DISCUSSION BY JAMES F. GOLZ

Mr. Ferguson has given us an admirably clear and concise case for the use of temporary annuities in the calculation of net reserves under excess of loss reinsurance. Mr. Ferguson points out that one should not simply take the primary retention as the net reserve whenever the direct reserve exceeds the retention. In order to properly reflect the benefits to the insurer of interest earnings and mortality experience, the net reserve should equal the present value of a temporary annuity of period sufficient to accrue benefits equal to the retention. The ceded reserve is then the present value of an annuity deferred for this same period. The sum of the two will, of course, equal the original direct reserve. Mr. Ferguson illustrates the situation with examples based upon reinsurance excess of $50,000 and $100,000 retentions.

However, a major insurer, if it has excess of loss reinsurance, is likely to operate under a retention considerably greater than those used by Mr. Ferguson. If for example the retention were $250,000, then even with a pension of $10,000 a year, the direct reserve would exceed the primary retention only for a annuitant under fourteen years of age if we use the table accompanying Mr. Ferguson's paper (Survivorship Annuitants' Mortality Table at 3%). And might not inaccuracies in non-pension portions of the reserve outweigh the difference between the "correct" and "incorrect" methods of splitting the direct reserve?

There is the additional problem of catastrophes. When the reserve is composed of more than one pension, one should calculate the net reserve as the sum of present values of each possible primary insurer payment pattern weighted by its probability of occurrence. For example, if annuitants of ages 45 and 55 each receive $10,000 a year paid continuously under reinsurance excess of $250,000 retention, then the net reserve would be

$$\sum_{m=1}^{\infty} \sum_{n=1}^{\infty} ({}_{m-1}|q_{45} \cdot {}_{n-1}|q_{55}) (\bar{a}_{\overline{mm}|} + \bar{a}_{\overline{nn}|})$$

where *mm* and *nn*, the payment years to the younger and older annuitants respectively, are appropriately limited by the primary retention. Such a calculation seems unduly complex.

Mr. Ferguson hypothesizes that the lack of availability of N_x *and* D_x commutation columns may have contributed to the use of incorrect

methods. Although it may not be possible to find the values used in the construction of an annuity table, developing columns consistent with the annuity values is a relatively straightforward process. Having the annuity values $\ddot{a}_x$, one need merely set D_0 equal to some convenient constant. Then $N_0 = \ddot{a}_0 \cdot D_0$ and the columns may be completed by backing off using

$$N_x = N_{x-1} - D_{x-1}$$

$$D_x = \frac{N_x}{\ddot{a}_x}$$

If it is desired, one may conveniently alter the interest assumption of the table by computing

$$D'_x = D_x \cdot \left(\frac{1+i}{1+i'}\right)^x \quad D_x \cdot \left(\frac{1+i}{1+i'}\right)^x$$

As with any such procedure, one must be careful not to carry the results beyond the significance of the input data.

My conclusion, then, is that the problem Mr. Ferguson has examined is one which occurs so rarely (at least in its simple form) that the benefits of the theoretically correct procedure are outweighed by the efforts of implementing it. Areas such as this do provide an opportunity for fruitful cooperation between insurer and reinsurer. Since reinsurers may suffer more from reserve inaccuracies, they have a legitimate interest in the techniques utilized. Perhaps it is time for reinsurers to help develop and implement reserving methods which serve their needs as well as those of primary insurers. In this respect, Mr. Ferguson's article forms an excellent first step.

AUTHOR'S REVIEW OF DISCUSSIONS

I am grateful to Mr. Golz for an interesting review of my paper. Mr. Golz accomplished at least three things in his review: he presented his opinion that the reserving technique is probably not worthwhile since the basic problem does not occur frequently; he pointed to a significant gap in my paper, as respects catastrophes; and he provided us with a technique for determining working values of N_x and D_x given only $\ddot{a}_x$.