The questions below were asked via the Q&A function during the webinar "Graduating Mortality Base Tables - Theory and Practice Part 1" held on 10 September 2025, where the presenters were unable to answer in the time available.

Questions have been lightly edited for sense and typographical errors but are otherwise as asked via the Q&A. We have removed the names of those asking the questions.
We have not deleted or fundamentally changed any questions that were not answered on the day.

Q. I have heard of discrimination laws that prohibit insurers from coming up with different sets of premium rates for males and females. Can you confirm there is no restriction on an insurer to reserve and conduct its own solvency assessment on the basis of gender-specific mortality tables - considering this is purely part of their internal capital management and risk management.
This is correct. Insurers' can utilise gender specific mortality tables for their own internal analysis and risk management. Additionally there is no restriction on Reinsurers using gender based tables for their pricing work.

Q. How do you think graduation techniques compare to survival models?
CMI's approach is based on scheduled data (where records are grouped together), where survival modelling treats each record individually. CMI does hold individual data in some of the investigations which would allow survival models to be considered. The Graduation and Modelling Working Party (GMWP) carried out a high-level investigation into using survival models, concluding that the approach tend to lead to very similar results to traditional schedule-based graduation (at least for quite large datasets), if the same covariates and factors are used.

Q. How would you choose between G3 and the other curves? G3 has less cumulative deviation up till about age 91 or so.
The GoLD chart on page 20 shows the difference between a simple G(2) graduation and the other graduations G(3) to G(6). If a point appears on the x-axis means that there is no difference between the illustrated graduation and G(2). The raw rates by age are also illustrated (as dots with confidence intervals) on the chart, and it can be seen by eye that the more complex graduations fit to these raw rates better than the G(3) graduation.

Q. Does the Poisson assumption that the mean and variance are equal ever hold in practice even for large data sets? Even when it doesn't hold it still needs to be the most commonly used distribution (eg more used the binomial, negative binomial). What exact checks do you normally do to check the Poisson assumption is appropriate?
Overdispersion is a key feature of CMI investigations - that is, that the distribution of events has higher variance than implied by the Poisson model. CMI recognises overdispersion within the fitting process, for example in the SAPS graduations a Quasi-Bayesian information criterion (QBIC) is used alongside a Poisson model - QBIC penalises extra parameters more strongly than BIC, so the fit for each model is the same but QBIC will tend to prefer a simpler model. GMWP looked at using the negative binomial distribution (where the variance is greater than the mean) as an alternative way of recognising overdispersion, but this did not change the resulting fitted mortality rates. This is documented in more detail in the GMWP working paper https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-wp-77

Q. Is there any removal of outliers?
Where data is seen to be incorrect, it is removed from the dataset. In addition, we choose the graduated age ranges and do not graduate where the data is sparse (typically the highest and lowest ages) or where data is likely to fail the assumption of homogeneity (e.g. retirements below age 55). We will address this further in part 2 of the webinar.

Q. Please confirm that the graduation we are covering focuses on one age curve at a time, as opposed to a GLM that can create a fit for multiple rating factors at the same time?
In the first session, we did focus on graduating single curves, though the use of generalised linear models (GLM) by the Income Protection Committee in their latest table was mentioned - the second session will touch on "co-graduation" (which allows us to graduate related tables together) as well. Using GLMs is an approach that is often used in mortality modelling - it can definitely be utilised in graduation, and co-graduation is an example of a GLM.

Q. Where can we get more practical material to practice graduation? I am from a non-traditional background and would like to learn more around this.
CMI subscribers can find the graduation software here: https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-wp-77
The Society of Actuaries (SOA) published a guide to mortality graduation, covering similar ground to the webinars, which can be found here:
https://www.soa.org/49347d/globalassets/assets/files/resources/tables-calcs-tools/2018-stat-mort-graduation.pdf

Q. What is your view on using splines rather than Gompertz–Makeham formulae for graduation?
CMI typically use G(s) on the basis that it tends to provide a good fit (in particular to old-age mortality data) and is likely to be more readily understood than spline models. Approaches using splines or GM(r,s) are likely to be useful for mortality at younger ages, or otherwise where mortality shows a different pattern to the exponential increases typical of old-age mortality. Appendix D of the GMWP report (available to CMI subscribers from https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-wp-77) discusses splines and Appendix H shows some results from using them.

Q. I understand that the focus is on mortality and morbidity. Is the same approach adopted for other decrements
CMI graduates tables where the decrements are mortality and morbidity (in the form of claim inception rates for critical illness and income protection). It is possible to apply the same principles to graduate rates for other decrements, but CMI does not produce such graduations.