

## DISCUSSION BY COSTANDY K. KHURY

Several readings of this paper made it eminently clear that a thorough study of the underlying bibliography is essential for a concise understanding of the proposed concept. In the process of studying Bierman and Hausman's article<sup>1</sup> (B&H) much of the initial gloss and promise which had originally stimulated my interest to thoroughly digest the paper dissolved and moved me to pen this discussion.

At least an assumption, a condition, and a constraint clearly spelled out by B&H are specifically either omitted, revised, or inaccurately reproduced without appropriate, and more importantly, necessary accounting by Cozzolino and Freifelder (C&F). In this manner much of the motivation for the effort as presented by C&F (based on bibliographic equivalence) is open to question. A few examples follow:

- A. An Assumption Omitted: The multi-stage dynamic programming model as constructed by B&H specifically assumes that once a default occurs credit will (theoretically) never again be extended. C&F, in adapting the model to the underwriting decision, faithfully reproduce the model but without carrying the implicit assumption through that once an insured incurs a loss, insurance is no longer afforded at subsequent periods during the implied renewal horizon. In other words, given a particular choice of  $(a, b)$ , there is an immediate implied assumption that there exists a period (horizon) such that if the risk incurs a loss within this period, then insurance will not again be afforded. The ultimate implications of this operating assumption appear to be at odds with the stated objectives of the paper. That is, strict application of this concept will "cause" profitable risks to be overlooked.
- B. A Condition Revised: The paper (C&F) recognizes frequency as the sole objective criterion entering the construction of  $V_m(a,b)$ . B&H, on the other hand, do recognize the amount of credit to be granted in the construction of the model. C&F revised this necessary operating condition by suppressing the severity element by way of utilizing the mean expected loss cost value. The implications of this revision are tantamount to underwriting a risk at renewal time which has incurred a loss and reaching the same

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<sup>1</sup>H. Bierman, Jr. and W. H. Hausman, "The Credit Granting Decision," *Management Science*, Vol. 16, No. 8 (1970)

yes/no underwriting decision whether the loss is a \$300 collision loss or a \$10,000 bodily injury liability verdict.

- C. A Constraint Inaccurately Reproduced: The time value of money concept along with the lapse problem both tend to effectively diminish the actual derivable value of the proposed approach to evaluating the individual driving record. C&F present these factors as important considerations while the B&H construction, in fact, recognizes these elements only as incidental and that their impact "may be" included. C&F are ultimately strained in effectively incorporating the full impact of these elements in the final constructions.

These examples, I believe, illustrate the degree to which the stated adaptation of C&F departs from B&H vis-a-vis the "entire compatibility" claim as made in the paper.

It was not entirely clear at first, but upon close scrutiny several necessary delineations were missing such that the full intent of the authors is often in doubt, to wit:

- A. C&F repeatedly speak of "good" and "bad" risks in an absolute sense. It is axiomatic to the practitioner that any risk may be protected (insured) against any hazard/peril at "some" price . . . not necessarily always affordable. Inasmuch as all the formulas and constructions utilize an implicit pure premium base, it is practically a mandate that the authors should delineate risks by way of a potential profitability standard instead of the phantom absolute good/bad standard.
- B. The terms "claim" and "accident" are used interchangeably throughout. Is the reader to assume (accordingly) that culpability is not a factor in the underwriting process . . . or is accident involvement the only criterion?

The repeated lack of specificity does little to help the authors define the precise extent of the idea embraced by their effort.

The basic yes/no criterion, as spelled out in the paper, depends on the prospective validity of:

$$\text{Premium} \geq \text{EV (accident costs)}$$

with appropriate qualifications to both sides of the inequality. In this man-

ner the size of Premium - (EV) is immaterial as long as it is non-negative. In other words, the size of the anticipated multi-period profit as compared to the capital and surplus required to support the corresponding written premium throughout the same multi-period is not a factor. This assumption is not realistic, and, the model [should] can be easily modified to accommodate a risk loading [ $\epsilon$ ] criterion such that:

$$\text{Premium} \geq \text{EV} + \epsilon (\text{Premium})$$

The investor is more apt to view this approach more seriously to the extent that from his point of view elegance is not presumed to really matter!

The authors' stated objective is aimed at aiding the underwriting process. B&H distilled their conclusion, with full qualification, into a decision table which in turn eliminates the need for computation of the profit expectation for each case separately. Accordingly, perhaps the primary application with respect to insurance should be effected by the agent. In other words, a decision table would be produced for each classification such that the agent could look-up whether the prospect is eligible or not. In this manner administration of the proposed multi-stage model is essentially expense-free. Also, the decision table would naturally reflect the most recent pure premium level, thus preserving the various profitability criteria.

This particular arrangement may be difficult for the authors to accept in view of the particular demonstration outlined in the paper. For example, reviewing Section 3 of the paper, one can spot a "large" gap whereby the authors pass from (emphasis added):

"... records of the applicant's rate class and other factors. . . ." to:

"The expected underwriting profit is negative and this applicant is rejected."

and thereby relegate the initial contribution of the driving record to "other factors." Later on (Section 5) the same gap appears where an (*a, b*) combination is produced presumably on the basis of such "other factors." The decision table approach proposed above would force the identification of these mysterious "other factors" and therefore demonstrate how the process initially takes classification attributes and "updates" them to include an individual's driving record. This is a most critical point which neither B&H nor C&F resolve.

Finally, one point which I could not reconcile in my mind. What is the

impact of assuming a static pure premium at all branch points of the decision tree? It is not difficult to conjecture that if a risk is "surcharged" after an accident has occurred, then more risks would satisfy the basic yes/no criterion. This is one variation which, if incorporated in the model, will significantly alter the modus operandi and perhaps present yet another opportunity for further research.