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Mortality Aggregation Examples

NAIC National Meeting
Summer 2019

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Agenda

- Key Concepts and Applicable VM-20 Language
- Examples and Comparison of Approaches
- Next Steps

Key Concepts for Mortality Aggregation

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✓ Mortality segments subject to the same or similar underwriting processes may be aggregated to calculate credibility

✗ Using separate mortality segment experience to set each corresponding assumption and then simply grouping the segments together to calculate credibility is not mortality aggregation under VM-20

✓ The aggregate experience must inform the mortality segment assumptions; two approaches are allowed under VM-20

Applicable VM-20 Language

VM-20 Section 9.C.2.d

vi. If the company uses the aggregate company experience for a group of mortality segments when determining the company experience mortality rates for each of the individual mortality segments in the group, the company shall either:

Top Down Approach

a. Use techniques to further subdivide the aggregate experience into the various mortality segments (e.g., start with aggregate non-smoker then use the conservation of total deaths principle, normalization or other approach to divide the aggregate mortality into super preferred, preferred and residual standard non-smoker class assumptions), or

Bottom Up Approach

b. Use techniques to adjust the experience of each mortality segment in the group to reflect the aggregate company experience for the group (e.g. by credibility weighting the individual mortality segment experience with the aggregate company experience for the group).

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Mortality Aggregation Examples

Disclaimer:

The examples presented are for illustrative purposes to demonstrate acceptable approaches. They are not intended to cover all complexities that may arise in practice. Additional variations and other methods may be appropriate. These examples are intended to illustrate general principles, not to be an exhaustive presentation of acceptable methods.

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Mortality Aggregation Example

Approach:
"Bottom Up"

Level of Aggregation:
All Segments

Identify Segments for Aggregation

(1)	(2)
Groups of Policies	**Segment Description**
Segment 1	MNS Ultra Preferred
Segment 2	MNS Super Preferred
Segment 3	MNS Preferred
Segment 4	MNS Standard
Segment 5	MSM Preferred
Segment 6	MSM Standard
Segment 7	FNS Ultra Preferred
Segment 8	FNS Super Preferred
Segment 9	FNS Preferred
Segment 10	FNS Standard
Segment 11	FSM Preferred
Segment 12	FSM Standard
Aggregate	All Segments Combined

Calculate Expected Claims and A/E Ratios

(1)	(3)	(4)	(5)	(6)
Groups of Policies	**Mortality Tables: 2015 VBT ALB**	**Expected Claim Amounts Using (3)**	**Actual Claim Amounts**	**A/E**
Segment 1	MNS RR 70	64	50	78.1%
Segment 2	MNS RR 80	343	300	87.5%
Segment 3	MNS RR 90	510	400	78.4%
Segment 4	MNS RR 110	617	500	81.0%
Segment 5	MSM RR 75	800	600	75.0%
Segment 6	MSM RR 125	833	700	84.0%
Segment 7	FNS RR 70	32	25	78.1%
Segment 8	FNS RR 80	226	200	88.5%
Segment 9	FNS RR 90	445	350	78.7%
Segment 10	FNS RR 110	545	450	82.6%
Segment 11	FSM RR 75	733	550	75.0%
Segment 12	FSM RR 125	756	650	86.0%
Aggregate		5904	4775	80.9%

Calculate Credibility and Credibility-Weighted (CW) A/E

(1)	(7)		(8)		(9)		(10)		(11)
Groups of Policies	Credibility	*	A/E	+	Credibility Complement	*	Aggregate A/E	=	CW A/E
Segment 1	15%	*	78.1%	+	85%	*	80.9%	=	80.5%
Segment 2	62%	*	87.5%	+	38%	*	80.9%	=	85.0%
Segment 3	78%	*	78.4%	+	22%	*	80.9%	=	79.0%
Segment 4	89%	*	81.0%	+	11%	*	80.9%	=	81.0%
Segment 5	95%	*	75.0%	+	5%	*	80.9%	=	75.3%
Segment 6	100%	*	84.0%	+	0%	*	80.9%	=	84.0%
Segment 7	5%	*	78.1%	+	95%	*	80.9%	=	80.7%
Segment 8	33%	*	88.5%	+	67%	*	80.9%	=	83.4%
Segment 9	66%	*	78.7%	+	34%	*	80.9%	=	79.4%
Segment 10	75%	*	82.6%	+	25%	*	80.9%	=	82.1%
Segment 11	92%	*	75.0%	+	8%	*	80.9%	=	75.5%
Segment 12	98%	*	86.0%	+	2%	*	80.9%	=	85.9%
Aggregate	100%								

Perform Calculations to Maintain Conservation of Deaths

(1)	(4)	(5)	(11)	(12) Col(4)*Col(11)	(13) Col(11)*NR	(14) Col(4)*Col(13)
Groups of Policies	**Expected Claim Amounts**	**Actual Claim Amounts**	**CW A/E**	**CW Expected Claim Amounts**	**Normalized CW A/E**	**Normalized Expected Claim Amounts**
Segment 1	64	50	80.5%	51	80.6%	52
Segment 2	343	300	85.0%	291	85.1%	292
Segment 3	510	400	79.0%	403	79.1%	404
Segment 4	617	500	81.0%	500	81.2%	501
Segment 5	800	600	75.3%	602	75.4%	603
Segment 6	833	700	84.0%	700	84.2%	701
Segment 7	32	25	80.7%	26	80.9%	26
Segment 8	226	200	83.4%	188	83.6%	189
Segment 9	445	350	79.4%	353	79.6%	354
Segment 10	545	450	82.1%	448	82.3%	449
Segment 11	733	550	75.5%	553	75.6%	554
Segment 12	756	650	85.9%	649	86.0%	650
Aggregate	5904	4775		**4766**		4775

Normalization Ratio (NR) = 4775 / 4766: 1.001905

Set the Assumption for Company Experience Mortality Rates

(1)	(3)	(13)	(15)
Groups of Policies	**Mortality Tables: 2015 VBT ALB**	**Normalized CW A/E**	**Company Experience Mortality Rates**
Segment 1	MNS RR 70	80.6%	80.6% of 2015 VBT MNS RR 70 ALB
Segment 2	MNS RR 80	85.1%	85.1% of 2015 VBT MNS RR 80 ALB
Segment 3	MNS RR 90	79.1%	79.1% of 2015 VBT MNS RR 90 ALB
Segment 4	MNS RR 110	81.2%	81.2% of 2015 VBT MNS RR 110 ALB
Segment 5	MSM RR 75	75.4%	75.4% of 2015 VBT MSM RR 75 ALB
Segment 6	MSM RR 125	84.2%	84.2% of 2015 VBT MSM RR 125 ALB
Segment 7	FNS RR 70	80.9%	80.9% of 2015 VBT FNS RR 70 ALB
Segment 8	FNS RR 80	83.6%	83.6% of 2015 VBT FNS RR 80 ALB
Segment 9	FNS RR 90	79.6%	79.6% of 2015 VBT FNS RR 90 ALB
Segment 10	FNS RR 110	82.3%	82.3% of 2015 VBT FNS RR 110 ALB
Segment 11	FSM RR 75	75.6%	75.6% of 2015 VBT FSM RR 75 ALB
Segment 12	FSM RR 125	86.0%	86.0% of 2015 VBT FSM RR 125 ALB

Applicable VM-20 Language

VM-20 Section 9.C.2.d

vi. If the company uses the aggregate company experience for a group of mortality segments when determining the company experience mortality rates for each of the individual mortality segments in the group, the company shall either:

Top Down Approach

a. Use techniques to further subdivide the aggregate experience into the various mortality segments (e.g., start with aggregate non-smoker then use the conservation of total deaths principle, normalization or other approach to divide the aggregate mortality into super preferred, preferred and residual standard non-smoker class assumptions), or

Bottom Up Approach

b. Use techniques to adjust the experience of each mortality segment in the group to reflect the aggregate company experience for the group (e.g. by credibility weighting the individual mortality segment experience with the aggregate company experience for the group).

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Mortality Aggregation Example

Approach:
"Top Down"

2 Levels of Aggregation:
Smoker Segments,
Non-Smoker Segments

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Identify Segments for Aggregation

(1)	(2)
Groups of Policies	**Segment Description**
Segment 1	MNS Ultra Preferred
Segment 2	MNS Super Preferred
Segment 3	MNS Preferred
Segment 4	MNS Standard
Segment 5	MSM Preferred
Segment 6	MSM Standard
Segment 7	FNS Ultra Preferred
Segment 8	FNS Super Preferred
Segment 9	FNS Preferred
Segment 10	FNS Standard
Segment 11	FSM Preferred
Segment 12	FSM Standard
Aggregate NS	All Non-Smoker Segments Combined
Aggregate SM	All Smoker Segments Combined

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Calculate Relativity Structure (here based on RR Tool output)

(1)	(3)	(4)	(5)	(6)
Groups of Policies	**Mortality Tables: 2015 VBT ALB**	**Expected Claim Amounts Using (3)**	**Actual Claim Amounts**	**A/E**
Segment 1	MNS RR 70	200	187	93.5%
Segment 2	MNS RR 80	484	495	102.3%
Segment 3	MNS RR 90	533	520	97.6%
Segment 4	MNS RR 110	582	563	96.7%
Segment 5	MSM RR 100	525	545	103.8%
Segment 6	MSM RR 125	833	850	102.0%
Segment 7	FNS RR 70	175	182	104.0%
Segment 8	FNS RR 80	335	320	95.5%
Segment 9	FNS RR 90	425	384	90.4%
Segment 10	FNS RR 110	542	531	98.0%
Segment 11	FSM RR 100	490	500	102.0%
Segment 12	FSM RR 150	725	745	102.8%
Aggregate NS		3276	3182	97.1%
Aggregate SM		2573	2640	102.6%
		Aggregate Non-Smoker Credibility:	100%	
		Aggregate Smoker Credibility:	85%	

Set the Assumption for the Company Experience Mortality Rates

(1)	(3)	(7)	(8)	(9)
Groups of Policies	**Mortality Tables: 2015 VBT ALB**	**Aggregation Level**	**Aggregate A/E**	**Company Experience Mortality Rates**
Segment 1	MNS RR 70	Non-Smoker	97.1%	97.1% of 2015 VBT MNS RR 70 ALB
Segment 2	MNS RR 80	Non-Smoker	97.1%	97.1% of 2015 VBT MNS RR 80 ALB
Segment 3	MNS RR 90	Non-Smoker	97.1%	97.1% of 2015 VBT MNS RR 90 ALB
Segment 4	MNS RR 110	Non-Smoker	97.1%	97.1% of 2015 VBT MNS RR 110 ALB
Segment 5	MSM RR 100	Smoker	102.6%	102.6% of 2015 VBT MSM RR 100 ALB
Segment 6	MSM RR 125	Smoker	102.6%	102.6% of 2015 VBT MSM RR 125 ALB
Segment 7	FNS RR 70	Non-Smoker	97.1%	97.1% of 2015 VBT FNS RR 70 ALB
Segment 8	FNS RR 80	Non-Smoker	97.1%	97.1% of 2015 VBT FNS RR 80 ALB
Segment 9	FNS RR 90	Non-Smoker	97.1%	97.1% of 2015 VBT FNS RR 90 ALB
Segment 10	FNS RR 110	Non-Smoker	97.1%	97.1% of 2015 VBT FNS RR 110 ALB
Segment 11	FSM RR 100	Smoker	102.6%	102.6% of 2015 VBT FSM RR 100 ALB
Segment 12	FSM RR 150	Smoker	102.6%	102.6% of 2015 VBT FSM RR 150 ALB

Comparison of Approaches

	"Top Down" Example	"Bottom Up" Example
Methodology	Uses relativities to subdivide the aggregate experience into mortality segments.	Uses credibility weighting to adjust the experience of each mortality segment to reflect the aggregate experience.
Source of experience data	Uses a company experience study A/E for the aggregate class(es), along with pre-defined expected relativities between mortality segments determined from a reliable and applicable external source.	Uses company experience study A/E and credibility results for all individual mortality segments and for the aggregate class.

Comparison of Approaches

	"Top Down" Example	"Bottom Up" Example
Updates based on new experience studies	The aggregate class A/E ratios(s) and aggregate credibility must be updated based on each new company experience study. The relativities would not change unless the external source (e.g. RR Tool, reinsurer) indicates that relationships between segments have changed or the external source data is no longer representative of the company experience.	The aggregate class and individual mortality segment credibilities and A/E ratios must be updated based on each new company experience study.

Comparison of Approaches

	"Top Down" Example	"Bottom Up" Example
Conservation of deaths	Conservation of deaths is maintained using the normalization process, such that the total amount of expected claims is not less than the aggregate.	
Prudent estimate assumptions	Anticipated experience assumptions are likely to be different by approach, but prescribed margins would be the same if the same level of aggregation is used to determine credibility.	

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Mortality Aggregation Examples

Other examples have been developed.
See Excel spreadsheet.

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Next Steps

Consider exposing examples for public comment

Review comments and revise accordingly

Post examples to the Industry Tab on the NAIC website