

Key Words as used in *A Bibliography of Business and Economic Forecasting*

The dimensions that are most useful for describing the bibliography's entries each contain a number of key words (shown in capital letters). These key words are not sufficient to offer a complete key wording of every article and so we have not hesitated to introduce further key words where needed. The total set of key words is therefore able to describe each entry in the bibliography.

The major dimensions of the key wording system are introduced below and most of the bibliography's entries are key worded on at least one of them.

These dimensions relate to:

- (1) area of application
- (2) variable to forecast
- (3) model with which to forecast
- (4) aid to model interpretation
- (5) method of model estimation
- (6) set of statistical problems
- (7) use and a user
- (8) analysis of the effectiveness of a forecasting method or a set of forecasts
- (9) aid to monitoring forecasting effectiveness
- (10) theory of how to develop and select a forecasting model
- (11) set of data related problems
- (12) concern with the effect of certain independent variables
- (13) theory underlying the forecasting model
- (14) problems of implementation

The fourteen dimensions are described below in more detail.

(1) *Area of application*, in the FIRM, an industrial SECTOR, or the economy as a whole, the MACROECONOMIC. In the first two cases the area can be specified more completely by reference to the sector under consideration and the particular product of that sector, e.g. FIRM: Retailing, Gasoline or SECTOR: CONSUMER DURABLES, Cars. Typical key words are of the form; APPLICATION - SECTOR: PRODUCTION AND MINING, Machine tools. A limited number of variables have been given their own headings, e.g. HEALTH. Some models have a specific geographical basis (REGIONAL MODELS) or a specific time horizon. The usual division into 'short', "medium" and "long" has not seemed helpful so we have only kept the last category, LONG TERM FORECASTING. In a similar vein, certain forecasting methods are more appropriate for different phases of the product LIFE CYCLE, e.g. NEW PRODUCT, LIFE CYCLE - PRODUCT, Declining etc.

(2) *Variable to forecast*, which is a principle focus in the article, e.g. PRICE. A number of important variables have distinct key words, ADVERTISING, COST, INTEREST RATES, MARKET SHARE, MARKET POSITION, MARKET SEGMENTATION, PRICE, STOCK PRICES, SUPPLY and manpower oriented variables key worded under MANPOWER PLANNING. A large number of the references we list discuss sales, demand or output and because of the frequency of occurrence of these concepts they have not been key worded as such. Thus any article with an area of application but no variable mentioned is concerned with sales etc. Other variables which are less often discussed are listed in the form, e.g. APPLICATION -

SECTOR (or FIRM): INVESTMENT, this being a sector level (or firm) study of investment behaviour. In the key word index these are referenced directly following the key words describing firm or sector level areas of application.

(3) *Model with which to forecast*, and here we have considered four main classes: PROBABILITY MODELS, REGRESSION models being a model with a single dependent variable, SIMULTANEOUS SYSTEM models when there are two-way relationships between the variables leading to a number of equations describing these interactions and TIME SERIES models which rely on only the past history of the variable being forecast to extrapolate ahead. Each one of these headings has a number of sub-headings describing the particular sub-model under consideration, e.g. REGRESSION - DISCRETE DEPENDENT catalogues those articles concerned with forecasting a variable which can only take discrete values. Besides these minor headings we thought there were a number of distinct sub-classes, important enough to give separate key words and we list them below as they relate to the four major classes above (1) MARKOV MODELS, (2) DISCRIMINANT ANALYSIS, DISTRIBUTED LAG, and PRODUCTION FUNCTIONS, (3) INDUSTRIAL DYNAMICS, INPUT-OUTPUT, DEMAND EQUATIONS, RECURSIVE SYSTEMS, SYSTEMS THEORY, MACROECONOMIC MODELS and SIMULATION, and (4) DIFFUSION MODELS, EXPONENTIAL SMOOTHING and TREND CURVES.

Two approaches to forecasting that do not fit into the scheme are based on the use of BUSINESS INDICATORS and JUDGEMENTAL FORECASTS. Since the former provide quantitative, replicable estimates of turning points they are included. Judgmental forecasts includes articles that evaluate their effectiveness or explain how they can be best used.

(4) *Aid to model interpretation*. The more complicated models, DISTRIBUTED LAG models, the SIMULTANEOUS SYSTEM models, and so on, are difficult to understand in that the linkages, lags and feedback make direct inference from the equations difficult. Discussion on this general problem is under MODEL INTERPRETATION, while the dynamic effects implicit in a model is referenced under MULTIPLIERS, as well as SIMULTANEOUS SYSTEM - DYNAMIC PROPERTIES. SPECTRAL ANALYSIS and SIMULATION, offer insight into the structure of these complicated models, e.g. SIMULATION -APPLICATION: Policy evaluation, SPECTRAL ANALYSIS - APPLICATION: Business cycle.

SIMULATION is also used to describe a system of equations (definitional or probabilistic) that interact, either simultaneously or sequentially as noted above. Applications of both SIMULATION and SPECTRAL ANALYSIS are listed, e.g. SPECTRAL ANALYSIS - APPLICATION: Policy evaluation, or SIMULATION - APPLICATION: Sector, *Agriculture*. Methodological problems associated with these approaches are also key worded.

(5) *Method of estimation*. The methods of model estimation typically used depend somewhat on the model, with maximum likelihood estimation (MLE) usually offering the underlying rationale whatever the model. However, we have not concerned ourselves with the fine niceties of estimation methods except as far as we think these results are usable to the forecaster (rather than the statistician). Consequently, articles which concern themselves only with a new method of estimation have been omitted. On the other hand, articles which develop our understanding of how to apply an estimation technique are included, e.g. ESTIMATION - MLE or ESTIMATION - OLS. Bayesian methods are listed separately under BAYESIAN.

(6) *Set of statistical problems*, such as the form and structure of the error distribution, e.g. ERROR DISTRIBUTION - NON NORMAL, ERROR SPECIFICATION - AUTOCORRELATED, MULTI-

COLLINEARITY and more generally, SPECIFICATION ERROR. Once these possibilities are admitted, the next stage adopted is often to test for their significance, the tests being described under AUTOCORRELATION - TESTS, MULTICOLLINEARITY - TEST, or SPECIFICATION ERROR - TESTS, etc.

(7) *Use and user.* Some articles specifically identify an organizational problem (e.g. USE - INVENTORY CONTROL, or USE - PRICING), and show how forecast information can help in its solution. Similarly, some models aim to help a specific user solve his forecasting problem (e.g. USER - FIRM: Production, although this heading is used sparingly).

(8) *Analysis of the effectiveness of a forecasting method or a set of forecasts,* and these we list under EVALUATION and COMPARATIVE METHODS. Thus an article classified under BUSINESS INDICATORS - EVALUATION examine the strengths and weaknesses of the business indicator approach while under COMPARATIVE METHODS - CAUSAL, Trend curves the two approaches names are compared. If a model is tested properly, by comparing its forecasts with what occurred after the model had been constructed, we note this additional evidence on effectiveness through the key EX ANTE. Articles concerned with whether we can forecast a particular variable are key worded, e.g. EVALUATION - INVESTMENT FORECASTS. The question of how models should be compared is described under LOSS FUNCTIONS and EVALUATION - THEORY OF while the accuracy of models in predicting turning points is described under the heading, TURNING POINTS - FORECASTING. Because forecasting is an activity carried out with the intent of influencing action a number of entries discuss the relationship between forecasting and decision-making under the heading DECISION RULES. A related heading, entries of which are also concerned with affecting the future through the choice of present actions is CONTROL THEORY. In principle the two headings are very similar, but the latter has been developed by control engineers and describes a formal mathematical approach to decision-making. While these headings include general discussion of how a decision is or should be selected, particular policies are also discussed under the headings POLICY EVALUATION, and PUBLIC EXPENDITURE.

(9) *Aid to monitoring forecasting effectiveness,* these are described under the general heading, FORECAST - MONITORING, as well as three more specific key words, CONFIDENCE INTERVAL, CONTROL CHARTS, and TOLERANCE INTERVAL. The use of forecasts in setting performance targets is described under USE - TARGET SETTING. Entries concerned with evaluating the effectiveness of forecasters are key worded USE - FORECASTER EVALUATION.

(10) *Theory of how to develop and select a forecasting model.* These two major questions are key worded: THEORY - MODELLING, FORECASTING, MODEL IDENTIFICATION and MODEL SELECTION. A related topic in causal modeling is what constitutes a "cause" and discussion of this epistemological question is listed under CAUSALITY.

(11) *Set of data related problems.* Unfortunately, the data, the building blocks of any forecasting model, are invariably prone to error, both definitional and theoretical. Questions such as whether the data are disaggregated and the differences that result from using aggregated rather than disaggregated data, how to operationalize an economic definition, and how to transform an annual series to comparable quarterly series are listed under DATA and its sub-headings. Questions concerning the effects of the different types of error and their estimation are key worded, DATA ERRORS. A problem that most often arises with national accounts is that of revisions to the data some time after first publication and the corresponding key word is DATA REVISIONS. Data problems arise when using INDEX NUMBERS and SURVEY data, topics discussed under the above. Two data related

topics of major interest to economists are the use of ATTITUDINAL DATA and EXPECTATIONS – DATA

(12) *Concern with the effect of certain “independent” variables.* Economists have long been concerned with the effect of price and income on the demand for consumer goods and services. Similarly, marketing men have tried to identify the effect of advertising or the effect of a sales promotion. Key words such as these are: ACCOUNTING PRACTICE, ADVERTISING - EFFECT OF, CAPACITY, CONCENTRATION, DISTRIBUTION, EDUCATION, EXCHANGE RATE, INCOME, INTEREST RATE, MARKET SHARE, POLLUTION, PRICE, TARIFF, TAX and TECHNOLOGY.

(13) *Theory*, such as the theory of efficient markets that dominates the financial literature’s concern with stock prices. Entries which contain a theoretical discussion are classified by, e.g. THEORY - EFFICIENT MARKETS: however, this particular set of key words is generally omitted from the index for we think that our headings are too wide to be helpful to the researcher particularly interested in the theory. Also, a large number of theories purport to describe CONSUMER BEHAVIOUR and these we list separately.

(14) *Problem of implementation.* Forecasting models require a set of data (DATA, DATA ERRORS etc.) which form a part of a management information system, MIS. The models themselves have to be accurately programmed, discussed under COMPUTERISATION and NUMERICAL METHODS. A cost-effective forecasting model efficiently linked to an information system is not sufficient to ensure its output is used. Forecasting is in part a political process within an organization, aimed at convincing the ultimate user of the forecast of a model’s worth. These aspects are discussed under FORECASTER BEHAVIOUR and USER REQUIREMENTS. Particular approaches to forecasting adopted by organizations are described under FORECASTING - PRACTICE, while FORECASTING - USAGE contains evidence on the frequency of usage of various methods.

Some key words did not fall neatly into the above categories. Each article is classified according to its complexity, BASIC and ADVANCED, intermediate articles being unclassified. Often a further mathematical technique is associated with the forecasting model such as mathematical programming (LP), CLUSTER ANALYSIS, FACTOR ANALYSIS. There is also the question of how the forecast variable is specified; the problem might require forecasting cumulative demand (DEMAND - CUMULATIVE) rather than the demand within a single period, or perhaps a probability (PROBABILITIES - FORECAST OF).