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Process to Determine if a VBT Update is Required

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CONTENTS

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Section 1: Introduction

The VBT Analysis Subgroup ("Subgroup") of the Joint Academy Life Experience Committee and SOA Preferred Mortality Oversight Group ("Joint Committee") recommends the approach documented in this report for determining when there is sufficient change in the emerging actual mortality experience relative to the current VBT to warrant changes to the table.

In VM-20, Section 9.C, companies are required to use an Industry Mortality Table for determining their prudent best estimate mortality. The industry mortality table is currently based on the 2015 VBT and corresponding RR Tables, advanced forward to the valuation date using prescribed mortality improvement factors published by the Society of Actuaries (SOA) and the American Academy of Actuaries (AAA). The experience data underlying the 2015 VBT is from 2002-2009 and was collected on a voluntary basis for the SOA for individual life experience studies. With the introduction of PBR, there has been a significant increase in the number of contributing companies and amount of exposures and claims via the mandatory data collection within VM-51. This mandatory collection of experience data will continue to occur on an annual basis. This cadence will also provide the ability to review experience data every year or couple of years to monitor changes in the emerging experience.

The approach described in the report defines a set of metrics to be monitored as additional experience becomes available. It also defines a "threshold" that, if exceeded, would set into action a process to complete a deeper analysis to determine whether areas of the 2015 VBT need to be refreshed and, if so, to complete updates to the VBT to bring the metrics back within the threshold. Finally, it describes the software tools that can be used to complete the recommended process.

Section 2: New Calculated Fields

New calculated fields were added to the individual life experience data to enable the calculation of the variance and skewness of A/Es. These fields were added by the data vendor because these calculations had to be added at the policy level in order to enable the appropriate aggregation of the data at higher levels and only the data vendor has access to the policy level data. They were added in addition to the expected deaths or $\sum_{i=1}^{n} f\, q_i^s$ (by count) and the expected claims or $\sum_{i=1}^{n} f b_i\, q_i^s$ (by amount). They are calculated for each of two policy year segments (one before the policy anniversary and one after the policy anniversary) in an observed calendar year. In one policy, the f for the segment after the policy anniversary in year y plus the f for the segment before the policy anniversary in year y+1 will equal one, unless the policy terminates in the policy year for a reason other than death.

The new fields added to the database are shown in Table 1 below.

Table 1
NEW CALCULATED FIELDS

Variable Name	Description	Formula
ExpDeathQx2015VBTwMI_byPol	Expected Deaths - Count - w/MI	$\sum_{i=1}^{n} f\left((q_i^s)\,(1-MI_x)^{(y-2015)}\right)$
ExpDeathQx2015VBTwMI_byAmt	Expected Deaths - Amount - w/MI	$\sum_{i=1}^{n} f\, b_i\left((q_i^s)(1-MI_x)^{(y-2015)}\right)$
2CenMomP1wMI_byAmt	2nd Central Moment - Amount - w/MI - Part 1	$\sum_{i=1}^{n} f\, b_i^2\left((q_i^s)(1-MI_x)^{(y-2015)}\right)$
2CenMomP2wMI_byAmt	2nd Central Moment - Amount - w/MI - Part 2	$\sum_{i=1}^{n} f\, b_i^2\left((q_i^s)(1-MI_x)^{(y-2015)}\right)^2$
3CenMomP1wMI_byAmt	3rd Central Moment - Amount - w/MI - Part 1	$\sum_{i=1}^{n} f\, b_i^3\left((q_i^s)(1-MI_x)^{(y-2015)}\right)$
3CenMomP2wMI_byAmt	3rd Central Moment - Amount - w/MI - Part 2	$\sum_{i=1}^{n} f\, b_i^3\left((q_i^s)(1-MI_x)^{(y-2015)}\right)^2$
3CenMomP3wMI_byAmt	3rd Central Moment - Amount - w/MI - Part 3	$\sum_{i=1}^{n} f\, b_i^3\left((q_i^s)(1-MI_x)^{(y-2015)}\right)^3$
2CenMomP2wMI_byPol	2nd Central Moment - Count - w/MI - Part 2	$\sum_{i=1}^{n} f\left((q_i^s)(1-MI_x)^{(y-2015)}\right)^2$
3CenMomP3wMI_byPol	3rd Central Moment - Count - w/MI - Part 3	$\sum_{i=1}^{n} f\left((q_i^s)(1-MI_x)^{(y-2015)}\right)^3$
2CenMomP1_byAmt	2nd Central Moment - Amount - Part 1	$\sum_{i=1}^{n} f\, b_i^2\,(q_i^s)$
2CenMomP2_byAmt	2nd Central Moment - Amount - Part 2	$\sum_{i=1}^{n} f\, b_i^2\,(q_i^s)^2$
3CenMomP1_byAmt	3rd Central Moment - Amount - Part 1	$\sum_{i=1}^{n} f\, b_i^3\,(q_i^s)$
3CenMomP2_byAmt	3rd Central Moment - Amount - Part 2	$\sum_{i=1}^{n} f\, b_i^3\,(q_i^s)^2$
3CenMomP3_byAmt	3rd Central Moment - Amount - Part 3	$\sum_{i=1}^{n} f\, b_i^3\,(q_i^s)^3$
2CenMomP2_byPol	2nd Central Moment – Count - Part 2	$\sum_{i=1}^{n} f\,(q_i^s)^2$
3CenMomP3_byPol	3rd Central Moment - Count - Part 3	$\sum_{i=1}^{n} f\,(q_i^s)^3$

Where,

n: the number of records (i). For each policy in a calendar year, there will be one or two records, one each for the periods before and after the anniversary date, as necessary.

x: age of the policyholder in policy year

y: calendar year of observation

f: fraction of the calendar year for which the life was credited in the period covered by the record.

q_i^s: the mortality rate from the standard table (2015 VBT)

b_i: the amount insured for life i

MI: 2019 Mortality Improvement scale for AG38 and VM20, published by the SOA and AAA.

A comment regarding the new fields:

The variables in Table 1 above have been developed to be used in formulas to calculate confidence intervals and levels of credibility such as the ones in the paper "Credibility Theory Practices" (https://www.soa.org/globalassets/assets/files/research/projects/research-cred-theory-pract.pdf).

Some readers may think that there is an error in the formulas for second order and third order variables. For example, the variable 2CenMomP2_byAmt (2nd Central Moment - Amount - Part 2) has a formula of $\sum_{i=1}^{n} f_i\, b_i^2\, (q_i^s)^2$. This variable is used to calculate the part of the following Klugman formula after the subtraction sign.

$$\sigma_d^2 = \frac{\sum_{i=1}^{n} b_i^2\, f_i\, q_i(1 - f_i q_i^s)}{E_d^2}$$

In the Klugman formula, q_i is the true mortality rate and equal to $\widehat{m} q_i^s$ and q_i^s is the same as defined in Table 1.

The reader may question why the variable f_i is squared in the Klugman formula but the f in Table 1 is not. The reason is as follows. In the Klugman formula, it is assumed that the data being summarized contains one record per policy per policy year. In general, f_i will have a value of 1 unless the policy lapses before the end of the policy year, in which case the expected mortality rate would be the product of f_i and q_i^s.

The data that we are using was collected on a calendar year basis. Each record was then split into before-anniversary and after-anniversary sub-records so that the correct duration could be assigned to each. If a policy is in force for a full policy year, there will be records in two consecutive calendar years with fractional periods that sum to 1. This will result in the same value as the Klugman formula in which f_i squared would have a value of 1.

Our formulas will produce a different result than the Klugman formula for policies that lapse before the end of the policy year. In that case, under the Klugman formula, the value of q_i^s squared would be multiplied by f_i squared whereas, under our formula, the value of q_i^s squared would be multiplied by f.

To apply the Klugman formula as defined in our data, we would need to combine each policy's after-anniversary record for a calendar year with its before-anniversary record from the subsequent year. It has been determined that this cannot be accomplished on a practical basis.

Section 3: Metrics

Several metrics will be utilized to determine whether the 2015 VBT should be updated and to enable the Joint Committee to assess which areas of the 2015 VBT to potentially update. These metrics are actual-to-expected ratios (A/E), confidence intervals (CI) of the A/E, and the absolute value of actual values minus expected values. The expected basis ("E") in the A/Es will be the 2015 VBT with and without a mortality improvement adjustment. The mortality improvement adjustment will 'improve' the expected VBT mortality to the observation year of the actual experience data. These two versions of A/Es, with and without improvement, will be useful in determining the extent to which mortality improvement may be a factor resulting in a breach of the threshold. The actual and expected values will be based on amount as opposed to count because the 2015 VBT was developed using amount-based mortality. A 95% CI will be assumed, but the percentage may be adjusted if more or less precision is warranted.

The Subgroup recommends the CIs have a skewness component in order to adequately address the appropriateness of the 2015 VBT, especially at older ages. However, hardware limitations (see Section 6) will defer implementation of CIs with skewness until a later point in time. Until the limitations are overcome, the CIs implemented in this VBT analysis process will assume a normal distribution. If skewness were to be taken into account, the CIs would be shifted to the right if skewness was positive or to the left if negative. In our analysis, we calculated the confidence intervals using both the Standard Normal distribution and the Translated Gamma Distribution. Only one of the 102 cells, which has an A/E close to the 97.5th percentile, moved from being outside the Standard Normal confidence interval to being inside the Gamma confidence interval. However, this could be a greater issue if smaller cells were to be analyzed in the course of determining the efficacy of the 2015 VBT.

3.1 CONFIDENCE INTERVALS

The CI formula, which assumes a normal distribution, requires the mean and standard deviation of the metric that is being tested as input. The upper and lower bounds of the CI interval are $u \pm z\sigma$, where u is the mean, σ is the standard deviation, and z is the value from the Standard Normal distribution for the selected confidence level (e.g., for a 95% confidence level, z = 1.96). For the analysis of the 2015 VBT, $u = m = A/E.$ The standard deviation of A/E (σ) is defined in Appendix A.

To take skewness into account, we developed confidence intervals using a Translated Gamma Distribution[1] to approximate the distribution of aggregate claims, S, then substitute A/E for S.

Confidence Interval for S: $[G^{-1}(0.025, Alpha, Beta) + X_0,\ G^{-1}(0.975, Alpha, Beta) + X_0]$

Where:

- G^{-1} is the inverse of the Gamma Distribution function. Note: if Microsoft Excel's Gamma.Inv function is used, replace $Beta$ with $1/Beta$
- $X_0 = E[S] - 2 \times [Var(S)]^2 \div (E[(S - E[S])^3])$
- $Alpha = 4 \times [Var(S)]^3 \div E[(S - E[S])^3]^2$
- $Beta = 2 \times [Var(S)] \div E[(S - E[S])^3]$

[1] Bowers Jr., Newton L., et al. (1997.) Society of Actuaries. Actuarial Mathematics. Pp. 387-389.

Using the available fields in the individual life experience data and the formulas in Appendices A and B, calculate the following input parameters for the inverse Gamma function.

- Mean: $E[S] = m = \left(\sum_{i=1}^{n} Death\ Claim\ Amount\right) \div \left(\sum_{i=1}^{n} ExpDeathQx2015VBTwMI\_byAmt\right)$
- Variance: $Var(S) = \frac{m}{E^2} \times 2CenMomP1wMI_{byAMT} - \frac{m^2}{E^2} \times 2CenMomP2wMIbyAmt$
- Skewness: $\gamma_i = E[(S - E[S])^3] = \frac{m}{E^3} \times 3CenMomP1wMIbyAmt - 3 \times \frac{m^2}{E^3} \times$ $3CenMomP2wMIbyAmt + \frac{m^3}{E[S]^3} \times 3CenMomP3wMIbyAmt$
- Where the expected claims equal $E = \left(\sum_{i=1}^{n} ExpDeathQx2015VBTwMI\_byAmt\right)$

If the upper and lower CI boundaries, as defined above, straddle the 100% point for any segment of the experience, the experience in that segment is considered to be consistent with the 2015 VBT. If the upper CI boundary is below the 100% point, the A/E for that segment is low, and the 2015 VBT is too high for that segment. If the lower CI boundary is above the 100% point, the A/E for that segment is high, and the 2015 VBT is too low for that segment.

Three other distributions, which include skewness, were considered: the transformed (not Translated) Gamma, Burr, and generalized Pareto. These distributions are all anchored at zero and spread probability from zero to infinity, which makes it hard to fit a distribution that is tightly spread around its mean and is also skewed. When these three distributions were applied, none of them appeared to fit as well as the Translated Gamma.

For the Gamma Distribution, the larger the alpha parameter, the more symmetric the distribution is. This is because the skewness coefficient is 2/alpha^2 and so goes to zero as the alpha parameter increases. Many of the cells in our analysis had large values of alpha; for these cells, the confidence intervals calculated based on the Standard Normal and Translated Gamma Distribution are very similar. However, it should be noted that this is less likely to be true when analyzing smaller subsets of the data.

Section 4: Determining Credible Data Cells

To test whether a threshold for adjusting the 2015 VBT or creating a new VBT is breached, the experience study data is grouped into fully credible sized **cells** using the following method.

1. The experience data is initially summarized by gender, smoker status, 10-year attained age bands and duration.

2. The data groups from #1 are combined to form fully credible cells. Data groups with consecutive durations within a gender/smoker status/age-band cohort are accumulated until full credibility is attained, as measured by a Z factor of 1, as calculated thusly:

   - The mean ($u = m = A/E$) and the variance (σ^2) of the A/E as described in Section 2 and the standard deviation, $= \sqrt{\sigma^2}$, are determined for each group in #1.

   - A limited fluctuation credibility Z factor[2], assuming a normal distribution, is determined for each group in #1 as:

     - $Z = min\left\{1, \frac{rm}{z\sigma}\right\}$, where
     - r is the error term = 0.05
     - z is 1.96 (based on a 95% probability)
     - m and σ are defined in Section 2.

In a few instances, the data for all durations within a gender/smoker status/age band were not fully credible.

[2] Klugman, Stuart, et al. (2009, December). "Credibility Theory Practices." *https://www.soa.org/globalassets/assets/files/research/projects/research-cred-theory-pract.pdf.*

Section 5: Trigger for Action

One possible trigger for action could be as follows. Confidence intervals for each cell from Section 3 are calculated and used to determine if the 'threshold' for further action on the 2015 VBT has been met. The 95% CI boundaries are determined around the A/Es for each cell. The cells where 100% falls within their 95% CI boundaries pass the CI test. If the number of cells that pass the CI test is greater than 95% of the total number of cells tested, no further action is needed. If the number of cells that pass the CI test is less than 95% of the total number of cells tested, the 'threshold' has been breached and the process to perform corrective actions on the 2015 VBT is initiated. Alternatively, the threshold for action could be based on a metric other than the count of cells; for example, the threshold could be based on whether the total exposed face amount (or expected death claims or actual death claims) of the cells that pass the CI test exceeds 95% of the total. Also, even if the count of cells (or other chosen metric) exceeds the 95% threshold, the cells that failed the CI test should be examined to ensure that there are no clusters, which may indicate a significant weakness in some areas of the table.

Section 6: VBT Corrective Actions

If the CI tests performed, as described in Section 4, indicate corrective action on the 2015 VBT is needed, the Joint Committee could begin a process to determine what areas of the VBT may need to be adjusted. Potential adjustments on the 2015 VBT may include slope adjustments using multiplicative factors and adjustments to mortality improvement factors. These adjustments may be made to a limited set of subsections of the table that warrant an update. The Joint Committee may use $|A - E|$ values to prioritize areas of the 2015 VBT to update. If too many partitions have failed the CI tests in Section 4, the Joint Committee may decide to create a completely new table in place of making adjustments to the existing 2015 VBT. The Joint Committee may alternatively decide to hold off on making any adjustments to the 2015 VBT if the number of cells that failed the CI test was small and degree of failure was minimal. Other considerations, such as potential industry disruption, should be taken into account before making any adjustments to the 2015 VBT.

Section 7: Software Tools

7.1 EXCEL WORKBOOK FOR DETERMINING DATA CELLS

An Excel workbook has been developed to create the data cells described in Section 3. Documentation on the functionality of the workbook is contained in the workbook. The workbook is currently set up with the 2009-2017 experience data. The workbook will need to be updated each time a review of the need to update the VBT takes place.

The analysis performed in the Excel workbook primarily uses CIs without a skewness adjustment based on the Standard Normal distribution. It also includes CIs with a skewness adjustment based on a Translated Gamma Distribution.

When we recalculated the confidence intervals using the Translated Gamma Distribution, only one cell – barely - changed "position" from the "In CI" group to the "Below" group. Under Standard Normal, the confidence interval for this cell was [100.0 %, 109.6%], which brackets 100%; under Gamma, the CI was [100.2%,109.9%].

The 102 cells identified by this process are listed in Appendix C.

7.2 TABLEAU WORKBOOK FOR VBT ANALYSIS

Several Tableau views have been developed to help identify the subsections of the 2015 VBT that may need to be adjusted as described in Section 5. These views include the capability to see the CI around various segments of the data. The workbook currently contains the 116 cells developed in the Excel workbook, described in Section 7.1, from the 2009-2017 data. These 116 data cells and their CIs can be viewed in the published Tableau views.

As of this writing, the published Tableau views show CIs without a skewness adjustment. To implement CIs with a skewness adjustment, an R subroutine needs to be called from Tableau and this capability and the skewness adjustment will be added by the SOA at a later date.

Section 8: Initial Findings

Our analysis was principally concerned with mortality experience based on face amount with mortality improvement assumed. The data provided by MIB included 33.8 million records. We excluded records with any of the following characteristics:

- PLT indicator equals “Y”
- Duration greater than 36
- Smoker Status equals “Unknown”
- Issue Age less than 18

After these exclusions, the number of remaining records was 31.8 million. These records had a mortality ratio of 90.7% based on face amount and 112.2% based on policy count. As discussed in Section 4, we summarized the records into 116 cells. Of the 116 cells, 104 were fully credible. We calculated mortality ratios and confidence intervals – assuming a Standard Normal distribution - for each of the cells. The confidence intervals were centered around the actual to expected ratio. All of the calculations were based on amount, not count.

This tab identified the cells of the current mortality table where 100% is within, below, or aobe the confidence interval

			FNS	FS	MNS	MS	All	%	Actual (Face)	Expected with MI (FACE)	A/E	Exp Pctg
Below	(red)	100% is below Confidence Interval	8	0	13	9	30	26%	25,950,613,945.00	23,793,512,471.68	109.1%	10%
In CI	(green)	100% is within Confidence Interval	11	1	17	3	32	28%	42,167,137,100.00	42,037,652,257.07	100.3%	18%
Above	(yellow)	100% is above Confidence Interval	14	1	25	2	42	36%	138,996,791,899.00	163,349,091,163.29	85.1%	69%
Not Cred.	(light blue)	Cell is not credible	1	6	1	4	12	10%	7,156,245,032.00	7,052,156,520.08	101.5%	3%
All			34	8	56	18	116	100%	214,270,787,976.00	236,232,412,412.13	90.7%	100%

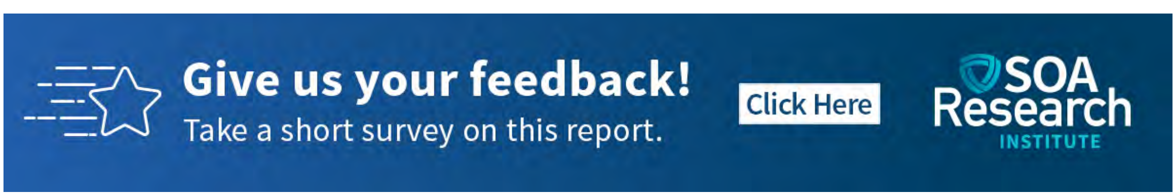
		AA\Dur ->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Female	NonSmoke	18 - 29	[1	---	---	---	---	---	---	---	---	---	---	1]																								
Female	NonSmoke	30 - 39	[2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2]														
Female	NonSmoke	40 - 49	[3	---	---	---	---	---	---	3]	[4	---	---	---	4]	[5	---	---	---	---	5]	[6	---	---	---	---	---	---	---	---	---	---	---	6]				
Female	NonSmoke	50 - 59	[7	---	---	---	---	---	---	---	7]	[8	---	---	8]	[9	---	---	9]	[10	---	---	10]	[11	---	11]	[12	---	12]	[13	---	---	---	---	---	---	---	13]
Female	NonSmoke	60 - 69	[14	---	---	---	---	---	---	---	---	---	---	14]	[15	---	---	---	---	15]	[16	---	---	16]	[17	---	17]	[18	18]	[19	19]	[20	---	---	---	---	---	20]
Female	NonSmoke	70 - 79	[21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	21]	[22	---	---	---	---	22]	[23	---	23]	[24	---	24]	[25	---	---	---	---	25]
Female	NonSmoke	80 - 89	[26	---	---	---	---	---	---	---	---	---	26]	[27	---	---	---	---	---	---	---	27]	[28	---	28]	[29	---	29]	[30	---	30]	[31	---	---	---	---	---	31]
Female	NonSmoke	90 Plus	[32	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	32]	[33	---	---	---	33]	[34	---	---	---	---	---	---	---	---	---	---	---	34]
Male	NonSmoke	18 - 29	[35	---	---	---	---	---	---	---	---	---	---	35]																								
Male	NonSmoke	30 - 39	[36	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	36]														
Male	NonSmoke	40 - 49	[37	---	---	---	---	37]	[38	---	38]	[39	---	39]	[40	---	---	40]	[41	---	---	---	---	---	---	---	---	---	---	---	---	---	---	41]				
Male	NonSmoke	50 - 59	[42	---	---	---	42]	[43	---	43]	[44	44]	[45	45]	[46	46]	[47	47]	[48	---	48]	[49	49]	[50	50]	[51	51]	[52	52]	[53	53]	[54	---	---	---	---	---	54]
Male	NonSmoke	60 - 69	[55	---	---	---	---	55]	[56	---	56]	[57	57]	[58	58]	[59	59]	[60	---	60]	[61	61]	[62	62]	[63	63]	[64]	[65]	[66]	[67]	[68]	[69	69]	[70	---	---	---	70]
Male	NonSmoke	70 - 79	[71	---	---	---	---	---	---	---	---	71]	[72	---	---	72]	[73	---	73]	[74	---	74]	[75	---	75]	[76	76]	[77	77]	[78]	[79]	[80	80]	[81	---	---	---	81]
Male	NonSmoke	80 - 89	[82	---	---	---	---	---	---	---	---	---	---	82]	[83	---	---	---	---	---	---	83]	[84	---	84]	[85	85]	[86	86]	[87	87]	[88	---	---	---	---	---	88]
Male	NonSmoke	90 Plus	[89	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	89]	[90	---	---	---	---	---	---	---	---	90]
Female	Smoker	18 - 29	[91	---	---	---	---	---	---	---	---	---	---	91]																								
Female	Smoker	30 - 39	[92	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	92]														
Female	Smoker	40 - 49	[93	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	93]				
Female	Smoker	50 - 59	[94	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	94]
Female	Smoker	60 - 69	[95	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	95]
Female	Smoker	70 - 79	[96	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	96]
Female	Smoker	80 - 89	[97	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	97]
Female	Smoker	90 Plus	[98	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	98]
Male	Smoker	18 - 29	[99	---	---	---	---	---	---	---	---	---	---	99]																								
Male	Smoker	30 - 39	[100	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	100]														
Male	Smoker	40 - 49	[101	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	101]				
Male	Smoker	50 - 59	[102	---	---	---	---	---	---	---	---	---	---	---	---	---	102]	[103	---	---	---	---	---	103]	[104	---	---	104]	[105	---	---	---	---	---	---	---	---	105]
Male	Smoker	60 - 69	[106	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	106]	[107	---	---	---	---	107]	[108	---	108]	[109	109]	[110	110]	[111	---	---	---	---	111]
Male	Smoker	70 - 79	[112	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	112]	[113	---	---	113]	[114	---	---	---	---	---	---	114]
Male	Smoker	80 - 89	[115	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	115]
Male	Smoker	90 Plus	[116	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	116]

- The 104 fully credible cells accounted for 96.7% of the expected death claims and had an A/E of 90.4%.
- Thirty-two of the cells had confidence intervals that included 100%. Those cells contained 20% of the expected death claims and had an A/E of 100%. They are shown as green blocks in the above chart.
- For 42 of the cells, 100% were above the upper limit of their confidence interval, indicating the tabular mortality rates were too high. Those cells contained 65% of the expected death claims and had an A/E of 85%. They are shown as yellow blocks.
- For 30 of the cells, 100% were below the lower limit of their confidence interval, indicating the tabular mortality rates were too low. Those cells contained 12% of the expected death claims and had an A/E of 109%. They are shown as red blocks.
- The 12 cells that were not full credible accounted for 3% of the expected death claims and had an A/E of 102%. Of those cells, 100% were above the upper limit of the confidence interval for nine cells, 100% were below the lower limit of the confidence interval for two cells, and 100% were within the confidence interval for one cell. The pattern of the cells where the table was too high or too low was generally consistent with the pattern found in the fully credible cells. They are shown as grey blocks.

Additional detail about the cells can be found in Appendix C. One of the notable findings was that cells with low A/E values occurred in the early durations, whereas cells with high A/E values occurred in the later durations. This indicates that the mortality rates of the current table are too high in the early durations and too low in the later durations. We also noted that both male and female insureds have low A/E ratios of 91%. However, smokers of both genders have A/E ratios of 102%, and non-smokers of both genders have A/E ratios of 90%.

Smoker Status	Gender	Actual Number	Exposed Face	Actual Face	Expected Face w MI	A/E Face w MI
NonSmoker	Female	508,689	30,269,870,244,043	61,801,047,713	69,016,454,689	89.5%
Smoker	Female	147,483	1,041,696,120,501	6,995,458,975	6,863,158,975	101.9%
NonSmoker	Male	737,501	58,485,607,547,753	130,576,882,205	145,683,514,706	89.6%
Smoker	Male	196,748	2,470,774,043,884	14,897,472,200	14,611,681,156	102.0%
NonSmoker	All	1,246,190	88,755,477,791,796	192,377,929,918	214,699,969,395	89.6%
Smoker	All	344,231	3,512,470,164,385	21,892,931,175	21,474,840,131	101.9%
All	Female	656,172	31,311,566,364,544	68,796,506,688	75,879,613,664	90.7%
All	Male	934,249	60,956,381,591,637	145,474,354,405	160,295,195,862	90.8%
All	**All**	**1,590,421**	**92,267,947,956,181**	**214,270,861,093**	**236,174,809,526**	**90.7%**

The MS-Excel workbook includes summaries by face amount band and other criteria.



Appendix A: Derivation of Variance of A/E

Assume:

n: the number of policies

q_i: the true mortality rate for life i

q_i^s: the mortality rate from the standard table (2015 VBT)

b_i: the amount insured for life i

d_i: is 0 if the life doesn't die, is 1 if it does

$A = \sum_{i=1}^{n} b_i \, d_i$ is the actual claims

$E = \sum_{i=1}^{n} b_i \, q_i^s$ is the expected claims

$m = \frac{A}{E} = \frac{\sum_{i=1}^{n} b_i d_i}{E}$ is also known as the mortality ratio

$q_i \approx m q_i^s$ is an estimate of the true mortality since the true mortality is unknown

For each life, $u = \frac{b_i m q_i^s}{E}$ and $X = \frac{b_i d_i}{E}$ and

$$Var(m) = \sigma_i^2 = E[(X-u)^2]$$

$$\sigma_i^2 = \left[\left(\frac{b_i}{E} - \frac{b_i m q_i^s}{E}\right)^2 \times m q_i^s\right] + \left[\left(0 - \frac{b_i m q_i^s}{E}\right)^2 \times (1 - m q_i^s)\right]$$

$$\sigma_i^2 = \left(\frac{b_i}{E}\right)^2 m q_i^s - 2\left(\frac{b_i}{E}\right)\left(\frac{b_i m q_i^s}{E}\right) m q_i^s + \left(\frac{b_i m q_i^s}{E}\right)^2 m q_i^s + \left(\frac{b_i m q_i^s}{E}\right)^2 - \left(\frac{b_i m q_i^s}{E}\right)^2 m q_i^s$$

$$\sigma_i^2 = \left(\frac{b_i}{E}\right)^2 m q_i^s - 2\left(\frac{b_i}{E}\right)\left(\frac{b_i m q_i^s}{E}\right) m q_i^s + \left(\frac{b_i m q_i^s}{E}\right)^2$$

$$\sigma_i^2 = \left(\frac{b_i}{E}\right)^2 m q_i^s - 2\left(\frac{b_i}{E}\right)^2 (m q_i^s)^2 + \left(\frac{b_i m q_i^s}{E}\right)^2$$

$$\sigma_i^2 = \left(\frac{b_i}{E}\right)^2 m q_i^s - \left(\frac{b_i}{E}\right)^2 (m q_i^s)^2$$

$$\sigma_i^2 = \left(\frac{b_i}{E}\right)^2 [m q_i^s (1 - m q_i^s)]$$

For all lives,

$$\sigma^2 = \frac{m}{E^2} \sum_{i=1}^{n} b_i^2 \, q_i^s - \frac{m^2}{E^2} \sum_{i=1}^{n} b_i^2 \, (q_i^s)^2$$

$$\sigma = \sqrt{\sigma} = \sqrt{Var(m)}$$

Appendix B: Derivation of Skewness of A/E

Assume:

n: the number of policies

q_i: the true mortality rate for life i

q_i^s: the mortality rate from the standard table (2015 VBT)

b_i: the amount insured for life i

d_i: is 0 if the life doesn't die, is 1 if it does

$A = \sum_{i=1}^{n} b_i\, d_i$ is the actual claims

$E = \sum_{i=1}^{n} b_i\, q_i^s$ is the expected claims

$m = \frac{A}{E} = \frac{\sum_{i=1}^{n} b_i d_i}{E}$ is also known as the mortality ratio

$q_i \approx mq_i^s$ is an estimate of the true mortality since the true mortality is unknown

For each life, $u = \frac{b_i m q_i^s}{E}$ and $X = \frac{b_i d_i}{E}$ and

$$\gamma_i = Skewness(m) = E[(X-u)^3]$$

$$\gamma_i = \left[\left(\frac{b_i}{E} - \frac{b_i m q_i^s}{E}\right)^3 \times\, mq_i^s\right] + \left[\left(0 - \frac{b_i m q_i^s}{E}\right)^3 \times (1 - mq_i^s)\right]$$

$$\gamma_i = \left(\frac{b_i}{E}\right)^3 (1 - mq_i^s)^3 \times mq_i^s + \left(\frac{b_i}{E}\right)^3 (-mq_i^s)^3 \times (1 - mq_i^s)$$

$$\gamma_i = \left(\frac{b_i}{E}\right)^3 (1 - mq_i^s) \times mq_i^s \times [(1 - mq_i^s)^2 - (mq_i^s)^2]$$

$$\gamma_i = \left(\frac{b_i}{E}\right)^3 (1 - mq_i^s) \times mq_i^s \times [1 - 2mq_i^s + (mq_i^s)^2 - (mq_i^s)^2]$$

$$\gamma_i = \left(\frac{b_i}{E}\right)^3 (1 - mq_i^s) \times mq_i^s \times [1 - 2mq_i^s]$$

$$\gamma_i = \left(\frac{b_i}{E}\right)^3 [mq_i^s - (mq_i^s)^2 - 2(mq_i^s)^2 + (2mq_i^s)^3]$$

$$\gamma_i = \left(\frac{b_i}{E}\right)^3 [mq_i^s - 3(mq_i^s)^2 + (2mq_i^s)^3]$$

For all lives,

$$\gamma = \frac{m}{E^3} \sum_{i=1}^{n} b_i^3\, q_i^s - 3\frac{m^2}{E^3} \sum_{i=1}^{n} b_i^3\, (q_i^s)^2 + 2\frac{m^3}{E^3} \sum_{i=1}^{n} b_i^3\, (q_i^s)^3$$

Appendix C: Credible Data Cells

This section lists the 102 data cells identified by the MS-Excel workbook. In this table, green rows had confidence intervals that included 100%. For yellow rows, 100% were above the upper limit of their confidence interval, indicating the tabular mortality rates were too high. For red rows, 100% were below the lower limit of their confidence interval, indicating the tabular mortality rates were too low. Blue rows were not fully credible.

Cell	Sex/ Tobac.	Attained Age	Dur	Actual Number	Actual Face	Expected Face with MI	Cred Factor Before Capping	Std.Dev.	A/E Face w/MI	# of std devs from 100%	Standard Normal Position	Std. Norm. Confidence Interval
1	FNS	18 - 29	1 - 12	1,281	184,275,463	212,227,145	42%	0.053	86.8%	(2.5)	Not Cred.	81.8% - 91.8%
2	FNS	30 - 39	1 - 22	6,313	1,343,665,084	1,791,732,137	103%	0.019	75.0%	(13.4)	Above	73.2% - 76.8%
3	FNS	40 - 49	1 - 8	7,148	2,099,216,584	2,639,434,607	104%	0.019	79.5%	(10.5)	Above	77.7% - 81.4%
4	FNS	40 - 49	9 - 13	5,671	1,466,871,706	1,955,732,988	110%	0.017	75.0%	(14.3)	Above	73.3% - 76.7%
5	FNS	40 - 49	14 - 19	5,355	773,981,929	929,738,050	101%	0.021	83.2%	(7.9)	Above	81.2% - 85.3%
6	FNS	40 - 49	20 - 32	4,719	305,471,370	278,063,088	101%	0.028	109.9%	3.6	Below	107.2% - 112.5%
7	FNS	50 - 59	1 - 9	13,003	2,759,300,489	3,516,609,707	105%	0.019	78.5%	(11.3)	Above	76.7% - 80.3%
8	FNS	50 - 59	10 - 13	7,806	1,627,621,243	2,112,231,706	103%	0.019	77.1%	(12.0)	Above	75.2% - 78.9%
9	FNS	50 - 59	14 - 17	7,877	1,269,868,861	1,615,220,318	108%	0.019	78.6%	(11.5)	Above	76.8% - 80.4%
10	FNS	50 - 59	18 - 21	7,669	789,738,410	871,068,808	108%	0.021	90.7%	(4.4)	Above	88.6% - 92.7%
11	FNS	50 - 59	22 - 24	5,384	428,896,728	434,640,716	109%	0.023	98.7%	(0.6)	In CI	96.5% - 100.9%
12	FNS	50 - 59	25 - 27	5,367	366,943,745	360,270,385	117%	0.022	101.9%	0.8	In CI	99.7% - 104%
13	FNS	50 - 59	28 - 36	5,789	331,779,703	313,084,720	127%	0.021	106.0%	2.8	Below	103.9% - 108%
14	FNS	60 - 69	1 - 12	22,485	3,722,500,377	4,511,005,009	106%	0.020	82.5%	(8.8)	Above	80.6% - 84.4%
15	FNS	60 - 69	13 - 18	15,642	1,768,503,538	2,175,504,186	103%	0.020	81.3%	(9.3)	Above	79.4% - 83.2%
16	FNS	60 - 69	19 - 22	11,437	827,144,336	826,719,976	107%	0.024	100.1%	0.0	In CI	97.8% - 102.3%
17	FNS	60 - 69	23 - 25	9,889	608,321,566	585,848,617	118%	0.022	103.8%	1.7	In CI	101.7% - 106%
18	FNS	60 - 69	26 - 27	6,824	386,325,167	374,550,822	107%	0.025	103.1%	1.3	In CI	100.8% - 105.5%
19	FNS	60 - 69	28 - 29	5,651	313,642,632	310,145,114	101%	0.025	101.1%	0.4	In CI	98.7% - 103.5%
20	FNS	60 - 69	30 - 36	7,647	396,377,687	389,554,278	133%	0.020	101.8%	0.9	In CI	99.9% - 103.6%
21	FNS	70 - 79	1 - 18	40,249	5,613,651,700	6,218,944,506	101%	0.023	90.3%	(4.3)	Above	88.1% - 92.4%
22	FNS	70 - 79	19 - 24	28,417	1,290,349,084	1,309,461,804	110%	0.023	98.5%	(0.6)	In CI	96.4% - 100.7%
23	FNS	70 - 79	25 - 27	16,477	644,066,340	625,655,383	107%	0.025	102.9%	1.2	In CI	100.6% - 105.3%
24	FNS	70 - 79	28 - 30	12,929	520,520,864	477,486,305	111%	0.025	109.0%	3.6	Below	106.6% - 111.4%
25	FNS	70 - 79	31 - 36	8,067	315,929,027	295,808,090	102%	0.027	106.8%	2.5	Below	104.3% - 109.3%
26	FNS	80 - 89	1 - 11	16,229	9,100,103,033	10,018,033,288	101%	0.023	90.8%	(4.0)	Above	88.7% - 93%
27	FNS	80 - 89	12 - 20	45,553	6,453,801,042	6,899,735,886	100%	0.024	93.5%	(2.7)	Above	91.3% - 95.8%
28	FNS	80 - 89	21 - 23	29,359	1,542,427,217	1,429,712,780	108%	0.026	107.9%	3.1	Below	105.5% - 110.3%
29	FNS	80 - 89	24 - 26	31,492	1,289,161,140	1,248,160,587	114%	0.023	103.3%	1.4	In CI	101.1% - 105.5%
30	FNS	80 - 89	27 - 29	25,423	947,423,658	924,501,875	104%	0.025	102.5%	1.0	In CI	100.1% - 104.9%
31	FNS	80 - 89	30 - 36	19,877	738,932,033	671,127,161	105%	0.027	110.1%	3.8	Below	107.6% - 112.6%
32	FNS	90 PLUS	1 - 18	16,202	7,870,810,390	9,244,744,623	104%	0.021	85.1%	(7.1)	Above	83.2% - 87.1%
33	FNS	90 PLUS	19 - 23	17,774	1,754,117,912	1,659,448,203	101%	0.027	105.7%	2.1	Below	103.2% - 108.2%
34	FNS	90 PLUS	24 - 36	37,684	1,949,307,655	1,799,371,007	133%	0.021	108.3%	4.0	Below	106.4% - 110.3%
35	MNS	18 - 29	1 - 12	2,971	450,504,232	460,645,382	51%	0.049	97.8%	(0.4)	Not Cred.	93.1% - 102.5%
36	MNS	30 - 39	1 - 22	9,810	3,172,926,122	3,096,924,317	122%	0.022	102.5%	1.1	In CI	100.4% - 104.5%
37	MNS	40 - 49	1 - 6	8,410	4,421,370,650	4,876,632,977	111%	0.021	90.7%	(4.5)	Above	88.7% - 92.6%
38	MNS	40 - 49	7 - 9	5,200	2,827,203,881	3,352,132,485	103%	0.021	84.3%	(7.5)	Above	82.4% - 86.3%
39	MNS	40 - 49	10 - 12	4,997	2,285,545,928	2,742,175,257	106%	0.020	83.3%	(8.3)	Above	81.4% - 85.3%
40	MNS	40 - 49	13 - 16	5,548	1,722,690,680	1,971,094,816	108%	0.021	87.4%	(6.1)	Above	85.4% - 89.4%
41	MNS	40 - 49	17 - 32	11,461	1,127,547,934	1,157,978,218	133%	0.019	97.4%	(1.4)	In CI	95.6% - 99.1%
42	MNS	50 - 59	1 - 5	11,150	4,559,584,269	5,363,960,608	104%	0.021	85.0%	(7.2)	Above	83% - 87%
43	MNS	50 - 59	6 - 8	9,063	4,194,170,397	4,878,932,229	112%	0.020	86.0%	(7.1)	Above	84.1% - 87.8%
44	MNS	50 - 59	9 - 10	6,987	3,364,653,530	3,734,292,303	109%	0.021	90.1%	(4.7)	Above	88.1% - 92.1%
45	MNS	50 - 59	11 - 12	6,345	2,506,650,133	3,128,153,571	105%	0.019	80.1%	(10.2)	Above	78.3% - 82%
46	MNS	50 - 59	13 - 14	6,815	2,375,976,856	3,043,878,908	109%	0.018	78.1%	(12.0)	Above	76.3% - 79.8%
47	MNS	50 - 59	15 - 16	6,390	1,932,524,975	2,362,934,168	105%	0.020	81.8%	(9.2)	Above	79.9% - 83.7%
48	MNS	50 - 59	17 - 19	9,304	1,943,084,241	2,341,886,542	120%	0.018	83.0%	(9.7)	Above	81.3% - 84.6%
49	MNS	50 - 59	20 - 21	6,114	922,698,233	954,009,328	103%	0.024	96.7%	(1.4)	In CI	94.4% - 99%
50	MNS	50 - 59	22 - 23	6,412	799,758,975	811,114,585	108%	0.023	98.6%	(0.6)	In CI	96.4% - 100.8%
51	MNS	50 - 59	24 - 25	6,818	740,286,673	758,980,779	116%	0.021	97.5%	(1.2)	In CI	95.5% - 99.6%
52	MNS	50 - 59	26 - 27	6,810	645,451,870	650,115,860	122%	0.021	99.3%	(0.3)	In CI	97.3% - 101.3%
53	MNS	50 - 59	28 - 29	5,603	462,501,522	455,654,179	114%	0.023	101.5%	0.7	In CI	99.3% - 103.7%
54	MNS	50 - 59	30 - 36	6,321	459,270,842	413,015,264	123%	0.023	111.2%	4.9	Below	109% - 113.4%
55	MNS	60 - 69	1 - 6	16,789	4,963,552,043	5,832,674,836	110%	0.020	85.1%	(7.6)	Above	83.2% - 87%
56	MNS	60 - 69	7 - 9	13,177	4,428,977,142	5,503,739,896	119%	0.017	80.5%	(11.3)	Above	78.8% - 82.1%
57	MNS	60 - 69	10 - 11	9,361	2,836,350,270	3,676,115,021	103%	0.019	77.2%	(12.0)	Above	75.3% - 79%
58	MNS	60 - 69	12 - 13	9,583	2,772,330,016	3,309,090,520	107%	0.020	83.8%	(8.1)	Above	81.9% - 85.7%

Cell	Sex/ Tobac.	Attained Age	Dur	Actual Number	Actual Face	Expected Face with MI	Cred Factor Before Capping	Std.Dev.	A/E Face w/MI	# of std devs from 100%	Standard Normal Position	Std. Norm. Confidence Interval
60	MNS	60 - 69	16 - 18	13,163	2,690,437,404	3,301,104,414	109%	0.019	81.5%	(9.7)	Above	79.7% - 83.3%
61	MNS	60 - 69	19 - 20	9,741	1,466,591,854	1,571,587,665	103%	0.023	93.3%	(2.9)	Above	91.1% - 95.5%
62	MNS	60 - 69	21 - 22	10,071	1,211,428,044	1,220,344,561	110%	0.023	99.3%	(0.3)	In CI	97.1% - 101.4%
63	MNS	60 - 69	23 - 24	11,850	1,345,986,901	1,322,329,890	126%	0.021	101.8%	0.9	In CI	99.8% - 103.7%
64	MNS	60 - 69	25 - 25	6,717	735,870,508	689,288,114	100%	0.027	106.8%	2.5	Below	104.2% - 109.3%
65	MNS	60 - 69	26 - 26	6,999	693,483,242	686,087,706	102%	0.025	101.1%	0.4	In CI	98.7% - 103.5%
66	MNS	60 - 69	27 - 27	6,991	695,303,170	657,550,713	105%	0.026	105.7%	2.2	Below	103.3% - 108.2%
67	MNS	60 - 69	28 - 28	6,791	673,024,577	597,949,021	108%	0.027	112.6%	4.7	Below	110% - 115.1%
68	MNS	60 - 69	29 - 29	6,004	554,362,231	524,307,436	102%	0.026	105.7%	2.2	Below	103.2% - 108.2%
69	MNS	60 - 69	30 - 31	9,775	870,693,559	788,159,850	134%	0.021	110.5%	5.0	Below	108.5% - 112.5%
70	MNS	60 - 69	32 - 36	8,254	683,083,928	631,217,430	132%	0.021	108.2%	3.9	Below	106.2% - 110.2%
71	MNS	70 - 79	1 - 10	25,555	6,478,922,231	7,521,250,470	108%	0.020	86.1%	(6.8)	Above	84.2% - 88.1%
72	MNS	70 - 79	11 - 14	18,357	3,844,420,131	4,421,900,621	106%	0.021	86.9%	(6.3)	Above	85% - 88.9%
73	MNS	70 - 79	15 - 17	15,533	2,643,119,887	2,874,771,117	107%	0.022	91.9%	(3.7)	Above	89.9% - 94%
74	MNS	70 - 79	18 - 20	18,684	2,228,982,156	2,435,065,674	114%	0.021	91.5%	(4.1)	Above	89.6% - 93.5%
75	MNS	70 - 79	21 - 23	23,203	2,147,592,671	2,229,344,792	126%	0.020	96.3%	(1.9)	In CI	94.5% - 98.2%
76	MNS	70 - 79	24 - 25	19,517	1,718,626,711	1,690,357,245	131%	0.020	101.7%	0.8	In CI	99.8% - 103.6%
77	MNS	70 - 79	26 - 27	21,030	1,723,370,576	1,696,144,498	142%	0.018	101.6%	0.9	In CI	99.9% - 103.3%
78	MNS	70 - 79	28 - 28	9,965	815,006,088	775,697,752	105%	0.026	105.1%	2.0	Below	102.6% - 107.5%
79	MNS	70 - 79	29 - 29	9,036	784,179,836	697,030,532	104%	0.028	112.5%	4.5	Below	109.9% - 115.1%
80	MNS	70 - 79	30 - 31	14,735	1,191,683,664	1,100,487,658	128%	0.022	108.3%	3.8	Below	106.2% - 110.3%
81	MNS	70 - 79	32 - 36	12,260	1,036,326,376	972,589,228	121%	0.022	106.6%	2.9	Below	104.4% - 108.7%
82	MNS	80 - 89	1 - 12	16,783	9,971,189,030	12,000,802,482	104%	0.020	83.1%	(8.3)	Above	81.2% - 85%
83	MNS	80 - 89	13 - 20	38,754	5,777,132,403	5,996,444,991	108%	0.023	96.3%	(1.6)	In CI	94.2% - 98.5%
84	MNS	80 - 89	21 - 23	30,673	2,661,373,250	2,584,452,972	117%	0.022	103.0%	1.3	In CI	100.8% - 105.1%
85	MNS	80 - 89	24 - 25	26,278	2,126,478,692	2,033,243,774	127%	0.021	104.6%	2.2	Below	102.6% - 106.6%
86	MNS	80 - 89	26 - 27	28,014	2,124,457,472	2,091,681,272	130%	0.020	101.6%	0.8	In CI	99.7% - 103.5%
87	MNS	80 - 89	28 - 29	25,120	2,002,932,806	1,885,408,728	129%	0.021	106.2%	3.0	Below	104.2% - 108.2%
88	MNS	80 - 89	30 - 36	35,220	2,868,830,972	2,797,560,153	153%	0.017	102.5%	1.5	In CI	100.9% - 104.2%
89	MNS	90 PLUS	1 - 26	26,915	6,425,973,621	7,860,221,305	102%	0.020	81.8%	(8.9)	Above	79.8% - 83.7%
90	MNS	90 PLUS	27 - 36	24,266	1,919,636,623	2,003,197,900	130%	0.019	95.8%	(2.2)	Above	94% - 97.6%
91	FSM	18 - 29	1 - 12	240	23,132,562	15,068,076	13%	0.296	153.5%	1.8	Not Cred.	125.4% - 181.6%
92	FSM	30 - 39	1 - 22	1,044	95,350,574	112,816,607	33%	0.065	84.5%	(2.4)	Not Cred.	78.3% - 90.7%
93	FSM	40 - 49	1 - 32	4,670	430,686,169	446,800,437	67%	0.036	96.4%	(1.0)	Not Cred.	92.9% - 99.9%
94	FSM	50 - 59	1 - 36	15,301	1,075,713,152	1,123,145,492	114%	0.021	95.8%	(2.0)	In CI	93.7% - 97.8%
95	FSM	60 - 69	1 - 36	30,048	1,491,973,073	1,583,813,301	110%	0.022	94.2%	(2.6)	Above	92.1% - 96.3%
96	FSM	70 - 79	1 - 36	43,047	1,683,151,040	1,494,353,805	88%	0.033	112.6%	3.9	Not Cred.	109.5% - 115.7%
97	FSM	80 - 89	1 - 36	42,308	1,682,475,349	1,541,358,207	85%	0.033	109.2%	2.8	Not Cred.	106% - 112.3%
98	FSM	90 PLUS	1 - 36	10,825	512,977,056	545,803,052	43%	0.056	94.0%	(1.1)	Not Cred.	88.7% - 99.3%
99	MSM	18 - 29	1 - 12	1,034	110,811,072	67,250,423	26%	0.163	164.8%	4.0	Not Cred.	149.3% - 180.3%
100	MSM	30 - 39	1 - 22	2,937	419,258,297	404,549,169	53%	0.050	103.6%	0.7	Not Cred.	98.9% - 108.4%
101	MSM	40 - 49	1 - 32	9,443	1,224,632,987	1,396,571,726	97%	0.023	87.7%	(5.3)	Not Cred.	85.5% - 89.9%
102	MSM	50 - 59	1 - 15	10,230	1,724,344,579	1,857,318,920	102%	0.023	92.8%	(3.1)	Above	90.6% - 95%
103	MSM	50 - 59	16 - 22	7,963	752,957,590	718,483,104	108%	0.025	104.8%	1.9	In CI	102.4% - 107.1%
104	MSM	50 - 59	23 - 26	5,262	355,435,043	313,782,774	100%	0.029	113.3%	4.6	Below	110.5% - 116%
105	MSM	50 - 59	27 - 36	6,316	330,238,040	260,502,513	125%	0.026	126.8%	10.3	Below	124.3% - 129.2%
106	MSM	60 - 69	1 - 17	15,538	1,766,204,853	2,102,340,950	101%	0.021	84.0%	(7.5)	Above	82% - 86%
107	MSM	60 - 69	18 - 23	12,709	964,200,867	943,437,883	108%	0.024	102.2%	0.9	In CI	99.9% - 104.5%
108	MSM	60 - 69	24 - 26	8,918	601,818,864	541,359,393	111%	0.025	111.2%	4.4	Below	108.7% - 113.6%
109	MSM	60 - 69	27 - 28	6,030	394,918,311	335,295,573	101%	0.030	117.8%	5.9	Below	114.9% - 120.6%
110	MSM	60 - 69	29 - 30	5,038	313,945,127	270,923,777	100%	0.029	115.9%	5.4	Below	113.1% - 118.7%
111	MSM	60 - 69	31 - 36	5,555	327,022,430	307,502,161	111%	0.024	106.3%	2.6	Below	104% - 108.7%
112	MSM	70 - 79	1 - 24	26,807	1,732,159,837	1,663,550,873	101%	0.026	104.1%	1.6	In CI	101.6% - 106.6%
113	MSM	70 - 79	25 - 28	15,279	837,808,365	737,993,079	116%	0.025	113.5%	5.4	Below	111.2% - 115.9%
114	MSM	70 - 79	29 - 36	14,461	838,973,493	742,375,021	132%	0.022	113.0%	6.0	Below	110.9% - 115.1%
115	MSM	80 - 89	1 - 36	36,650	1,863,752,214	1,593,731,325	128%	0.023	116.9%	7.3	Below	114.7% - 119.2%
116	MSM	90 PLUS	1 - 36	6,578	338,990,231	354,712,490	68%	0.036	95.6%	(1.2)	Not Cred.	92.2% - 99%

Cell	Sex/ Tobac.	Attained Age	Dur	Actual Number	Actual Face	Expected Face with MI	Cred Factor Before Capping	Std.Dev.	A/E Face w/MI	# of std devs from 100%	Standard Normal Position	Std. Norm. Confidence Interval
59	MNS	60 - 69	14 - 15	9,807	2,550,697,060	3,198,286,390	105%	0.019	79.8%	(10.4)	Above	77.9% - 81.6%
60	MNS	60 - 69	16 - 18	13,163	2,690,437,404	3,301,104,414	109%	0.019	81.5%	(9.7)	Above	79.7% - 83.3%
61	MNS	60 - 69	19 - 20	9,741	1,466,591,854	1,571,587,665	103%	0.023	93.3%	(2.9)	Above	91.1% - 95.5%
62	MNS	60 - 69	21 - 22	10,071	1,211,428,044	1,220,344,561	110%	0.023	99.3%	(0.3)	In CI	97.1% - 101.4%
63	MNS	60 - 69	23 - 24	11,850	1,345,986,901	1,322,329,890	126%	0.021	101.8%	0.9	In CI	99.8% - 103.7%
64	MNS	60 - 69	25 - 25	6,717	735,870,508	689,288,114	100%	0.027	106.8%	2.5	Below	104.2% - 109.3%
65	MNS	60 - 69	26 - 26	6,999	693,483,242	686,087,706	102%	0.025	101.1%	0.4	In CI	98.7% - 103.5%
66	MNS	60 - 69	27 - 27	6,991	695,303,170	657,550,713	105%	0.026	105.7%	2.2	Below	103.3% - 108.2%
67	MNS	60 - 69	28 - 28	6,791	673,024,577	597,949,021	108%	0.027	112.6%	4.7	Below	110% - 115.1%
68	MNS	60 - 69	29 - 29	6,004	554,362,231	524,307,436	102%	0.026	105.7%	2.2	Below	103.2% - 108.2%
69	MNS	60 - 69	30 - 31	9,775	870,693,559	788,159,850	134%	0.021	110.5%	5.0	Below	108.5% - 112.5%
70	MNS	60 - 69	32 - 36	8,254	683,083,928	631,217,430	132%	0.021	108.2%	3.9	Below	106.2% - 110.2%
71	MNS	70 - 79	1 - 10	25,555	6,478,922,231	7,521,250,470	108%	0.020	86.1%	(6.8)	Above	84.2% - 88.1%
72	MNS	70 - 79	11 - 14	18,357	3,844,420,131	4,421,900,621	106%	0.021	86.9%	(6.3)	Above	85% - 88.9%
73	MNS	70 - 79	15 - 17	15,533	2,643,119,887	2,874,771,117	107%	0.022	91.9%	(3.7)	Above	89.9% - 94%
74	MNS	70 - 79	18 - 20	18,684	2,228,982,156	2,435,065,674	114%	0.021	91.5%	(4.1)	Above	89.6% - 93.5%
75	MNS	70 - 79	21 - 23	23,203	2,147,592,671	2,229,344,792	126%	0.020	96.3%	(1.9)	In CI	94.5% - 98.2%
76	MNS	70 - 79	24 - 25	19,517	1,718,626,711	1,690,357,245	131%	0.020	101.7%	0.8	In CI	99.8% - 103.6%
77	MNS	70 - 79	26 - 27	21,030	1,723,370,576	1,696,144,498	142%	0.018	101.6%	0.9	In CI	99.9% - 103.3%
78	MNS	70 - 79	28 - 28	9,965	815,006,088	775,697,752	105%	0.026	105.1%	2.0	Below	102.6% - 107.5%
79	MNS	70 - 79	29 - 29	9,036	784,179,836	697,030,532	104%	0.028	112.5%	4.5	Below	109.9% - 115.1%
80	MNS	70 - 79	30 - 31	14,735	1,191,683,664	1,100,487,658	128%	0.022	108.3%	3.8	Below	106.2% - 110.3%
81	MNS	70 - 79	32 - 36	12,260	1,036,326,376	972,589,228	121%	0.022	106.6%	2.9	Below	104.4% - 108.7%
82	MNS	80 - 89	1 - 12	16,783	9,971,189,030	12,000,802,482	104%	0.020	83.1%	(8.3)	Above	81.2% - 85%
83	MNS	80 - 89	13 - 20	38,754	5,777,132,403	5,996,444,991	108%	0.023	96.3%	(1.6)	In CI	94.2% - 98.5%
84	MNS	80 - 89	21 - 23	30,673	2,661,373,250	2,584,452,972	117%	0.022	103.0%	1.3	In CI	100.8% - 105.1%
85	MNS	80 - 89	24 - 25	26,278	2,126,478,692	2,033,243,774	127%	0.021	104.6%	2.2	Below	102.6% - 106.6%
86	MNS	80 - 89	26 - 27	28,014	2,124,457,472	2,091,681,272	130%	0.020	101.6%	0.8	In CI	99.7% - 103.5%
87	MNS	80 - 89	28 - 29	25,120	2,002,932,806	1,885,408,728	129%	0.021	106.2%	3.0	Below	104.2% - 108.2%
88	MNS	80 - 89	30 - 36	35,220	2,868,830,972	2,797,560,153	153%	0.017	102.5%	1.5	In CI	100.9% - 104.2%
89	MNS	90 PLUS	1 - 26	26,915	6,425,973,621	7,860,221,305	102%	0.020	81.8%	(8.9)	Above	79.8% - 83.7%
90	MNS	90 PLUS	27 - 36	24,266	1,919,636,623	2,003,197,900	130%	0.019	95.8%	(2.2)	Above	94% - 97.6%
91	FSM	18 - 29	1 - 12	240	23,132,562	15,068,076	13%	0.296	153.5%	1.8	Not Cred.	125.4% - 181.6%
92	FSM	30 - 39	1 - 22	1,044	95,350,574	112,816,607	33%	0.065	84.5%	(2.4)	Not Cred.	78.3% - 90.7%
93	FSM	40 - 49	1 - 32	4,670	430,686,169	446,800,437	67%	0.036	96.4%	(1.0)	Not Cred.	92.9% - 99.9%
94	FSM	50 - 59	1 - 36	15,301	1,075,713,152	1,123,145,492	114%	0.021	95.8%	(2.0)	In CI	93.7% - 97.8%
95	FSM	60 - 69	1 - 36	30,048	1,491,973,073	1,583,813,301	110%	0.022	94.2%	(2.6)	Above	92.1% - 96.3%
96	FSM	70 - 79	1 - 36	43,047	1,683,151,040	1,494,353,805	88%	0.033	112.6%	3.9	Not Cred.	109.5% - 115.7%
97	FSM	80 - 89	1 - 36	42,308	1,682,475,349	1,541,358,207	85%	0.033	109.2%	2.8	Not Cred.	106% - 112.3%
98	FSM	90 PLUS	1 - 36	10,825	512,977,056	545,803,052	43%	0.056	94.0%	(1.1)	Not Cred.	88.7% - 99.3%
99	MSM	18 - 29	1 - 12	1,034	110,811,072	67,250,423	26%	0.163	164.8%	4.0	Not Cred.	149.3% - 180.3%
100	MSM	30 - 39	1 - 22	2,937	419,258,297	404,549,169	53%	0.050	103.6%	0.7	Not Cred.	98.9% - 108.4%
101	MSM	40 - 49	1 - 32	9,443	1,224,632,987	1,396,571,726	97%	0.023	87.7%	(5.3)	Not Cred.	85.5% - 89.9%
102	MSM	50 - 59	1 - 15	10,230	1,724,344,579	1,857,318,920	102%	0.023	92.8%	(3.1)	Above	90.6% - 95%
103	MSM	50 - 59	16 - 22	7,963	752,957,590	718,483,104	108%	0.025	104.8%	1.9	In CI	102.4% - 107.1%
104	MSM	50 - 59	23 - 26	5,262	355,435,043	313,782,774	100%	0.029	113.3%	4.6	Below	110.5% - 116%
105	MSM	50 - 59	27 - 36	6,316	330,238,040	260,502,513	125%	0.026	126.8%	10.3	Below	124.3% - 129.2%
106	MSM	60 - 69	1 - 17	15,538	1,766,204,853	2,102,340,950	101%	0.021	84.0%	(7.5)	Above	82% - 86%
107	MSM	60 - 69	18 - 23	12,709	964,200,867	943,437,883	108%	0.024	102.2%	0.9	In CI	99.9% - 104.5%
108	MSM	60 - 69	24 - 26	8,918	601,818,864	541,359,393	111%	0.025	111.2%	4.4	Below	108.7% - 113.6%
109	MSM	60 - 69	27 - 28	6,030	394,918,311	335,295,573	101%	0.030	117.8%	5.9	Below	114.9% - 120.6%
110	MSM	60 - 69	29 - 30	5,038	313,945,127	270,923,777	100%	0.029	115.9%	5.4	Below	113.1% - 118.7%
111	MSM	60 - 69	31 - 36	5,555	327,022,430	307,502,161	111%	0.024	106.3%	2.6	Below	104% - 108.7%
112	MSM	70 - 79	1 - 24	26,807	1,732,159,837	1,663,550,873	101%	0.026	104.1%	1.6	In CI	101.6% - 106.6%
113	MSM	70 - 79	25 - 28	15,279	837,808,365	737,993,079	116%	0.025	113.5%	5.4	Below	111.2% - 115.9%
114	MSM	70 - 79	29 - 36	14,461	838,973,493	742,375,021	132%	0.022	113.0%	6.0	Below	110.9% - 115.1%
115	MSM	80 - 89	1 - 36	36,650	1,863,752,214	1,593,731,325	128%	0.023	116.9%	7.3	Below	114.7% - 119.2%
116	MSM	90 PLUS	1 - 36	6,578	338,990,231	354,712,490	68%	0.036	95.6%	(1.2)	Not Cred.	92.2% - 99%

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