ARAB REPUBLIC OF EGYPT
الهيئة العامة للرقابة المالية
FINANCIAL REGULATORY AUTHORITY

EGYPTIAN LIFE TABLES

ELT(14/18)

مجمع المعرفة للثقافة المالية
FINANCIAL LITERACY KNOWLEDGE HUB

Where knowledge is created and disseminated حيث نصنع المعرفة وننشرها

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FRA Chairman

It is with great pride to present in this document the first ever Egyptian Actuarial Life Tables.

The Financial Regulatory Authority (FRA) as the prudential and conduct regulator for all non-bank financial institutions and markets is striving to build a robust insurance sector to achieve the SDGs, support the efforts to increase saving and investment ratios in the economy to promote sustainable and equitable economic growth.

Stemming from the understanding of the extreme importance of data for the insurance profession, The FRA in collaboration with Africa Re-Foundation (ARF) within the framework of a partnership agreement, embarked on an endeavor to construct the first ever Actuarial Life Tables with the financial support of ARF starting from 2021.

After the evaluation of the technical and financial proposals by the relevant steering committee members, Barnett Waddingham (BW) – an actuarial consulting firm – was chosen to construct the first Egyptian Actuarial Life Tables.

The development of the Egyptian Actuarial Life Tables contributes in improving the pricing of life insurance policies. This in turn supports life insurance companies to accurately calculate the premium of insurance products according to Egyptian data and principles from the market experience.

Introducing the Egyptian Actuarial Life Tables marks a key step toward streamlining the life insurance market in Egypt. It is worth mentioning that life insurance companies operating in Egypt price their products based on the English actuarial tables developed in 1967/70 which gave inaccurate and archaic representation of the local life insurance market in some instances. Therefore, it was necessary to construct the new tables to help insurance firms roll out innovative products covering all segments of the society.

This step is just a starting point, as the FRA is embarking on a digital connectivity with insurance companies whereby data gathering pertinent to the updates of the attached actuarial tables will be done accurately and in a timely fashion digitally.

Finally, I would like to thank my colleagues at the FRA, the steering committee, the ARF and all relevant stakeholders for their efforts and belief in this project.

Mohamed Farid Saleh, Ph.D.

Chairman
Financial Regulatory Authority
(FRA)

Financial Regulatory Authority

Egyptian Committee for Actuarial Tables

Proposed actuarial tables

Barnett Waddingham LLP

13 September 2022

Version control

Version	Date	Comments
1	29/07/2021	Initial draft, with individual endowment mortality tables only
2	30/09/2021	Second draft, with further tables
3	25/08/2022	Complete report, including extensions to age 75
4	13/09/2022	Added rates for ages 18 and 19

Contents

Summary

This report contains actuarial tables based on data supplied by Egyptian insurance companies, via the Egyptian Committee for Actuarial Tables (ECAT).

Section 2 discusses the use of these tables.

Section 3 describes the data that was collected, and how we have processed and validated it. As part of the validation process some data was re-submitted, and some data was excluded from the graduations, as it appeared to be incomplete or otherwise unreliable.

Section 4 describes the principles and methods used in the graduation process. These are consistent with the approach taken by the Continuous Mortality Investigation (CMI), which produces actuarial tables for the UK actuarial profession.

We have separated the data into smaller datasets based on combinations of business type (individual or group); policy type (endowment, term assurance or whole of life); cover type (mortality, accelerated benefits and riders); and gender (male, female, or "combined", including cases where gender is not recorded).

We have treated the datasets differently, according to their size:

- Section 5 describes the results of the graduation process for those datasets which were large enough for us to consider a full graduation. In some cases, the results of trial graduations were implausible, so we have used our judgement to adjust the graduation results.
- Section 6 provides supplementary analysis of datasets that are too small to be graduated directly, but can be analysed in comparison to other datasets.
- Some datasets were not analysed at all, as they were too small to produce reliable results.

Appendices contain further details:

- Appendices 1 and 2 describe the data, including the data validation process.
- Appendix 3 has details of the graduations, including parameter values and statistical tests.
- Appendix 4 contains the graduated rates, which are also available in an accompanying spreadsheet.
- Appendix 5 contains a certificate of peer review

1. Introduction

Purpose and scope

The Egyptian Committee for Actuarial Tables (ECAT) appointed Barnett Waddingham LLP (Barnett Waddingham or BW) to construct the first ever Egyptian Actuarial Tables (actuarial tables).

This report describes the dataset underlying the actuarial tables and the construction of the actuarial tables. Version 1 of this report included the proposed mortality tables for individual endowment policies only. Version 2 added proposed tables for other policy types, to age 60. Version 3 extended rates to age 75.

This report has been written by Ben Keating, Lukasz Fronczuk, Viv Maclure and Jon Palin of Barnett Waddingham.

Compliance with actuarial standards

The Institute and Faculty of Actuaries sets actuarial professional standards for its members. This report and the work carried out to produce it is subject to, and in our opinion, complies with "APS X2: Review of Actuarial Work", with Dave Grimshaw of Barnett Waddingham having provided independent peer review. Please see Appendix 5 for further details.

Distribution and use

We have prepared this report for ECAT with the expectation that ECAT will make it available to Egyptian insurance companies, and that it may be made available to other parties. We have assumed that the users of this report have sufficient background and technical competence in insurance matters and that they will seek explanation of any part that is not clear. Judgements as to the conclusions drawn in this report should be made only after studying the report in its entirety as parts considered in isolation may be misleading.

In making available the report, neither ECAT nor BW offer any warranty expressed or implied as to the accuracy of the report or any part thereof or any underlying assumptions upon which the report is based; and the third parties to whom the report is disclosed acknowledge that the report has been prepared for use by ECAT, and not for the purposes of any specific third party, and they undertake not to rely on the report or any part thereof or to treat any part as a substitute for their own due diligence investigations. They also acknowledge and accept that BW and ECAT will have no liability to the third parties for the contents of the report in contract, tort, negligence, breach of any statute of otherwise.

Any reference to BW in any reports, accounts or other published documents or any oral report is not authorised without our prior written consent.

Reliances and limitations

In preparing this report we have relied on the accuracy and completeness of information provided by ECAT, including information received orally, without independent verification. We reviewed this information for reasonableness and internal consistency; this is described in the Data validation section.

This report is based on data and information available to Barnett Waddingham at the time of writing. Barnett Waddingham is under no obligation to update or correct inaccuracies which may become apparent in the report.

This report is subject to the terms, including limitation of liability, set out in the Contract between Barnett Waddingham and the Financial Regulatory Authority, dated 29 April 2020.

2. Use of actuarial tables

The actuarial tables in this report will provide a useful starting point for setting assumptions. However, users of these tables should consider whether these tables are suitable for the purpose for which they would be used and whether it is appropriate to modify the rates to reflect their own portfolios, views and circumstances.

Differences between portfolios

The tables that we have produced are based on a combined dataset, described in Section 3, which has been collected from fourteen Egyptian insurance companies.

We have allowed for variation in claim rates:

- by policy type;
- by age, for all tables;
- by gender, where we have sufficient data; and
- by policy duration, where there is a clear difference in claim rates.

However, claim rates may vary by other factors, including benefit amount, occupation, and other measures of affluence or socio-economic status. Users of the tables should consider modifying the tables before using them for their specific portfolios, which may have a different make-up to the dataset underlying the tables.

Users should also consider whether their policy conditions and/or underwriting approach could differ from those used generally, which would underlie the data used to produce these tables.

Gender-specific and Combined tables

We recommend the use of separate tables for males and females where possible, given the extensive evidence of significant differences in claim rates between the genders. However, in some cases the form or volume of the data supplied means that we have only been able to produce a "Combined" table that does not distinguish by gender.

Such Combined tables should be treated with caution, as the proportions of males and females underlying such a table, which is unknown to us, may not be representative of a specific portfolio to which users wish to apply the table.

Limitations of the data

The rates rely on the data provided by insurers to ECAT. While we have carried out checks on the data we cannot be certain of the quality of the data supplied.

For many datasets analysed, there is no clear difference in rates between the first policy year and later policy years. This is perhaps surprising, if policies are subject to any form of initial underwriting, so users should consider whether this is appropriate, or whether tables should be adjusted so they are higher at longer durations and lower at shorter durations.

The relationship in graduated rates between some tables is not what one might expect. For example at some ages the rates for mortality plus an accelerated benefit are lower than those for mortality only. This could reflect differences in the characteristics of policyholders with and without accelerated benefits, or may indicate weaknesses in the data.

Adjusting tables

As noted above, users may wish to adjust the tables to reflect possible differences between their specific portfolio and the broader dataset used to produce the tables. Such differences could be based on a quantitative comparison of the experience of the specific portfolio with a table, or a qualitative view of likely differences.

In our experience, users of actuarial tables commonly modify them by multiplying the rates at each age for a table by a suitable number. For example, if users perceive that rates should be lower for policyholders with higher benefit amounts, then they could multiply the rates by a value below 100% for higher benefit amounts, and multiply by a value above 100% for lower benefit amounts.

Changes in claim rates over time

Our graduations reflect experience during 2014-2018. Users of the tables should consider adjusting these rates before using them for future periods as:

- Mortality in many countries has tended to reduce over time, albeit with short-term volatility.
- The tables are based on data to 2018, and so do not allow for any impact of the coronavirus pandemic on mortality or other claim rates.

We have not attempted to analyse changes in claim rates over time in the ECAT dataset due to its limited size.

3. Data

The actuarial tables that we have produced are based on data obtained from Egyptian insurers. We are grateful to ECAT for helping us to obtain the data, and for assisting us with data validation and queries.

Data collection

ECAT has provided us with data from fourteen Egyptian insurance companies. Each insurer was assigned a reference code by ECAT, so the identities of the insurers are unknown to us.

The data was intended to cover the years from 2014. Some insurers provided data for earlier years but we did not use this data as it was only available for a subset of companies.

The data includes:

- Business types: Individual and Group
- Policy types: Endowment, Term Assurance, and Whole of life
- Cover types:
    - Mortality
    - Mortality + Accelerated Total Permanent Disability (TPD)
    - Mortality + Accelerated Partial Permanent Disability (PPD)
    - Mortality + Accelerated Critical Illness (CI)
    - TPD Rider
    - PPD Rider
    - CI Rider

In addition to the main cover types listed above, some datasets included policies that provided other types of cover that are outside of the scope of this report.

Definitions of policy and cover types applied by us throughout our work have been provided in Appendix 1.

Data validation

We undertook several stages of data validation, as summarised in Table 3.1 below. Further details on the type of data checking and review that was carried out is provided in Appendix 2.

Table 3.1: Data validation process

Stage	Validation	Overview
1	Initial review	Seeking to understand the data provided and to identify key issues, e.g. missing or inconsistent data. This stage of validation led to a considerable number of queries being raised, requesting further information to aid our understanding and to highlight any key data issues.

Stage	Validation	Overview
2	Validity and consistency of data	Checking that data fields have valid entries and the data is internally consistent, e.g. dates are in appropriate orders, data across multiple spreadsheets is consistent, and claims are consistent with cover types. This stage led to further queries, in particular to seek further clarification on the cover types.
3	Reasonability of data	Review of distribution of various data fields. A summary of this review was included in the data summaries that were sent back to ECAT, to forward to each insurer.
4	Validation of exposure/crude rates	High-level review of exposures and crude rates. Unusual features were highlighted alongside the data summaries.
5	Consistency of data resubmissions	Ensuring changes could be explained. Some queries resulted from this stage.

In addition to the checks carried out by BW, insurers were asked to review the data summary for the data they had submitted. The data summaries included:

- Results of various reasonability checks
- An overview of any assumptions we made
- Presentation of exposure, claims and crude rates

We received confirmation of appropriateness of our data treatment from 6 insurers.

Outcome of validation

We sent various batches of queries to ECAT to raise with the insurers. This resulted in the following outcomes for a number of datasets:

- Resubmission of data
- Clarification of understanding

However, it was not possible to rectify the issues with all the datasets and, where there were material issues, the data was excluded from our analysis. The following data was excluded:

- One insurer's Individual dataset due to incomplete claim data.
- Five insurers' Group datasets and one insurer's Individual dataset due to incomplete data or data that appears to be unreliable.

Upon completion of the data validation summarised above, we produced a "clean" dataset. As described below, we restricted the ranges of ages and calendar years used in our analysis, based on the apparent quality and reliability of the data.

Data manipulation

Data was supplied in multiple formats and required extensive manipulation to transform the data into a consistent format. The extent of inconsistencies in the data formats required specific data manipulation processes to be applied to datasets from different insurers.

Once in a consistent format, standard checks could be carried out and exposure could be calculated.

Derivation of the exposed to risk and number of claims

The graduation process starts with claims and exposure (as defined below) grouped into "analysis cells" by integer age, policy duration, and calendar year. The data is aggregated for all insurers, where the data is deemed "clean", and is segmented into homogeneous groups, e.g. business type, policy type, cover type and gender (where gender has been provided).

Policyholder ages are calculated using **age last birthday**.

A **claim** is attributed to the appropriate analysis cell based on the age of the policyholder, policy duration, and calendar year at the time of claim. A description of events that lead to a claim under the different cover types is provided in Appendix 1.

Exposure for an analysis cell is defined as the amount of time, expressed as the fraction of a year, that a policy spends in force (at the specific age, policy duration and calendar year for that cell) prior to the policy ceasing due to a claim or for any other reason. Most policies contribute exposure to multiple analysis cells.

We used a day-count approach to calculate **central exposure** which allows for the exact time the policyholder spent exposed to risk.

The exposure period for age x, policy year p, and calendar year y is defined as follows:

- The beginning of the exposure period is the latest of: the policyholder's x^{th} birthday, the start of the p^{th} policy year, and 1 January of year y.
- The end of the exposure period is the earliest of: the policyholder's $(x+1)^{th}$ birthday, the start of the $(p+1)^{th}$ policy year, 1 January of year (y+1), and the policy termination date, if any, due to expiry, withdrawal or claim.

Crude claim rates have been derived by dividing the number of claims in the analysis cell by the corresponding exposure.

Data sufficiency

There are a large number of combinations of business type, policy type and cover type, and for some of these combinations there are too few claims (in some cases none) to allow meaningful analysis of experience.

Based on the numbers of claims, Table 3.2 shows the datasets for which:

- We aimed to produce an actuarial table – marked with ticks. These are discussed in Section 5.
- There are too few claims to carry out any analysis – marked with crosses. These are not considered further in this report.
- We compared data to graduated tables for other datasets, but did not produce a graduated actuarial table directly – marked with question marks. These are discussed in Section 6.

Table 3.2: Datasets for which we aim to produce actuarial tables (✓) or related analysis (?)

	Endowment		Term Assurance		Whole of life	
	Individual	Group	Individual	Group	Individual	Group
Mortality	✓	✓	?	✓	?	✗
Mortality + Accelerated TPD	✓	✓	?	✓	✗	✗
Mortality + Accelerated PPD	✗	✗	✗	?	✗	✗
Mortality + Accelerated CI	✗	✗	?	✗	✗	✗
Rider TPD	✗	✗	✗	✗	✗	✗
Rider PPD	✗	✗	✗	✗	✗	✗
Rider CI	✗	✗	✗	✗	✗	✗

Graduation period

We have restricted the graduation dataset to the calendar years from 2014 to 2018 inclusive. This five-year period is sufficient to limit the impact of year-to-year volatility, but excludes older experience that may be less indicative of current and future experience. Although we have data for 2019, we have excluded this, as claims experience for 2019 appear markedly lower than for earlier years, which may be due to incomplete reporting of claims, due to delays in notification, admission or settlement, rather than reflecting genuine changes in claims experience.

We note that the graduation dataset does not include the period of the coronavirus pandemic, which is likely to have had a material impact on recent claims.

Data volumes

Charts 3A to 3J show the exposure (measured on the left-hand axis) and numbers of claims (right-hand axis) at each age for the datasets that we have graduated. The charts include data for all policy durations.

The charts show the age range of 20 to 60 inclusive, as there is relatively little exposure outside this age range. As discussed in Section 4, we have not graduated all of these ages for every dataset. In particular, the data for Group Endowment Mortality appears implausible for ages 59 and 60.

In some cases we have used different y-axis scales for different datasets to show the data volumes more clearly; however we have used consistent scales within each row of charts to enable comparison by gender.

Chart 3A: Individual Endowment Mortality Males

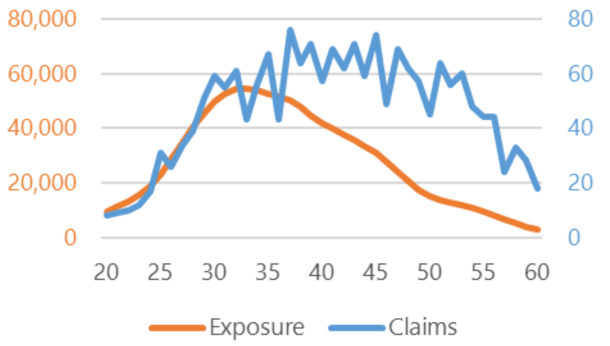


Chart 3B: Individual Endowment Mortality Females

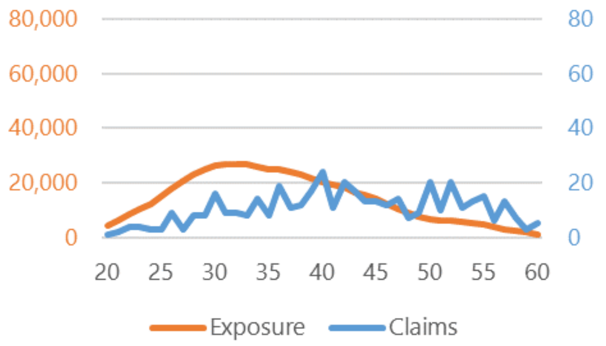


Chart 3C: Group Endowment Mortality Combined

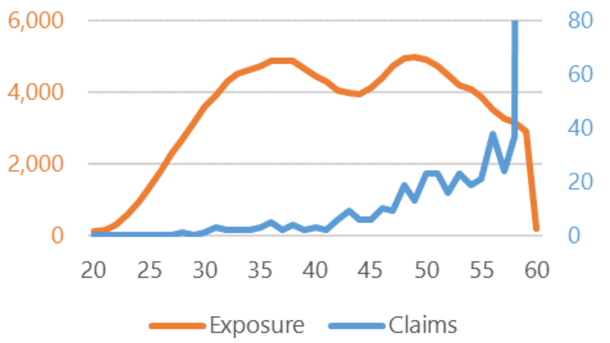


Chart 3D: Group Term Assurance Mortality Combined

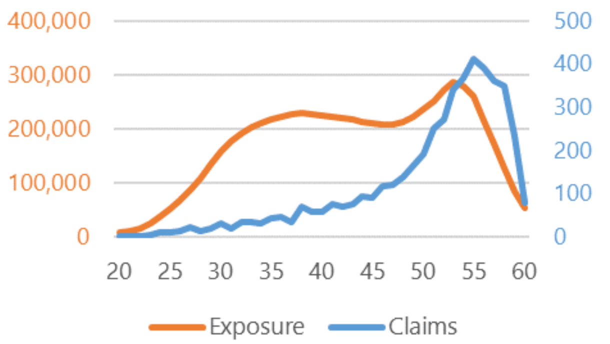


Chart 3E: Individual Endowment Mortality + accelerated TPD Males

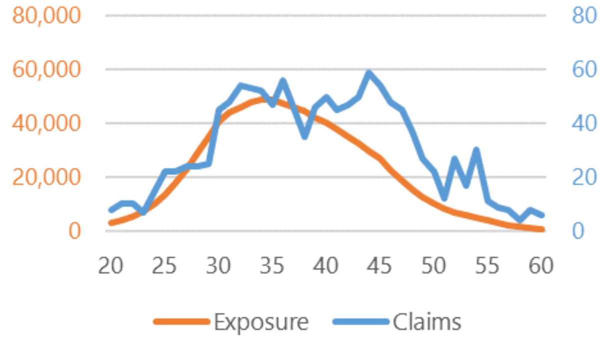


Chart 3F: Individual Endowment Mortality + accelerated TPD Females

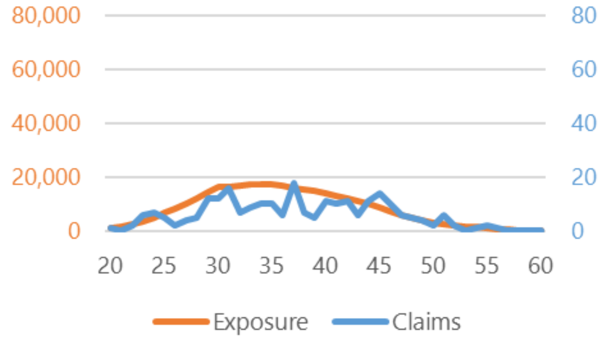


Chart 3G: Group Endowment Mortality + accelerated TPD Males

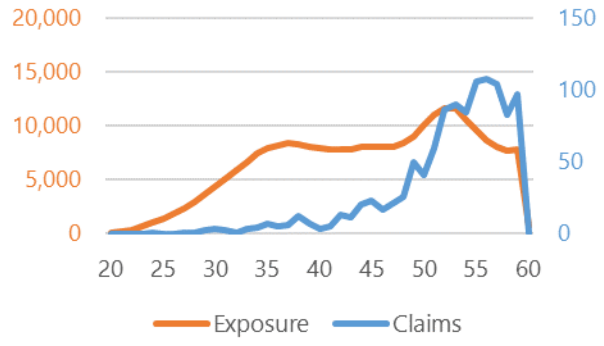


Chart 3H: Group Endowment Mortality + accelerated TPD Females

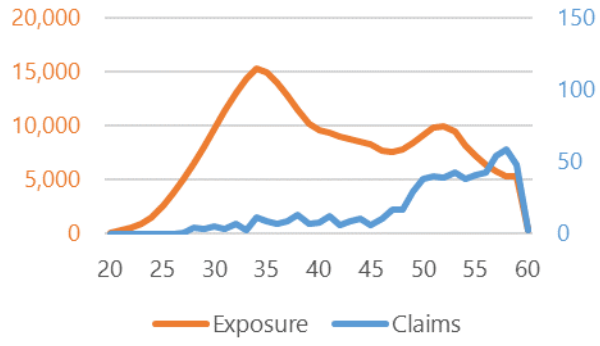


Chart 3I: Group Term Assurance Mortality + accelerated TPD Males

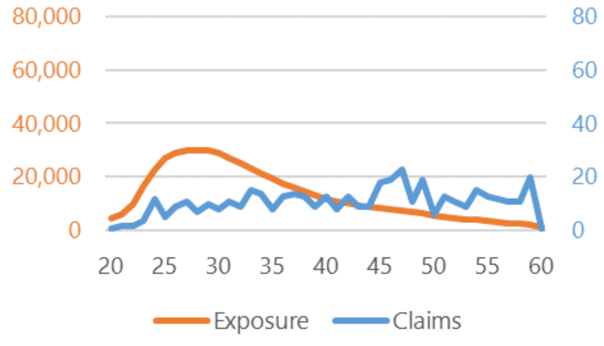
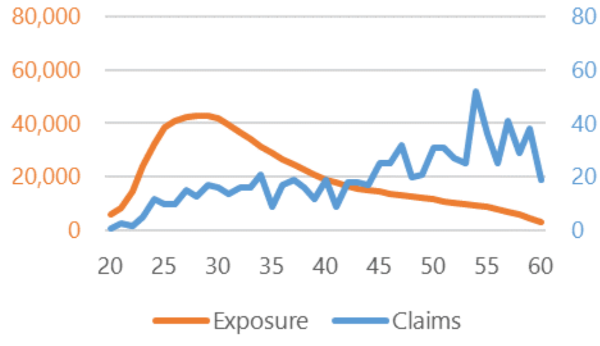


Chart 3J: Group Term Assurance Mortality + accelerated TPD Combined



4. Graduation methods

This section describes the methods that we have used to graduate the actuarial tables.

Overall process

The broad overall process that we have followed is:

1. For each dataset:
   - Consider which ages to graduate
   - Consider whether to graduate policy durations separately
   - Consider a range of candidate formulae
   - Fit each of those formula to the dataset
   - Select the preferred formula from the candidates
2. Compare results for related datasets for consistency:
   - Compare males and females
   - Compare different durations
3. Extend graduated rates to higher ages

Candidate formulae

We have considered a range of parametric formulae from the "GM(r,s)" family, a generalisation of the Gompertz-Makeham formula. Writing x for age, m_x for the central graduated rate, and a_i and b_i for the parameters, this has the general form below, where r and s denote the number of parameters in each component:

$$m_x = (a_0 + a_1 + \cdots + a_{r-1}x^{r-1}) + \exp\,(b_0 + b_1 x + \cdots + b_{s-1}x^{s-1})$$

For example, the GM(1,2) formula is:

$$m_x = a_0 + \exp\,(b_0 + b_1 x)$$

and the GM(0,3) formula is:

$$m_x = \exp\,(b_0 + b_1 x + b_2 x^2)$$

Fitting the formulae

We have fitted the formula parameters using maximum likelihood estimation, under a Poisson model for claims. We do this by finding the parameter values that maximise the expression:

$$\sum_x (C_x \log(m_x) - E_x m_x)$$

where C_x and E_x are the numbers of claims and central exposures at age x respectively, as described in Section 3.

Formula selection

When choosing between formulae for a particular dataset we aim to find a formula that:

- fits the data well;
- has a plausible shape (e.g. mortality increasing steadily with age, except perhaps for the youngest ages); and
- does not have so many parameters that it "over-fits" the data and reflects random variations rather than genuine patterns in claims by age.

The balance between these aims is based on a combination of statistical tests and judgement. The results of the statistical tests are set out in Appendix 3.

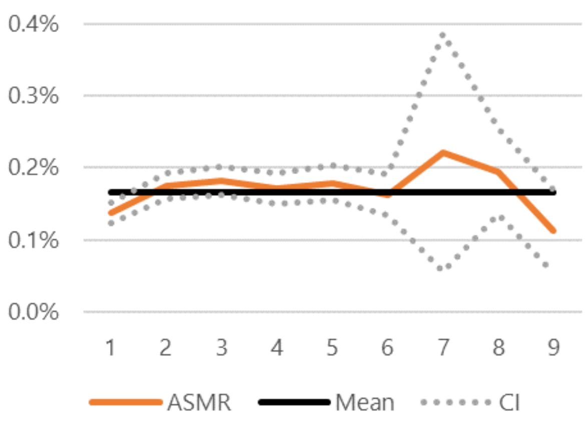
Gender

Claims experience tends to differ for males and females (generally with higher rates for males at each age), and we have reflected this in our graduations where there is sufficient data to enable us to do so. Where there is insufficient data to produce separate tables for males and females – typically because some of the data provided to us did not specify gender – we have produced "Combined" tables, using male, female and unspecified gender. As noted in Section 2, users of a Combined table should consider whether it should be adjusted to reflect potential differences in between the gender mix of the data underlying it, which is unknown to us, and the specific portfolio to which users may wish to apply the table.

Policy duration

Our analysis of age standardised mortality rates (ASMRs) shows that claim rates for male Individual Endowment Mortality tend to be lower in first year of a policy than in later years – Chart 4A shows this. We plot the ASMR by policy duration, together with statistical confidence intervals and see that rates are lower for duration 1 than for durations 2 to 6. Results for years 7 and above are inconclusive as the confidence intervals are wide due to low data volumes.

Chart 4A – Age-standardised mortality rates by policy duration, male Individual Endowment Mortality



Because of this we consider separate graduated rates for policy year 1 and policy years 2+ for Individual Endowment Mortality.

It is not unexpected to see lower claim rates at shorter policy durationsif policies are underwritten. For other datasets there is no clear difference in rates between policy year 1 and policy years 2+, so we graduate all years together. This is perhaps surprising, so users should consider whether this is appropriate, and whether rates should be adjusted so that they are higher at longer durations and lower at shorter durations.

Central and initial rates

As noted above, we use central rates (m_x) when graduating the tables. However, users of the tables may find it more helpful to work with initial rates (q_x) – these are set out in Appendix 3. We convert from m_x to q_x using the method shown below.

Initial rates are defined in terms of forces (μ_x) as follows:

$$q_x = 1 - \exp\left(-\int_0^1 \mu_{x+t}\,dt\right)$$

We use Boole's rule for numerical integration:

$$\int_0^1 f(t)\,dt \approx \frac{1}{90}(7f(0) + 32f(0.25) + 12f(0.5) + 32f(0.75) + 7f(1))$$

using the approximation $m_x \approx \mu_{x+0.5}$, so that $f(t) = \mu_{x+t} \approx m_{x+t-0.5}$.

These combine to give:

$$q_x = 1 - exp\left(-\frac{1}{90}(7m_{x-0.5} + 32m_{x-0.25} + 12m_x + 32m_{x+0.25} + 7m_{x+0.5})\right)$$

Graduation age range

For most datasets, we have restricted the graduation age range to 20-60, a there is limited data outside that range, as shown in Section 3. However, for Group Endowment Mortality, we have further restricted the graduation age range to 30-58, as discussed in Section 5.1.

Ages 18 and 19

ECAT has asked us to provide rates for ages 18 and 19, as this would be helpful for users of the tables. There is little data at these ages, so we have not used data at these ages in our graduations.

For most users of the tables, we think it will be reasonable to use the same rates at ages 18 and 19 as at age 20. This is because rates do not appear to differ greatly at those ages, and the assumption may not be financially material due to the low volumes of business.

In the tables in Appendix 4, we have set the rates at ages 18 and 19 equal to those at age 20. However, as noted in Section 2, users of the tables should consider whether rates are appropriate for their purposes.

High age extensions

We have been asked to produce rates up to age 75. However, there is not sufficient data to graduate rates directly for ages above 60 so we have instead made an assumption about the relationship between rates in the ECAT dataset and mortality rates for the general population, based on data from the World Health Organisation (WHO) available from https://apps.who.int/gho/data/view.main.60500. We note that we have used the WHO mortality rates to extend all tables, including those with an accelerated benefit.

Having estimated $q_x^{(WHO)}$, by gender, we do the following for each table:

- Calculate the ratio, r_{60}, between the table and the general population at age 60 (using male, female or combined general population rates depending on the table): $r_{60} = q_{60}^{(ECAT)} \div q_{60}^{(WHO)}$.
- Calculate values for this ratio at older ages, on the assumption that it converges linearly towards a value of 100% at age 100:
  - $r_x = 1 + (r_{60} - 1) \times (100 - x) \div 40$
- Calculate rates up to age 75 for the table using these ratios: $q_x^{(ECAT)} = q_x^{(WHO)} \times r_x$
- Review the resulting rates to ensure they progress in a plausible manner

5. Graduation results

This section contains results of the graduations, shown in four stages:

- "Trial graduations" – graduating each dataset in isolation.
- "Comparisons" of related datasets – these comparisons highlight a number of issues with the trial graduations that we address in the final tables.
- "Final tables for ages 20 to 60" – including simplifications and adjustments where rates from the trial graduations appear implausible.
- "Extensions to age 75" – extending the rates beyond the graduation age range.

Appendix 3 contains detailed results of the graduations, including parameter values and statistical tests, and Appendix 4 contains tables of the final rates. We have also provided a spreadsheet of these rates.

5.1 Trial graduations

This section shows the results of graduations of each dataset in isolation, without considering whether results are reasonable in comparison to other tables. We note that because charts in this section use a logarithmic scale, crude rates are not shown where the rate is nil.

Individual Endowment Mortality

For Individual Endowment Mortality there is a clear difference in mortality rates between policy year 1 and policy years 2+. We have used a GM(1,2) graduation of data for ages 20-60 for males and females and for each duration.

Charts 5A to 5D show the results of the trial graduations.

Chart 5A – Individual endowment mortality, males duration 1

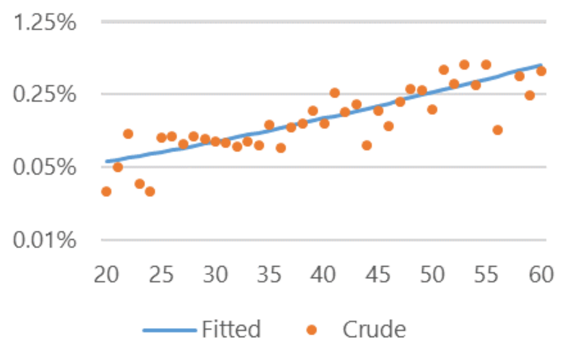


Chart 5B – Individual endowment mortality, males durations 2+

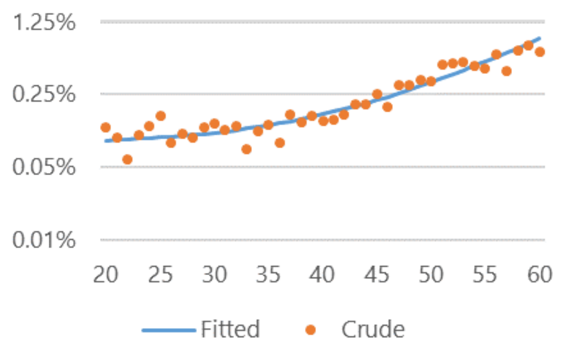


Chart 5C – Individual endowment mortality, females duration 1

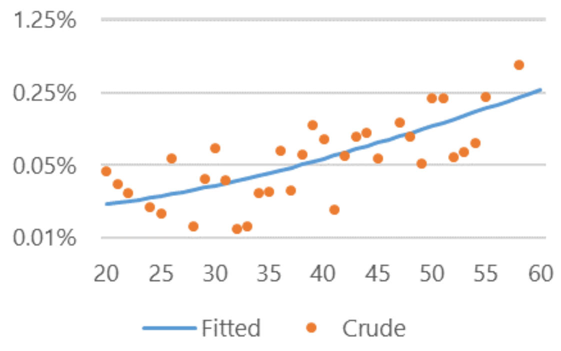
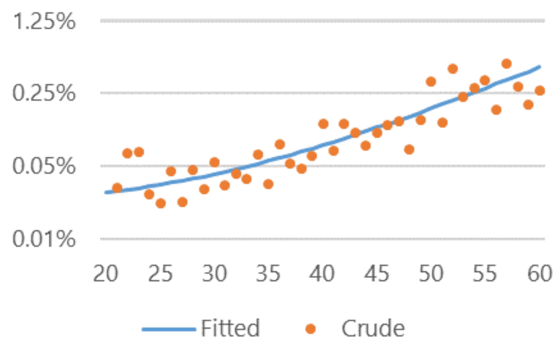


Chart 5D – Individual endowment mortality, females durations 2+



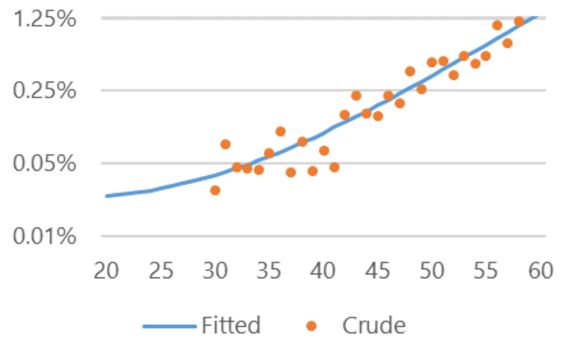
Group Endowment Mortality

For group endowment mortality, little of the data we have received identifies gender, so we have only been able to produce a combined gender table. For this dataset, we have graduated data for ages 30-58 rather than 20-60:

- There is only one claim for ages below 30. Including these ages in the graduation dataset would lead to mortality rates at these ages that are lower than seem reasonable in comparison to other datasets.
- Chart 3C shows that while there is a fairly steady progression of crude mortality rates up to age 58, the crude rates for ages 59 and 60 are much higher, and appear to be unreliable.

We have used a GM(1,2) formula for group endowment mortality, and used the same formula and fitted parameters to extrapolate graduated rates down to age 20 and up to age 60. Chart 5E shows the results of the trial graduation. Rates for ages 59 and 60, where the data appears unreliable, are not visible here.

Chart 5E – Group endowment mortality rates

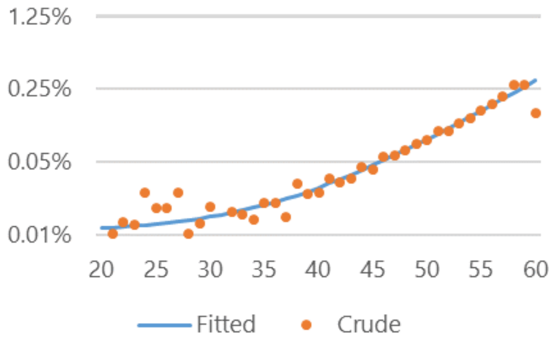


Group Term Assurance

For group term assurance mortality, gender is identified for little of the data, so we have only been able to produce a combined table.

Chart 5F compares results from using a GM(1,2) formulae with crude rates.

Chart 5F – Group term assurance mortality, combined



Individual Endowment Mortality + Accelerated TPD

Charts 5G and 5H show results for male and female individual endowment mortality + accelerated TPD. For these tables, we have used GM(0,3) formulae rather than GM(1,2) as for other datasets. The different formula has been necessary in order to reflect the "U-shape" to claim rates, particularly for males.

Chart 5G – Individual endowment mortality + accelerated TPD, males

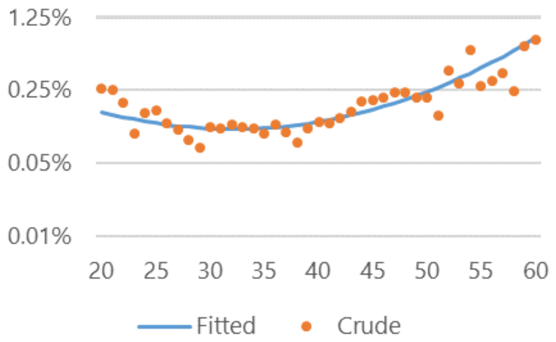
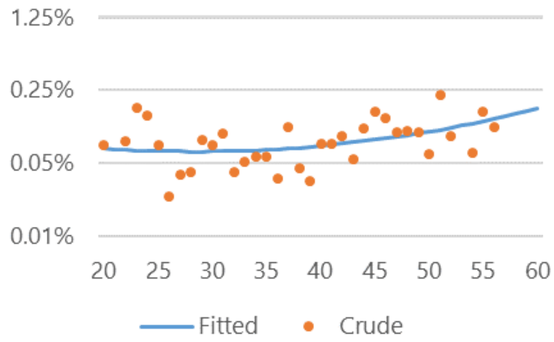


Chart 5H – Individual endowment mortality + accelerated TPD, females



Group Endowment Mortality + Accelerated TPD

Charts 5I and 5J show results for male and female group endowment mortality + accelerated TPD. These use GM(1,2) formulae.

Chart 5I – Group endowment mortality + accelerated TPD, males

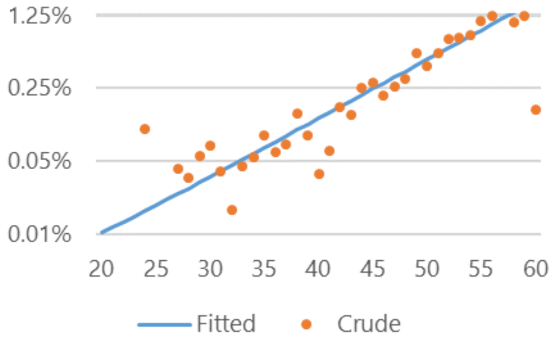
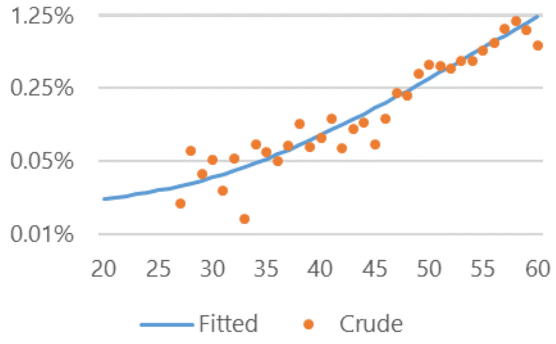


Chart 5J – Group endowment mortality + accelerated TPD, females



Group Term Assurance Mortality + Accelerated TPD

For this dataset, little of the data is identified as female, so we have only been able to produce male and combined tables.

Charts 5K and 5L show results for male and combined group term assurance mortality + accelerated TPD. These tables both use GM(1,2) formulae.

Chart 5K – Group term assurance mortality + accelerated TPD, males

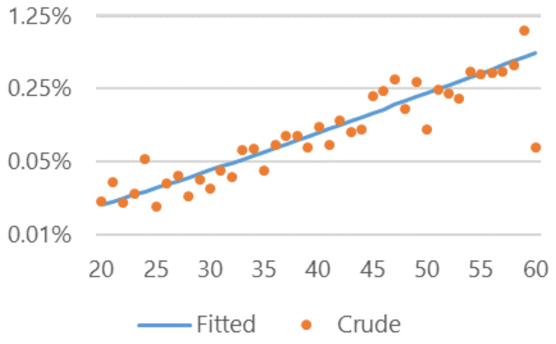
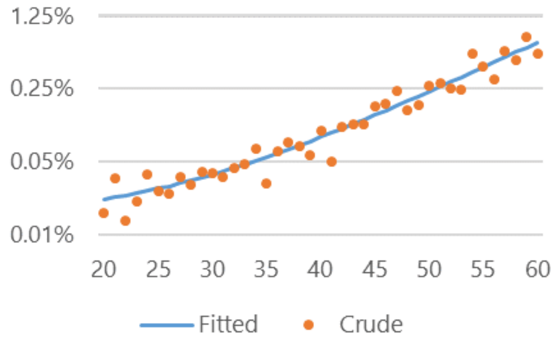


Chart 5L – Group term assurance mortality + accelerated TPD, combined



5.2 Comparisons

This section compares related tables. The comparisons highlight a number of issues with the trial graduations that we address in the final tables.

Individual Endowment Mortality

Chart 5M compares the Individual Endowment Mortality tables by gender and duration. They all have broadly similar shapes, with female rates being lower than male rates, and rates for policy year 1 being lower than for policy years 2+.

Chart 5N shows female rates as a proportion of male rates for each duration.

Chart 5M – Comparison of individual endowment mortality tables

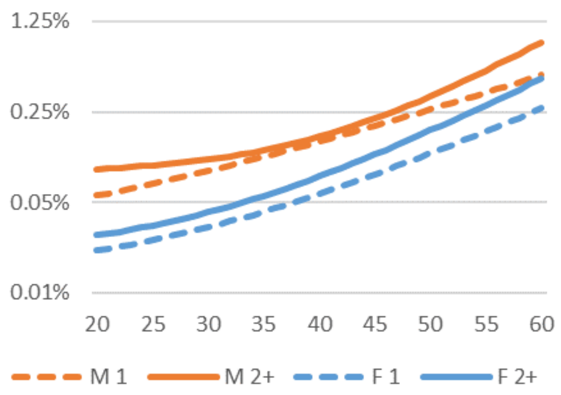


Chart 5N – Female individual endowment mortality as a proportion of male individual endowment mortality

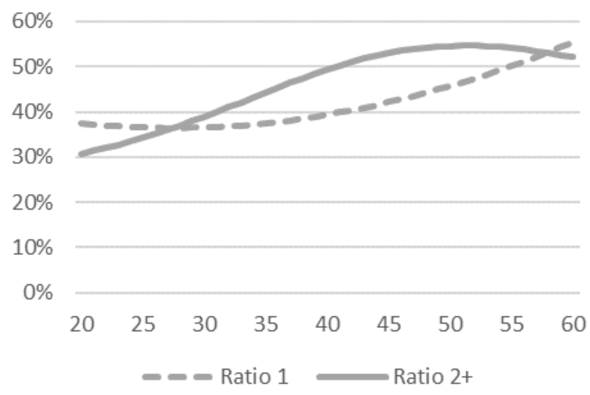


Chart 5O compares the proposed table for males for durations 2+ with ultimate rates from the A1967-70 table for assured lives and Chart 5P plots the ratio between them. This comparison was requested by ECAT, as we understand the A1967-70 table is currently used in Egypt. The charts show that there is a marked difference in the shapes of the two tables, which justifies the decision to produce new tables based on Egyptian data.

Chart 5O – Comparison of Male 2+ and A1967-70 ultimate

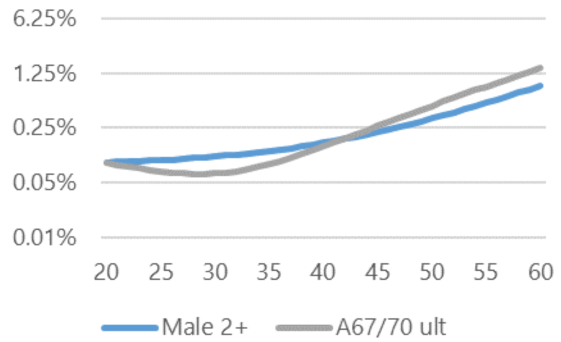
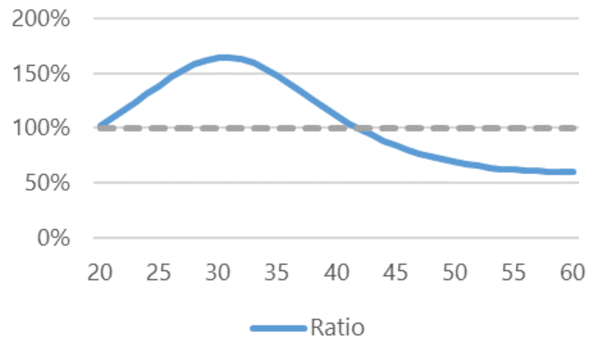


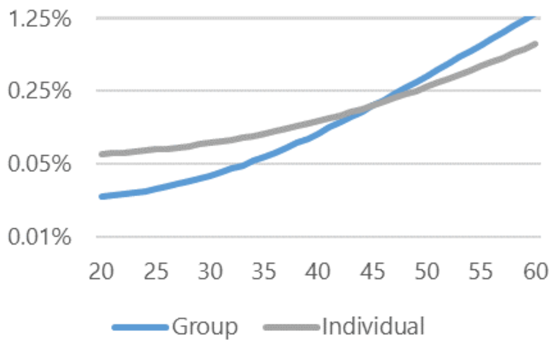
Chart 5P – Ratio: Male 2+ divided by A1967-70 ultimate



Group and Individual Endowment Mortality

Mortality rates for group endowment have quite a different shape to those for individual endowment, shown in Chart 5Q, using combined gender and durations in each case. This might be due to the Group dataset having a much higher proportion of females, or might be due to differences between the products.

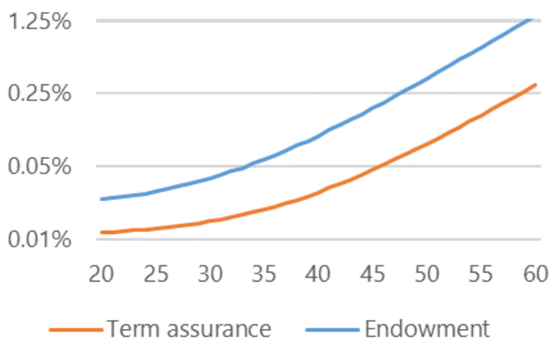
Chart 5Q – Comparison of group and individual endowment mortality rates (combined gender and duration)



Group Term Assurance Mortality

Chart 5R compares Group Mortality Combined trial graduation rates for Term assurance and Endowment. The rates for Term assurance are very low.

Chart 5R – Comparison of Term assurance and Endowment Mortality rates (Combined gender)



Individual Endowment Mortality + Accelerated TPD

Charts 5S and 5T compare the male and female tables for individual endowment mortality + accelerated TPD. The ratio of female to male rates is implausibly low at older ages, and Chart 5S suggests that the female rates are less reliable than the male rates, as we would expect rates to increase more sharply with age than seen for females.

Chart 5S – Comparison of Male and Female rates for Individual Endowment Mortality + accelerated TPD

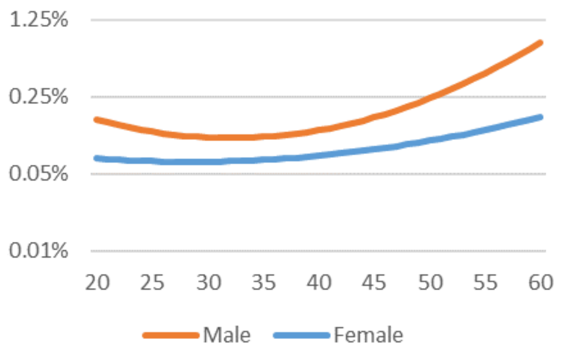
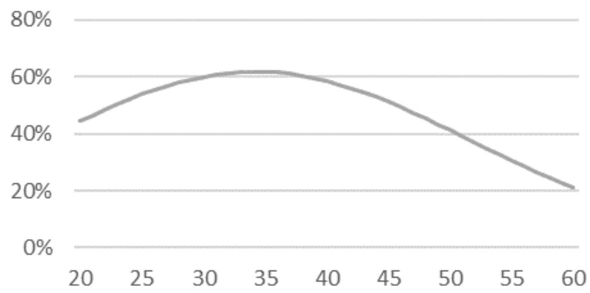


Chart 5T – Ratio of Female to Male rates for Individual Endowment Mortality + accelerated TPD



Group Endowment Mortality + Accelerated TPD

Charts 5U and 5V compare the male and female tables for group endowment mortality + accelerated TPD. The ratio of female to male rates is implausibly low at older ages, and Chart 5U suggests that the male rates are less reliable than the female rates, as we would not expect such low rates at the youngest ages shown

Chart 5U – Comparison of Male and Female rates for Group Endowment Mortality + accelerated TPD

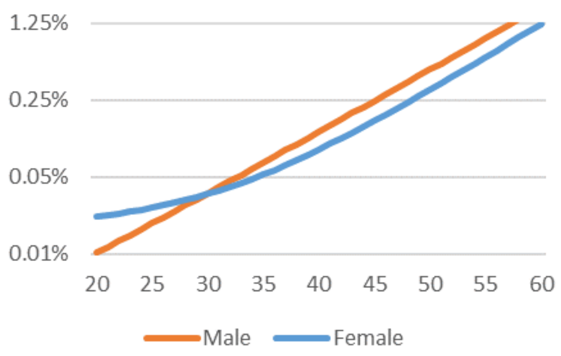
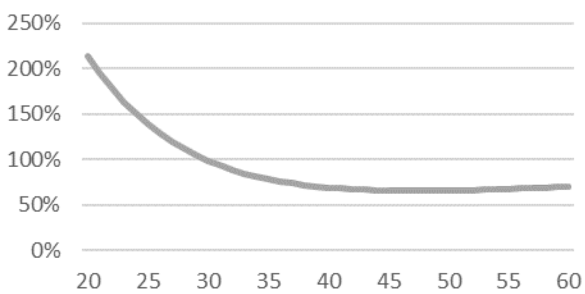


Chart 5V – Ratio of Female to Male rates for Group Endowment Mortality + accelerated TPD



Group Term Assurance Mortality + Accelerated TPD

Charts 5W and 5X compare the male and Combined tables for group term assurance mortality + accelerated TPD. The rates are broadly similar, which might be due to a very low proportion of females in the Combined dataset. Given the similarity of the shapes, it is not clear if the Male or Combined rates are more plausible.

Chart 5W – Comparison of Male and Combined rates for Group Term assurance Mortality + accelerated TPD

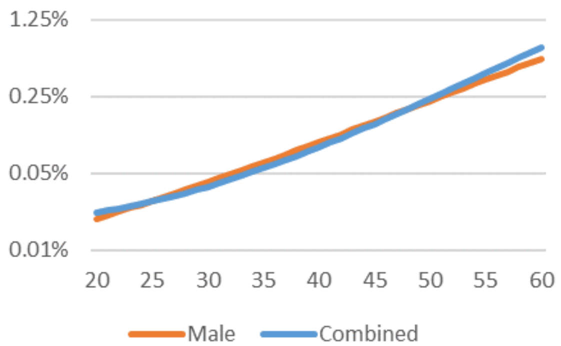
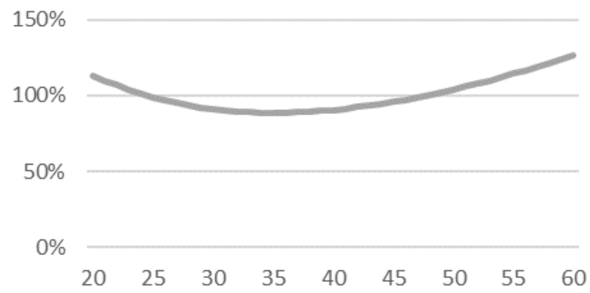


Chart 5X – Ratio of Combined to Male rates for Group Term assurance Mortality + accelerated TPD



Comparison of Mortality + Accelerated TPD tables to Mortality only tables

In this section we show comparisons between mortality + accelerated TPD and mortality only tables for the three cases where we have both tables for the same combination of product type and gender.

Charts 5Y and 5Z show results for individual endowment males and individual endowment females.

If the characteristics of policyholders for the products with and without accelerated TPD were the same, then we would expect to see higher claim rates for the product with accelerated TPD. While this is the case for individual endowment for younger ages, it is not the case for older ages. If the data is accurate and credible, this suggests that the holders of different policy types have different characteristics. As a result, while ECAT has requested that we attempt to derive TPD-only rates by comparing the rates shown, we do not think that this would produce reasonable results.

Chart 5Y – Individual endowment males – mortality with and without accelerated TPD

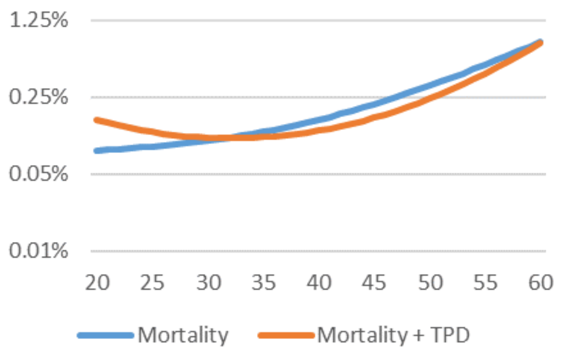
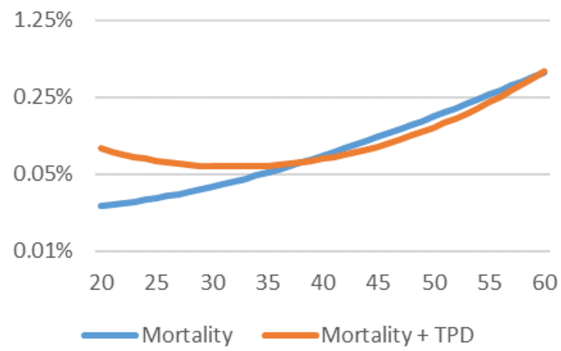


Chart 5Z – Individual endowment females – mortality with and without accelerated TPD



5.3 Final tables for ages 20 to 60

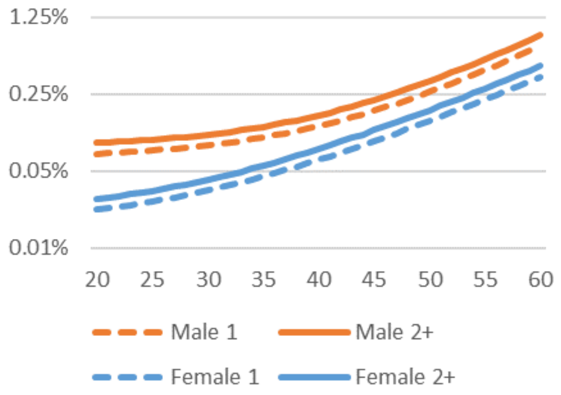
This section describes the final tables. In some cases these are the same as the trial graduations, but in other cases we have made simplifications or adjustments where rates from the trial graduations appear implausible, as described below.

Individual Endowment Mortality

For policy years 2+, we have used the trial graduations without adjustment. For policy year 1 we have set the male and female rates to 80% of the rates for policy years 2+.

Chart 5AA shows a comparison of the final rates.

Chart 5AA – Comparison of individual endowment mortality tables



Group Endowment Mortality

We have used the trial graduations without adjustment.

Group Term Assurance Mortality

The comparisons in Section 5.2 show that the mortality rates for group term assurance mortality combined are exceptionally low in comparison with other tables.

For this reason, we recommend using Group Endowment Mortality rates when considering Group Term Assurance Mortality business.

Individual Endowment Mortality + Accelerated TPD

For males, we have used the trial graduations without adjustment. For females, we have set the rate at each age to 55% of the male rate at the same age, to achieve a better shape. The multiplier of 55% is the adjustment to the male rates that minimises the deviance statistic – a measure of goodness of fit.

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beyond the expected

Charts 5AB and 5AC compare the final male and female rates. The dotted lines show results of the trial graduations for comparison.

Chart 5AB – Comparison of male and female rates for individual endowment mortality + accelerated TPD

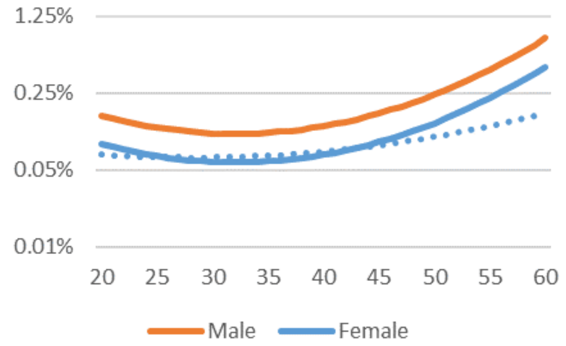
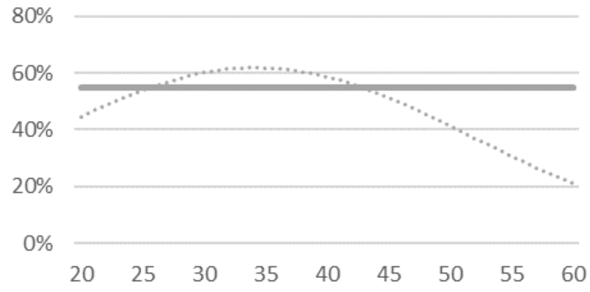


Chart 5AC – Ratio of female to male rates for individual endowment mortality + accelerated TPD



Group Endowment Mortality + Accelerated TPD

For females, we have used the trial graduations without adjustment. For males, we have set the rate at each age to 145% of the female rate at the same age, to achieve a better shape. The multiplier of 145% is the adjustment to the female rates that minimises the deviancestatistic.

Charts 5AD and 5AE compare the final male and female rates. The dotted lines show results of the trial graduations for comparison.

Chart 5AD – Comparison of male and female rates for group endowment mortality + accelerated TPD

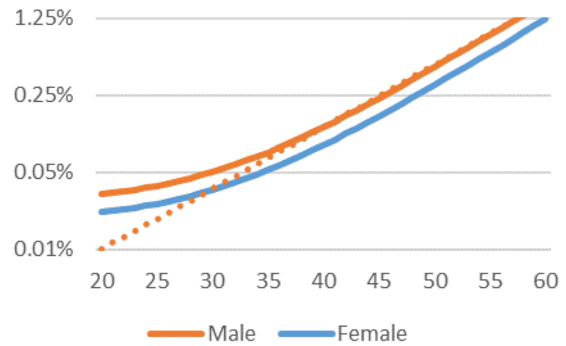
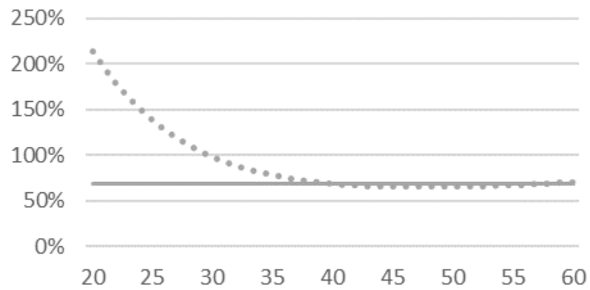


Chart 5AE – Ratio of female to male rates for group endowment mortality + accelerated TPD



Group Term Assurance Mortality + Accelerated TPD

We have used the trial graduations without adjustment.

5.4 Extensions to age 75

We have produced extensions to the tables up to age 75, using the methods described in Section 4. These extensions are provided for completeness and are not based on insured lives' data.

Chart 5AF illustrates the extensions for mortality only tables, and Chart 5AG shows this for mortality + accelerated TPD tables. Both charts show that the ordering of rates at age 60 continues to higher ages, and the relative spread of the rates narrows slightly as age increases.

Chart 5AF – Comparison of extensions to age 75 for mortality only tables

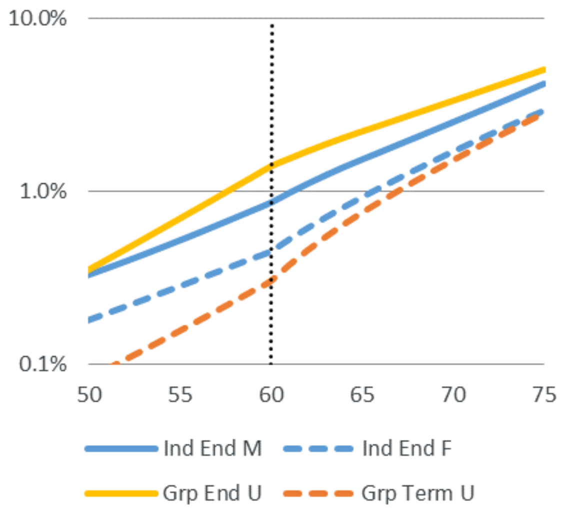
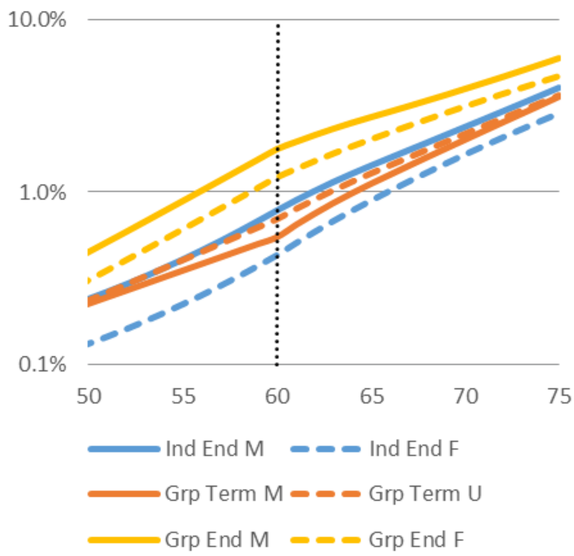


Chart 5AG – Comparison of extensions to age 75 for mortality + accelerated TPD tables



6. Analysis of other datasets

As noted in Section 3, we have divided the datasets into three groups:

- those with sufficient claims to produce graduated tables, described in Section 5;
- those with insufficient claims to carry out any analysis, not considered in our report; and
- those with sufficient claims to carry out some analysis, but not enough to produce graduations.

This section contains analysis for the latter group, shown with question marks in Table 3.2.

Method

We have analysed these datasets using an "Actual ÷ Expected" (A/E) method. Under this approach, we compare:

- Actual claims for the dataset under investigation.
- Expected claims for the dataset, based on its exposure and assuming that claim rates were the same as under a comparable previously graduated table.
    - For Individual tables, we use the Individual Endowment Mortality tables as the comparator table, for the appropriate gender and policy years 2+.
    - For Group tables, we use the Group Endowment Mortality Combined table as the comparator.

If we can obtain a credible estimate of the A/E statistic, then it could be used to scale the comparator table before using the scaled rates to represent the dataset under investigation.

Results

Table 6.1 shows the results of our analysis. We show the best estimate in bold, followed by the 95% confidence interval in brackets. We calculate a confidence interval for the A/E statistic, as well as its mean, to show the degree of confidence we have in the analysis for each table. (The confidence intervals are narrower where data volumes are higher). Note that we show n/a for the A/E statistic for the female group term assurance mortality + accelerated PPD dataset, as no claims were recorded.

For most datasets, the confidence intervals are fairly wide, and have values above and below 100%. Only for the male individual term assurance mortality dataset can we be confident that rates are significantly different, with 95% confidence, from the relevant comparator table.

We would expect that products with accelerated benefits would have higher claim rates than equivalent products without accelerated benefits.

However it is notable that for Individual term assurance:

- the A/Es for mortality + accelerated TPD are lower than for mortality only, albeit with a large overlap in confidence intervals for females; and
- the A/Es for mortality + accelerated CI are lower than for mortality only for females, although again with a large overlap in confidence intervals.

Analysis of UK tables suggests that accelerated critical illness rates could be three times as high as corresponding mortality rates, although this multiplier may not be directly applicable to Egyptian business due to differing policy definitions and populations. We have no direct experience of accelerated TPD or accelerated PPD rates, but would expect the multiplier to be significantly lower than for critical illness.

Table 6.1 – Results of "Actual ÷ expected" analysis

Dataset	Males	Females
Individual term assurance mortality	**124%** (107%-142%)	**148%** (95%-221%)
Individual whole of life mortality	**73%** (47%-109%)	**107%** (65%-165%)
Individual term assurance mortality + accelerated TPD	**91%** (80%-104%)	**90%** (39%-176%)
Group term assurance mortality + accelerated PPD	**91%** (60%-132%)	**n/a** (0%-824%)
Individual term assurance mortality + accelerated CI	**132%** (96%-178%)	**123%** (40%-288%)

Appendix 1 – Definitions

Definitions of the policy types

The following policy type definitions have been discussed with ECAT and are assumed in the treatment of the data:

Policy type	Definition
Endowment assurance	A policy where the benefit, which can be a guaranteed sum assured or current policy value, is paid at the earlier of claim event or policy maturity. Unit linked and universal life policies are included in this category.
Term assurance	A policy where the benefit is paid only for a claim event that occurs within the policy term. No maturity benefit is paid under this contract.
Whole of Life	A policy where the benefit is paid when a claim event occurs, whenever this is (i.e. the policy term is throughout life).

Definitions of the cover types

The table below sets out our understanding of how each of the cover types operate and the claim events that arise.

Cover type	Claim event	Claim terminates the entire cover
Mortality benefit	Death from any cause. This also includes cases where an increased sum assured is paid if death is accidental.	Yes
Mortality + Accelerated critical illness (CI)	Earlier of death or diagnosis of a critical illness	Yes
Mortality + Accelerated Total Permanent Disability (TPD)	Earlier of death or occurrence of total and permanent disability. The disability may result from any reason (accident or sickness).	Yes
Mortality + Accelerated Partial and Permanent Disability (PPD)	Earlier of death or occurrence of partial and permanent disability. The disability may result from any reason (accident or sickness).	Yes
Critical illness rider	Diagnosis of a critical illness. The claim terminates the rider cover, but the main life policy the rider is attached to remains in force.	No

Total Permanent Disability rider	Occurrence of total and permanent disability. The disability may result from any reason (accident or sickness). The claim terminates the rider cover, but the main life policy the rider is attached to remains in force.	No
Partial Permanent Disability rider	Occurrence of partial and permanent disability. The disability may result from any reason (accident or sickness). The claim terminates the rider cover, but the main life policy the rider is attached to remains in force.	No

The data provided by the insurers contained more categories than provided in the above table. Broadly they can be classified into the following categories:

- Accidental death benefit only (i.e. claim is not paid for natural death);
- Mortality + more than one accelerator (claim is paid upon death or any of more than two additional events, e.g. mortality + accelerated TPD + accelerated CI, where the claim is paid on the earliest of death, TPD or diagnosis of CI);
- Disability or critical illness benefits where scope of the cover is limited compared to the typical cover of that kind (e.g. TPD due to accident only, CI covering cancer only),
- Any combinations of these.

We have not analysed these categories as the amount of available data was low.

Appendix 2 – Data validation

Stage	Validation	Details
1	Initial review	• Assessed alignment of the data to the initial data specification. • Assessing completeness of the data – ensuring data fields have been populated. • Identifying any clear inconsistencies within the data such as claims made prior to the policy inception. • Sought to understand the nature of the cover types by looking at data provided as limited information/documentation had been provided.
2	Validity and consistency of data	• Checked dates exist to accurately calculate exposure – policy inception date, policy exit date, reason for the exit. • Checked uniqueness of policy identifiers. • Checked consistency of dates – date of birth before policy inception date, and policy inception date before claim/termination date. • Checked validity/plausibility of data fields, such as appropriate coding for policy type, cover type, gender, smoking status and medical rating indicator. • Identified number of blank entries. • Checked consistency of data provided across multiple spreadsheets. • Checked consistency of in force and claims data. • Checked information provided in the data is consistent with the nature of the additional policy benefits explained by the insurers (e.g. entire cover ceases upon claim under an accelerated policy, rider cover ceases on policyholder's death, etc)
3	Reasonability of data	• Examined minimum, maximum and mean value of benefit amounts (initial and current benefit amounts). • Examined minimum and maximum values for date-type variables (dates of birth, policy inception, claim and exit).
4	Validation of exposure/crude rates	• Reviewed (at a high-level) the exposures and crude rates, in particular looking for material changes in exposure and volatility of rates.
5	Consistency of data resubmissions	• Checked that any resubmissions were consistent with previous submissions (i.e. all changes could be explained).

Appendix 3 – Details of the graduations

In this section, we show parameter values and various goodness of fit statistics for each table. We note that:

- Overdispersion is derived from the Deviance, and should be fairly close to 1
- For the signs, runs and serial correlation tests, we first show the statistic (numbers of positive/negative deviations, number of runs of deviation of the same sign, and serial correlation) followed by the probability in brackets. Values close to 0% or 100% indicate a poor fit.

Individual endowment mortality

Table A3.1: Parameter values for Individual Endowment Mortality tables

Gender / duration	Male 1	Male 2+	Female 1	Female 2+
Graduation age range	20-60	20-60	20-60	20-60
Formula	GM(1,2)	GM(1,2)	GM(1,2)	GM(1,2)
Parameter a_0	0.00066061	0.00082576	0.00015629	0.00019536
Parameter b_0	-11.97702731	-11.75388376	-11.59208864	-11.36894509
Parameter b_1	0.11501381	0.11501381	0.09866765	0.09866765
Parameter b_2	n/a	n/a	n/a	n/a

Table A3.2: Goodness of fit statistics for Individual Endowment Mortality tables

Gender / duration	Male 1	Male 2+	Female 1	Female 2+
Deviance	45.64	51.79	46.93	45.83
Overdispersion	1.20	1.36	1.24	1.21
Signs test	21/20 (50%)	24/17 (17%)	19/22 (38%)	16/25 (11%)
Runs test	17 (10%)	22 (42%)	21 (50%)	25 (9%)
Serial correlation test	+12.8% (21%)	+3.6% (41%)	-0.3% (51%)	-26.5% (95%)

Group mortality

Table A3.3: Parameter values for Group Mortality tables

Policy type / gender	Endowment / Term assurance Combined
Graduation age range	30-58
Formula	GM(1,2)
Parameter a_0	0.00019399
Parameter b_0	-12.85882346
Parameter b_1	0.14301719
Parameter b_2	n/a

Table A3.4: Goodness of fit statistics for Group Mortality tables

Policy type / gender	Endowment / Term assurance Combined
Deviance	23.47
Overdispersion	0.90
Signs test	14/15 (50%)
Runs test	20 (6%)
Serial correlation test	-25.9% (95%)

Individual endowment mortality + accelerated TPD

Table A3.7: Parameter values for Individual Endowment Mortality + accelerated TPD tables

Gender	Male	Female
Graduation age range	20-60	20-60
Formula	GM(0,3)	GM(0,3)
Parameter a_0	n/a	n/a
Parameter b_0	-4.19433821	-4.79217521
Parameter b_1	-0.165220337	-0.165220337
Parameter b_2	0.002573406	0.002573406

Table A3.8: Goodness of fit statistics for Individual Endowment Mortality + accelerated TPD tables

Gender	Male	Female
Deviance	60.35	63.02
Overdispersion	1.59	1.66
Signs test	19/22 (38%)	15/26 (6%)
Runs test	14 (1%)	13 (1%)
Serial correlation test	+29.7% (3%)	+28.4% (3%)

Group mortality + accelerated TPD

Table A3.7: Parameter values for Group Mortality + accelerated TPD tables

Policy type Gender	Endowment Male	Endowment Female	Term assurance Male	Term assurance Combined
Graduation age range	20-60	20-60	20-60	20-60
Formula	GM(1,2)	GM(1,2)	GM(1,2)	GM(1,2)
Parameter a_0	0.000255462	0.000176181	0.000041634	0.000143149
Parameter b_0	-12.54358786	-12.91515141	-10.59236107	-11.75079033
Parameter b_1	0.141670015	0.141670015	0.089746669	0.112795763
Parameter b_2	n/a	n/a	n/a	n/a

Table A3.8: Goodness of fit statistics for Group Mortality + accelerated TPD tables

Policy type Gender	Endowment Male	Endowment Female	Term assurance Male	Term assurance Combined
Deviance	72.88	39.12	54.15	41.51
Overdispersion	1.92	1.03	1.43	1.09
Signs test	17/24 (17%)	15/26 (6%)	19/22 (38%)	21/20 (50%)
Runs test	19 (32%)	17 (20%)	22 (49%)	27 (6%)
Serial correlation test	+41.4% (0%)	+18.2% (12%)	-22.6% (93%)	-34.5% (99%)

Appendix 4 – Final tables

Table A4.1: Initial rates (q_x) for Individual Endowment Mortality tables

Age	Male Duration 1	Male Durations 2+	Female Duration 1	Female Durations 2+
*18**	*0.072318%*	*0.090389%*	*0.022242%*	*0.027801%*
*19**	*0.072318%*	*0.090389%*	*0.022242%*	*0.027801%*
20	0.072318%	0.090389%	0.022242%	0.027801%
21	0.073082%	0.091344%	0.022933%	0.028665%
22	0.073939%	0.092415%	0.023695%	0.029618%
23	0.074901%	0.093617%	0.024536%	0.030670%
24	0.075979%	0.094965%	0.025465%	0.031830%
25	0.077190%	0.096478%	0.026490%	0.033111%
26	0.078547%	0.098175%	0.027621%	0.034525%
27	0.080071%	0.100078%	0.028869%	0.036085%
28	0.081780%	0.102214%	0.030246%	0.037806%
29	0.083697%	0.104610%	0.031766%	0.039706%
30	0.085848%	0.107299%	0.033444%	0.041803%
31	0.088261%	0.110314%	0.035295%	0.044117%
32	0.090969%	0.113698%	0.037338%	0.046671%
33	0.094006%	0.117494%	0.039593%	0.049489%
34	0.097413%	0.121752%	0.042081%	0.052599%
35	0.101236%	0.126529%	0.044827%	0.056031%
36	0.105525%	0.131889%	0.047858%	0.059819%
37	0.110336%	0.137901%	0.051202%	0.063999%
38	0.115734%	0.144647%	0.054893%	0.068611%
39	0.121789%	0.152214%	0.058966%	0.073702%
40	0.128583%	0.160702%	0.063461%	0.079320%
41	0.136203%	0.170225%	0.068421%	0.085519%
42	0.144753%	0.180908%	0.073895%	0.092360%
43	0.154343%	0.192892%	0.079936%	0.099909%
44	0.165102%	0.206335%	0.086602%	0.108240%
45	0.177171%	0.221415%	0.093958%	0.117434%
46	0.190710%	0.238331%	0.102076%	0.127578%
47	0.205897%	0.257305%	0.111034%	0.138773%
48	0.222933%	0.278589%	0.120919%	0.151126%
49	0.242042%	0.302462%	0.131828%	0.164758%
50	0.263477%	0.329238%	0.143865%	0.179799%
51	0.287520%	0.359271%	0.157148%	0.196397%

52	0.314487%	0.392954%	0.171805%	0.214710%
53	0.344733%	0.430730%	0.187978%	0.234918%
54	0.378655%	0.473095%	0.205824%	0.257214%
55	0.416699%	0.520603%	0.225515%	0.281815%
56	0.459365%	0.573876%	0.247242%	0.308957%
57	0.507210%	0.633610%	0.271214%	0.338903%
58	0.560861%	0.700583%	0.297664%	0.371941%
59	0.621018%	0.775669%	0.326846%	0.408390%
60	0.688466%	0.859840%	0.359041%	0.448600%
61	0.794230%	0.977030%	0.427076%	0.524242%
62	0.908944%	1.102768%	0.503807%	0.608722%
63	1.032215%	1.236496%	0.589702%	0.702441%
64	1.163446%	1.377453%	0.685158%	0.805718%
65	1.301826%	1.524667%	0.790477%	0.918770%
66	1.451163%	1.682561%	0.907098%	1.043136%
67	1.617132%	1.857539%	1.037035%	1.180965%
68	1.801743%	2.051622%	1.181404%	1.333336%
69	2.007255%	2.267079%	1.341373%	1.501376%
70	2.236216%	2.506460%	1.518156%	1.686253%
71	2.491492%	2.772634%	1.713013%	1.889172%
72	2.776311%	3.068824%	1.927239%	2.111374%
73	3.094306%	3.398653%	2.162168%	2.354127%
74	3.449568%	3.766193%	2.419159%	2.618723%
75	3.846700%	4.176017%	2.699596%	2.906470%

* Rates for ages 18 and 19 have been set to the corresponding rate at age 20, as described in Section 4.

Table A4.2: Initial rates (q_x) for Group Mortality tables

Age	Endowment / Term assurance Combined
*18**	*0.023947%*
*19**	*0.023947%*
20	0.023947%
21	0.024646%
22	0.025453%
23	0.026385%
24	0.027459%
25	0.028698%
26	0.030128%
27	0.031778%
28	0.033682%
29	0.035878%
30	0.038411%
31	0.041334%
32	0.044707%
33	0.048597%
34	0.053086%
35	0.058265%
36	0.064240%
37	0.071132%
38	0.079084%
39	0.088258%
40	0.098841%
41	0.111050%
42	0.125134%
43	0.141381%
44	0.160123%
45	0.181742%
46	0.206679%
47	0.235442%
48	0.268618%
49	0.306880%
50	0.351007%
51	0.401894%
52	0.460573%

53	0.528231%
54	0.606234%
55	0.696154%
56	0.799798%
57	0.919243%
58	1.056873%
59	1.215427%
60	1.398043%
61	1.549691%
62	1.709506%
63	1.876754%
64	2.050526%
65	2.229752%
66	2.419313%
67	2.625800%
68	2.850666%
69	3.095487%
70	3.361975%
71	3.651988%
72	3.967551%
73	4.310862%
74	4.684320%
75	5.090532%

* Rates for ages 18 and 19 have been set to the corresponding rate at age 20, as described in Section 4.

Table A4.3: Initial rates (q_x) for Individual Endowment Mortality + accelerated TPD tables

Age	Male	Female
*18**	*0.154956%*	*0.085256%*
*19**	*0.154956%*	*0.085256%*
20	0.154956%	0.085256%
21	0.145977%	0.080314%
22	0.138228%	0.076049%
23	0.131565%	0.072382%
24	0.125869%	0.069247%
25	0.121040%	0.066590%
26	0.116997%	0.064365%
27	0.113673%	0.062536%
28	0.111013%	0.061072%
29	0.108974%	0.059951%
30	0.107525%	0.059153%
31	0.106643%	0.058667%
32	0.106313%	0.058486%
33	0.106531%	0.058606%
34	0.107301%	0.059030%
35	0.108633%	0.059763%
36	0.110550%	0.060818%
37	0.113081%	0.062210%
38	0.116266%	0.063963%
39	0.120158%	0.066105%
40	0.124821%	0.068671%
41	0.130334%	0.071705%
42	0.136792%	0.075259%
43	0.144310%	0.079396%
44	0.153027%	0.084194%
45	0.163106%	0.089741%
46	0.174746%	0.096148%
47	0.188181%	0.103543%
48	0.203693%	0.112082%
49	0.221619%	0.121951%
50	0.242364%	0.133373%
51	0.266415%	0.146616%
52	0.294358%	0.162004%
53	0.326904%	0.179930%
54	0.364912%	0.200867%

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55	0.409429%	0.225394%
56	0.461731%	0.254216%
57	0.523376%	0.288197%
58	0.596281%	0.328396%
59	0.682801%	0.376119%
60	0.785845%	0.432982%
61	0.898102%	0.507298%
62	1.019080%	0.590426%
63	1.148293%	0.682781%
64	1.285050%	0.784694%
65	1.428450%	0.896397%
66	1.582649%	1.019413%
67	1.753738%	1.155866%
68	1.943731%	1.306841%
69	2.154894%	1.473474%
70	2.389776%	1.656939%
71	2.651245%	1.858452%
72	2.942525%	2.079264%
73	3.267244%	2.320652%
74	3.629483%	2.583922%
75	4.033827%	2.870394%

* Rates for ages 18 and 19 have been set to the corresponding rate at age 20, as described in Section 4.

Table A4.4: Initial rates (q_x) for Group Mortality + accelerated TPD tables

Age	Endowment Male	Endowment Female	Term assurance Male	Term assurance Combined
*18**	*0.031613%*	*0.021803%*	*0.019279%*	*0.021840%*
*19**	*0.031613%*	*0.021803%*	*0.019279%*	*0.021840%*
20	0.031613%	0.021803%	0.019279%	0.021840%
21	0.032536%	0.022440%	0.020698%	0.022739%
22	0.033601%	0.023174%	0.022250%	0.023745%
23	0.034827%	0.024020%	0.023949%	0.024871%
24	0.036240%	0.024994%	0.025806%	0.026131%
25	0.037868%	0.026117%	0.027838%	0.027542%
26	0.039743%	0.027411%	0.030061%	0.029121%
27	0.041904%	0.028901%	0.032492%	0.030889%
28	0.044394%	0.030619%	0.035152%	0.032868%
29	0.047263%	0.032598%	0.038061%	0.035084%
30	0.050568%	0.034878%	0.041243%	0.037563%
31	0.054377%	0.037504%	0.044724%	0.040339%
32	0.058764%	0.040531%	0.048532%	0.043446%
33	0.063819%	0.044018%	0.052697%	0.046924%
34	0.069644%	0.048035%	0.057253%	0.050817%
35	0.076354%	0.052664%	0.062236%	0.055175%
36	0.084085%	0.057997%	0.067688%	0.060052%
37	0.092992%	0.064142%	0.073650%	0.065512%
38	0.103253%	0.071221%	0.080172%	0.071624%
39	0.115075%	0.079377%	0.087306%	0.078465%
40	0.128695%	0.088773%	0.095110%	0.086122%
41	0.144385%	0.099598%	0.103645%	0.094692%
42	0.162460%	0.112070%	0.112981%	0.104286%
43	0.183282%	0.126437%	0.123193%	0.115023%
44	0.207267%	0.142989%	0.134362%	0.127041%
45	0.234896%	0.162056%	0.146578%	0.140493%
46	0.266720%	0.184021%	0.159940%	0.155548%
47	0.303375%	0.209323%	0.174555%	0.172399%
48	0.345593%	0.238468%	0.190539%	0.191258%
49	0.394213%	0.272038%	0.208022%	0.212365%
50	0.450204%	0.310703%	0.227142%	0.235986%
51	0.514678%	0.355234%	0.248053%	0.262422%
52	0.588912%	0.406518%	0.270923%	0.292006%

53	0.674376%	0.465575%	0.295935%	0.325111%
54	0.772756%	0.533576%	0.323288%	0.362157%
55	0.885988%	0.611870%	0.353200%	0.403610%
56	1.016294%	0.702003%	0.385911%	0.449991%
57	1.166220%	0.805752%	0.421681%	0.501886%
58	1.338682%	0.925158%	0.460795%	0.559944%
59	1.537019%	1.062558%	0.503564%	0.624895%
60	1.765048%	1.220634%	0.550328%	0.697551%
61	1.942585%	1.361851%	0.646884%	0.797618%
62	2.126550%	1.513138%	0.752712%	0.906441%
63	2.315516%	1.674300%	0.867554%	1.023907%
64	2.507847%	1.844991%	0.990944%	1.149758%
65	2.701720%	2.024711%	1.122204%	1.283577%
66	2.904814%	2.215845%	1.264643%	1.428397%
67	3.127381%	2.421705%	1.423351%	1.588562%
68	3.371497%	2.643058%	1.600326%	1.765606%
69	3.639477%	2.880672%	1.797824%	1.961207%
70	3.933898%	3.135314%	2.018385%	2.177205%
71	4.257635%	3.407740%	2.264877%	2.415610%
72	4.613888%	3.698694%	2.540529%	2.678628%
73	5.006226%	4.008898%	2.848986%	2.968676%
74	5.438618%	4.339050%	3.194351%	3.288402%
75	5.915487%	4.689815%	3.581252%	3.640712%

* Rates for ages 18 and 19 have been set to the corresponding rate at age 20, as described in Section 4.

Appendix 5 – Certificate of peer review

Compliance with actuarial standards

The Institute and Faculty of Actuaries sets actuarial professional standards for its members, including "APS X2: Review of Actuarial Work" (https://actuaries.org.uk/standards/standards-and-guidance/professional-standards-directory/). This report and the work carried out to produce it has been subject to independent peer review by Dave Grimshaw MA FIA of Barnett Waddingham LLP.

This appendix has been provided by Dave to attest that:

- Dave has the appropriate experience and expertise to undertake this role. Specifically, Dave has been extensively involved in the production of mortality and critical illness tables, including those produced by the CMI in the UK.
- In Dave's opinion, the work complies with APS X2. Specifically:
    1. Suitable use has been made of the insured lives data supplied by Egyptian insurance companies to ECAT; in particular, it has not been used where the data appears questionable or inconsistent.
    2. Appropriate methods have been used to graduate the data, over reasonable age ranges, with the resulting rates appearing plausible.
    3. Appropriate methods have been used to extend these rates to a more complete range of ages.

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