Appendix 4

The results, (4.3), (4.4), etc., are all direct or indirect consequences of the following simple lemma:

Let m have the distribution (2.3), i.e. be binomial with parameters η and K, and let s, t and j be non-negative integers; then

$$E\{m^{(s)}(K-j)^{(m-t)}/K^{(m)}\} = \eta^s(1-\eta)^{j-t}(K-j)!\times(K-j+t-s)! \quad (A4.1)$$

Proof: First note that $\binom{K}{m} = K^{(m)}/m!$; thus

$$\sum_{m=0}^{K}\binom{K}{m}\eta^m(1-\eta)^{K-m}m^{(s)}(K-j)^{(m-t)} =$$

$$\{(K-j)!\,(1-\eta)^{j-t}/(K-j+t)!\}$$

$$\times\sum_{m=0}^{K-j+t} m^{(s)}\binom{K-j+t}{m}\eta^m(1-\eta)^{K-j+t-m}$$

$$= \{(K-j)(1-\eta)^{j-t}/(K-j+t)!\}\,E\{m^{(s)}\}$$

(where now m is binomially distributed with parameters η and $K-j+t$)

$$= (K-j)!\,(1-\eta)^{j-t}/(K-j+t)!\,\eta^s(K-j+t)^{(s)},$$

which is the same as (A4.1).

For example, from (3.1)

$$E\{(m-1)\Pr(D=d|m)\} = E\{m(m-1)(K-d)^{(m-1)}/K^{(m)}\}$$
$$= (K-d)!\,\eta^2(1-\eta)^{d-1}/(K-d+1-2)!$$

which reduces to (4.3).

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Book review

Introduction to Decision Science, by S. M. Lee and L. J. Moore; 589 pages. (*Petrocelli/Charter, Input Two-Nine*, £9·00)

Business applications of decision sciences, by S. Paranka; 156 pages. (*Petrocelli/Charter, Input Two-Nine*, £6·00)

It is natural that those who have had experiences of teaching classes at universities or similar institutions should find it convenient to collect their lecture notes, to add to them and to edit them, and then to offer them, in book form, to a wider readership. Both these books appear to have had this origin. Such texts are certainly of use to the author's students. What we are interested in is if there is some more extensive public which could profit from them.

Although the titles of these two volumes might give a different impression, they are addressed to the same audience. The much larger one, entitled *Introduction to Decision Science*, is according to its preface 'intended primarily for undergraduate students of business, administration, social sciences and engineering', while the smaller one 'should be useful as a text for an advanced undergraduate course or a graduate level course in business decision making'.

Both deal, at different lengths, with modelling, Bayesian decision making (Paranka on 14 pages, Lee and Moore in a short section with the final remark: 'there is no unanimous opinion among scholars and practising managers about the Bayesian decision rule's superiority over other decision analysis techniques under uncertainty'), linear programming, queueing theory, simulation, Markov analysis, and inventory control.

Lee and Moore have also one chapter each on network models: PERT-CPM, and on game theory (but not on bidding), Paranka has three chapters concerned with computers (hardware as well as software), and one on regression and correlation. In the Lee-Moore book reference to computers appears in the appendix, which contains programs for linear programming and for goal programming, in FORTRAN.

Both books have, of course, references, and Lee and Moore have also, after their chapters, 'Questions' and 'Problems' (roughly: theory and practice). To compare the treatment of selected topics, covered in both books, we choose linear programming, and queueing.

Paranka has a chapter 'Linear Programming Model' of 18 pages, with a very brief description of the concept, describing well the graphical approach with two variables, and somewhat clumsily the 'algebraic method', about which he states: 'although the algebraic solution can handle more than three variables, it is not an efficient method. The Simplex Method is the easiest and quickest approach to finding the optimal solution (page 56). The latter method is presented 'conceptually' on a few pages. There follow applications to capital budgeting, and to media allocation.

Lee-Moore have four chapters on the same topic: Linear programming: Introduction and graphical solutions; Simplex method of linear programming; Goal programming; Transportation and assignment methods. These cover 212 pages. Topics not dealt with by Paranka are sensitivity analysis, details of the simplex method, and those of the last two titles mentioned. Goal programming, in particular, attempts to minimize deviations from desired goals, and the treatment leans heavily on the publications and joint-publications of the first mentioned author.

The chapter on Queueing Theory in Paranka's book (16 pages) relies mainly on simulation. That on 'Waiting line analysis—Queueing theory' (42 pages) in the larger book deals more extensively with basic theory. (We might mention here that we have used the spelling 'queu(e)ing as it is done in the two books.)

The general impression of the *Introduction to Decision Science* is that of a text from which a manager can get a reasonably clear idea of what techniques of this science are about. Paranka's book might serve a similar purpose for those who are less interested. But will they want to read such a book at all? Both books are typical products of the trans-Atlantic climate in business education, and they are not the worse for it. But their wide dissemination into the British market must be doubtful.

S. Vajda (Sussex)