MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

Product	Number
200 Series	
Tax-Qualified Long-Term Care Policy Form	MM-200-P-MD et al.
300 Series	
Tax-Qualified Long-Term Care Policy Form	MM-300-P-MD et al.
400 Series	
Tax-Qualified Long-Term Care Policy Form	MM-400-P-MD et al.
500 Series	
Tax-Qualified Comprehensive Long-Term Care Policy Form	MM500-P-MD et al.
Tax-Qualified Facility Only Long-Term Care Policy Form	MM501-P-MD et al.
511 Series	
Tax-Qualified Comprehensive Long-Term Care Policy Form	MM500-P-1-MD et al.
Tax-Qualified Facility Only Long-Term Care Policy Form	MM501-P-1-MD et al.

Massachusetts Mutual Life Insurance Company (MassMutual) is requesting a rate increase on the above listed long-term care policy forms. The company issued these policy forms in Maryland between September 23, 2000 and February 27, 2013.

Nationwide, the company is requesting the same rate increase, except where required due to regulatory restrictions. The nationwide request captures all MassMutual long-term care products that are no longer being marketed in any jurisdiction, which includes the following five rate series: 200, 300, 400, 500, and 511. This actuarial memorandum captures the pooled experience of the above-listed policy forms and similar policy forms issued nationwide across the five rate series.

As indicated in the enclosed cover letter, the company is limiting the requested rate increase to a single 15% increase, as requested by the Department. Pursuant to COMAR 31.14.01.04(5), the company originally requested a phased-in rate increase in Maryland such that no policyowner would receive a rate increase of more than 15% in a single calendar year. This phased-in increase is actuarially equivalent to the nationwide request. Section 2 below describes the nationwide requested rate increase. This actuarial memorandum reflects the nationwide request, except the rate tables and Section 19 use the actuarial equivalent Maryland request.

In Maryland, the company is limiting its requested rate increase to 15% to comply with COMAR 31.14.01.04(5) and as requested by the Department. However, the justification and support provided in this memorandum serve to demonstrate the appropriateness of the original cumulative request.

1. **Purpose of Filing**

   This actuarial memorandum has been prepared for the purpose of demonstrating that the requested nationwide rate increase meets the minimum requirements of the 2014 National Association of Insurance Commissioners (NAIC) Long-Term Care Insurance Model Regulation (Model Regulation). The enclosed supplement to the actuarial memorandum demonstrates compliance with the applicable regulatory requirements of this jurisdiction to the extent they differ from the Model Regulation, and includes other commonly requested information of this jurisdiction. It may not be suitable for other purposes.

2. **Requested Rate Increase**

   Nationwide, the company is requesting a premium rate increase to achieve a rate level consistent with that on its currently marketed 513 Series new business product. The resulting rate increase varies by rate series and all available options and riders. This rate increase is then capped on a seriatim basis such that no insured will receive a rate increase in excess of 100%. The company is seeking this rate increase request to help alleviate the adverse performance on this business.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

The table below provides the distribution, range, and average requested rate increases for each series based on the nationwide distribution of business. The enclosed cover letter provides similar information based on the jurisdiction-specific distribution.

Nationwide Rate Increase Request Distribution, Range, and Average Increase by Series[1]

Rate Increase	All	200	300	400	500	511
0-10%	<1%	0%	<1%	<1%	1%	1%
11-20%	2	<1	<1	1	3	16
21-30%	5	1	<1	2	6	32
31-40%	8	1	1	3	11	40
41-50%	5	2	1	3	12	8
51-60%	5	2	2	4	11	2
61-70%	5	3	2	6	9	0
71-80%	4	4	3	5	7	0
81-90%	4	3	3	6	6	0
91-100%	61	84	88	71	33	0
Minimum	0	12	6	5	0	4
Maximum	100	100	100	100	100	59
Average	77	93	95	89	70	31

[1] As of December 31, 2016 and excludes policies assumed to be paid-up prior to the rate increase implementation date. The enclosed cover letter provides the jurisdiction-specific distribution.

While larger rate increases than requested nationwide are needed to alleviate the adverse performance on this business, at this time, the company does not anticipate additional rate increases beyond the current request; however, it will continue to monitor the business and reserves the right to request additional rate increases in the future.

Maryland rate tables reflecting the proposed rate increase for policy forms affected by this rate increase are enclosed with this filing. These rate tables reflect rate increases to bring the rates to a level consistent with that on the 513 Series new business rates.

The rate increases will be implemented on a seriatim basis such that no Maryland insured will receive more than a 15% rate increase or a rate decrease. The enclosed rate tables do not capture any seriatim caps. The actual rates implemented may vary from those in the enclosed rate tables due to the seriatim caps and implementation rounding algorithms. Pursuant to COMAR 31.14.01.04(5), the company originally requested a phased-in rate increase in Maryland such that no policyowner would receive a rate increase of more than 15% in a single calendar year. This Maryland phased-in increase is actuarially equivalent to the nationwide request. However, the company the company is limiting the rate increase request to a single 15% increase, as requested by the Department.

The Maryland renewal premium rate schedules, assuming the Maryland requested increase is implemented, are not greater than the 513 Series premium rate schedules, except for differences attributable to benefits.

3. **Description of Benefits**

The 200, 300, 400, 500, and 511 Series are existing tax-qualified policy forms that provide long-term care coverage. They are individually and jointly underwritten and provide comprehensive and facility only coverage on a reimbursement basis. Certain policy forms also included a rider to convert to coverage on an indemnity basis. These rate series have benefit eligibility requirements that involve

activities of daily living (ADL) deficiencies or cognitive impairment. Waiver of premium is provided when certain benefits are being paid.

A daily benefit amount, benefit period, and elimination period were selected at issue. The available choices for benefit period and elimination period varied by rate series and are shown in Section 21 below.

At issue, the policyowner may have had the option to choose one of the following inflation options, the availability of which varied by rate series as shown in Section 21 below: no inflation, simple 5% inflation, compound 3% inflation, or compound 5% inflation. The simple inflation option provides for benefit levels that increase on each anniversary date by 5% of the daily benefit amount chosen at issue for the life of the insured. The compound inflation option provides for benefit levels that increase on each anniversary date by 3% or 5% compounded annually for the life of the insured. These automatic increasing benefits apply even when the insured is in claim status.

Premiums are paid for the life of the policy, unless the policyowner elected at issue a limited premium payment period, which varies by rate series as shown Section 21. An additional option was available for all premium payment periods in which the policyowner could pay a higher first year premium followed by discounted (reduced) renewal premium thereafter (a.k.a., discounted renewal).

At issue, the policyowner may have been offered the option of selecting riders (e.g., return of premium, shared care) that provide the types of coverage, which vary by rate series, as shown in the enclosed rate tables.

The 200, 300, and 400 Series (a.k.a., pre-500 business) offered joint coverage policies. Joint coverage provides equal coverage for two persons if both apply and are issued coverage under the policy. When one of the joint lives dies or exhausts their benefits or terminates, coverage continues for the remaining insured. The new premium rate will be the premium that would have been charged for an individual policy at the original issue age and risk class of the remaining insured.

The 500 and 511 Series (a.k.a., 500+ business) are participating policy forms. Explicit dividend margin was incorporated into the pricing for the 500+ business that was to be released to policyowners if experience emerged favorably. However, as emerging experience is worse than that expected with the dividend margin such that no dividends have been or are expected to be paid on these policy forms.

Most jurisdictions included Partnership-eligible policy forms or options for each rate series, subject to the individual Partnership requirements of each jurisdiction. Most jurisdictions issued the 200 Series under one policy form, but issued two sets of rates based on issue date. The first set of rates were originally priced in 2000 and the second was subsequently repriced in 2001, where the issue date range of each set is jurisdiction-specific.

A contingent benefit upon lapse (CBUL) will be available to all policyowners at the time of the rate increase.

4. **Renewability**

These policies are guaranteed renewable for life.

5. **Applicability**

This rate increase applies to all policies issued on these policy forms in this jurisdiction. The rate changes will apply to the premium of the base policy form and all associated options and riders.

6. **Actuarial Assumptions**

The following assumptions are used to project the experience shown in this filing.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

a. Morbidity reflects claim costs developed using the 2014 Milliman *Long-Term Care Guidelines (Guidelines)* with adjustments for underwriting selection and an all-lives exposure basis. The claim costs were further adjusted based on historical claim experience by rate series, attained age, policy duration, benefit period, benefit payment type, gender, and underwriting class, to the extent credible. These adjustment factors can be found in Exhibit A-3a of Appendix A to this memorandum.

b. Mortality Rates reflect the 2012 Individual Annuity Mortality Basic gender-distinct table (2012IAM). The mortality rates were adjusted based on historical experience by attained age, policy duration, gender, underwriting class, and partner status, to the extent credible. These adjustment factors can be found in Exhibit A-1a of Appendix A to this memorandum.

c. Voluntary Lapse Rates vary by policy duration and partner status. The following table provides lapse rates for lifetime-payment policies.

Duration	Single	Partnered
1	4.00%	1.50%
2	5.50	2.50
3	3.50	2.00
4	3.00	1.50
5	2.50	1.20
6	2.00	0.90
7	1.75	0.70
8	1.25	0.60
9+	0.90	0.50

The lapse rates in the above table were adjusted based on the following criteria for the additional premium payment options:

- For the ten-pay option, a reduction of 50% of the above lapse rates is assumed for durations one through eight, and 0% lapse thereafter.

- For the twenty-pay option, a reduction of 25% of the above lapse rates is assumed for durations one through fifteen, and 0% lapse thereafter.

- For the paid-up at age 65 option, a reduction of 25% of the above lapse rates is assumed for all durations with issue ages 60 and lower, and 0% lapse for all durations with issue ages greater than 60.

- For the discounted renewal option, a reduction of 25% of the above lapse rates is assumed for all durations.

d. Benefit Expiry Rates reflect assumed policy termination due to exhaustion of benefits on limited benefit period policies. The rates are based on the *Guidelines* and vary by gender, benefit period, and attained age as shown in the following table.

Gender	Benefit Period in Years	Attained Age*										
		<65	65	70	75	80	85	90	95	100	105	110+
Female	2	0.0%	0.0%	0.1%	0.2%	0.4%	1.2%	3.1%	6.1%	9.1%	14.6%	20.0%
	3	0.0	0.0	0.1	0.1	0.3	0.8	2.2	4.7	7.5	14.1	20.0
	4	0.0	0.0	0.0	0.1	0.2	0.6	1.5	3.3	5.7	12.4	20.0
	5	0.0	0.0	0.0	0.1	0.1	0.4	1.1	2.4	4.5	10.1	20.0
	6	0.0	0.0	0.0	0.0	0.1	0.3	0.9	2.1	3.9	7.7	20.0
	7	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.9	1.9	20.0
	Lifetime	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Male	2	0.0	0.0	0.1	0.1	0.3	0.7	1.8	3.3	4.7	7.4	20.0
	3	0.0	0.0	0.0	0.1	0.2	0.4	1.1	2.2	3.5	6.5	20.0
	4	0.0	0.0	0.0	0.0	0.1	0.3	0.7	1.5	2.5	5.4	20.0
	5	0.0	0.0	0.0	0.0	0.1	0.2	0.5	1.1	2.0	4.5	20.0
	6	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.9	1.9	3.6	20.0
	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.9	20.0
	Lifetime	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

* The assumption varies by attained age, but is shown every five years for display purposes.

e. <u>Insured Behavior Due to the Rate Increase.</u> At the time of a rate increase, insureds have the option to elect a CBUL or reduced benefit options (RBO). An increase in morbidity for adverse selection due to the rate increase based on the percentage of insureds that elect CBUL and RBO is assumed.

Insureds who elect a CBUL are modeled as a lapse (i.e., the CBUL benefit is not modeled), which results in a slightly lower lifetime loss ratio than if the CBUL benefit had been modeled.

CBUL and RBO election are functions of rate increase magnitude. Adverse selection associated with the requested increase is a function of CBUL and RBO election. The following provides approximate averages for these assumptions based on the nationwide distribution for all rate series combined: 5% CBUL election rate, 13% RBO election rate, and 3% morbidity increase due to adverse selection.

f. <u>Interest Rate</u> consistent with the maximum valuation interest rate applicable to the year of issue (ranges from 3.5% to 4.5% and averages 4.1%) is used to demonstrate compliance with the minimum loss ratio requirements.

g. <u>Annual Improvement</u> is assumed for 10 future years in the mortality and morbidity assumptions. Annual improvement factors vary by attained age based on the G2 improvement scale from the 2012IAM table.

h. <u>Expenses</u> have not been explicitly projected. Originally filed expense assumptions are assumed to remain appropriate, except that commissions are not paid on the increased premium.

i. <u>Dividends</u> are not projected in the current experience as the company has not historically paid a dividend and does not anticipate paying a dividend in the future on its long-term care business for the 500+ business.

The above assumptions are based on the experience of policies issued by MassMutual, industry experience, and actuarial judgment. These assumptions are based on the nationwide experience of all long-term care business issued by MassMutual, which includes the 200, 300, 400, 500, 511, and 513 Series. In developing the persistency assumptions, policy termination experience through December 31, 2016 was used. For the morbidity assumption, claim experience through December 31, 2016 with claim runout through December 31, 2017 was used. The above assumptions are deemed reasonable for the particular policy forms in this filing and are considered "most likely" (without explicit margin).

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

In establishing the assumptions described in this section, the policy design, underwriting, and claims adjudication practices for the above-referenced policy forms were taken into consideration. Appendix A to this memorandum provides a description of the development of and justification for the assumptions used in this filing.

The company is currently marketing one long-term care product, the 513 Series, in this jurisdiction. A comparison of the projection assumptions used in this filing and those used for pricing the 513 Series product is included in Appendix B to this memorandum.

7. **Marketing Method**

   These policy forms were marketed by agents of MassMutual and/or by independent brokers.

8. **Underwriting Description**

   These policies were individually underwritten with the use of various underwriting tools in addition to the application, which may have included medical records, paramedical functional assessments, cognitive screenings, face-to-face interviews, and/or attending physician statements.

9. **Premiums**

   Premiums are unisex and payable for life unless the insured selected a limited premium payment period option. The premiums may vary by policy form, issue age, elimination period, benefit period, initial daily benefit amount, inflation option, premium payment option, underwriting class, joint status, discounts (e.g., partner status at issue), home care coverage, and the selection of any riders.

10. **Issue Age Range**

    Issue ages are from 18 to 84.

11. **Area Factors**

    Area factors are not used for these products.

12. **Premium Modalization Rules**

    The following modal factors and percent distributions (based on the nationwide in-force insured count as of December 31, 2016) are applied to the annual premium (AP):

Premium Mode	Modal Factors	Percent Distribution
Annual	1.000*AP	44%
Semi-Annual	0.520*AP	4
Quarterly[1]	0.265*AP	9
Monthly[1]	0.088*AP	43

    [1] Factor may vary based on policy form and payment option.

13. **Reserves**

    Active life reserves and reserves for the election of a CBUL have not been used in the experience exhibits for this rate increase analysis. Claim reserves as of December 31, 2017 have been discounted to the incurral date of each respective claim and included in historical incurred claims. Incurred but not reported (IBNR) reserves have not been used as the incurred claims include paid claim runout through December 31, 2017.

14. Trend Assumptions

As this is not medical insurance, an explicit medical cost trend is not included in the projections.

15. Demonstration of Satisfaction of Loss Ratio Requirements

This filing uses nationwide experience of all policies of the 200, 300, 400, 500, and 511 Series. This pooled experience captures all MassMutual long-term care products that are no longer being marketed in any jurisdiction. Pooling these forms' experience is appropriate as the nationwide rate increase request brings the pool to a consistent rate basis (i.e., 513 Series new business product), the policy forms have similar benefits, it is consistent with how MassMutual manages the business, and combining experience increases credibility.

Exhibit I provides actual and projected experience using current assumptions. Actual experience is provided from inception through 2016 (with claim runout through 2017) and then projected on a seriatim basis for 60 years using the current assumptions described above in Section 6. The actual and projected experience is based on nationwide premiums. The after increase projected experience reflects the requested nationwide increase by series (shown in Section 2) on a seriatim basis.

Values in Exhibit I are shown (a) before and (b) after the requested nationwide rate increase. Included are calendar year earned premiums, incurred claims, end of year lives, annual loss ratios, and cumulative loss ratios. As shown in Exhibit I, the anticipated lifetime loss ratio with the requested nationwide rate increase exceeds the minimum loss ratio required by pre-rate stability regulation.

The following table demonstrates that the lifetime loss ratios by series also exceed the minimum loss ratio required by pre-rate stability regulation. The 'All' row corresponds to that shown in Exhibit I.

Lifetime Loss Ratios at the Maximum Valuation Interest Rate by Series

Series	Before Increase	After Increase
All	161%	119%
200	188	141
300	196	146
400	157	113
500	121	89
511	95	79

Exhibit II provides a demonstration that the requested nationwide rate increase meets the 58%/85% minimum loss ratio test under moderately adverse conditions as required by post-rate stability regulation. This exhibit shows that the sum of the accumulated value of incurred claims without the inclusion of active life reserves, and the present value of projected incurred claims, without the inclusion of active life reserves, will not be less than the sum of the following:

1. Accumulated value of the initial earned premium times 58%,
2. 85% of the accumulated value of prior premium rate schedule increases,
3. Present value of projected initial earned premium times 58%, and
4. 85% of the present value of projected premium in excess of the projected initial earned premium.

The following table demonstrates that the 58%/85% test is passed by series. The 'All' row corresponds to that shown in Exhibit II. Values in the table are shown in millions of dollars.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

58%/85% Test by Series ($ in millions)

Series	Item 5[1]	Item 7[2]	Result[3]
All	$3,355	$7,245	Pass
200	821	2,119	Pass
300	730	1,945	Pass
400	743	1,516	Pass
500	817	1,307	Pass
511	244	358	Pass

[1] Item 5 is the Lifetime Earned Premium Times Prescribed Factor.
[2] Item 7 is Lifetime Incurred Claims with Rate Increase.
[3] Test of whether Item 7 is not less than Item 5.

16. Actual-to-Expected Experience

The following table provides a comparison of actual and projected experience using current assumptions to that expected using original pricing assumptions. Values in the following table are shown (a) before and (b) after the requested nationwide rate increase.

Actual and Expected Loss Ratios by Series

Series	Lifetime Loss Ratio			Actual-to-Expected	
	Before Increase[1]	After Increase[1]	Expected[2]	Before Increase	After Increase
All	146%	109%	57%	2.58	1.92
200	171	129	54	3.15	2.39
300	177	133	56	3.14	2.35
400	129	95	54	2.39	1.76
500	121	89	58	2.10	1.54
511	95	79	69	1.38	1.15

[1] Using current interest assumption on a basis that is consistent with original pricing, which may differ from that used in Exhibit I, as described below.
[2] Projected actual policies sold from issue using original pricing assumptions.

Actual and projected experience in the above table is identical to that described in Exhibit I, except uses a current interest assumption on a basis that is consistent with original pricing. For the pre-500 business; original pricing used an earnings interest rate basis, a current earnings interest rate assumption of 5.0% is used in this table. For the 500+ business, original pricing used a valuation interest rate basis, so a current maximum valuation interest rate assumption as described above in Section 6 (which is also consistent with that used in Exhibit I) is used in this table.

Expected experience uses the actual policies sold and projects from issue on a seriatim basis using the original pricing assumptions for each series. Consistent with the original pricing projections, the expected experience based on original pricing assumptions includes an adjustment for dividend margin assumed in pricing for the 500+ business.

Exhibit III provides a comparison of the current and original pricing assumptions that underlie the actual and expected experience described above.

17. History of Previous Rate Revisions

No prior rate increases have been implemented on these products.

18. Analysis Performed to Consider a Rate Increase

The experience table in Section 16 above demonstrates that experience has been more adverse from that expected using original pricing assumptions as the actual-to-expected (A:E) loss ratios exceed 1.0.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

The adverse experience for all rate series combined is largely driven by higher than expected persistency and morbidity.

The following table provides a comparison of actual and projected nationwide experience for all rate series combined to that expected in pricing with respect to interest, lapse (combination of voluntary lapse and benefit expiry), mortality, morbidity, and improvement. The current and original pricing assumptions are provided in Exhibit III.

Impact of Changing from Pricing to Current Assumptions

Scenario	Lifetime Loss Ratio (LLR)	Incremental Impact on the LLR[1]	Increase Needed[2]
Original pricing assumptions	57%	N/A	N/A
Historical experience through 2016 & projections with pricing assumptions[3]	62	10%	35%
Historical experience through 2016 & projections with pricing assumptions except for current:			
Interest	68	10	33
Interest, lapse	76	12	38
Interest, lapse, mortality	108	41	120
Interest, lapse, mortality, morbidity	151	41	117
Interest, lapse, mortality, morbidity, improvement	146	-3	-10
Historical experience through 2016 & projections with all current most-likely assumptions[4]	146	158	444

[1] Calculated as the ratio of the lifetime loss ratio in a given row to that in the row immediately above it less one.
[2] Shows the rate increase needed to reproduce the lifetime loss ratio in the row immediately above it. Calculated without regard to CBUL, RBO, adverse selection, and higher waiver claims due to the needed rate increase.
[3] This row reflects actual historical experience and pricing assumptions projected from the valuation date For participating rate series (500+), the explicit dividend margin assumed in pricing was removed (reduces the lifetime loss ratio) as no dividends have been or are expected to be paid on these policy forms.
[4] This row is calculated in regards to the pricing lifetime loss ratio of 57%.

For the business subject to rate stability regulation, an analysis of the projected loss ratio compared to that assumed at the time of original pricing revealed that experience has unfolded more than moderately adverse and crossed the original pricing threshold for which the company could consider a rate increase.

Based on our understanding of the available original pricing materials and actuarial judgment, the assumed original pricing threshold before which a rate increase may be considered is a 10% increase in the original pricing lifetime loss ratio for the pre-500 Series, a 13% increase for the 500 Series, and a 14% increase for the 511 Series. Section 15 demonstrates that the lifetime loss ratios are well in excess of this assumed original pricing threshold. That is, the before increase A:E exceeds 1.10 for the pre-500 Series, 1.13 for the 500 Series, and 1.14 for the 511 Series.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

19. **Average Annual Premium in Maryland (Based on December 31, 2016 In-Force[1])**

The number of insureds and the corresponding average annual premium that will be affected by this rate increase filing are:

Rate Series	Number of Insureds	Before Increase Premium	After Reduced Requested Increase Premium
200 Series	1,037	$1,862	$2,142
300 Series	1,014	1,998	2,297
400 Series	838	2,858	3,287
500 Series	698	3,828	4,401
511 Series	133	3,424	3,936
All	3,720	2,548	2,930

[1] Excludes policies assumed to be paid up prior to implementation of the requested rate increase.

20. **Proposed Effective Date**

This rate increase will apply to policies on their next policy anniversary date following at least a 90-day policyowner notification period following disposition of this filing by the department of insurance.

21. **Distribution of Business as of December 31, 2016 (Based on Nationwide In-Force Insured Count)**

Issue Ages	Percent Distribution					
	All	200	300	400	500	511
<40	2%	1%	2%	2%	2%	3%
40-44	4	4	5	5	4	5
45-49	11	10	13	11	9	9
50-54	23	22	24	25	20	21
55-59	30	29	31	29	29	25
60-64	20	21	18	19	24	23
65-69	8	9	6	7	10	12
70-74	2	3	1	2	2	2
75-79	<1	1	<1	<1	<1	<1
80+	<1	<1	<1	<1	<1	0
Average Issue Age	56	56	56	55	57	56

Elimination Period	Percent Distribution					
	All	200	300	400	500	511
0-Day	1%	2%	1%	1%	N/A	N/A
30-Day	8	13	12	6	3	2
60-Day	4	4	4	4	3	2
90-Day	83	81	79	83	87	91
180-Day	4	<1	4	6	7	5

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

Benefit Period	Percent Distribution					
	All	200	300	400	500	511
2 Years	2%	N/A	N/A	N/A	5%	5%
3 Years	14	14	8	9	20	29
4 Years	6	N/A	5	3	12	13
5 Years	8	N/A	N/A	6	24	20
6 Years	10	11	8	6	9	24
10 Years	2	N/A	N/A	3	4	1
Lifetime	58	75	79	73	26	8

Inflation Option	Percent Distribution					
	All	200	300	400	500	511
None	10%	11%	6%	12%	11%	11%
Simple 5%	30	38	32	35	25	N/A
Compound 3%	10	N/A	N/A	N/A	15	72
Compound 5%	50	51	62	53	49	17

Premium Payment Duration	Percent Distribution					
	All	200	300	400	500	511
Ten-Pay	13%	10%	18%	16%	12%	5%
Twenty-Pay	1	1	1	1	N/A	N/A
Pay to Age 65	<1	N/A	N/A	N/A	2	1
Lifetime-Pay	86	89	81	83	86	94

Discounted Renewal Premium Payment Option	Option Election Rate					
	All	200	300	400	500	511
	4%	5%	5%	7%	1%	<1%

Coverage Type	Percent Distribution					
	All	200	300	400	500	511
Facility Only	1%	2%	1%	1%	2%	1%
Comprehensive	99	98	99	99	98	99

Benefit Type	Percent Distribution					
	All	200	300	400	500	511
Indemnity	29%	22%	45%	46%	19%	N/A
Reimbursement	71	78	55	54	81	100%

Underwriting Class[1]	Percent Distribution					
	All	200	300	400	500	511
Preferred	59%	75%	61%	58%	48%	42%
Standard	35	21	34	37	44	47
Substandard	6	4	5	5	8	11

[1] At issue, the labels may have differed, but were grouped into these three generic labels.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

Address: 1295 State Street, Springfield, MA 01111

Actuarial Memorandum

June 26, 2018

22. Number of Insureds and Annualized Premium (Based on December 31, 2016 In-Force[1])

The number of insureds and annualized premium that will be affected by this rate increase filing are:

Series	Number of Insureds	Annualized Premium
Maryland		
200	1,037	$1,931,222
300	1,014	2,025,559
400	838	2,395,056
500	698	2,672,086
511	133	455,439
Total	3,720	9,479,362
Nationwide		
200	18,177	$30,422,853
300	14,234	26,720,648
400	12,294	30,219,392
500	18,208	57,728,588
511	6,605	19,167,127
Total	69,518	164,278,608

[1] Excludes policies assumed to be paid up prior to implementation of the requested rate increase.

23. Actuarial Certification

I am a Principal and Consulting Actuary for Milliman, Inc. and retained by MassMutual to render an opinion with regard to long-term care insurance rates. I am a member of the American Academy of Actuaries. I meet the Academy's qualification standards to render this actuarial opinion and am familiar with the requirements for filing long-term care insurance premiums and rate increases.

This memorandum has been prepared in conformity with all applicable Actuarial Standards of Practice, including Actuarial Standards of Practice No. 8, "Regulatory Filings for Health Benefits, Accident and Health Insurance, and Entities Providing Health Benefits" and 18, "Long-Term Care Insurance".

I hereby certify that, to the best of my knowledge and judgment, this rate submission is in compliance with the applicable laws and regulations of this jurisdiction and the rules of the department of insurance.

In my opinion, the rates are not excessive or unfairly discriminatory, and bear reasonable relationship to the benefits based on the loss ratio standards of this jurisdiction.

This filing will enhance premium adequacy, but may not be sufficient to prevent future rate action. Additional rate increases are needed to certify that rates will remain stable under moderately adverse conditions.

In forming my opinion, I have used actuarial assumptions and actuarial methods (which gave consideration to policy design, underwriting, and claim adjudication) and such tests of the actuarial calculations as I considered necessary. Based on these assumptions, or statutory requirements where necessary, the premium rate filing is in compliance with the loss ratio standards of this jurisdiction.

I have relied on data and information provided by MassMutual and its third party administrator to develop this memorandum, including but not limited to management's view of when a rate change may be considered, policy design, underwriting and claim adjudication process, seriatim in-force data, claim data, dividend expectation, and the company's long-term earnings rate. I have not audited or independently verified the data and information provided, but have reviewed it for reasonableness.

The basis for contract reserves has been previously filed and there is no anticipation of any changes.

Missy Gordon, FSA, MAAA
Principal and Consulting Actuary

Date: June 26, 2018

Exhibit I-a
Massachusetts Mutual Life Insurance Company
Actual and Projected Experience by Calendar Year
Nationwide Experience Before Requested Rate Increase
All Rate Series Combined

	Calendar Year	Actual or Projected Experience using Current Assumptions				Cumulative Loss Ratio with interest
		A	B	C = B / A	D	E
		Earned Premium	Incurred Claims	Incurred Loss Ratio	End of Year Lives	Actual (Column C) with Max. Val. Interest
Historical Experience	2000	613,240	0	0%	1,775	0%
	2001	8,395,491	64,652	1%	7,642	1%
	2002	21,414,123	527,514	2%	15,522	2%
	2003	38,423,209	1,663,767	4%	24,571	3%
	2004	58,600,776	1,499,223	3%	34,074	3%
	2005	88,587,224	5,917,061	7%	45,088	4%
	2006	108,266,631	4,124,523	4%	50,082	4%
	2007	121,895,279	9,601,387	8%	54,405	5%
	2008	137,228,636	9,464,000	7%	58,834	6%
	2009	146,783,646	14,396,475	10%	61,275	6%
	2010	157,044,149	18,532,382	12%	64,748	7%
	2011	170,045,482	18,642,615	11%	70,309	8%
	2012	193,342,609	23,728,913	12%	77,353	8%
	2013	201,251,429	26,201,269	13%	79,455	9%
	2014	196,209,517	34,432,838	18%	78,588	10%
	2015	183,819,465	40,611,186	22%	77,807	11%
	2016	174,917,980	38,574,940	22%	77,020	12%
Projected Future Experience	2017	172,241,693	54,502,773	32%	75,896	13%
	2018	165,047,886	64,573,658	39%	74,783	14%
	2019	159,193,087	76,343,329	48%	73,661	16%
	2020	153,983,243	89,588,731	58%	72,510	17%
	2021	147,746,139	104,201,577	71%	71,315	19%
	2022	137,446,581	120,433,978	88%	70,064	22%
	2023	132,732,324	138,582,927	104%	68,748	24%
	2024	129,872,384	158,883,088	122%	67,363	26%
	2025	126,757,990	181,614,373	143%	65,906	29%
	2026	123,622,884	206,607,058	167%	64,374	32%
	2027	120,368,173	235,581,471	196%	62,755	35%
	2028	116,967,040	269,002,445	230%	61,041	39%
	2029	113,456,899	305,504,461	269%	59,228	43%
	2030	109,825,829	344,664,339	314%	57,316	47%
	2031	106,008,521	386,163,349	364%	55,304	51%
	2032	101,998,825	429,058,224	421%	53,195	56%
	2033	97,852,727	473,046,524	483%	50,994	61%
	2034	93,538,391	517,519,441	553%	48,705	66%
	2035	89,062,425	560,960,575	630%	46,338	71%
	2036	84,436,790	602,251,794	713%	43,902	76%
	2037	79,713,710	640,558,320	804%	41,411	82%
	2038	74,897,097	675,013,035	901%	38,880	87%
	2039	70,011,512	704,314,318	1,006%	36,326	93%
	2040	65,100,920	727,055,899	1,117%	33,766	99%
	2041	60,193,802	742,866,216	1,234%	31,221	104%
	2042	55,333,340	751,591,594	1,358%	28,709	109%
	2043	50,562,872	753,035,208	1,489%	26,251	114%
	2044	45,918,427	747,286,278	1,627%	23,864	119%
	2045	41,436,080	734,525,898	1,773%	21,566	124%
	2046	37,149,904	715,189,527	1,925%	19,373	128%
	2047	33,089,359	689,963,515	2,085%	17,298	132%
	2048	29,278,136	659,215,478	2,252%	15,351	136%
	2049	25,733,967	624,218,429	2,426%	13,540	139%
	2050	22,468,351	585,694,514	2,607%	11,871	142%
	2051	19,487,186	545,003,489	2,797%	10,344	145%
	2052-2056	62,359,938	2,096,396,469	3,362%	33,661	154%
	2057-2061	25,527,035	1,172,994,097	4,595%	14,417	158%
	2062-2066	9,257,249	561,639,676	6,067%	5,517	160%
	2067-2071	3,137,808	234,707,490	7,480%	1,949	161%
	2072-2076	1,014,695	85,792,699	8,455%	651	161%

With Interest Accum./Disc. To 12/31/2016

History	2,606,149,452	300,048,738	12%
Future	2,054,217,459	7,196,453,881	350%
Lifetime	4,660,366,911	7,496,502,619	161%

Exhibit I-b
Massachusetts Mutual Life Insurance Company
Actual and Projected Experience by Calendar Year
Nationwide Experience After Requested Rate Increase
All Rate Series Combined

	Calendar Year	Actual or Projected Experience using Current Assumptions				Cumulative Loss Ratio with interest
		A	B	C = B / A	D	E
						Actual (Column C)
		Earned Premium	Incurred Claims	Incurred Loss Ratio	End of Year Lives	with Max. Val. Interest
	2000	613,240	0	0%	1,775	0%
	2001	8,395,491	64,652	1%	7,642	1%
	2002	21,414,123	527,514	2%	15,522	2%
	2003	38,423,209	1,663,767	4%	24,571	3%
	2004	58,600,776	1,499,223	3%	34,074	3%
	2005	88,587,224	5,917,061	7%	45,088	4%
	2006	108,266,631	4,124,523	4%	50,082	4%
	2007	121,895,279	9,601,387	8%	54,405	5%
Historical	2008	137,228,636	9,464,000	7%	58,834	6%
Experience	2009	146,783,646	14,396,475	10%	61,275	6%
	2010	157,044,149	18,532,382	12%	64,748	7%
	2011	170,045,482	18,642,615	11%	70,309	8%
	2012	193,342,609	23,728,913	12%	77,353	8%
	2013	201,251,429	26,201,269	13%	79,455	9%
	2014	196,209,517	34,432,838	18%	78,588	10%
	2015	183,819,465	40,611,186	22%	77,807	11%
	2016	174,917,980	38,574,940	22%	77,020	12%
	2017	172,241,693	54,502,773	32%	75,896	13%
	2018	165,047,886	64,573,658	39%	74,783	14%
	2019	193,905,673	69,864,427	36%	69,593	15%
	2020	219,884,359	74,797,204	34%	68,507	16%
	2021	209,608,788	86,868,963	41%	67,380	18%
	2022	192,251,573	100,252,490	52%	66,200	19%
	2023	185,256,046	115,223,460	62%	64,959	21%
	2024	181,165,775	131,965,598	73%	63,654	22%
	2025	176,650,552	150,706,199	85%	62,280	24%
	2026	172,174,308	171,313,984	100%	60,835	26%
	2027	167,573,253	195,218,527	116%	59,310	29%
	2028	162,766,675	222,801,144	137%	57,693	31%
	2029	157,844,724	252,934,816	160%	55,984	34%
	2030	152,798,932	285,289,591	187%	54,182	37%
	2031	147,499,211	319,603,964	217%	52,285	40%
Projected	2032	141,934,047	355,112,169	250%	50,298	43%
Future	2033	136,199,570	391,578,105	288%	48,223	47%
Experience	2034	130,229,439	428,512,082	329%	46,065	50%
	2035	124,031,369	464,671,676	375%	43,834	54%
	2036	117,615,741	499,147,320	424%	41,537	58%
	2037	111,075,348	531,236,282	478%	39,188	62%
	2038	104,402,975	560,226,140	537%	36,801	66%
	2039	97,626,961	585,041,762	599%	34,391	70%
	2040	90,813,881	604,503,781	666%	31,976	74%
	2041	83,998,197	618,268,543	736%	29,574	78%
	2042	77,243,782	626,199,721	811%	27,203	81%
	2043	70,608,758	628,123,912	890%	24,881	85%
	2044	64,143,595	624,119,494	973%	22,627	88%
	2045	57,898,999	614,301,538	1,061%	20,456	92%
	2046	51,922,915	598,999,614	1,154%	18,383	95%
	2047	46,256,958	578,751,855	1,251%	16,421	98%
	2048	40,934,871	553,860,871	1,353%	14,580	100%
	2049	35,982,176	525,379,988	1,460%	12,866	103%
	2050	31,415,738	493,889,217	1,572%	11,285	105%
	2051	27,244,607	460,485,896	1,690%	9,839	107%
	2052-2056	87,099,966	1,782,225,558	2,046%	32,070	114%
	2057-2061	35,505,612	1,008,831,723	2,841%	13,781	117%
	2062-2066	12,782,679	488,059,780	3,818%	5,290	119%
	2067-2071	4,292,602	205,074,360	4,777%	1,874	119%
	2072-2076	1,372,527	74,896,024	5,457%	627	119%

With Interest Accum./Disc. To 12/31/2016

History	2,606,149,452	300,048,738	12%
Future	2,714,409,444	6,039,206,031	222%
Lifetime	5,320,558,896	6,339,254,769	119%

Exhibit II
Demonstration that the Requested Rate Increase Passes the 58%/85% Loss Ratio Minimum
Massachusetts Mutual Life Insurance Company
All Rate Series Combined Nationwide Experience

1	Accumulated value of initial earned premium	2,606,149,452	x	58%	=	1,511,566,682
2a	Accumulated value of earned premium	2,606,149,452				
2b	Accumulated value of prior premium rate schedule increases (2a - 1)	0	x	85%	=	0
3	Present value of future projected initial earned premium	1,718,816,688	x	58%	=	996,913,679
4a	Present value of future projected premium	2,714,409,444				
4b	Present value of future projected premium in excess of the projected initial earned premiums (4a - 3)	995,592,757	x	85%	=	846,253,843
5	**Lifetime Earned Premium Times Prescribed Factor: Sum of 1, 2b, 3, and 4b**					**3,354,734,204**
6a	Accumulated value of incurred claims without the inclusion of active life reserves					300,048,738
6b	Present value of future projected incurred claims without the inclusion of active life reserves					6,945,086,935
7	**Lifetime Incurred Claims with Rate Increase: Sum 6a and 6b**					**7,245,135,673**
8	Test: 7 is not less than 5					Pass

Items 2a, 4a, and 6a are consistent with the accumulated and present values shown in Exhibit I-b.
All accumulated or present values use the maximum valuation interest rate for contract reserves applicable for the year of issue, which ranges from 3.5% to 4.5%.
Item 3 reflects the impact of CBUL and RBO to align persistency with that in Item 4a.
Item 6b is 15% higher than incurred claims shown in Exhibit I-b to reflect moderately adverse conditions.

Exhibit III
Massachusetts Mutual Life Insurance Company
Comparison of Current and Original Pricing Assumptions

		Morbidity
Current Assumptions	**All**	Claim costs are developed using the 2014 Milliman *Long-Term Care Guidelines* (*Guidelines*) with adjustments for underwriting selection and an all-lives exposure basis. The claim costs were further adjusted based on historical claim experience by rate series, attained age, policy duration, benefit period, benefit payment type, gender, and underwriting class, to the extent credible. An exhibit containing the adjustment factors is provided in Appendix A to the actuarial memorandum.
Original Assumptions	**200 Series 300 Series 400 Series**	Claim costs were developed using The Reports of the Society of Actuaries and actuarial judgment. The following are durational morbidity factors: Duration / Factor 1 / 0.10 2 / 0.20 3 / 0.40 4 / 0.60 5 / 0.80 6+ / 1.00
	500 Series	Claim costs were developed starting with the 400 Series claim costs and were modified based on experience of the company's reinsurance carrier.
	511 Series	The morbidity assumption was derived using industry experience as reported in the Intercompany Study 1984-2004 published by the Society of Actuaries Long Term Care Experience Committee (2004 Study) and adjusted, to the extent credible, by the aggregate experience of the company's reinsurer.

		Mortality
Current Assumptions	**All**	Mortality Rates reflect the 2012 Individual Annuity Mortality Basic gender-distinct table (2012IAM). The mortality rates were adjusted based on historical experience by attained age, policy duration, gender, underwriting class, and partner status, to the extent credible. An exhibit containing the adjustment factors is provided in Appendix A to the actuarial memorandum.
Original Assumptions	**200 Series 300 Series**	1975-80 Select and Ultimate mortality table.
	400 Series	1994 Group Annuity Mortality (GAM) Static gender-distinct table.
	500 Series	80% of Annuity 2000 (A2000) Mortality table is used for active lives along with underwriting selection. Disabled Life Mortality is assumed to be the lesser of the claim termination rate and a multiple of the active mortality rate. The multiple varies by claim termination age. For claim termination ages less than or equal to 75, the multiple is 20.0. For claim termination ages greater than 90, the multiple is 5.0. The multiple grades linearly from ages 75 to 90.
	511 Series	A2000 Mortality table is used for active lives along with adjustments by attained age and gender. The disabled mortality assumption is derived using industry experience as reported in the 2004 Study.

		Lapse Rates
Current Assumptions	**All**	Voluntary lapse rates (excludes benefit expiry) vary by policy duration and partner status.

Lifetime-Payment Lapse Rates

Duration	Single	Partnered
1	4.00%	1.50%
2	5.50%	2.50%
3	3.50%	2.00%
4	3.00%	1.50%
5	2.50%	1.20%
6	2.00%	0.90%
7	1.75%	0.70%
8	1.25%	0.60%
9+	0.90%	0.50%

For the ten-pay option, a reduction of 50% of the above lapse rates is assumed for durations one through eight, and 0% lapse thereafter. For the twenty-pay option, a reduction of 25% of the above lapse rates is assumed for durations one through fifteen, and 0% lapse thereafter. For the paid up at age 65 option, a reduction of 25% of these lapse rates was assumed until age 60, and 0% lapse thereafter. For the non-level payment option, a reduction of 25% of the above lapse rates is assumed for all durations.

		Lapse Rates
Original Assumptions	**200 Series 300 Series**	Lapse rates vary by duration. Lapse rates for the lifetime-payment option are provided in the table below.

Duration	Lapse Rates
1	8.00%
2	6.00%
3	5.00%
4	4.00%
5+	3.50%

For limited-pay policies, 2.00% lapse is assumed during the premium payment period.

400 Series

Lapse rates vary by duration.

Lapse Rates

Duration	Lifetime	10 Pay	20 Pay
1	7.00%	2.00%	2.00%
2	4.00%	2.00%	2.00%
3	3.00%	2.00%	2.00%
4	2.50%	2.00%	2.00%
5	2.00%	2.00%	2.00%
6	2.00%	1.50%	1.50%
7	2.00%	1.25%	1.25%
8	2.00%	1.00%	1.00%
9	2.00%	1.00%	1.00%
10	2.00%	0.00%	1.00%
11	2.00%	0.00%	1.00%
12	2.00%	0.00%	1.00%
13	2.00%	0.00%	1.00%
14	2.00%	0.00%	1.00%
15	2.00%	0.00%	1.00%
16+	2.00%	0.00%	0.00%

		Lapse Rates Continued

500 Series

Voluntary lapse rates vary by duration and issue age. Lapse rates for the lifetime-payment option are provided in the table below.

	Lifetime-Payment Lapse Rates									
	Issue Ages									
Duration	**<40**	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80+**
0	7.50%	5.50%	3.75%	3.00%	2.50%	2.50%	3.25%	4.50%	5.50%	7.75%
1	5.75%	4.25%	3.00%	2.25%	2.00%	2.00%	2.50%	3.50%	4.50%	6.00%
2	4.25%	3.25%	2.25%	1.75%	1.50%	1.50%	1.75%	2.50%	3.25%	4.25%
3	3.25%	2.25%	1.75%	1.25%	1.00%	1.00%	1.25%	2.00%	2.50%	3.25%
4	2.00%	1.50%	1.00%	0.75%	0.75%	0.75%	1.00%	1.25%	1.50%	2.25%
5	1.75%	1.25%	0.75%	0.65%	0.65%	0.65%	0.75%	1.00%	1.25%	2.00%
6	1.50%	1.00%	0.65%	0.65%	0.65%	0.65%	0.65%	0.75%	1.00%	1.75%
7	1.25%	0.75%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.75%	1.50%
8	1.00%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	1.25%
9	0.75%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	1.00%
10	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.75%
11+	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%

For limited-pay policies, the voluntary lapse rates are 3.5% in the first year and 0% thereafter.

511 Series

Voluntary lapse rates vary by duration and issue age.

	Lifetime-Payment Lapse Rates									
Pol Dur	**Issue Ages**									
	<40	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80+**
0	8.60%	4.50%	3.70%	3.55%	2.85%	3.50%	3.50%	3.85%	4.05%	3.55%
1	5.55%	4.15%	3.60%	2.90%	2.40%	2.35%	2.75%	3.15%	3.00%	3.10%
2	3.55%	3.00%	2.25%	2.10%	1.80%	1.85%	1.95%	1.95%	2.05%	2.05%
3	3.30%	2.05%	2.15%	1.70%	1.50%	1.55%	1.60%	1.80%	1.85%	1.75%
4	2.15%	1.95%	1.70%	1.35%	1.05%	1.00%	1.20%	1.15%	1.20%	1.35%
5	2.15%	1.95%	1.60%	1.10%	1.00%	1.00%	1.10%	1.15%	1.15%	1.25%
6	2.15%	1.95%	1.60%	1.10%	1.00%	1.00%	1.10%	1.15%	1.15%	1.25%
7	1.35%	1.35%	1.25%	1.05%	0.95%	0.90%	0.95%	1.05%	1.00%	1.00%
8	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%
9	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%
10+	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%

	Limited-Payment Lapse Rates									
Pol Dur	**Issue Ages**									
	<40	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80+**
0	3.20%	2.65%	2.30%	2.00%	1.85%	1.90%	2.15%	2.30%	2.35%	2.15%
1	2.85%	2.45%	2.05%	1.75%	1.55%	1.60%	1.70%	1.90%	2.00%	1.85%
2	2.30%	1.80%	1.55%	1.20%	1.10%	1.20%	1.25%	1.30%	1.70%	1.30%
3	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
4	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%
5	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%
6	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
7+	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Original Assumptions

Exhibit III
Massachusetts Mutual Life Insurance Company
Comparison of Current and Original Pricing Assumptions

		Benefit Expiry Rates
Current Assumptions	**All**	Benefit expiry rates reflect assumed policy termination due to exhaustion of benefits on limited benefit period policies. The rates are based on the 2014 *Guidelines* and vary by gender, benefit period, and attained age. A table containing the benefit expiry rates is provided in Section 6 of the actuarial memorandum.
Original Assumptions	**All**	An explicit benefit expiry assumption was not included in the original pricing memoranda.

		Interest Rate
Current Assumptions	**All**	

Series	Maximum Valuation at Issue[1]	Current[2]
200	4.5%	5.0%
300	4.5%	5.0%
400	4.1%	5.0%
500	4.0%	4.0%
511	3.7%	3.7%

[1] Average interest rates by series are shown. Interest rate varies by policy from 3.5% to 4.5% and is based on policy issue date.

[2] Basis that is consistent with original pricing, which is earnings rate for pre-500 and maximum valuation rate for 500+.

Original Assumptions	**200 Series**	6.5% earnings rate
	300 Series	6.0% earnings rate
	400 Series	5.0% earnings rate
	500 Series	4.0% maximum valuation rate
	511 Series	4.0% maximum valuation rate

		Improvement
Current Assumptions	**All**	Annual improvement in the mortality and morbidity assumptions is assumed for 10 future years. Annual improvement factors vary by attained age based on the G2 improvement scale from the 2012IAM table.
Original Assumptions	**All**	An annual improvement assumption was not included in pricing.

Appendix A
Development and Justification of Current Assumptions

The current actuarial assumptions used in this filing were developed independently by Milliman.

The persistency and morbidity assumptions were developed using historical experience on MassMutual policies. Where actual experience had low credibility or did not exist, experience on other policy forms issued by MassMutual or industry experience was considered. Historical experience through December 31, 2016 was used in the assumption development and morbidity experience included claim runout through December 31, 2017. Experience on all of MassMutual's long-term care products, including its currently marketed 513 Series product, was combined in determining the assumptions described herein. As such, for the purposes of this Appendix, "500+ Series" experience is defined as the combined experience of the 500, 511, and 513 Series.

Improvement (mortality and morbidity), benefit expiry, and rate increase dependent assumptions were developed using industry experience and actuarial judgment.

Predictive analytics was used in the development of the mortality and morbidity assumptions. The voluntary lapse assumption utilized traditional techniques and credibility measures.

The rest of this appendix provides details on the development and justification of the current assumptions.

Persistency

The assumptions for mortality and voluntary lapse were developed based on MassMutual's historical experience through December 31, 2016. The benefit expiry assumption was developed using the 2014 Milliman *Long-Term Care Guidelines (Guidelines)*.

Mortality

The mortality assumption utilizes the 2012 Individual Annuity Mortality Basic gender-distinct table (2012IAM) and experience-adjustment factors to be applied to 2012IAM. To develop the experience-adjustment factors, we used predictive analytics as described in the Predictive Analytics section below.

Exhibit A-1 supports the mortality assumption and provides the following information for all rate series by partner (marital) status, gender, policy duration, attained age band, underwriting class, and rate series:

- Exhibit A-1a – Provides the adjustment factors that are to be applied to the 2012IAM hazard rates; the adjusted hazard rates are converted back into mortality probabilities to create the adjusted mortality assumption.

- Exhibit A-1b

  o Policy year exposure [A] reflects the length of time a covered life is exposed to the risk of death (i.e., exact exposure basis).

  o Actual deaths [B]

  o Mortality probabilities underlying actual experience [C], 2012IAM [D], and the adjusted assumption [E]

  Mortality probabilities were calculated by first calculating the hazard rate of mortality, then transforming into a probability. For example, the actual mortality probability [C] = 1 – EXP(-([B] / [A])).

  o Actual-to-expected (A:E) ratios are calculated as actual mortality probabilities to the 2012IAM mortality probabilities [F] and the adjusted assumption [G]. The adjusted A:E [G] provides an indication of fit. This fit will not be perfect (i.e., ratio deviates from 1.0) because the main goal is to develop an assumption that generalizes well to new data by balancing assumption complexity and fit on the historical experience.

Lifetime-Pay Voluntary Lapse

Exhibit A-2a(i) provides total exposure, composite termination probabilities, expected mortality probabilities, derived voluntary lapse probabilities, credibility percent, and smoothed voluntary lapse probabilities for single (without a partner) policies by duration. This exhibit includes experience for policies with a lifetime premium payment option. Exhibit A-2a(ii) provides similar information for partnered (married) policies.

In general, the smoothed voluntary lapse probabilities were set in such a way that the combined-duration smoothed probabilities were close to the derived voluntary lapse probabilities (see the rows at the bottom of the exhibits). In developing the ultimate (duration 9+) voluntary lapse probability, the actual voluntary lapse experience was considered, to the extent credible.

To develop derived voluntary lapse probabilities, the actual composite terminations were used, where composite terminations represent all terminations with the exclusion of benefit expiries; a separate benefit expiry assumption was developed based on the *Guidelines* as described below.

The actual composite termination probabilities were calculated by transforming hazard rates as follows:

Annualized Composite Termination Probability = 1 – EXP(-(Actual Composite Termination / Exposure))

Actual composite terminations (excluding benefit expiry) were assigned to the duration in which it occurred. Each death or voluntary lapse contributes 1.0 to the actual termination count. Exposure reflects an exact exposure basis.

The expected mortality probability corresponds to that underlying the adjusted assumption described in the Mortality section above; that is, 2012IAM with the experience-adjustment factors in Exhibit A-1a.

The derived voluntary lapse probability was then calculated according to the following formula:

Derived Voluntary Lapse Probability = 1 – (1 – Composite Termination Probability)
/ (1 – Expected Mortality Probability)

Other Payment Options Voluntary Lapse

The smoothed lapse probabilities for other premium payment options (i.e., limited and discounted renewal premium payment options) are a scalar of the lifetime-pay lapse probabilities shown in Exhibit A-2a.

For the 10-pay option, the scalars were developed from a comparison of the lifetime-pay derived lapse probabilities to the 10-pay derived lapse probabilities based on MassMutual experience. Exhibit A-2b provides similar information as Exhibit A-2a, but for policies with a 10-year premium payment period.

For the 20-pay, paid-up at age 65, and discounted renewal payment options, termination experience was of limited credibility. As such, scalars based on actuarial judgment were developed for these options to apply to the lifetime-pay lapse rates. These options are immaterial to the projections for this block of business as they account for <5% of the in-force distribution of business as of December 31, 2016.

The relationships for each payment option were used to develop the smoothed lapse assumptions for the 10-pay, 20-pay, paid-up at age 65, and discounted renewal options detailed in Section 6 of the actuarial memorandum. For insureds with a limited payment duration and the discounted renewal payment option, both scalars are applied to the base lifetime-pay lapse rate.

Benefit Expiry

Benefit expiry probabilities reflect assumed policy lapses due to exhaustion of benefits based on the 2014 *Guidelines* and vary by attained age, gender, and benefit period. Policies with lifetime benefits do not have an expiry assumption (i.e., rate of 0%).

Morbidity

The morbidity assumption uses claim costs from the 2014 *Guidelines* with experience-adjustment factors based on MassMutual experience. To develop the experience-adjustment factors, we used predictive analytics as described in the Predictive Analytics section below.

Exhibit A-3 supports the morbidity assumption and provides the adjustment factors as well as an A:E exhibit for the key experience buckets used in the development of the factors:

- Exhibit A-3a – Provides the adjustment factors that are to be applied to the 2014 *Guidelines* claim costs.
- Exhibit A-3b
  - Exposure [A] reflects the length of time a covered life is in force (i.e., an exact exposure basis).
  - Actual incurred claim counts [B] and dollars [C] are based on historical claim experience from inception through December 31, 2016, with runout through December 31, 2017. Actual incurred claim dollars were valued as paid claims plus claim reserves. Paid claims and claim reserves were discounted to the year of incurral.

o   2014 *Guidelines* expected incurred claims [D] are valued as the 2014 *Guidelines* claim costs multiplied by actual all-lives exposure. The claim costs vary by gender, attained age, policy duration, benefit period, elimination period, payment type, level of home care coverage, inflation type, and coverage type (comprehensive/facility only). Policy design, claims adjudication, and degree of underwriting were considered in developing the claim costs.

o   Adjusted expected incurred claims [E] are calculated by applying each applicable adjustment from Exhibit A-3a to the 2014 *Guidelines* expected incurred claims [D].

o   A:E ratios are calculated as actual incurred claims to the 2014 *Guidelines* expected incurred claims [F] and adjusted expected incurred claims [G]. The adjusted A:E [G] provides an indication of fit. This fit will not be perfect (i.e., ratio deviates from 1.0) because the main goal is to develop an assumption that generalizes well to new data by balancing assumption complexity and fit on the historical experience.

Improvement

For projected mortality improvement, the G2 improvement scale from the 2012IAM mortality table was used. This assumption was also used for projected morbidity improvement. The G2 improvement scale varies by attained age and is applied beginning in the first projection year and continues for 10 projection years.

Rate Increase Dependent Assumptions

At the time of a rate increase, insureds have options to elect a contingent benefit upon lapse (CBUL) or reduced benefit options (RBO). Adverse selection is assumed relative to CBUL and RBO elections. These insured behavior assumptions are provided below, and were developed primarily based on actuarial judgment with high-level consideration for the experience of other carriers in the LTC industry, to the extent available.

Contingent Benefit Upon Lapse Election Rates

A CBUL election rate is determined as a function of the magnitude of the rate increase and applied on a seriatim basis. The CBUL election rate is determined as a factor of 0.08 multiplied by the rate increase percentage for rate increases greater than 15%. The rate increase percentage is rounded to the nearest 10% prior to applying this factor to remove implied specificity. For rate increases less than or equal to 15%, no CBUL is assumed.

No CBUL elections are assumed for insureds with a limited premium payment option.

Reduced Benefit Options

The RBO election rate is based on the CBUL election rate. The RBO election rate is assumed to be two and a half times the CBUL election rate (i.e., 2.5 multiplied by CBUL election) for rate increases greater than 15%. Because the RBO election rate is based on the CBUL election rate; no RBO is assumed for increases less than or equal to 15% or for insureds with a limited premium payment option.

Based on the RBO election function, the reduction to premium and claims can then be determined as follows:

Reduction to premium and claims due to the election of RBO
= 1 – (Average premium level after the rate increase with RBO election / Premium level after the full rate increase without any RBO election), where

Average premium level after the rate increase with RBO election
= weighted average premium level of the assumed percentage of insureds electing RBO with the percentage assumed to accept the full rate increase

Adverse Selection

The adverse selection assumption is a function of the CBUL and RBO election rates, such that the relative increase to morbidity due to adverse selection varies by the rate increase's magnitude. The percentage increase in morbidity due to adverse selection was developed from the following formula and actuarial judgment. We assume that at the time of the rate increase, insureds that elect a CBUL will be selective in that their relative morbidity is 25% lower than that of the remaining pool. Similarly, we assume that at the time of the rate increase, insureds that elect an RBO will be selective in that their relative morbidity is 12.5% lower than that of the remaining pool.

PoolMorb = AdvSelMorb x (1 – CBUL – RBO) + [(1 – 25%) x AdvSelMorb] x CBUL + [(1 – 12.5%) x AdvSelMorb] x RBO, where

PoolMorb =   morbidity of the pool before the rate increase = 1.0
AdvSelMorb =   adverse morbidity of the remaining pool after the rate increase due to selective lapses
CBUL =   percentage of policies that elect CBUL
RBO =   percentage of policies that elect RBO

Solving the above for the adverse selection component results in the following formula:

Adverse Selection = 1 / (1 – 25% x CBUL – 12.5% x RBO)

Predictive Analytics

In developing the mortality and morbidity adjustment factors, predictive analytics was employed in the form of a penalized generalized linear model (GLM).

A penalized GLM is similar to a traditional GLM. The only difference is that it adds an additional constraint that penalizes the size of the model's coefficients in order to control overfitting the model to the historical data. This penalty placed on the coefficients can be seen as a credibility lever, which controls how much weight is given to the company's actual experience. A high penalty would give no weight to the data, leaving the benchmark assumption (i.e., the 2012IAM for mortality or the 2014 *Guidelines* for morbidity) unadjusted. No penalty would give full weight to the company's actual data potentially making large adjustments to the benchmark, which could be overfitting the actual experience. When using a penalized GLM it is important to choose a penalty that gives the right amount of weight to the actual data to avoid underfitting or overfitting the experience.

A standard approach for choosing such a penalty is to use a k-fold cross-validation to test a series of penalty values. A k-fold cross-validation splits the data into k subsets and iteratively trains and tests the model independently on each subset of the data. This process gives an estimation of how well a model will generalize to new data that was not used to develop the assumption. Through the k-fold cross-validation we evaluated the impact the penalty had on the model's generalizability by testing a range of 100 penalties. We selected the penalty that minimized the k-fold cross-validation prediction error. Using this approach, we were able to determine the amount of weight to give actual experience versus the benchmark assumption through a statistically robust and automated process.

Credibility

Traditional techniques were employed to develop the voluntarily lapse assumption, which considers actual historical experience, its associated credibility, and actuarial judgment. The credibility percentage was determined as (Number of Events / Credibility Threshold)$^{1/2}$, where an event is defined as an actual voluntary lapse. A credibility standard of a 90% confidence interval for the number of events with an error of plus or minus 7.5% was chosen. Based on these parameters, 481 events is the criterion for full credibility.

Exhibit A-1a
Mortality Hazard Rate Adjustment Factors

Attained Age	Factor
<55	0.99
55	0.97
56	0.94
57	0.91
58	0.88
59	0.85
60	0.82
61	0.79
62	0.77
63	0.74
64	0.72
65	0.71
66	0.71
67	0.73
68	0.74
69	0.76
70	0.78
71	0.80
72	0.82
73	0.83
74	0.85
75	0.87
76	0.89
77	0.90
78	0.90
79	0.90
80	0.91
81	0.92
82	0.94
83	0.95
84	0.96
85	0.96
86	0.97
87	0.98
88	0.99
89	0.99
90	1.00
91	1.00
92	1.00
93	1.00
94	1.00
95	1.00
96	1.00
97	1.00
98	1.00
99	1.00
100+	1.00

Gender	Factor
Male	0.98
Female	0.96

Partner Status	Factor
Single	0.99
Partnered	0.95

Underwriting Class	Factor
Preferred	0.94
Standard	0.99
Substandard	1.01

Duration	Factor
1	0.82
2	0.71
3	0.64
4	0.59
5	0.56
6	0.64
7	0.72
8	0.77
9	0.79
10	0.81
11	0.83
12	0.85
13	0.87
14	0.89
15	0.91
16	0.93
17	0.95
18	0.97
19	0.98
20+	0.98

Exhibit A-1b
Actual-to-Expected (A:E) Mortality Experience through December 31, 2016
All Rate Series Combined

Policy or Policyowner Characteristic	Policy Year Exposure [A]	Actual		Expected Mortality Probability		Actual-to-Expected Mortality	
		Deaths [B]	Probability [C]	2012IAM [D]	Adjusted [E]	2012IAM [F] = [C] / [D]	Adjusted [G] = [C] / [E]
Partner Status							
Partnered	633,561	1,725	0.3%	0.7%	0.4%	0.41	0.77
Single	227,515	974	0.4%	0.8%	0.5%	0.53	0.91
Gender							
Female	481,531	1,253	0.3%	0.6%	0.3%	0.44	0.79
Male	379,545	1,446	0.4%	0.8%	0.4%	0.46	0.85
Policy Duration							
1-3	283,626	351	0.1%	0.4%	0.2%	0.28	0.52
4-6	226,364	530	0.2%	0.6%	0.3%	0.40	0.93
7-9	171,663	650	0.4%	0.8%	0.4%	0.50	0.91
10-12	125,828	668	0.5%	1.0%	0.6%	0.52	0.86
13+	53,595	500	0.9%	1.5%	1.0%	0.61	0.90
Attained Age							
<65	569,972	776	0.1%	0.4%	0.2%	0.36	0.68
65-69	165,496	562	0.3%	0.9%	0.4%	0.38	0.79
70-74	83,040	591	0.7%	1.3%	0.7%	0.53	0.95
75-79	30,756	399	1.3%	2.2%	1.4%	0.59	0.93
80-84	9,331	229	2.4%	3.9%	2.7%	0.63	0.91
85+	2,481	142	5.6%	7.7%	5.8%	0.73	0.97
Underwriting							
Preferred	536,646	1,597	0.3%	0.7%	0.4%	0.42	0.77
Standard	275,333	848	0.3%	0.7%	0.4%	0.45	0.81
Substandard	49,096	254	0.5%	0.7%	0.4%	0.76	1.34
Rate Series							
200 Series	316,341	1,493	0.5%	0.9%	0.5%	0.54	0.94
300 Series	229,396	643	0.3%	0.6%	0.4%	0.43	0.79
400 Series	152,091	340	0.2%	0.6%	0.3%	0.38	0.74
500+ Series	163,247	223	0.1%	0.5%	0.3%	0.26	0.52
Total	861,076	2,699	0.3%	0.7%	0.4%	0.45	0.82

Exhibit A-2a(i)
Derived Lifetime-Pay Voluntary Lapse Experience through December 31, 2016
Single Policies for All Rate Series Combined

Duration	Exposure	Composite Termination Probability	Expected Mortality Probability	Derived Lapse Probability	Credibility Percent	Smoothed Lapse Probability
1	23,407	4.2%	0.3%	4.0%	100%	4.00%
2	21,264	5.8%	0.3%	5.5%	100%	5.50%
3	19,703	3.8%	0.3%	3.6%	100%	3.50%
4	18,369	3.3%	0.3%	3.0%	100%	3.00%
5	17,007	2.8%	0.3%	2.5%	93%	2.50%
6	15,568	2.3%	0.4%	1.9%	79%	2.00%
7	14,443	2.2%	0.5%	1.7%	73%	1.75%
8	13,494	1.9%	0.5%	1.4%	62%	1.25%
9	12,543	1.9%	0.6%	1.3%	59%	0.90%
10	11,331	1.7%	0.7%	0.9%	47%	0.90%
11	10,159	1.4%	0.8%	0.6%	40%	0.90%
12	8,603	1.5%	0.9%	0.6%	34%	0.90%
13	6,007	2.2%	1.1%	1.1%	32%	0.90%
14	3,887	2.1%	1.4%	0.7%	23%	0.90%
15	2,128	2.1%	1.6%	0.5%	14%	0.90%
16	834	2.1%	2.0%	0.1%	10%	0.90%
17	65	0.0%	2.4%	-2.4%	0%	0.90%
1-3	64,374	4.6%	0.3%	4.4%	100%	4.3%
4-6	50,944	2.8%	0.3%	2.5%	100%	2.5%
7+	83,493	1.9%	0.8%	1.1%	100%	1.1%
8+	69,050	1.8%	0.8%	1.0%	100%	1.0%
9+	55,556	1.8%	0.9%	0.9%	100%	0.9%
All	198,811	3.0%	0.5%	2.5%	100%	2.5%

Exhibit A-2a(ii)
Derived Lifetime-Pay Voluntary Lapse Experience through December 31, 2016
Partnered Policies for All Rate Series Combined

Duration	Exposure	Composite Termination Probability	Expected Mortality Probability	Derived Lapse Probability	Credibility Percent	Smoothed Lapse Probability
1	63,015	1.7%	0.3%	1.5%	100%	1.50%
2	58,226	2.8%	0.2%	2.6%	100%	2.50%
3	54,233	2.2%	0.2%	1.9%	100%	2.00%
4	50,328	1.7%	0.2%	1.4%	100%	1.50%
5	45,537	1.4%	0.2%	1.2%	100%	1.20%
6	39,531	1.2%	0.3%	0.9%	86%	0.90%
7	35,798	1.1%	0.4%	0.7%	77%	0.70%
8	32,859	1.0%	0.4%	0.6%	68%	0.60%
9	30,266	1.0%	0.5%	0.5%	58%	0.50%
10	27,255	0.9%	0.5%	0.4%	53%	0.50%
11	24,529	1.1%	0.6%	0.5%	50%	0.50%
12	20,834	1.0%	0.7%	0.3%	42%	0.50%
13	15,039	1.0%	0.8%	0.1%	33%	0.50%
14	10,352	1.4%	1.0%	0.5%	33%	0.50%
15	5,487	1.4%	1.2%	0.1%	18%	0.50%
16	2,042	1.1%	1.5%	-0.5%	9%	0.50%
17	138	0.7%	1.9%	-1.2%	0%	0.50%
1-3	175,475	2.2%	0.2%	2.0%	100%	2.0%
4-6	135,396	1.4%	0.3%	1.2%	100%	1.2%
7+	204,599	1.0%	0.6%	0.5%	100%	0.6%
8+	168,800	1.0%	0.6%	0.4%	100%	0.5%
9+	135,942	1.0%	0.7%	0.4%	100%	0.5%
All	515,469	1.6%	0.4%	1.2%	100%	1.2%

Exhibit A-2b(i)
Derived 10-Pay Voluntary Lapse Experience through December 31, 2016
Single Policies for All Rate Series Combined

Duration	Exposure	Composite Termination Probability	Expected Mortality Probability	Derived Lapse Probability	Credibility Percent	Ratio to Lifetime-Pay Lapse[1]	Smoothed Ratio to Lifetime-Pay[2]	Smoothed Lapse Probability
1	1,950	1.8%	0.2%	1.6%	27%	0.41	0.50	2.00%
2	1,884	3.9%	0.2%	3.7%	38%	0.68	0.50	2.75%
3	1,820	2.4%	0.2%	2.3%	30%	0.64	0.50	1.75%
4	1,793	1.7%	0.2%	1.5%	24%	0.51	0.50	1.50%
5	1,733	1.6%	0.2%	1.4%	24%	0.57	0.50	1.25%
6	1,587	0.8%	0.2%	0.6%	14%	0.31	0.50	1.00%
7	1,499	1.1%	0.3%	0.8%	16%	0.45	0.50	0.88%
8	1,442	0.4%	0.3%	0.1%	9%	0.07	0.50	0.63%
9	1,371	0.4%	0.4%	0.1%	8%	0.06	0.00	0.00%
10	1,251	0.2%	0.4%	-0.2%	0%	-0.17	0.00	0.00%
11	1,103	0.2%	0.5%	-0.3%	0%	-0.46	0.00	0.00%
12	902	0.2%	0.5%	-0.3%	0%	-0.51	0.00	0.00%
13	502	0.4%	0.6%	-0.2%	0%	-0.17	0.00	0.00%
14	282	0.7%	0.7%	0.0%	0%	-0.01	0.00	0.00%
15	143	0.7%	0.9%	-0.2%	0%	-0.42	0.00	0.00%
16	52	0.0%	1.0%	-1.0%	0%	-7.48	0.00	0.00%
17	3	0.0%	0.8%	-0.8%	0%	0.33	0.00	0.00%
All	19,318	1.4%	0.3%	1.1%	69%	0.43	0.43	1.1%

[1] Values in this column are calculated as the ratio of the 10-pay derived lapse probability to the corresponding lifetime-pay derived lapse probability from Exhibit A-2a (e.g., Duration 3 ratio = 2.3% / 3.6%).

[2] Values in this column are calculated as the ratio of the 10-pay smoothed lapse probability to the corresponding lifetime-pay smoothed lapse probability from Exhibit A-2a (e.g., Duration 3 ratio = 1.75% / 3.50%).

Exhibit A-2b(ii)
Derived 10-Pay Voluntary Lapse Experience through December 31, 2016
Partnered Policies for All Rate Series Combined

Duration	Exposure	Composite Termination Probability	Expected Mortality Probability	Derived Lapse Probability	Credibility Percent	Ratio to Lifetime-Pay Lapse[1]	Smoothed Ratio to Lifetime-Pay[2]	Smoothed Lapse Probability
1	8,646	0.7%	0.2%	0.5%	35%	0.35	0.50	0.75%
2	8,528	1.4%	0.2%	1.2%	48%	0.46	0.50	1.25%
3	8,431	1.3%	0.2%	1.1%	46%	0.59	0.50	1.00%
4	8,325	1.1%	0.2%	0.9%	41%	0.65	0.50	0.75%
5	7,960	1.2%	0.2%	1.0%	42%	0.89	0.50	0.60%
6	6,899	0.5%	0.2%	0.3%	25%	0.39	0.50	0.45%
7	6,371	0.9%	0.2%	0.6%	28%	0.90	0.50	0.35%
8	6,009	0.4%	0.3%	0.2%	14%	0.27	0.50	0.30%
9	5,560	0.4%	0.3%	0.1%	11%	0.18	0.00	0.00%
10	4,936	0.5%	0.3%	0.2%	19%	0.44	0.00	0.00%
11	4,360	0.4%	0.4%	0.0%	14%	0.02	0.00	0.00%
12	3,477	0.4%	0.4%	0.0%	6%	-0.09	0.00	0.00%
13	1,986	0.4%	0.5%	-0.2%	0%	-1.09	0.00	0.00%
14	1,158	0.6%	0.6%	0.0%	0%	0.00	0.00	0.00%
15	599	0.7%	0.7%	0.0%	0%	-0.20	0.00	0.00%
16	216	0.5%	0.8%	-0.3%	0%	0.72	0.00	0.00%
17	11	0.0%	1.0%	-1.0%	0%	0.83	0.00	0.00%
All	83,473	0.8%	0.2%	0.6%	100%	0.50	0.43	0.5%

[1] Values in this column are calculated as the ratio of the 10-pay derived lapse probability to the corresponding lifetime-pay derived lapse probability from Exhibit A-2a (e.g., Duration 3 ratio = 1.1% / 1.9%).

[2] Values in this column are calculated as the ratio of the 10-pay smoothed lapse probability to the corresponding lifetime-pay smoothed lapse probability from Exhibit A-2a (e.g., Duration 3 ratio = 1.00% / 2.00%).

Exhibit A-3a
Morbidity Adjustment Factors

	Rate Series			
Duration	200 Series	300 Series	400 Series	500+ Series
1	0.99	1.05	1.02	1.00
2	1.01	1.12	1.05	0.99
3	1.02	1.11	1.05	0.97
4	1.08	1.03	0.99	0.96
5	1.05	0.96	0.95	0.96
6	1.10	0.99	0.92	0.98
7	1.05	1.01	0.95	0.98
8	1.10	1.03	0.94	0.98
9	1.09	1.02	0.93	0.97
10	1.14	1.02	0.90	0.99
11	1.08	0.96	0.91	1.00
12	1.05	0.92	0.93	1.00
13	0.99	0.90	0.97	1.00
14	0.99	0.95	0.99	1.00
15	0.96	0.98	1.00	1.00
16	0.97	1.00	1.00	1.00
17	0.97	1.00	1.00	1.00
18	1.00	1.00	1.00	1.00
19	1.00	1.00	1.00	1.00
20+	1.00	1.00	1.00	1.00

Gender	Factor
Male	1.04
Female	0.91

Underwriting Class	Factor
Preferred	0.90
Non-Preferred	1.05

Attained Age	Rate Series				Benefit Period		Benefit Type	
	200 Series	300 Series	400 Series	500+ Series	Lifetime	Non-Lifetime	Indemnity	Reimbursement
<55	1.02	1.00	1.00	1.00	1.02	1.00	1.03	0.99
55	1.02	1.00	1.00	1.00	1.02	1.00	1.03	0.99
56	1.02	1.00	1.00	1.00	1.02	1.00	1.03	0.99
57	1.02	1.00	0.97	0.99	0.99	0.99	1.01	0.97
58	1.00	0.98	0.94	0.99	0.94	0.97	0.99	0.93
59	0.98	0.98	0.93	0.98	0.92	0.95	0.96	0.91
60	0.93	0.97	0.91	0.98	0.88	0.92	0.91	0.89
61	0.93	0.96	0.88	0.98	0.87	0.90	0.89	0.88
62	0.92	0.95	0.88	0.99	0.86	0.89	0.86	0.89
63	0.93	0.95	0.90	1.00	0.89	0.89	0.85	0.93
64	0.96	0.93	0.90	1.00	0.91	0.88	0.86	0.94
65	1.00	0.91	0.91	1.01	0.92	0.91	0.89	0.94
66	0.99	0.91	0.93	1.00	0.93	0.91	0.92	0.92
67	1.00	0.92	0.96	1.00	0.96	0.92	0.96	0.92
68	1.01	0.96	0.96	0.99	0.99	0.93	1.03	0.90
69	0.99	0.98	0.95	0.99	0.97	0.95	1.05	0.87
70	0.97	1.01	0.97	0.98	0.99	0.93	1.04	0.89
71	0.97	1.02	0.96	0.98	1.02	0.93	1.05	0.90
72	1.00	1.05	0.95	0.98	1.06	0.92	1.09	0.90
73	0.99	1.03	0.97	0.99	1.06	0.91	1.07	0.91
74	1.01	1.03	1.00	0.99	1.13	0.91	1.07	0.96
75	1.05	1.01	1.00	0.99	1.15	0.92	1.07	0.98
76	1.07	0.99	1.01	0.99	1.13	0.93	1.06	1.00
77	1.06	0.96	1.02	1.00	1.10	0.95	1.03	1.01
78	1.10	0.96	1.00	1.00	1.10	0.97	1.02	1.03
79	1.10	0.96	0.99	0.99	1.05	0.98	1.02	1.02
80	1.09	0.97	0.98	0.99	1.03	1.00	1.03	1.00
81	1.10	0.99	0.97	0.99	1.04	1.01	1.04	1.01
82	1.10	1.00	0.97	0.99	1.03	1.03	1.05	1.01
83	1.07	1.01	0.97	0.99	1.02	1.02	1.05	1.00
84	1.06	1.02	0.97	0.99	1.02	1.02	1.03	1.01
85	1.04	1.02	0.98	0.99	1.01	1.01	1.02	1.00
86	1.02	1.01	0.98	0.99	1.00	1.00	1.01	1.00
87	1.00	1.01	0.99	0.99	0.99	1.00	1.00	0.99
88	0.99	1.01	0.99	1.00	0.99	1.00	0.99	1.00
89	0.98	1.00	1.00	1.00	0.98	1.00	0.99	0.99
90	0.99	1.00	1.01	1.00	0.98	1.02	0.99	1.00
91	0.99	1.00	1.01	1.00	0.98	1.02	0.99	1.00
92	1.00	0.99	1.01	1.00	0.98	1.02	0.99	1.01
93	1.00	1.00	1.01	1.00	0.98	1.02	0.99	1.01
94	1.01	1.00	1.01	1.00	0.99	1.02	1.00	1.01
95	1.01	1.00	1.00	1.00	0.99	1.02	1.00	1.01
96	1.01	1.00	1.00	1.00	1.00	1.01	1.00	1.01
97	1.01	1.00	1.00	1.00	1.00	1.01	1.00	1.01
98	1.01	1.00	1.00	1.00	1.00	1.01	1.00	1.01
99	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.01
100+	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.00

Exhibit A-3b
Actual-to-Expected (A:E) Morbidity Experience through December 31, 2016 with Claim Runout
All Rate Series Combined

Policy or Policyowner Characteristic	Exposure [A]	Actual Incurred Claims		Expected Incurred Claims		Actual-to-Expected Incurred Claims	
		Count [B]	Dollars [C]	2014 *Guidelines* [D]	Adjusted [E]	2014 *Guidelines* [F] = [C] / [D]	Adjusted [G] = [C] / [E]
Partner Status							
Partnered	633,635	876	124,048,594	149,444,034	120,544,568	0.83	1.03
Single	227,993	826	121,211,932	150,297,766	124,715,707	0.81	0.97
Gender							
Female	482,025	1,023	154,581,170	199,983,051	159,654,075	0.77	0.97
Male	379,604	679	90,679,357	99,758,749	85,606,200	0.91	1.06
Policy Duration							
1-3	283,773	161	19,695,627	17,501,435	17,393,115	1.13	1.13
4-6	226,507	296	38,343,898	39,734,217	38,289,115	0.97	1.00
7-9	171,790	424	53,999,057	67,107,620	55,942,454	0.80	0.97
10-12	125,922	466	77,447,114	90,364,783	76,093,914	0.86	1.02
13+	53,636	355	55,774,830	85,033,744	57,541,678	0.66	0.97
Attained Age							
<64	569,996	358	49,741,046	61,277,039	49,275,898	0.81	1.01
65-69	165,548	275	47,126,413	60,891,816	46,645,563	0.77	1.01
70-74	83,119	315	51,145,259	66,942,436	54,400,783	0.76	0.94
75-79	30,888	350	53,617,580	56,798,760	50,974,964	0.94	1.05
80-84	9,475	261	30,528,317	35,272,061	30,218,075	0.87	1.01
85+	2,603	143	13,101,912	18,559,687	13,744,992	0.71	0.95
Underwriting							
Preferred	536,926	996	143,125,012	188,629,862	149,574,881	0.76	0.96
Non-Preferred	324,703	706	102,135,515	111,111,938	95,685,395	0.92	1.07
Benefit Type							
Indemnity	261,867	486	89,470,260	93,878,830	76,889,898	0.95	1.16
Reimbursement	599,762	1,216	155,790,266	205,862,969	168,370,377	0.76	0.93
Rate Series							
200 Series	316,802	1,023	144,886,364	159,218,142	136,496,321	0.91	1.06
300 Series	229,457	375	62,282,938	81,754,214	64,361,822	0.76	0.97
400 Series	152,111	204	24,106,166	39,255,569	29,031,345	0.61	0.83
500+ Series	163,258	100	13,985,059	19,513,874	15,370,786	0.72	0.91
Total	861,628	1,702	245,260,527	299,741,799	245,260,275	0.82	1.00

Appendix B
Massachusetts Mutual Life Insurance Company
Comparison of Current and 513 Series Pricing Assumptions

	Morbidity
Current Assumptions	Claim costs are developed using the 2014 Milliman Long-Term Care Guidelines (Guidelines) with adjustments for underwriting selection and an all-lives exposure basis. The claim costs were further adjusted based on historical claim experience by rate series, attained age, policy duration, benefit period, benefit payment type, gender, and underwriting class, to the extent credible. An exhibit containing the adjustment factors is provided in Appendix A to the actuarial memorandum.
513 Pricing Assumptions	The morbidity assumption was derived using industry experience as reported in the Intercompany Study 1984-2004 published by the Society of Actuaries Long Term Care Experience Committee (2004 Study) and adjusted, to the extent credible, by the aggregate experience of the company's reinsurer.

	Mortality
Current Assumptions	Mortality Rates reflect the 2012 Individual Annuity Mortality (IAM) Basic gender-distinct table. The mortality rates were adjusted based on historical experience by attained age, policy duration, gender, underwriting class, and partner status, to the extent credible. An exhibit containing the adjustment factors is provided in Appendix A to the actuarial memorandum.
513 Pricing Assumptions	A2000 Mortality table is used for active lives along with adjustments by attained age and gender. The disabled mortality assumption is derived using industry experience as reported in the 2004 Study.

Lapse Rates

Current Assumptions	Voluntary lapse rates (excludes benefit expiry) vary by policy duration and partner status.

Lapse Rate Assumptions

Duration	Single	Partnered
1	4.00%	1.50%
2	5.50%	2.50%
3	3.50%	2.00%
4	3.00%	1.50%
5	2.50%	1.20%
6	2.00%	0.90%
7	1.75%	0.70%
8	1.25%	0.60%
9+	0.90%	0.50%

For the ten-pay option, a reduction of 50% of the above lapse rates is assumed for durations one through eight, and 0% lapse thereafter. For the twenty-pay option, a reduction of 25% of the above lapse rates is assumed for durations one through fifteen, and 0% lapse thereafter. For the paid up at age 65 option, a reduction of 25% of these lapse rates was assumed until age 60, and 0% lapse thereafter. For the non-level payment option, a reduction of 25% of the above lapse rates is assumed for all durations.

513 Pricing Assumptions

Voluntary lapse rates vary by duration and issue age.

Lifetime-Payment Lapse Rates

Pol Dur	<40	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+
					Issue Ages					
0	8.60%	4.50%	3.70%	3.55%	2.85%	3.50%	3.50%	3.85%	4.05%	3.55%
1	5.55%	4.15%	3.60%	2.90%	2.40%	2.35%	2.75%	3.15%	3.00%	3.10%
2	3.55%	3.00%	2.25%	2.10%	1.80%	1.85%	1.95%	1.95%	2.05%	2.05%
3	3.30%	2.05%	2.15%	1.70%	1.50%	1.55%	1.60%	1.80%	1.85%	1.75%
4	2.15%	1.95%	1.70%	1.35%	1.05%	1.00%	1.20%	1.15%	1.20%	1.35%
5	2.15%	1.95%	1.60%	1.10%	1.00%	1.00%	1.10%	1.15%	1.15%	1.25%
6	2.15%	1.95%	1.60%	1.10%	1.00%	1.00%	1.10%	1.15%	1.15%	1.25%
7	1.35%	1.35%	1.25%	1.05%	0.95%	0.90%	0.95%	1.05%	1.00%	1.00%
8	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%
9	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%
10+	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%

Limited-Payment Lapse Rates

Pol Dur	<40	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+
					Issue Ages					
0	3.20%	2.65%	2.30%	2.00%	1.85%	1.90%	2.15%	2.30%	2.35%	2.15%
1	2.85%	2.45%	2.05%	1.75%	1.55%	1.60%	1.70%	1.90%	2.00%	1.85%
2	2.30%	1.80%	1.55%	1.20%	1.10%	1.20%	1.25%	1.30%	1.70%	1.30%
3	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
4	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%
5	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%
6	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
7+	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Appendix B
Massachusetts Mutual Life Insurance Company
Comparison of Current and 513 Series Pricing Assumptions

Benefit Expiry Rates	
Current Assumptions	Benefit expiry rates reflect assumed policy termination due to exhaustion of benefits on limited benefit period policies. The rates are based on the 2014 Guidelines and vary by gender, benefit period, and attained age. A table containing the benefit expiry rates is provided in Section 6 of the actuarial memorandum.
513 Pricing Assumptions	An explicit benefit expiry assumption was not included in the original pricing memoranda.

Interest Rate	
Current Assumptions	<table><tr><td>**Series**</td><td>**Maximum Valuation at Issue[1]**</td><td>**Current[2]**</td></tr><tr><td>200</td><td>4.5%</td><td>5.0%</td></tr><tr><td>300</td><td>4.5%</td><td>5.0%</td></tr><tr><td>400</td><td>4.1%</td><td>5.0%</td></tr><tr><td>500</td><td>4.0%</td><td>4.0%</td></tr><tr><td>511</td><td>3.7%</td><td>3.7%</td></tr></table> *[1] Average interest rates by series are shown. Interest rate varies by policy from 3.5% to 4.5% and is based on policy issue date.* *[2] Basis that is consistent with original pricing, which is earnings rate for pre-500 and maximum valuation rate for 500+.*
513 Pricing Assumptions	3.5% maximum valuation rate

Improvement	
Current Assumptions	Annual improvement in the mortality and morbidity assumptions is assumed for 10 future years. Annual improvement factors vary by attained age based on the G2 improvement scale from the 2012 IAM table.
513 Pricing Assumptions	An annual improvement assumption was not included in pricing.