

## Practice (non-assessed) question on Graduation and interpretation of results

1. Crude estimates of mortality obtained by a Poisson model have been graduated by a life assurance actuary using a parametric approach with the formula:

$$\mu_x = \alpha + \beta c^x$$

where  $\alpha, \beta$  and  $c$  are parameters estimated by maximum likelihood

- (a) What name do we give to this formula?
- (b) Give two advantages and two shortcomings of this method of graduation compared to other methods.
- (c) If the results of the graduation for ages 30 to 40 inclusive are tested using a chi-squared test, what is the appropriate number of degrees of freedom for this test?
- (d) When the graduation is first performed, an error is made in calculating the mortality rate at age 30. This is not detected by the chi-squared test. Which other test is most likely to detect this error?
- (e) The graduation fails the signs test but the actuary says 'that is okay because I am intending to use these graduated rates for annuity pricing'. Explain how the signs test has been failed and why the actuary might be comfortable with this result.
- (f) The observations used in this analysis included insurance policies sold online and policies sold via a financial advisor. Explain how a parametric formula graduation might be helpful in testing whether mortality varies by sales channel here?
- (g) List 3 other ways in which the observed data might suffer heterogeneity.