ARTICLES, PAPERS AND PUBLICATIONS OF ACTUARIAL INTEREST


OPERATIONAL RESEARCH QUARTERLY

Vol. 20, No. 1, March 1969

KINGSMAN, B. G. Commodity Purchasing
An interesting paper which develops a basis for 'good' purchasing rules in a market with fluctuating prices. On the basis that some commodity will be required n periods from now, and that the buyer will have several opportunities on which to make his purchase, the buyer can reasonably wait for a low price if he has many future opportunities, but as the deadline approaches he would be wiser to buy at a rather higher 'low price' if he is not already covered.

The method proposed is based on finding 'break points'—prices at which the buyer is indifferent as to whether he buys or waits until his next opportunity. However the calculation of these 'break points' depends on a number of assumptions about future variability and trends of prices, in particular that prices in successive periods are independent. Subject to these assumptions the method appears to quantify an approach which is subjectively reasonable.

WHITE, D. J. Problems involving Infrequent but Significant Contingencies
This paper is concerned with problems in which it is desired to find a decision rule which will reduce to a low level the occurrence of undesirable events. Although it may be possible to formulate such problems analytically (e.g. queueing problems) it may be extremely difficult to solve the resulting mathematical expression. One possibility is to use simulation, but the author gives three examples in which he has been able, by assuming that the probability (frequency) of the undesirable event will be low, to simplify the mathematics to manageable proportions. Having solved the reduced problem, it is necessary to check that this solution remains satisfactory.

Vol. 20, No. 2, June 1969

This paper describes a practical method of machine/job scheduling where set-up times are necessary between jobs. The method is based on the optimization of a set of permutations, the permutations being the number of ways in which the jobs could be allocated. A first possible solution (initial permutation) is found, and then it is improved by switching either single jobs or, more usually, sequences of jobs.
ZIOTNIS, S. Towards a Unifying Theory for Integer Linear Programming
The suggestion in this letter is that many of the methods which have been proposed for solving 'all integer' or 'mixed integer' programming problems can be put into a common framework. The method proposed involves the imposition of both upper and lower bounds on all variables, and the progressive tightening of these bounds as the calculations proceed.

LACHENBRUCH, P. A. Frequency and Timing of Intercourse: Its relation to the Probability of Conception
A good deal of research on fertility during the last few years has been concerned with the detailed analysis of the processes involved in family building. Thus births may be analysed into conception and foetal death; the periods exposed to risk may be calculated excluding periods of pregnancy and post-partum amenorrhoea, and the chance of conception may be classified according to factors such as the size of the family, interval since previous birth, and coital patterns. Investigation into these items would be carried out by means of stochastic models, two examples of which are to be found in this volume.

Srinivasan derives 'expected' values of the intervals between successive births, and the interval since the latest births, from assumptions as to the monthly chance of conception, etc. These expected values can be compared with actual values derived from sample surveys. The model is being tested on data collected currently in fertility surveys conducted in India.

MEEGAMA, S. A. Malaria Eradication and Its Effect on Mortality Levels
The dramatic fall in mortality rates in Ceylon which occurred when malaria was eradicated after the second world war is well known. In this paper Meegama points out that the reduction in the number of deaths was of the order of five times the number of deaths actually ascribed to malaria. Hitherto, it has been thought that malaria as 'the great debilitator' tended to lower the general health and resistance to disease of the population and so aggravated substantially the effects of other diseases. There was, however, a considerable expansion in the public health and medical services in Ceylon during the late 1940s, and by means of an analysis of mortality changes in certain areas in Ceylon, and a comparison with Guatemala, where the eradication of malaria was not accompanied by an expansion of public health services, the conclusion is reached that malaria eradication does not necessarily lead to a great decline in the death-rates from other diseases, but certain other factors have also to be present. In Ceylon, the operative factors were rural hospitals and maternity homes, para-medical health services and free milk.
OPPENHEIMER, V. K. *The interaction of demand and supply and its effect on the female labour force in the United States*

Up to 1940, most working women were young women who had not yet married, or, if married, had not yet started child-bearing. The 1950 and 1960 censuses, however, indicate that large numbers of married women aged over 35 are now returning to the labour force or even entering it for the first time. After considering various measures of the supply and demand of female labour of various types, the paper suggests that while the demand for female labour has been rising, the supply of the traditionally more preferred type—the young woman—was declining. In response to this declining supply, demand readjusts itself so that workers who used to be discriminated against are now acceptable and, perhaps, even sought after. In turn, this broadening of the demand for female labour led to an increase in the supply of older married women to the labour market.

Volume 22, Nos. 1, 2 and 3; March, July and November 1968

DAY, L. H. *Natality and Ethnocentrism. Some Relationships suggested by an Analysis of Catholic–Protestant Differentials*

This Paper surveys fertility differentials from a number of countries with 'distinguishable' Catholic minorities, and also Protestant and Catholic countries where fertility is low, in conjunction with indicators of the level of economic development. The conclusion is that Catholic pro-natalism tends to increase fertility only under two conditions. Firstly, that there is a high level of economic development; that is, a climate in which one could reasonably expect both the predisposition and the opportunity for effective control to be most widespread. The second condition is that the persons at whom pro-natalist teaching is directed think of themselves as members of an important minority group in the population. It is suggested that members of a group such as the Roman Catholic Church will be more aware of membership of the group and consequently more receptive to the values and attitudes associated with membership, where they are conscious of minority status. Mr Day's conclusion is that any future liberalization of the Church's position on birth control will be of little direct help in solving the population problem in underdeveloped Catholic countries, apart from the indirect effect of removing some of the political barriers currently impeding education in the practice of family planning.

CHOU, R. C. AND BROWN, S. *A Comparison of the Size of Families of Roman Catholics and Non-Catholics in Great Britain*

An analysis of data from a 1966 sample survey of married women in Great Britain was analysed to compare 'ideal' and actual family size between Roman Catholics and others, allowing also for variables other than religion (occupation, age, and age at marriage). Data for 526 women were analysed, half of whom were Roman Catholics. Catholics prefer larger families, the average difference between the ideal family size of Catholics and Non-Catholics being about half a child. The number of live births was also higher among Catholics.

GLASS, D. V. *Fertility Trends in Europe since the Second World War*

This Paper, prepared for the University of Michigan Conference on fertility and family planning, held in November 1967, discusses developments since the war—but largely initiated in the 1930s—which have considerably narrowed the range of
fertility in Europe. In many western and north-western countries age at marriage has fallen and the probability of marriage has increased, especially for women. In such countries, too, marital fertility has tended to stabilize and in some cases has risen—partly but not solely a function of changes in age at marriage. In southern and eastern Europe, by contrast, the decline in marital fertility has continued especially in those eastern European countries in which the grounds for legal abortion have been greatly extended and where legal abortion has come to be used as a major method of birth prevention. Within countries there is evidence of a reduction in socioeconomic differences in marital fertility.

**Keyfitz, N. Changing Vital Rates and Age Distributions**

Improvement in the death-rate may make the population consist more of young people or more of old people, depending on the ages at which the improvement takes place. A numerical measure of the age-incidence of mortality improvement is the change in average age of the stable population, with fertility held constant, but with new mortality substituted for the old. A neutral change in mortality is defined as one which is either constant at all ages or has an incidence such that the age distribution as measured above is unaffected. The effect of fertility changes is also analysed; as the interaction between mortality and fertility turns out to be small, the meaning of the mortality component is relatively unambiguous. An analysis of (among others) English records shows that at the start of records the effect of mortality decline was to make the population younger, as occurs now in under-developed countries. At the end of the 19th century, and again at the present time, however, mortality improvements tend to advance the mean age.

**Wolfers, D. The Determinance of Birth-Intervals and their Means**

Two physiological determinants of the interval between two consecutive live births are the duration of post-partum infecundity, and the monthly probability of conception. The author discusses ways in which the observed distribution can be analysed, and points out that women who naturally have a shorter birth interval will be more strongly represented in the data as they will give rise to more births. A method is presented for obtaining a quantity called the mean birth interval (women) which fulfils the condition that all women in the sample population are equally represented.

**Demographic Institute, University of Göteborg, Sweden**

**Hyrenius, H., Holmberg, I. and Carlsson, M. Demographic Models DM3**

Some of the work on simulation models which has been carried on at Göteborg has been described in reports previously noticed in these pages. The present report describes the construction and testing of a dynamic model, in which the mortality, nuptiality and fertility are assumed to take the form of functions which change with time. In this way it is hoped to study the 'demographic transition', the progression which has occurred in industrial countries from high levels of fertility and mortality to the current low levels. Sweden is unique in possessing statistics covering the transitional period, and parallel with the work to secure improved input data, a fresh scrutiny of these older statistics has been made, on the basis of which the development of the Swedish population is being subjected to closer analysis. No doubt future reports will be issued giving the results obtained with the model.
WHEATCROFT, G. S. A. *The Present State of the Tax Statute Law*

Prof. Wheatcroft first describes the present state of the law, as represented by statutes, regulations and reported decisions of the courts, dealing with Income Tax, Estate Duty, Capital Gains Tax and Corporation Tax. He deduces that in its present state the tax statute law is extremely untidy and difficult to follow, and that this makes the teaching of tax law more difficult, the giving of advice more time-consuming and the comprehension of the law by the taxpayer more uncertain. He makes certain suggestions for improvement of the existing law, first by consolidating the existing statutes, and then by a critical examination with a view to simplification; any future amendments to the law should be by way of textual amendment to the consolidating act which should be reprinted annually. He makes a plea for introducing a relaxation into the rule of budget secrecy, so that draft taxation provisions could be discussed thoroughly before being given the force of law.

SHEPHERD, J. R. AND SURREY, M. J. C. *The Short-Term Effects of Tax Change*

The effects of any tax change can be divided into direct and indirect effects; for example an increase in the rates of income tax means that consumers have less disposable income and their spending is reduced (not necessarily proportionately); this is the direct effect, and in consequence output of consumer goods falls, which in turn leads to lower incomes from wages and profits, and so to further reductions in spending and so on; all these being indirect effects. This article describes a formal model consisting of a set of equations from which, given the direct effect, the indirect effects on the main national accounting aggregates can be calculated. The model is designed to cover a period of two years, as beyond this it is unlikely to give satisfactory results, and provides estimates for each of the eight quarters following the change. As an illustration, the effects of a reduction of 6d. in the standard rate and 3d. in each of the reduced rates of income tax for the 1968/69 financial year are computed. Details of the equations used, though not of their derivation, are given in an appendix.

TAYLOR, B. *Investment: Art, Science or What?*

The author defines three component functions of investment management; that of the security analyst who forecasts the expected yield of a security and the risks associated therewith; the portfolio analyst who selects efficient portfolios to combine either the minimum total risk for a given yield, or the maximum yield for a given risk; and the investor who chooses the most appropriate portfolio from those presented to him by the combined work of the portfolio and security analysts. He then goes on to consider the assessment of portfolio performance, and starts with the yardstick by which performance is to be measured; this should be the
unmanaged portfolio most relevant to the investor in question, should deal adequately with irregular receipts and outlays, and should make it possible to decide whether a better than average performance has been due to skill, or merely to random fluctuations. A possible solution divides the performance of the fund into two parts, yield and degree of risk. It appears that patterns of share behaviour on which predictions can be based are rare; the author suggests that it is up to the 'chartists' to prove that such patterns do exist. Suggestions for the use of computers as tools for investment analysis are given. In conclusion the author states that the end-product of investment work is security dealing which is more profitable than random selection. The question of science or art can only be settled by such a comparison which involves continuous measurement of performance, precisely and rigorously assessed.

Money Supply and the Banks

February 1969

Money Supply and the Banks

This article is a further contribution to the debate on the importance of the supply of money as a key factor in national expenditure and inflation. The definition of money supply is first considered, and a distinction is drawn between money in the sense of that which can be spent immediately and near-money such as a deposit with a building society which is moderately liquid but cannot be spent directly. The inadequacy of present statistics is pointed out, as is the relevance of velocity of circulation to the discussion. Additions to the stock of near-money do not necessarily or even probably, represent deductions from the amounts which would otherwise have been deposited with banks, but do tend to limit the willingness of the public to hold deposits and also the ability of the banks to create new deposits. Over the period since 1946, the course of government finance has been such as to increase the liquid assets available to the banking system, but this has been partly offset by the action of the public who have preferred to transfer some of the deposits so created into forms of near-money. It is suggested that bank deposits in relation to gross national product, had become out of line at the end of the war, and until gross national product had caught up in the late 1950's bank deposits grew only slowly; since then the two have moved very much in line.

Three Banks Review

March 1969

Tress, R. C. The Next Stage in Regional Policy

This article reviews the changes which have occurred since the publication of the Barlow Report in 1940. It states that while broad national policy continues to be ruled by the assumptions in that report, the time has come to institute a new policy more in tune with the needs of the times. The two principles on which the Barlow recommendations are based are dispersion of population and employment out of the conurbations and development of industry in the depressed areas. Experience has shown that development in the sense of taking work to the depressed areas is inadequate to the task set for it, and dispersion is likewise inadequate to the scale of population growth which requires to be accommodated, and to the style of life which today's citizens choose. It is suggested that the correct course to follow
is to consider the technical requirements of industry—not as restrictive as they once were but still important—and build up a policy for the location of industry therefrom; then to translate the claims of industry for particular sites into populations and thence to ascertain what further additions to employment would be necessary to make these populations into viable communities; finally to provide the infrastructure which will bring about this desired pattern of location.

JOURNAL OF COMMON MARKET STUDIES
September 1968


This article shows, by example, the difficulties but also the opportunities, in technical co-operation between countries. Difficulties have arisen in European technological effort because of a tendency to treat each project separately rather than as part of an overall programme. Without a consensus of opinion about the objectives of such effort, results are unlikely to be spectacular. The options available are either to develop such agreement about objectives as to make a strong technological authority possible, or to attempt to develop national solutions, even though the cost might appear prohibitive.

JOURNAL OF ACCOUNTING RESEARCH
Vol. 6, No. 2, Autumn 1968

BRIEF, R. P. AND OWEN, J. A Least Squares Allocation Model

This short paper gives a method of allocating joint costs between various activities. The method used is essentially to minimize weighted sums of squares of deviations from expected values, and attention is given to various systems of weighting which could be used. The mathematics is developed in an appendix.

EMPIRICAL RESEARCH IN ACCOUNTING
Selected Studies, 1968

GREENBALL, M. N. Evaluation of the Usefulness to Investors of Different Accounting Estimators of Earnings: a Simulation Approach

This paper is an attempt to provide a means of answering the question: 'Do certain accounting methods generate earnings estimates which are more useful to outside investors than those generated by other accounting methods?' A simulation experiment consisting of 110 runs characterized by (1) a set of market opportunities, (2) the prices of these opportunities, (3) accounting information, (4) investors and (5) a success index. (1) Consists of a set of 20 firms each beginning operations at time 0 and ending T decision periods later; each firm manufactures and sells a single product, subject to a market demand function and a production function requiring material, labour and plant inputs. The accounting periods of each firm do not coincide with decision periods. For (2), the price of each firm's shares, a cash dividend is assumed paid just prior to the end of each decision period; however here owners are assumed to pay no taxes and to be indifferent between cash dividends and capital gains; market prices of shares are generated by a random walk process about a normal rate of return independent of the firm and the time. Six separate
accounting estimators were tested, and seven investors were assumed, one making use of earnings data produced by each accounting estimator and one relying on no earnings data.

Although the results of the study are interesting in themselves, the chief interest lies in the use of a simulation model as a means of deciding the usefulness to investors of different accounting methods; the value of this tool of research is only now becoming widely appreciated.

**STORE, M. L. Problems in Search of Solutions**

An article by the President of the American Institute of Certified Public Accountants setting out the need for research, some topics in which research is necessary, and the necessity of making the best use of resources. Of interest to anyone interested in the problems of research in any profession; the particular topics may not interest any individual but the philosophy expressed in the article should appeal to all.

*The Banker*

March 1969

**SANFORD, C. T. AND WRIGHT, P. M. Estate Duty and Long-term Capital Gains**

This article attempts to throw some light on the effects of inflation, direct and indirect, on the incidence of estate duty. The authors use a property price index calculated on four groups of assets—cash and fixed interest securities, ordinary shares, land and finally residential and industrial buildings. Over the period 1949–67 the property price index has increased in roughly the same proportion as the retail price index, but in the case of the property price index the bulk of the increase came in the second half of the period, whereas the retail price index rose more rapidly in the earlier half. By calculating the property price index, weighted by asset distribution in 1957–58, for each range of estate separately, it appears that the owners of the larger estates have been more successful in retaining their real value. The authors conclude with a plea for a wholesale reform of estate duty legislation.

April 1969

**DU CANN, E., HOLDER, F. W. AND PALAMOUNTAIN, E. Unit Trusts: a Survey**

These three articles discuss firstly the growth and prospects of the unit trust movement, secondly the entry of the banks into unit trust management and thirdly the linkage with life assurance. Most actuaries will be more concerned with the third article by Mr Palamountain. He gives the history of the linkage of unit trust with life assurance, and of the life assurance tax relief, and concludes that it is reasonable to suppose that no discriminatory action against equity-linked policies to render premiums ineligible for tax relief will be proposed. He then considers the relative attractions of conventional life assurance with terminal bonuses and true equity linked policies, and concludes that there is a place for both. Finally there is a brief mention of the adaptation of equity-linkage to pension contracts.

**Publications Issued by Her Majesty's Stationery Office**

*Occupational Pension Schemes: Third Survey by the Government Actuary. (5s. 6d.)*

A sample survey of pension schemes in the private sector of the economy, together
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with a complete survey of public sector schemes, was made at 31 December 1967. The rate and validity of response were examined, and details are given of:

(i) The estimated number and size of schemes, and the number of employers and employees involved.
(ii) The amount of contributions paid by employer and employee and the method of calculation, together with the overall income and outgo of schemes.
(iii) The conditions for entry, number contracted out, pension ages and benefits at normal and early retirement; also subsequent augmentation of pension.
(iv) Death and withdrawal benefits.


These regulations reduce from five to three years the maximum interval between valuations for new friendly societies engaging in long-term business, and other societies in respect of their life or endowment business where the funds exceed £1,000,000 or the annual premium income £150,000.

National Superannuation and Social Insurance: proposals for earnings-related social security. (Cmd. 3883) (6s.)

This White Paper proposes an earnings-related scheme for national pensions and incapacity benefits, whose levels will be reviewed every two years. Initially employees will pay 4¾% of their earnings through the PAYE system, up to a limit of 1½ times national average earnings; employers will pay an amount equivalent to 4½% of their employees earnings, without limit, together with ¼% to the Redundancy Fund. Each side will pay a further 2% toward the cost of sickness and injury benefits and the National Health Service. The Exchequer will contribute 18% of the amounts paid by employers and employees.

Benefits will be related to 60% of earnings up to half the national average, with 25% of earnings between half and 1½ times that average, and the transition will be accelerated to give full benefits after 20 years.

Pensions (Increase) Act, 1969. (2s.)

The Act supplements public service pensions by 2% for each complete year of retirement before 1 July 1968, with a maximum of 18% for those who retired not later than 1 July 1955.

C.S.O.: Statistical News 3. (6s.)

The five main papers are on developments in input–output statistics; on civil aviation statistics; on invisible earnings and payments; on the new standard industrial classification (by R. E. Beales, F.I.A.) and on an integrated mathematical model of the fuel economy by C. I. K. Forster, F.I.A. and I. J. Whitting.

Sample Census, 1966: England and Wales: Migration Summary Tables, Part 1. (£2. 10s.)

The numbers changing their usual address within one and five years previous to the census date are given by age, sex, marital condition, region (both of present and previous address) occupation and socio-economic group. A Regional Report will deal with migration between areas within regions.

The Registrar General's Statistical Review of England and Wales, 1967, Part II Tables, Population. (£1. 10s.)

A new Table gives the annual net movements of migrants according to country issuing passport.
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The Registrar General’s Decennial Supplement, England and Wales, 1961: Area Mortality Tables. (£1. 15s.)

The volume gives live and still births, still-birth rates, death and death-rates by certain cause of death and region for 1959–63. Deaths and death-rates are further subdivided by sex and age-group (under 4 weeks; under 1 year; 1–4; 5–14; 15–44; 45–64; 65 and over). An appendix gives the 1961 Census population by sex, age-group and hospital region.

Users are warned that the figures relating to urban areas have been substantially altered in the list of corrections subsequently issued.

Employment and Productivity Gazette, May 1969 (Vol. LXXVII, No. 5). (6s.)

This issue contains the first part of a sample survey of earnings in September 1968, giving the distribution of earnings by occupation, age-group and region.