRAN (FORMula TRANslator). A computer language often used in scientific studies.

Function A relation between a dependent variable and one or more independent variables.

Game Theory. Branch of mathematics which deals with the theory of contests between players under certain specified rules, and makes it possible to determine strategies maximizing gains and minimizing losses.

Gaming. The interactive use of a model to permit a human participant to make successive decisions under a defined set of conditions, often in competition or interaction with one or more other participants.

- Gaussian (or Normal) Distribution.* Particular frequency distribution, often assumed as the distribution of the errors of observations (named after K. F. Gauss, 1777–1855).
- Global Atmospheric Research Programme (GARP).* A programme of observational and experimental studies of the atmosphere, including the design and testing of theoretical models of physical processes in the global atmosphere (GARP is sponsored jointly by the International Council of Scientific Unions and the World Meteorological Organization).
- Greenhouse Effect.* Effect produced by such gases as carbon dioxide in permitting the inward transmission of radiation from the sun, but preventing its outward re-radiation from the ground, and thus raising the equilibrium temperature.
- Hardware.* Physical computer equipment (as contrasted with *Software*).
- Heuristic.* Encouraging investigation of a problem, rather than providing a direct solution.
- Hierarchy.* A body of persons or things in grades, orders, or classes, one above another.
- Hybrid Computer.* Computer using both analogue and digital representations of data, and methods of processing them, for the computational solution of problems.
- Implicit Function.* Functional relationship in which the dependent variable is not expressed explicitly in terms of the independent variables.
- Incremental.* Using small, step-by-step, increases (or decreases) of a variable quantity.
- Interactive Facilities.* Computer facilities which lend themselves to easy man-machine interaction, e.g. direct keyboard input and graphical displays of results, together with appropriate software to permit immediate modification in response to different instructions.
- International Biological Programme (IBP).* A world study of biological productivity and human welfare which lasted from 1964 to 1974, and was sponsored by the International Council of Scientific Unions.
- Iterative Method.* Method involving the repeated application of an algorithm.
- Least Squares Method.* Method for fitting a curve to given points which minimizes the sum of the squares of the deviations of the points from the curve.
- Linear Function.* A relation between variables for which the ratio of a change in an independent variable to the change produced in the dependent variable is constant.
- Linear Programming.* The analysis of problems in which a linear function of variables is to be optimized, when those variables are subject to linear constraints.
- List Processing.* Method of processing data in the form of an ordered set of items so arranged that each item contains a pointer to the next in order, thus allowing insertions and deletions without the need to move the items.
- Markov Process.* Sequence of events in which the probability of an event is dependent only on the event immediately preceding it (named after A. A. Markov, 1856–1922).
- Maximum Likelihood Method.* Method of estimating statistical characteristics from a sample of data, which gives estimates with certain optimal properties.

- Mini-Max.* Decision criterion which involves choosing the action (policy) which minimizes the maximum loss. Strategy of game theory minimizing a player's maximum possible loss.
- Model.* A representation of a system in another medium.
- Monte-Carlo Method.* Solution of a problem by performing sampling experiments on a stochastic model.
- Natural Frequencies.* Frequencies with which a system oscillates in the absence of outside influence.
- Nonlinear Function.* Opposite of *Linear Function*.
- Nonlinear Programming.* Procedure for locating the maximum or minimum value of a function of several variables which is subject to constraints, when the function and/or constraint(s) are nonlinear.
- Normal Distribution.* See *Gaussian Distribution*.
- Numerical Analysis.* Branch of mathematics concerned with arithmetic (computational) procedures and their application. Method of obtaining useful quantitative solutions to problems that have been expressed mathematically.
- Objective Function.* A function representing the goal or criterion to be used when optimizing a system.
- Optimization.* Maximizing or minimizing of a function which may be subject to some constraints. Also, a procedure used to select a solution from among several possible ones which would best satisfy a criterion.
- Parameter.* Quantity which may be kept constant while the effect of other variables is considered. An independent variable in terms of which other variables may be expressed.
- Phenology.* Study of major behavioural changes in organisms (dormancy, reproduction, etc.) in relation to the seasonal progression of climatic variables and day length.
- Probability Distribution.* The relative frequencies with which a random variable assumes particular values (e.g. Gaussian Distribution).
- Pseudo-Random Numbers.* Sequence of numbers produced by a recursive rule, satisfying some of the standard tests of randomness.
- Random Numbers.* Sequence of numbers which do not exhibit any regular pattern, such as the numbers drawn in a lottery.
- Random Process.* See *Stochastic Process*.
- Recursion Formula.* Formula enabling a term in a sequence to be computed from one or more of the preceding terms. [Note the description of 'recursive estimation' in Section 9.2].
- Regression Coefficient.* Coefficient of the independent variable in an equation designed to predict the values of a corresponding dependent variable.
- Resilience.* Ability of a system to absorb stresses created by external disturbances, without major modification of the system.
- Sensitivity Analysis.* Technique used in the analysis of models for computer simulation, in which input variables or parameters are deliberately changed in order to determine the corresponding effects on the output.
- Simulation.* The process of representing the behaviour of a system (real or hypothetical) by that of an analogous model.
- Simulation Language.* Language used to programme a computer for simulation modelling.