# CORRESPONDENCE

## A Formula for Approximate Integration

The Editor,                                     14 *March* 1946
*The Journal of the Institute of*
  *Actuaries Students' Society*

Sir,

Of the formulae for approximate integration given in the text-books *Actuarial Mathematics* and *Life Contingencies* there appears to be none that lends itself to the evaluation, without the use of fractional ages, of an integral where the limits of integration differ by 5, 25, 35, 55, etc., years, i.e. an odd multiple of 5 that is not also a multiple of 3. This seems rather strange when one considers that temporary assurances requiring, for example, the evaluation of 25-year contingent assurances, are not uncommon.

The following formula I derived from first principles, and have since learnt that it was discovered as early as 1722 by Professor Cotes. It is accurate provided sixth differences are zero:

$$\int_0^{5n} u_x \, dx = \frac{5n}{288} \{ 19 (u_0 + u_{5n}) + 75 (u_n + u_{4n}) + 50 (u_{2n} + u_{3n}) \}.$$

The coefficients, expressed to four places of decimals, are ·3299, 1·3020 and ·8681, so that the very convenient form

$$\int_0^{5n} u_x \, dx = n \{ ·33 (u_0 + u_{5n}) + 1·3 (u_n + u_{4n}) + ·87 (u_{2n} + u_{3n}) \}$$

would be sufficiently accurate for many purposes. The error involved, when $n = 1$, would be approximately

$$- ·002 (u_1 - u_2 - u_3 + u_4) \quad \text{or} \quad - \underline{·004 \Delta^2 u_1}.$$

This formula would appear to be useful for any multiple of 5, and particularly for terms of 5, 25 and 35 years when none of the following formulae, Simpson's Rule (repeated), the 'three-eighths' rule,

Weddle's Rule, Hardy's Formula or Shovelton's Formula, can be used directly without requiring the evaluation of functions relating to fractional ages.

I am, Sir,

Yours truly,

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### The Life Table Myth

The Editor,                                  *3 September* 1946

*The Journal of the Institute of*
  *Actuaries Students' Society*

Dear Sir,

With reference to Mr N. E. Coe's letter on 'The Life Table Myth' in the last number, I should like to ask Mr Coe how in fact does the Actuary calculate premiums which yield a reasonable profit? What are the general considerations he mentions? Does he simply do a spot of crystal gazing? It seems to me that provided there is *some* competition between Companies and provided Companies want business the Actuary must pay some attention to actual experience. Like the Railways he charges what the 'traffic will bear', but if he departs too far from 'experience', his competitor is liable to think that it might be profitable to undercut him. A complete monopoly could, of course, take into account the total volume of business only. Within limits set by this consideration it could charge whatever premiums it liked, but even so it would take into account experience and anticipated trends so as to avoid *unnecessary* losses. In other words a 'forecast' of some kind would serve at least as a guide.

Yours truly,

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[*The Editor will be glad to print letters from members of the Society which are concerned with subjects likely to be of general interest to actuaries.*]