

In his third closing comment with respect to company objectives, Mr. Rodermund, in my opinion, misses the point. The objective of this method is not to tell a company which natural markets it ought to seek, because each company has an operating philosophy and a base of operations which is fundamental to the operation of that company. Much of this basic philosophy can be reflected in Ferrari's approach as shown by the examples. It is a credit to the technique that it is able to accommodate this type of restriction rather than requiring a company to either write a maximum amount of one line or write none of it.

In summary, I believe that this paper represents one of the landmarks in actuarial work and will be referred to many times over the years as actuaries attempt to quantify the decision making processes in the insurance business. Providing more information and eliminating the guesswork in certain areas can only lead to sounder decisions and a greater degree of confidence in the conclusions reached.

AUTHOR'S REVIEW OF DISCUSSIONS

The author is gratified that his paper on portfolio selection inspired comment by four reviewers of considerable stature in the insurance industry. The large body of literature on portfolio selection is no longer void of an application to the property and liability insurance business and the dialogue contained in the reviews is a welcome supplement to the original effort.

Much of the criticism contained in the reviews was predictable since the same limitations of portfolio selection can be found in the financial literature on securities portfolios. Indeed, many of the problems surrounding practical application were suggested in the paper and the reviewer, in some cases, simply expanded on them.

Rennie seems particularly disturbed over "the assumption that the expected return and risk on each line of insurance are single valued, regardless of the proportion of the total portfolio committed to that line of insurance." This is a valid concern but Rennie did not give the author credit for recognizing this problem. The author states that "Perhaps the most troublesome problem with the input to a portfolio selection model is that the assumptions of risk and return may not hold up if an attempt is actually made to acquire a prescribed portfolio," and then goes on to discuss this admittedly troublesome limitation.

The author agrees with Bondy that one should not resign himself to losses in certain lines, but he would also argue that if the likelihood for im-

provement of an unprofitable line is remote, then an expectation of loss may be a warranted assumption, at least in the short run or until underlying conditions are changed. Bondy also points out that the nature of the insurance business forbids solutions that prescribe movement in opposite directions of complementary lines. He uses as examples increases in fire and auto bodily injury and decreases in extended coverages and auto property damage. This is certainly a constraint on portfolio flexibility, but it also suggests that long-range planning should include recognition of possible undesirable effects of complementarity of coverages. The inflexibility that arises from packaging, for example, may involve marginal costs that have been largely overlooked.

Some of the reviewers reaffirmed the author's concern about inputs to the portfolio selection model based on historical data. In a recent issue of the *Journal of Finance* a more optimistic view is expressed by Keith Smith of the University of California who, in discussing historical inputs for investment portfolio selection, states:¹

Although this admittedly has shortcomings, it would seem to be a lower bound on the abilities of security analysts. That is, if portfolio selection and revision are effective using historically generated inputs, then a real-time system, in which subjective factors are incorporated, should work even better.

Rodermund questions the relevancy of the techniques described in the paper and irreverently likens portfolio selection to the twelve-balls problem. Apparently he fails to recognize that portfolio selection techniques, like management gaming, simulation models, and even recreational mathematics, have usefulness not because they always provide answers but because they improve the decision-maker's or problem-solver's ability to identify crucial variables, to detect the impact of constraints and to understand the relationships between alternative decisions and their possible outcomes. To the extent that this is accomplished, the inescapable real-world decision process is improved. The actuary, because of his quantitative orientation, should take the lead in exploring the relevance to insurance of the new techniques in operations research and computer science.

Rodermund attempts to discredit the technique of quantifying subjective judgment by labeling it "seat-of-pants" wisdom. By venturing such an

¹ Smith, Keith V., "A Transition Model for Portfolio Revision," *Journal of Finance*, Vol. XXII, No. 3, September, 1967, p. 431.

unsophisticated objection he appears to be completely unfamiliar with the wide body of literature dealing with the quantification of subjective elements in decision-making. Rodermund is quick to dissent without considering the advantages of attempting to quantify all or part of the decision process such as (1) the focus of attention on pertinent variables or relations that might otherwise be ignored or treated superficially and (2) the testing of assumptions, expectations, and proposed decisions on an experimental basis.² Also, the power and versatility of a computer can be best utilized only after a problem has been described in quantitative language. Thus, quantifying a problem may improve decision-making either directly, by facilitating better understanding of the problem, or indirectly, by allowing the high-speed calculating capacity of a computer to aid in the analysis of complex situations. Naturally, there are limitations but as one author has so aptly stated, ". . . quantitative analysis can lead either wittingly or unwittingly to error, but that does not mean that nonquantitative analyses are any less misleading."³ It is ironic and unfortunate that Rodermund should present his criticism just a few hours before Sterling T. Tooker was to deliver an address to the Society urging the casualty actuary to "change from the comfort of his traditional role and accept an area of responsibility in which his errors can be both seen and quantified, and often corrected."

The actuary has developed little solid theory that either explains or prescribes decisions regarding the composition of a company's insurance portfolio. The paper on portfolio selection was an attempt to fill partially the gap between theory and practice. It is hoped that the potential of portfolio selection techniques in insurance suggests additional questions to the creative actuary such as:

1. Of what practical significance is the fact that portfolio selection analysis can provide a theoretical justification for insuring unprofitable lines?
2. Is portfolio selection theory, with risk measured by variability of returns, more relevant to company decisions than the actuarial theory of ruin, where risk is viewed as the probability that losses will exceed a certain amount?
3. Does portfolio selection analysis offer the potential for a novel look

² For a discussion of these and other advantages see, for example, Holt, Charles C., et al., *Planning Production, Inventories and Work Force* (Englewood Cliffs, New Jersey: Prentice-Hall, 1960) p. 10.

³ Kahn, Herman, *On Thermonuclear War* (Princeton, New Jersey: Princeton University, 1960), p. ix.

at the provocative proposition of including investment return in the rate-making process?

4. Does a company have objectives with regard to the composition of business in its insurance portfolio, or is the portfolio the result of numerous uncoordinated decisions?

The relevance of the original paper should be clear from the broad theoretical and practical issues it raises and the author commends and thanks the Society for inviting him to present it. This investigation of a technique not traditionally used by the actuary hopefully provides an example of the kind of thinking urged by Mr. Tooker when he told this Society, "we urgently need a broader application of your skills and training to contribute to the success of our business."