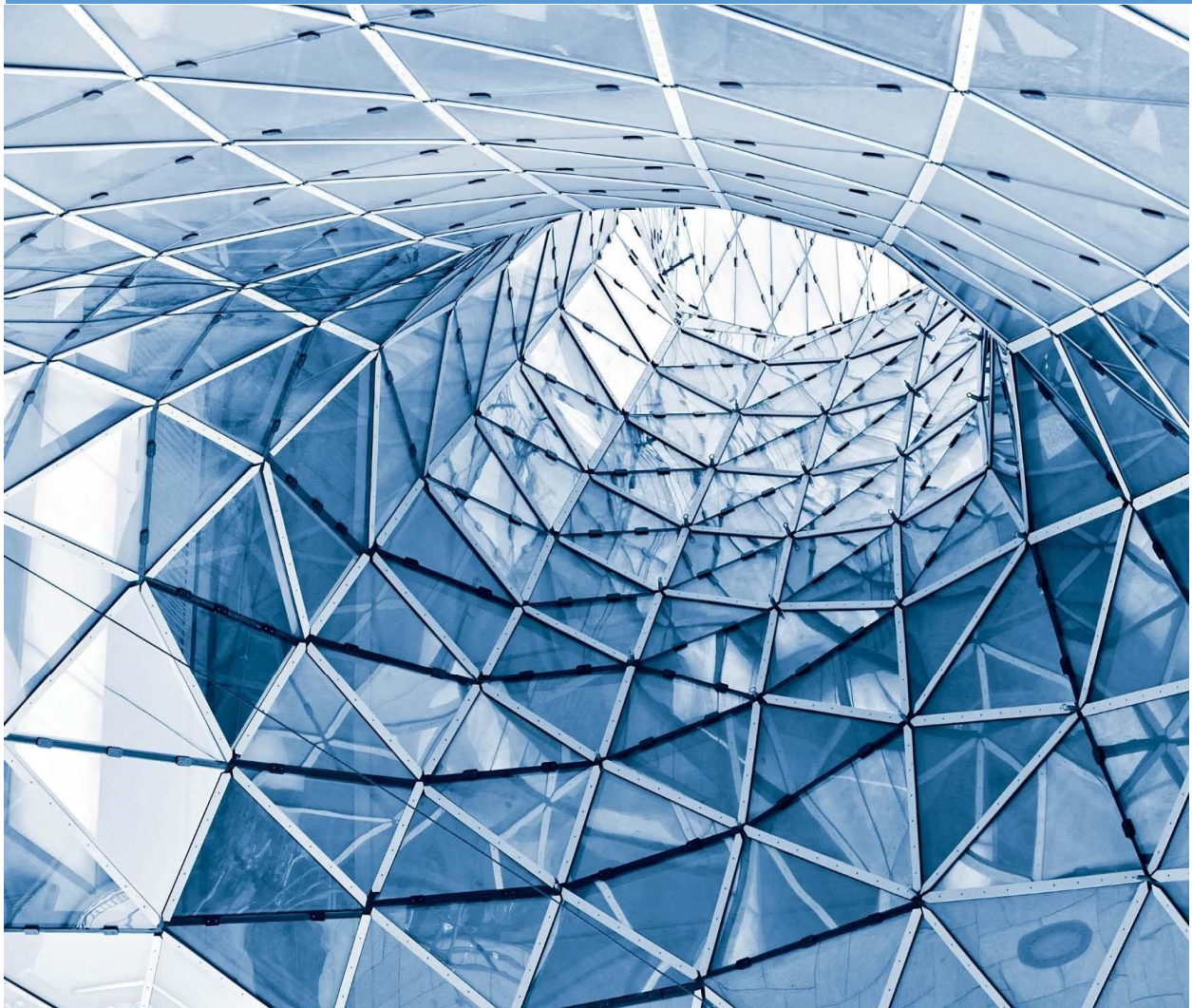




SOCIETY OF
ACTUARIES



Younger Issue Age Mortality Analysis



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Younger Issue Age Mortality Analysis

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Background

The Society of Actuaries (SOA) and MIB have partnered to create a series of micro studies that utilizes data collected by MIB as the Statistical Agent for the States of New York and Kansas. This report is the third in this series and analyzes younger issue age mortality. Prior studies on preferred mortality and older age mortality can be found on the SOA website.

In virtually all insurance mortality table development, development of mortality rates at the youngest issue ages has required some shortcuts because of the small amount of data, and especially death claims, available at those ages. This analysis is being done to determine how recent experience, from the statistical agent data collected by MIB, is emerging relative to the 2015 VBT.

In this study, the 2015 VBT has been used as the expected basis of mortality. For issue ages under 18, the tables used are the gender-distinct Unismoke tables (table numbers 3273 to 3276 on the Mortality Database of the SOA, <http://mort.soa.org>).

For issue ages 18+, the tables used are the smoker-distinct and gender-distinct tables (table numbers 3265 to 3272 on the Mortality Database of the SOA, <http://mort.soa.org>), when the smoking status is shown as non-smoker or smoker. Unismoke rates are used when the smoking status has not been provided. ANB or ALB versions of the tables are used based on the method which each contributing company uses to calculate issue age in its data.

MIB has created a database as identified under Data Base Elements in Appendix A. Since this database includes Company Code, it remains internal to MIB. In order to protect company confidentiality, a second database, without company code and preferred class information, has been developed and published along with this report.

The Excel file published with this report provides pivot tables which access the database. These pivot tables can be filtered to provide alternate breakdowns and information of interest to the individual user.

Global information

This study is based on experience during study years 2009 through 2013. Eighty-eight (88) companies contributed to the data. A total of 491,383 death claims is included in the study which has a total exposure of 78,271,600 policy years producing an average mortality rate of 6.278/1,000. The total death claim amount for the period is 4,201,932,984. With a total exposure amount of over 3.1 trillion, this produces an average mortality rate of 1.343/1,000. The database covers the span of issue ages 0 through 24, durations 1 through 25 and 26+, and can be split by insurance plan and policy size.

Table 1

Death claims, exposure and mortality rates by issue age group						
Issue age group	# of death claims	Exposure in policy years	Mortality rate per 1,000	Death claim amount (\$M)	Exposure in amount years (\$M)	Mortality rate per 1,000
0	23,405	14,701,704	1.592	184	406,005	0.453
1-9	40,231	21,849,380	1.841	417	810,735	0.514
10-14	55,508	8,663,824	6.407	407	305,898	1.331
15-17	67,842	6,873,090	9.871	495	213,225	2.320
0-17	186,986	52,087,998	3.590	1,503	1,735,862	0.866
18-21	168,371	13,998,808	12.028	1,246	513,785	2.426
22-24	136,026	12,184,794	11.164	1,453	879,759	1.652
18-24	304,397	26,183,602	11.625	2,699	1,393,543	1.937
Total	491,383	78,271,600	6.278	4,202	3,129,405	1.343

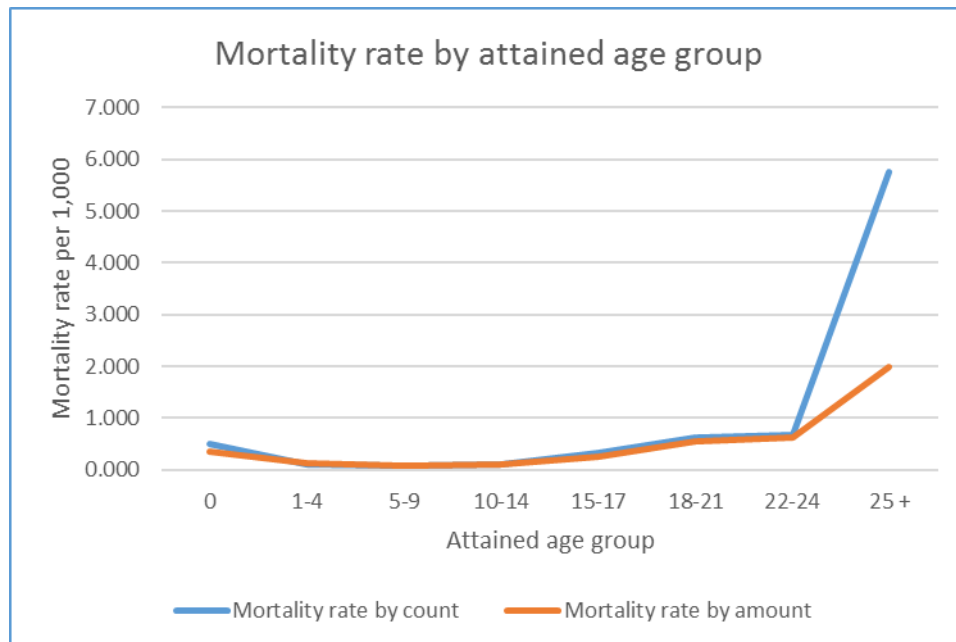
When we look at the 0-17 issue age group, the study includes 186,986 death claims, has an exposure of 52,087,998 policy years producing an average mortality rate of 3.590/1,000. The total death claim amount for this issue age group is 1,502,504,013. With a total exposure amount of over 1.7 trillion, this produces an average mortality rate of 0.866/1,000.

An analysis by attained age group was performed using the data for issue ages 0-17 only. The following table provides the basic information for this analysis. The mortality rates per 1,000 are shown in the graph below. As can be seen, the mortality rates for attained ages 0-24 are well in line with any regular mortality table. For attained ages 25+, the average mortality rate per 1,000 increases to 5.75 when expressed by count and 1.99 when expressed by amount.

Table 2

Death claims, exposure and mortality rates by attained age group (issue ages 0-17)						
Attained age group	# of death claims	Exposure in policy years	Mortality rate per 1,000	Death claim amount (\$M)	Exposure in amount years (\$M)	Mortality rate per 1,000
0	134	271,194	0.494	6	18,121	0.355
1-4	230	1,930,187	0.119	17	132,014	0.132
5-9	250	3,369,495	0.074	16	210,095	0.074
10-14	510	4,341,589	0.117	23	239,702	0.096
15-17	1,017	3,151,514	0.323	42	166,429	0.253
18-21	2,770	4,459,142	0.621	121	223,962	0.542
22-24	2,247	3,280,924	0.685	98	153,120	0.638
25 +	179,828	31,283,952	5.748	1,179	592,421	1.990
Total	186,986	52,087,998	3.590	1,503	1,735,862	0.866

Graph 1



Gender

1. Again considering issue ages 0-17 only, exposure by count is 44% female and 56% male while exposure by amount is 47.5% female and 52.5% male. Males are more predominant in the higher issue age groups.

Table 3

Exposure by gender										
Issue age group	Exposure in policy years			By count (%)		Exposure in amount years			By amount (%)	
	Female	Male	Total	Female	Male	Female	Male	Total	Female	Male
0	6,663,471	8,038,233	14,701,704	45.3%	54.7%	197,552	208,453	406,005	48.7%	51.3%
1-9	9,908,686	11,940,694	21,849,380	45.3%	54.7%	391,894	418,841	810,735	48.3%	51.7%
10-14	3,666,603	4,997,221	8,663,824	42.3%	57.7%	142,180	163,718	305,898	46.5%	53.5%
15-17	2,689,782	4,183,308	6,873,090	39.1%	60.9%	93,688	119,537	213,225	43.9%	56.1%
Total	22,928,541	29,159,456	52,087,998	44.0%	56.0%	825,313	910,549	1,735,862	47.5%	52.5%

2. The A/E ratio by count is 93.9%, higher for females than for males while the A/E ratio by amount is 104.7%, lower for females than for males. For the issue age group 1-9, the A/E ratio by count for males is 73.6% much lower than the A/E ratio of 105.2% by amount. This is caused by a face amount distribution issue.

Table 4

A/E ratios by gender with 2015 VBT								
Issue age group	# of death claims		By count			By amount		
	Female	Male	Female	Male	Total	Female	Male	Total
0	7,380	16,025	102.0%	112.4%	108.9%	103.9%	105.9%	105.3%
1-9	11,754	28,477	97.6%	73.6%	79.3%	94.9%	105.2%	102.2%
10-14	13,338	42,170	98.0%	92.4%	93.7%	97.0%	104.8%	102.9%
15-17	15,574	52,268	100.1%	100.2%	100.2%	101.9%	110.2%	108.4%
Total	48,046	138,940	99.2%	92.2%	93.9%	98.6%	106.8%	104.7%

Company data

As previously mentioned, MIB has created a database as identified under Data Base Elements in Appendix A. Since this database includes Company Code, it remains internal to MIB. MIB has screened the data by company and has come up with the following interesting conclusions.

88 companies contributed to the data. The largest 5 companies account for 65% of the death claims while the largest 10 companies account for 81% of the death claims. When analyzing the data for issue ages 0-17, only 86 companies contributed some exposure to the database.

Companies have been split by quartile. The split is being done using the A/E ratio by amount. This method is similar to what is usually done to create company splits. The quartiles are split by 22 companies/22 companies/21 companies/21 companies. Quartile 1 is the 22 companies with the lowest A/E ratio by amount, Quartile 4 is the 21 companies with the highest A/E ratio by amount. The largest % of any single company is in quartile one for policies exposed, where one company has 40.2%. The largest % for amount exposed is 39.2% and is in quartile two.

Table 5

Death claims and A/E ratios by quartile with 2015 VBT															
Issue age group	Quartile 1			Quartile 2			Quartile 3			Quartile 4			TOTAL		
	# of death claims	A/E ratio by count	A/E ratio by amount	# of death claims	A/E ratio by count	A/E ratio by amount	# of death claims	A/E ratio by count	A/E ratio by amount	# of death claims	A/E ratio by count	A/E ratio by amount	# of death claims	A/E ratio by count	A/E ratio by amount
0	504	93.3%	66.6%	7,957	101.1%	94.7%	11,112	105.5%	112.4%	3,832	150.7%	145.7%	23,405	108.9%	105.3%
1-9	1,721	85.7%	72.1%	15,144	54.3%	92.3%	17,512	104.4%	112.7%	5,854	143.5%	134.8%	40,231	79.3%	102.2%
10-14	2,132	89.1%	60.5%	23,958	81.6%	94.2%	24,136	102.3%	112.5%	5,282	136.1%	147.9%	55,508	93.7%	102.9%
15-17	2,325	95.4%	75.2%	28,044	90.6%	97.5%	30,930	105.6%	116.0%	6,543	129.4%	161.6%	67,842	100.2%	108.4%
Total	6,682	90.6%	69.1%	75,103	78.2%	94.8%	83,690	104.4%	113.7%	21,511	138.3%	147.4%	186,986	93.9%	104.7%

Issue age

The database shows that there is a large exposure at issue age 0 representing more than 28% of exposure by count and more than 23% of exposure by amount.

The A/E ratios are expressed using the 2015 VBT as the expected basis. In this study, the VBT tables being used are the gender-distinct Unismoke tables (table numbers 3273 to 3276 on the Mortality Database of the SOA, <http://mort.soa.org>).

The following table presents the A/E ratios by issue age group. Globally, the ratios are higher and less volatile by amount than by count.

Table 6

DATA BY ISSUE AGE GROUP	DATA BY COUNT				DATA BY AMOUNT			
	NUMBER OF DEATH CLAIMS	EXPOSURE IN POLICY YEARS	EXPECTED NUMBER OF DEATH CLAIMS	A/E RATIO BY COUNT	DEATH CLAIM AMOUNT	EXPOSURE IN AMOUNT YEARS	EXPECTED DEATH CLAIM AMOUNT	A/E RATIO BY AMOUNT
0	23,405	14,701,704	21,491	108.9%	184,031,217	406,004,822,585	174,760,668	105.3%
1-9	40,231	21,849,380	50,720	79.3%	416,621,895	810,734,534,523	407,416,941	102.3%
10-14	55,508	8,663,824	59,251	93.7%	407,240,002	305,897,789,626	395,884,203	102.9%
15-17	67,842	6,873,090	67,726	100.2%	494,610,899	213,225,002,003	456,200,962	108.4%
Total	186,986	52,087,998	199,187	93.9%	1,502,504,013	1,735,862,148,737	1,434,262,774	104.8%

Duration

When looking at death claims by duration for issue ages 0-17, the number of death claims at duration 26+ represents about 93% of all the death claims reported. Let's first look at the data by count. The following table identifies the data for certain issue age groups by duration.

Table 7

DATA BY COUNT																											
Number of death claims by duration																											
Issue age group	Duration																										TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	
0	134	41	29	31	16	21	23	18	26	11	20	24	28	43	72	81	93	138	170	195	226	279	197	220	198	21,071	23,405
1-9	77	45	35	35	42	36	37	61	78	89	115	148	149	197	209	273	293	313	341	372	431	381	408	432	471	35,163	40,231
10-14	17	33	27	32	43	78	83	91	109	119	104	114	118	115	131	117	123	151	149	191	174	212	218	218	239	52,502	55,508
15-17	52	62	68	72	66	65	65	74	85	83	97	99	79	87	100	86	90	117	105	115	148	175	184	212	209	65,247	67,842
0-17	280	181	159	170	167	200	208	244	298	302	336	385	374	442	512	557	599	719	765	873	979	1,047	1,007	1,082	1,117	173,983	186,986

Exposure in policy years (K)																											
Number of death claims by duration																											
Issue age group	Duration																										TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	
0	271	253	240	233	230	233	236	243	254	264	273	283	292	301	313	325	339	349	355	361	364	355	340	321	301	7,374	14,702
1-9	701	598	531	487	457	440	427	426	439	444	444	451	454	457	465	477	497	511	522	534	546	543	534	521	521	9,417	21,849
10-14	249	206	181	165	156	151	147	147	151	154	154	155	156	155	155	159	168	176	183	189	195	195	195	198	204	4,320	8,664
15-17	162	137	121	111	105	103	105	108	111	113	112	109	105	101	99	99	102	106	111	115	121	125	131	137	143	3,983	6,873
0-17	1,384	1,193	1,072	996	948	927	914	924	956	975	983	998	1,006	1,013	1,032	1,061	1,106	1,142	1,172	1,199	1,226	1,218	1,200	1,184	1,168	25,093	52,088

Expected death claims by duration																											
Number of death claims by duration																											
Issue age group	Duration																										TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	
0	61	33	24	20	18	19	18	18	19	20	21	24	27	34	54	84	121	158	184	202	209	210	205	199	189	19,320	21,491
1-9	65	50	42	38	37	35	43	52	67	84	104	127	151	179	210	241	273	295	310	322	333	335	334	334	338	46,324	50,720
10-14	26	28	34	42	53	63	71	78	86	90	92	95	96	96	96	98	104	111	119	130	143	154	168	187	210	56,784	59,251
15-17	57	60	61	61	61	61	64	67	69	70	69	67	64	63	64	67	74	84	95	109	125	141	160	181	201	65,530	67,726
0-17	208	171	161	162	168	178	195	215	241	264	287	312	338	372	423	491	571	647	709	761	810	839	867	900	937	187,959	199,187

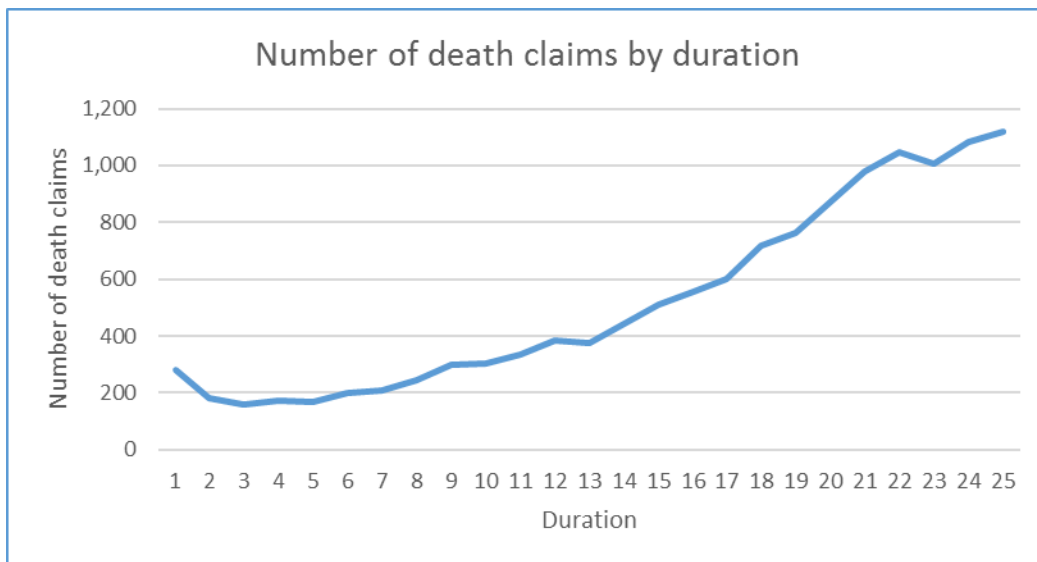
A/E ratio by duration																											
Number of death claims by duration																											
Issue age group	Duration																										TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	
0	221%	124%	122%	156%	89%	113%	127%	99%	136%	55%	93%	101%	103%	125%	134%	96%	77%	87%	92%	97%	108%	133%	96%	110%	105%	109%	109%
1-9	119%	91%	83%	92%	113%	103%	87%	118%	117%	106%	111%	117%	98%	110%	100%	113%	107%	106%	110%	116%	129%	114%	122%	129%	140%	76%	79%
10-14	67%	119%	80%	76%	82%	124%	117%	116%	127%	132%	112%	120%	123%	120%	137%	119%	119%	136%	125%	147%	122%	138%	130%	117%	114%	92%	94%
15-17	91%	103%	111%	117%	109%	106%	102%	111%	123%	118%	140%	148%	123%	139%	156%	128%	121%	140%	111%	106%	119%	124%	115%	117%	104%	100%	100%
0-17	134%	106%	99%	105%	99%	113%	106%	113%	124%	114%	117%	123%	111%	119%	121%	113%	105%	111%	108%	115%	121%	125%	116%	120%	119%	93%	94%

A total of 186,986 death claims is included in the database for the present analysis.

At duration 1, the A/E ratios are high for issue age 0 and issue age group 1-9. The A/E ratios then decrease to 67% and 91% for the older issue age groups. Almost all global A/E ratios are over 100%. At younger ages, and especially at age 0, more analysis will be performed and included in the Select period section.

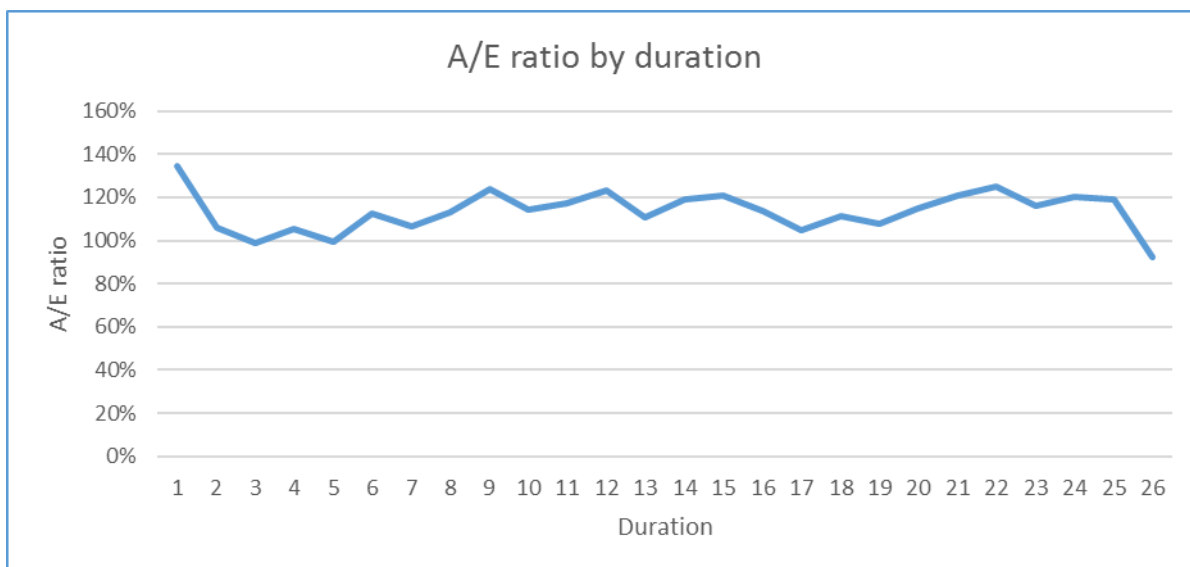
The graph below shows the number of death claims by duration for the first 25 durations. There is a larger number of death claims at duration 1, followed by a decrease for 4 to 5 years and then a steady increase up to the ultimate durations.

Graph 2



The next graph shows the A/E ratios by duration. Globally, the A/E ratios remain relatively flat by duration, implying that, globally, there does not seem to be any effect of anti-selection at these younger ages.

Graph 3



Let's now look at the data by amount. The following table identifies the data for certain issue age groups by duration.

Table 8

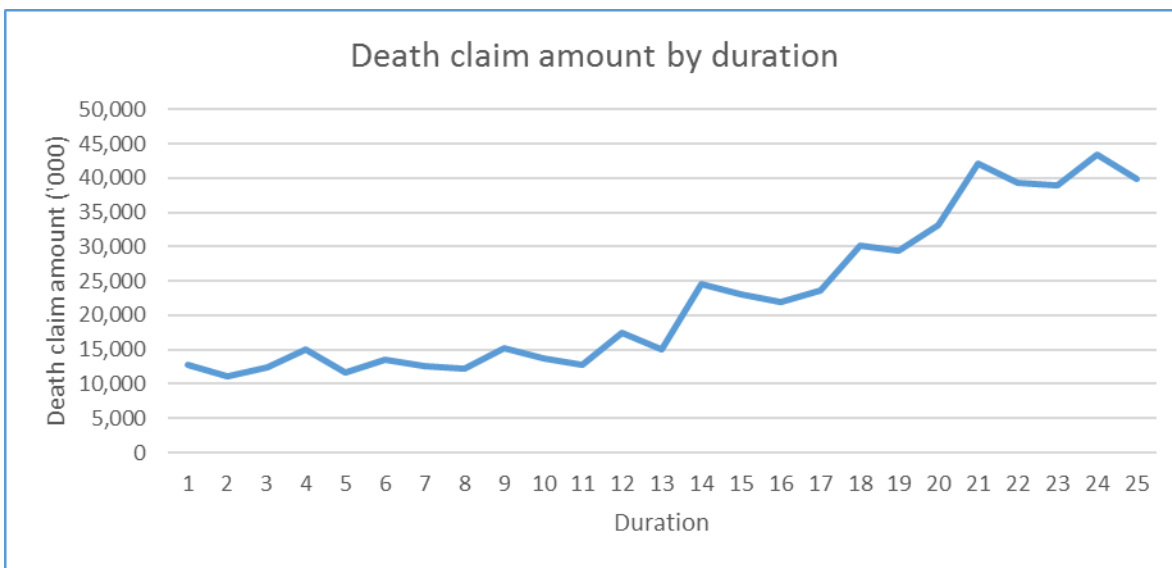
DATA BY AMOUNT																											
Death claim amount by duration ('K)																											
Issue age group	Duration																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	TOTAL
0	6,433	3,632	4,376	1,518	1,629	996	1,208	616	1,495	311	585	708	666	2,931	1,818	2,525	3,243	4,791	6,424	6,659	8,736	8,929	7,871	6,771	5,284	93,876	184,031
1-9	3,560	2,719	2,179	2,360	3,871	3,089	2,127	2,946	3,182	3,928	3,692	6,586	5,925	8,606	8,577	11,059	10,785	13,779	14,682	15,139	20,205	15,681	15,809	16,260	17,756	202,121	416,622
10-14	605	2,389	1,428	1,963	2,282	4,943	5,574	4,150	4,250	6,050	4,081	6,067	5,118	6,572	7,035	5,439	5,474	5,934	5,048	7,844	7,642	8,401	7,948	8,565	8,652	273,785	407,240
15-17	2,287	2,418	4,354	9,206	3,878	4,500	3,653	4,517	6,321	3,408	4,366	4,035	3,243	6,416	5,587	2,906	4,098	5,654	3,311	3,517	6,304	7,235	11,894	8,221	367,711	494,611	
0-17	12,885	11,158	12,337	15,048	11,660	13,528	12,562	12,228	15,248	13,698	12,723	17,396	14,953	24,525	23,018	21,928	23,599	30,157	29,465	33,159	42,157	39,314	38,863	43,490	39,913	937,493	1,502,504
Exposure in amount years ('M)																											
Issue age group	Duration																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	TOTAL
0	18,121	16,452	15,112	14,247	13,685	13,297	12,830	12,438	12,380	12,394	12,282	12,363	12,535	12,696	12,361	13,541	14,122	14,441	14,755	14,741	14,811	13,899	12,938	11,716	10,352	66,794	406,005
1-9	51,825	44,724	39,006	34,880	31,522	29,061	26,951	25,242	24,449	23,951	23,117	22,896	22,616	22,391	22,383	22,767	23,536	24,173	24,526	24,918	24,874	24,310	23,650	22,920	22,089	127,957	810,735
10-14	17,733	15,249	13,426	12,269	11,291	10,568	9,865	9,272	8,995	8,891	8,734	8,771	8,703	8,560	8,385	8,385	8,574	8,705	8,748	8,800	8,751	8,502	8,472	8,527	8,667	59,052	305,898
15-17	11,647	10,240	9,174	8,504	7,920	7,516	7,159	6,847	6,650	6,561	6,312	6,070	5,759	5,383	5,103	4,962	4,899	4,915	4,967	5,009	5,153	5,241	5,434	5,714	5,921	50,167	213,225
0-17	99,325	86,665	76,718	69,899	64,418	60,442	56,805	53,799	52,474	51,797	50,446	50,101	49,614	49,030	48,931	49,655	51,130	52,235	52,996	53,469	53,588	51,953	50,494	48,878	47,029	303,971	1,735,862
Expected death claim amount by duration ('K)																											
Issue age group	Duration																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	TOTAL
0	4,201	2,206	1,524	1,212	1,061	1,064	990	933	928	929	961	1,029	1,149	1,419	2,179	3,441	4,970	6,474	7,621	8,212	8,488	8,162	7,777	7,230	6,477	84,123	174,761
1-9	4,848	3,733	3,081	2,727	2,549	2,291	2,668	3,035	3,669	4,502	5,371	6,425	7,535	8,770	10,081	11,485	12,888	13,915	14,537	14,994	15,150	14,971	14,762	14,541	14,325	194,565	407,417
10-14	1,755	1,979	2,420	3,073	3,763	4,408	4,790	4,977	5,135	5,249	5,256	5,383	5,402	5,349	5,212	5,202	5,350	5,536	5,743	6,078	6,426	6,721	7,270	8,006	8,908	266,491	395,884
15-17	4,008	4,436	4,635	4,685	4,574	4,488	4,388	4,268	4,170	4,112	3,930	3,751	3,558	3,380	3,317	3,389	3,596	3,904	4,286	4,750	5,344	5,942	6,681	7,571	8,414	340,623	456,201
0-17	14,811	12,355	11,659	11,698	11,947	12,251	12,836	13,213	13,903	14,792	15,518	16,589	17,644	18,918	20,789	23,516	26,804	29,829	32,186	34,034	35,407	35,795	36,490	37,349	38,124	885,803	1,434,263
A/E ratio by duration																											
Issue age group	Duration																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+	TOTAL
0	153%	165%	287%	125%	153%	94%	122%	66%	161%	34%	61%	69%	58%	207%	83%	73%	65%	74%	84%	81%	103%	109%	101%	94%	82%	112%	105%
1-9	73%	73%	71%	87%	152%	135%	80%	97%	87%	87%	69%	102%	79%	98%	85%	96%	84%	99%	101%	101%	133%	105%	107%	112%	124%	104%	102%
10-14	34%	121%	59%	64%	61%	112%	116%	83%	83%	115%	78%	113%	95%	123%	135%	105%	102%	107%	88%	129%	119%	125%	109%	107%	97%	103%	103%
15-17	57%	55%	94%	196%	85%	100%	83%	106%	152%	83%	111%	108%	91%	190%	168%	86%	114%	145%	77%	74%	104%	106%	108%	157%	98%	108%	108%
0-17	87%	90%	106%	129%	98%	110%	98%	93%	110%	93%	82%	105%	85%	130%	111%	93%	88%	101%	92%	97%	119%	110%	107%	116%	105%	106%	105%

More than \$1.5B of death claim amount is included in the database for the present analysis. At age 0, there is a large number of death claim amount in the early durations, then a decrease up to duration 10 and then a regular increase for the rest of the durations.

At duration 1, the A/E ratio is over 100% only for issue age 0. Globally the A/E ratios fluctuate between 80%-120% producing an A/E ratio of 105% for all durations.

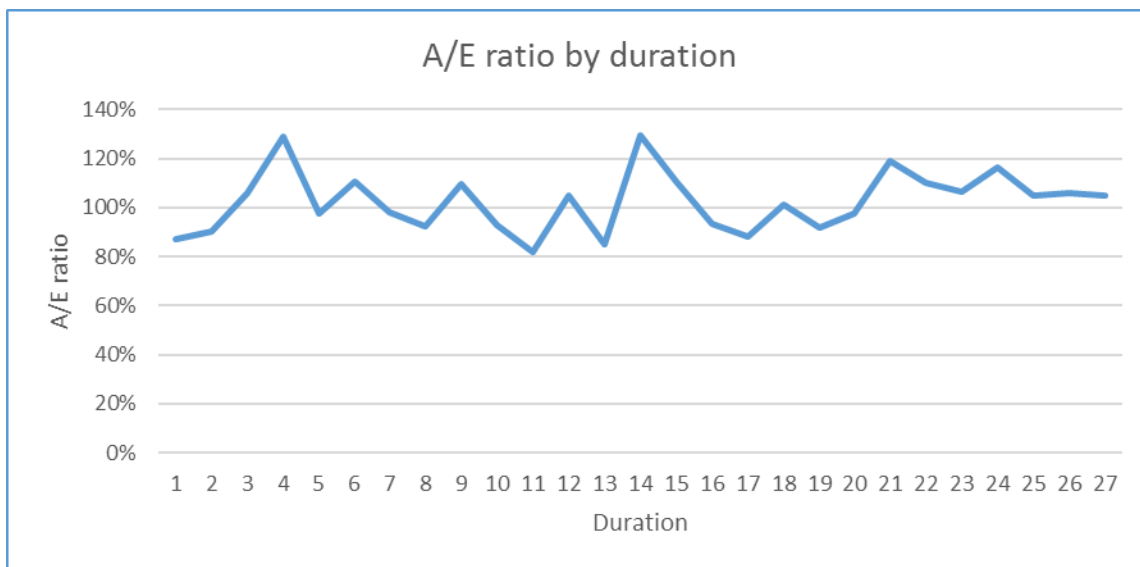
The graph below shows the death claim amounts by duration for the first 25 durations. They are relatively level by duration for the first 10 years and then increase steadily for the rest of the durations.

Graph 4



The next graph shows the A/E ratios by duration. The A/E ratios fluctuate around the 100% and remain relatively flat by duration.

Graph 5



Select period

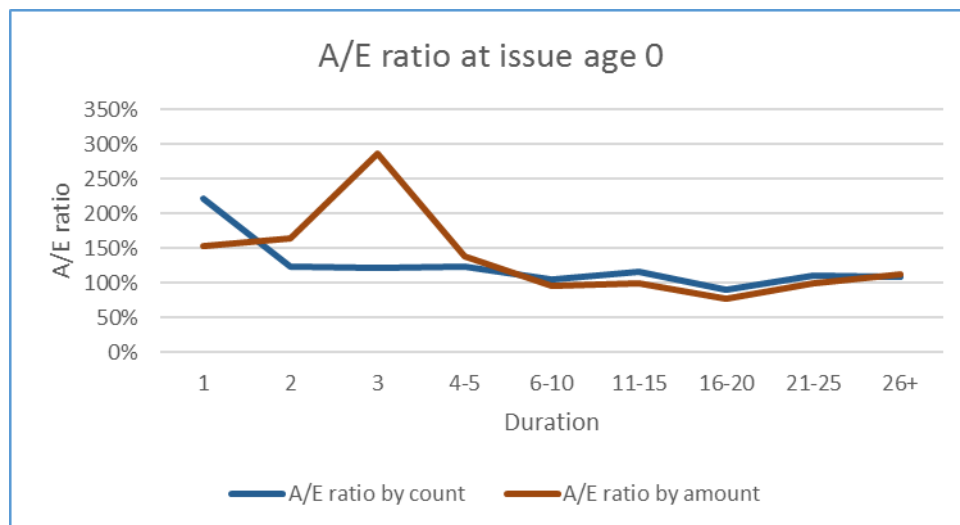
In virtually all prior work, insurance mortality tables at the younger ages have been created on an aggregate, or attained ages, basis. With the Stat Agent data, an analysis of A/E ratios by duration for issue ages 0 to 17 globally has concluded that there does not seem to be any effect of anti-selection at these younger ages, except possibly at issue age 0.

The following table and graph provide the results for issue age 0. The A/E ratios by duration reveal that there might be anti-selection at this issue age as the number of death claims, death claim amounts and A/E ratios tend to decline generally, at least for the first 10 durations. Because the number of death claims in some cells is not very high, some duration A/E ratios may not be credible. Because of that, this conclusion must be taken with great care.

Table 9

ISSUE AGE 0 - A/E ratio with 2015 VBT								
Duration	# of death claims	Death claim amount	Exposure in policy years	Exposure in amount years	Expected # of death claims	Expected death claim amount	A/E ratio by count	A/E ratio by amount
1	134	6,432,753	271,194	18,120,618,054	61	4,200,840	221%	153%
2	41	3,631,917	252,512	16,451,739,846	33	2,206,256	124%	165%
3	29	4,376,433	240,173	15,112,452,252	24	1,523,610	122%	287%
4-5	47	3,147,497	462,367	27,932,057,458	38	2,273,719	124%	138%
6-10	99	4,625,699	1,230,229	63,339,713,591	94	4,844,955	106%	95%
11-15	187	6,708,947	1,461,254	62,938,204,545	160	6,737,214	117%	100%
16-20	677	23,642,186	1,729,214	71,600,122,793	749	30,717,727	90%	77%
21-25	1,120	37,589,957	1,680,752	63,716,214,446	1,012	38,133,213	111%	99%
26+	21,071	93,875,828	7,374,009	66,793,699,600	19,320	84,123,135	109%	112%
TOTAL	23,405	184,031,217	14,701,704	406,004,822,585	21,491	174,760,668	109%	105%

Graph 6



Attained age

As already said, in virtually all prior work, insurance mortality tables at the younger issue ages have been created on an aggregate, or attained ages, basis. With the Stat Agent data, an analysis by attained age is possible and such analysis may be used to determine how recent experience is emerging relative to the 2015 VBT.

For this analysis, the data for issue ages 0-17 only and all durations are being used. Table 10 on the next page shows the results of this analysis by count while Table 11 on the following page indicates the results by amount.

Table 10

Data by duration group and attained age group - NUMBER OF DEATH CLAIMS													
Duration	Attained age												TOTAL
	0	1-4	5-9	10-14	15-17	18-19	20-24	25-29	30-39	40-49	50-59	60+	
1	134	58	19	17	52								280
2		70	14	21	51	25							181
3		44	12	22	32	49							159
4-5		58	44	36	45	83	71						337
6-10			161	124	171	219	485	92					1,252
11-15				290	239	206	596	615	103				2,049
16-20					427	646	896	716	828				3,513
21-25							1,741	1,080	2,182	229			5,232
26+								1,435	5,258	12,835	24,637	129,818	173,983
TOTAL	134	230	250	510	1,017	1,228	3,789	3,938	8,371	13,064	24,637	129,818	186,986

Data by duration group and attained age group - A/E RATIO BY COUNT													
Duration	Attained age												TOTAL
	0	1-4	5-9	10-14	15-17	18-19	20-24	25-29	30-39	40-49	50-59	60+	
1	221.0%	141.1%	80.5%	66.5%	90.6%								134.4%
2		119.8%	67.2%	96.6%	113.0%	101.1%							105.9%
3		111.3%	60.5%	111.9%	88.8%	107.0%							98.8%
4-5		125.4%	99.0%	97.6%	69.3%	114.9%	109.2%						102.2%
6-10			108.4%	110.9%	101.1%	134.4%	113.0%	122.7%					114.2%
11-15				114.7%	91.8%	99.3%	119.6%	138.1%	151.8%				118.3%
16-20					88.2%	95.1%	115.1%	127.1%	122.9%				110.5%
21-25							112.1%	129.7%	124.2%	108.9%			120.2%
26+								120.2%	108.7%	119.0%	133.3%	85.0%	92.6%
TOTAL	221.0%	124.1%	97.2%	108.9%	91.0%	103.0%	114.0%	126.6%	114.1%	118.8%	133.3%	85.0%	93.9%

Data by duration group and attained age group - MORTALITY RATE/1,000													
Duration	Attained age												TOTAL
	0	1-4	5-9	10-14	15-17	18-19	20-24	25-29	30-39	40-49	50-59	60+	
1	0.494	0.147	0.062	0.068	0.321								0.202
2		0.131	0.052	0.099	0.401	0.521							0.152
3		0.102	0.047	0.114	0.306	0.574							0.148
4-5		0.102	0.076	0.100	0.238	0.620	0.631						0.173
6-10			0.082	0.112	0.348	0.717	0.680	0.763					0.267
11-15				0.131	0.311	0.532	0.717	0.851	0.990				0.407
16-20					0.326	0.513	0.689	0.781	0.928				0.619
21-25							0.680	0.800	1.126	1.565			0.873
26+								0.744	1.027	2.095	4.288	21.023	6.933
TOTAL	0.494	0.119	0.074	0.117	0.323	0.553	0.686	0.782	1.040	2.083	4.288	21.023	3.590

Table 11

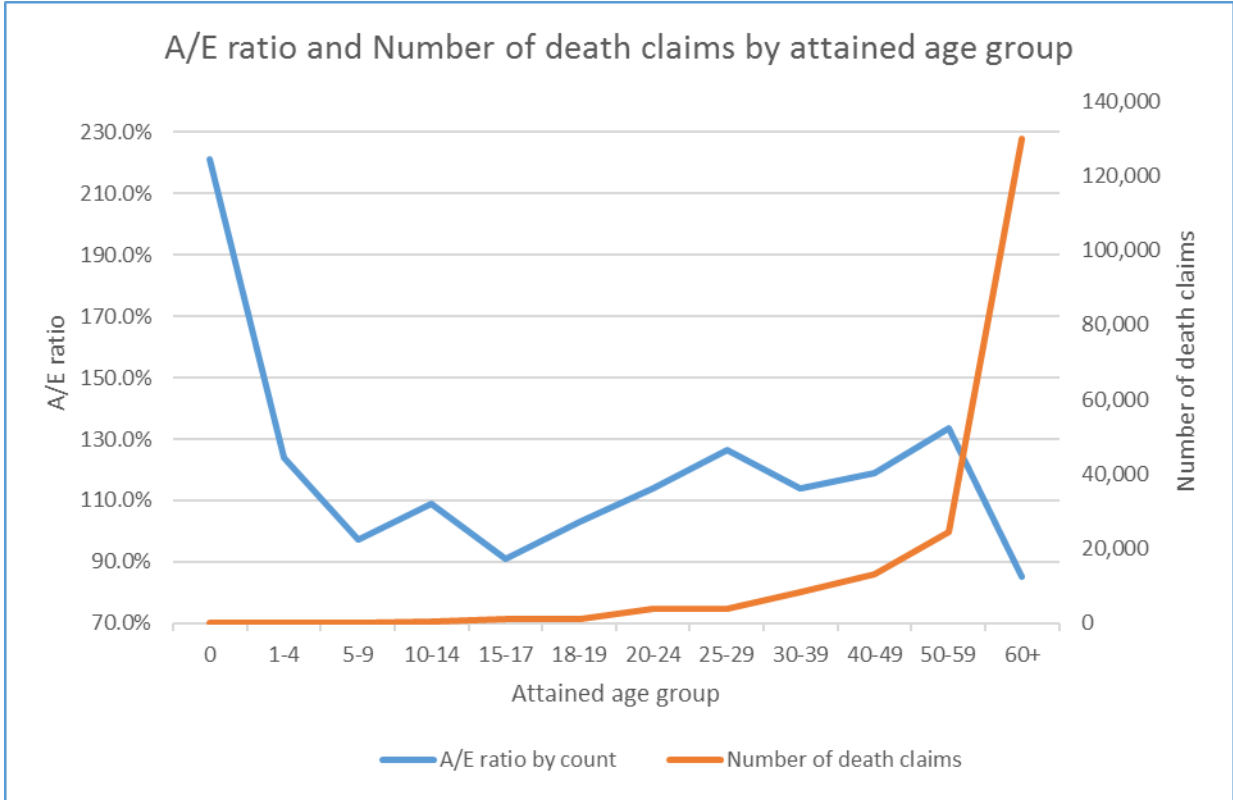
Data by duration group and attained age group - DEATH CLAIM AMOUNT ('000)													
Duration	Attained age												
	0	1-4	5-9	10-14	15-17	18-19	20-24	25-29	30-39	40-49	50-59	60+	TOTAL
1	6,433	2,855	705	605	2,287								12,885
2		5,380	952	1,101	2,556	1,170							11,158
3		5,452	524	1,319	2,751	2,290							12,337
4-5		3,763	4,493	2,163	2,710	4,066	9,512						26,707
6-10			8,849	6,221	7,685	12,181	27,629	4,699					67,264
11-15				11,535	8,675	8,143	27,043	29,529	7,691				92,615
16-20					15,496	22,897	38,675	29,837	31,404				138,308
21-25							65,648	41,412	87,611	9,066			203,737
26+								40,734	99,287	142,153	142,598	512,721	937,493
TOTAL	6,433	17,450	15,523	22,944	42,159	50,747	168,507	146,210	225,993	151,220	142,598	512,721	1,502,504

Data by duration group and attained age group - A/E RATIO BY AMOUNT													
Duration	Attained age												
	0	1-4	5-9	10-14	15-17	18-19	20-24	25-29	30-39	40-49	50-59	60+	TOTAL
1	153.1%	91.5%	40.8%	34.5%	57.0%								87.0%
2		130.3%	61.4%	70.6%	77.8%	63.8%							90.3%
3		203.3%	36.1%	93.1%	101.1%	67.6%							105.8%
4-5		131.0%	144.8%	83.8%	57.6%	74.3%	193.6%						113.0%
6-10			107.3%	95.9%	75.7%	118.5%	99.9%	107.1%					100.1%
11-15				102.5%	69.2%	78.6%	101.1%	118.1%	217.1%				103.5%
16-20					75.7%	78.1%	104.7%	107.4%	98.5%				94.5%
21-25							105.2%	113.7%	116.0%	102.8%			111.2%
26+								113.8%	99.9%	109.6%	131.2%	100.1%	105.8%
TOTAL	153.1%	136.3%	96.5%	91.6%	72.8%	83.7%	106.2%	113.0%	107.5%	109.1%	131.2%	100.1%	104.7%

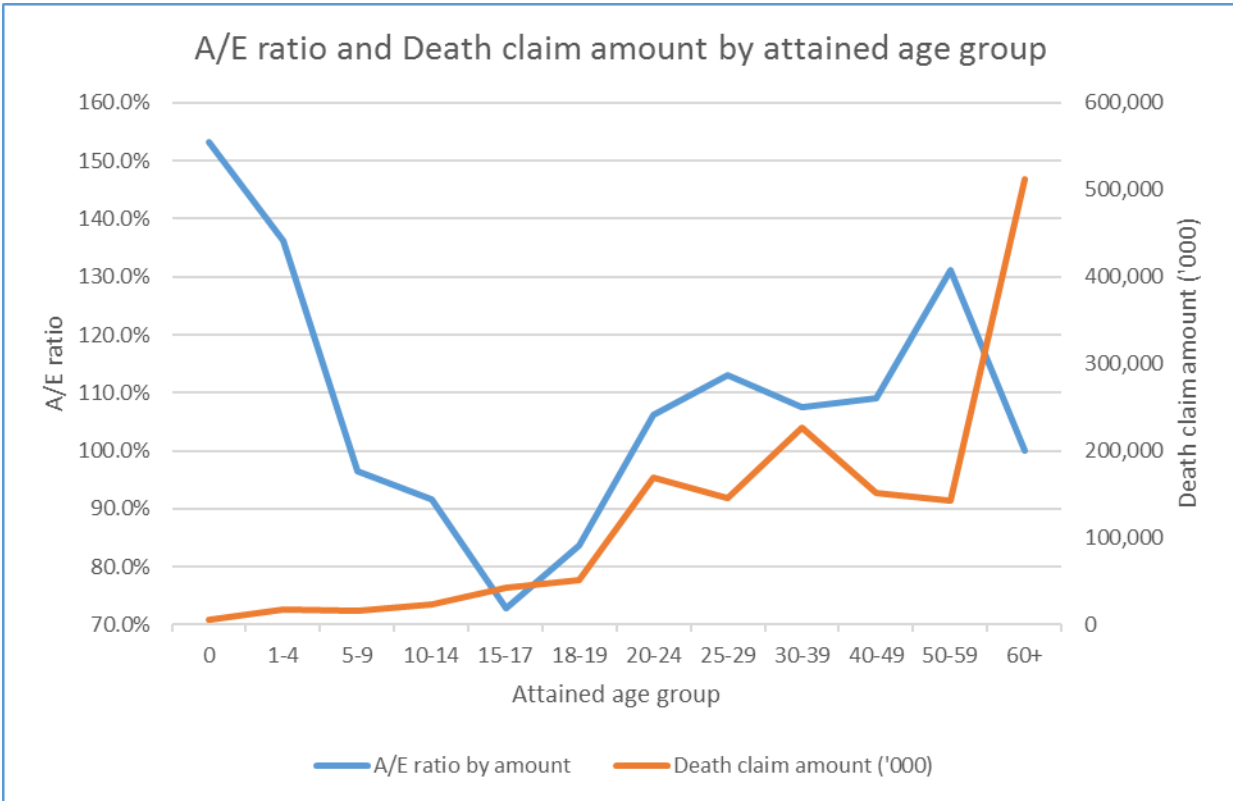
Data by duration group and attained age group - MORTALITY RATE/1,000													
Duration	Attained age												
	0	1-4	5-9	10-14	15-17	18-19	20-24	25-29	30-39	40-49	50-59	60+	TOTAL
1	0.355	0.097	0.031	0.034	0.196								0.130
2		0.143	0.047	0.070	0.269	0.324							0.129
3		0.186	0.028	0.093	0.345	0.361							0.161
4-5		0.105	0.112	0.084	0.194	0.401	1.118						0.199
6-10			0.082	0.095	0.258	0.635	0.605	0.668					0.244
11-15				0.114	0.231	0.419	0.608	0.733	1.425				0.373
16-20					0.277	0.419	0.625	0.664	0.745				0.533
21-25							0.636	0.702	1.048	1.493			0.809
26+								0.708	0.921	1.845	4.160	18.745	3.084
TOTAL	0.355	0.132	0.074	0.096	0.253	0.448	0.639	0.700	0.946	1.820	4.160	18.745	0.866

Looking at the Graphs 7 and 8 on the following page, the A/E ratios decrease up to attained age group 15-17 and then increase, finishing with a big drop for attained ages 60+.

Graph 7



Graph 8



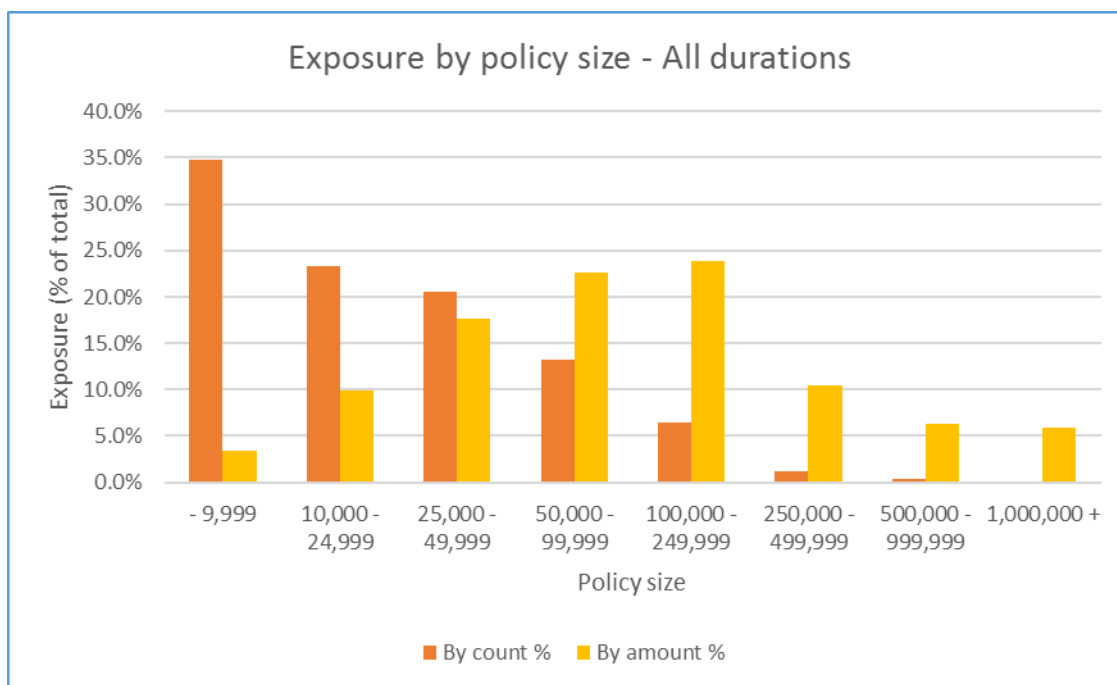
Policy size

In this analysis, the data for issue ages 0-17 and all durations are being used. Exposure by count decreases with policy size from 34.8% for band under 10,000 to 0.1% for band 1,000,000 +. Exposure by amount shows an almost normal curve. The following table and graph illustrate this exposure by policy size.

Table 12

Mortality exposure - All durations		
Policy size	By count	By amount
	%	%
- 9,999	34.8%	3.4%
10,000 - 24,999	23.4%	9.9%
25,000 - 49,999	20.5%	17.7%
50,000 - 99,999	13.2%	22.6%
100,000 - 249,999	6.4%	23.9%
250,000 - 499,999	1.2%	10.4%
500,000 - 999,999	0.4%	6.3%
1,000,000 +	0.1%	5.8%
TOTAL	100.0%	100.0%

Graph 9



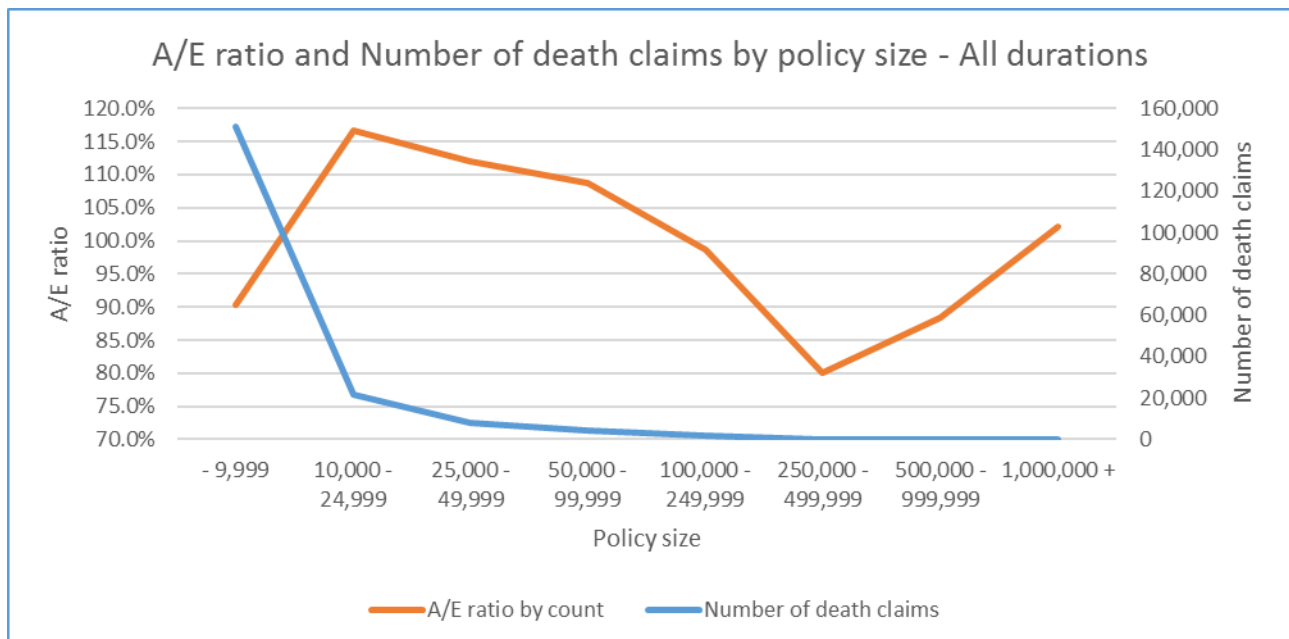
The number of death claims decreases sharply with policy size. A/E ratios tend to be lower for bands 100,000 to 999,999, but also for band under 10,000. This 90.2% A/E ratio for the under 10,000 band has a marked influence on the global 93.9% A/E ratio.

More than 80% of the number of death claims are in the under 10,000 band size. For band size 1,000,000 and over, the number of death claims is below the minimum number to be credible.

Table 13

Number of death claims and A/E ratio with 2015 VBT - All durations		
Policy size	Number of death claims	A/E ratio by count
- 9,999	151,340	90.2%
10,000 - 24,999	21,638	116.6%
25,000 - 49,999	7,980	112.0%
50,000 - 99,999	4,138	108.8%
100,000 - 249,999	1,614	98.6%
250,000 - 499,999	193	80.1%
500,000 - 999,999	58	88.5%
1,000,000 +	25	102.1%
TOTAL	186,986	93.9%

Graph 10

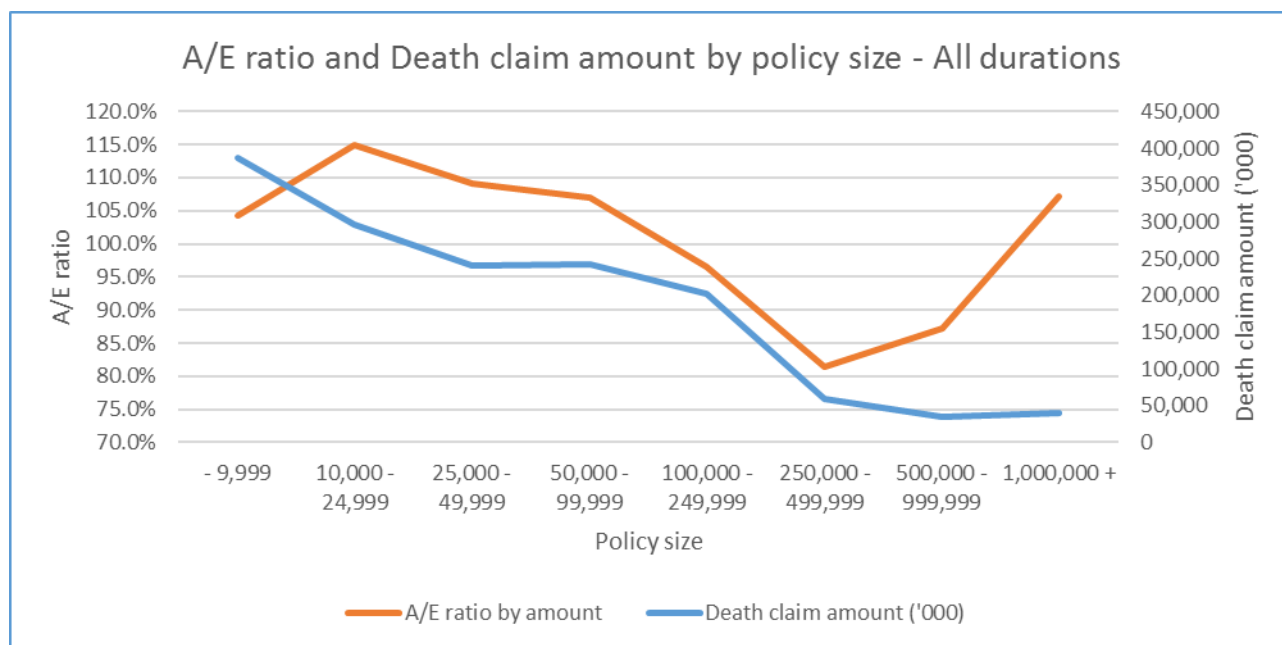


The death claim amounts also decrease with policy size but less sharply, as anticipated. The A/E ratios are most of the time over 100% when the band sizes are under 100,000. In addition, the A/E ratios at band sizes 100,000 and over are under 100%, reflecting possibly the underwriting being done at those higher amounts by the companies. Again, because of the low number of death claims at amounts 1,000,000 and over, the A/E ratio may not be credible. It is important to note that the A/E ratio for the band size under 10,000 is much higher by amount at 104.4% than by count at 90.2%. This is caused by a face amount distribution issue.

Table 14

Death claim amount and A/E ratio with 2015 VBT - All durations		
Policy size	Death claim amount ('000)	A/E ratio by amount
- 9,999	387,167	104.4%
10,000 - 24,999	296,950	115.0%
25,000 - 49,999	240,264	109.1%
50,000 - 99,999	242,892	107.0%
100,000 - 249,999	202,036	96.6%
250,000 - 499,999	59,096	81.4%
500,000 - 999,999	34,204	87.3%
1,000,000 +	39,895	107.1%
TOTAL	1,502,504	104.7%

Graph 11

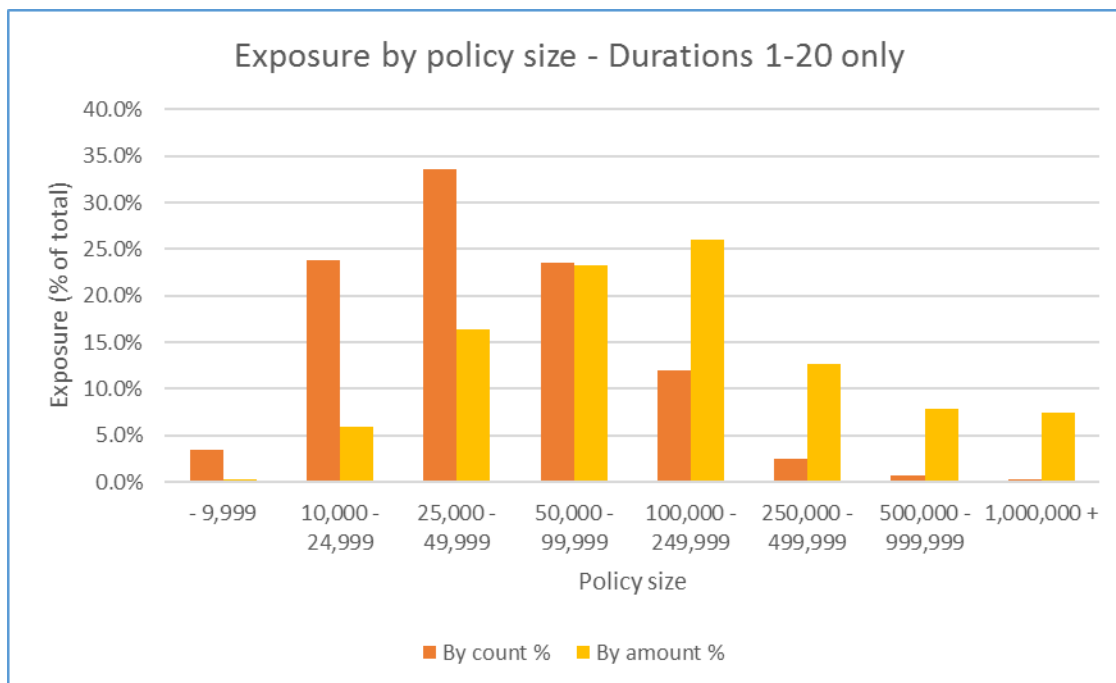


By limiting the analysis to the first 20 durations, exposure by count shows a completely different pattern as shown in the following table and graph. The exposure at policy size under 10,000 decreases sharply. Exposure by amount shows a very similar pattern to the one that includes all durations.

Table 15

Mortality exposure - Durations 1-20 only		
Policy size	By count	By amount
	%	%
- 9,999	3.5%	0.3%
10,000 - 24,999	23.7%	6.0%
25,000 - 49,999	33.6%	16.4%
50,000 - 99,999	23.6%	23.3%
100,000 - 249,999	12.0%	26.0%
250,000 - 499,999	2.5%	12.7%
500,000 - 999,999	0.8%	7.9%
1,000,000 +	0.3%	7.5%
TOTAL	100.0%	100.0%

Graph 12

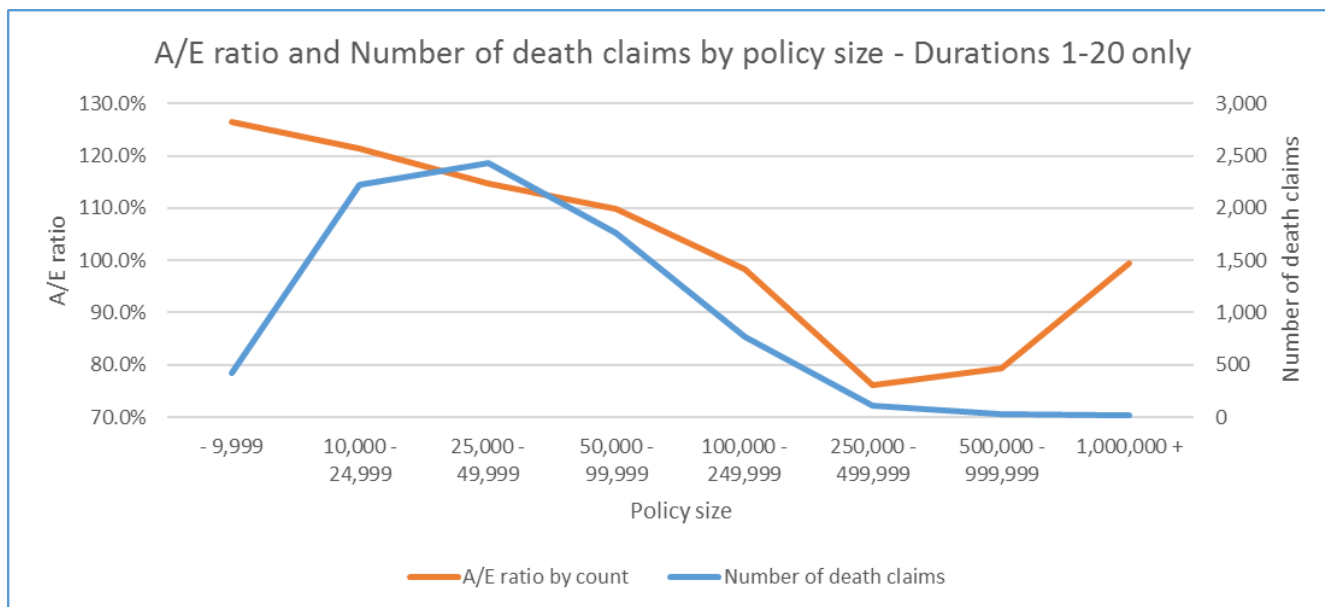


The number of death claims shows a very different pattern when durations are limited to the first 20 durations. A/E ratios decrease regularly with policy size. For band size 1,000,000 and over, the number of death claims is below the minimum number to be credible. The following table and graph illustrate these conclusions.

Table 16

Durations 1-20 only		
Number of death claims and A/E ratio with 2015 VBT		
Policy size	Number of death claims	A/E ratio by count
- 9,999	418	126.4%
10,000 - 24,999	2,228	121.3%
25,000 - 49,999	2,437	114.7%
50,000 - 99,999	1,763	109.8%
100,000 - 249,999	767	98.3%
250,000 - 499,999	107	76.0%
500,000 - 999,999	34	79.4%
1,000,000 +	17	99.4%
TOTAL	7,771	113.0%

Graph 13

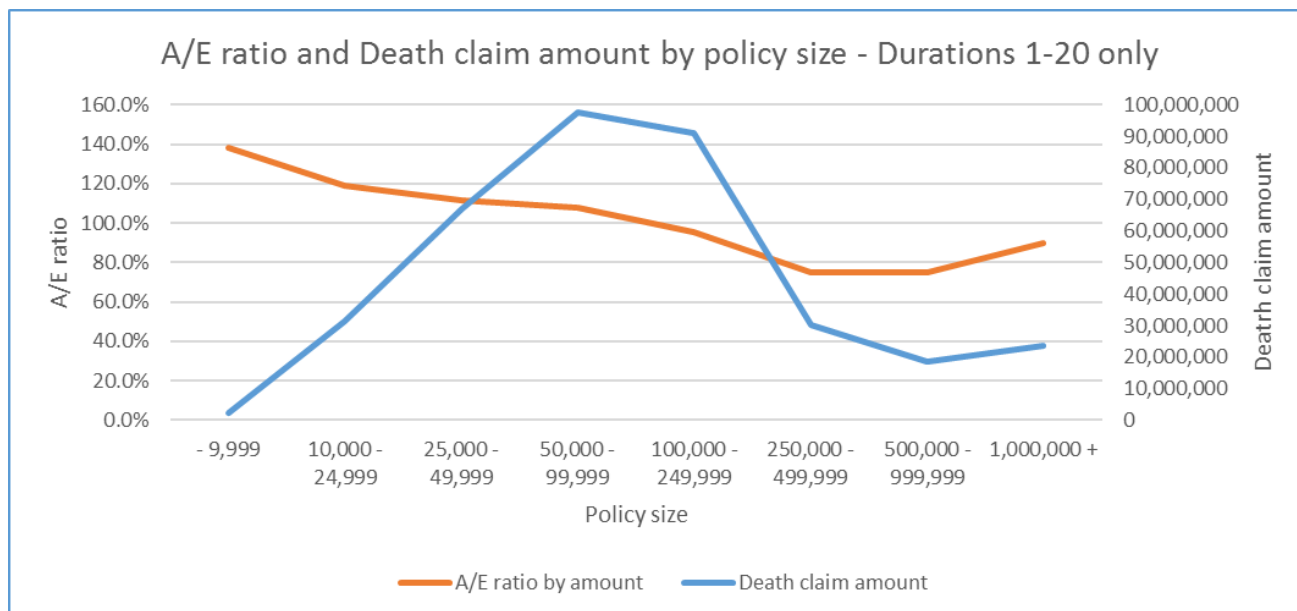


The pattern in amount is very similar to that by count as can be shown in the following table and graph.

Table 17

Durations 1-20 only		
Death claim amount and A/E ratio with 2015 VBT		
Policy size	Death claim amount	A/E ratio by amount
- 9,999	2,090,886	138.0%
10,000 - 24,999	31,173,808	118.8%
25,000 - 49,999	67,042,895	111.7%
50,000 - 99,999	97,680,934	107.5%
100,000 - 249,999	90,809,885	95.2%
250,000 - 499,999	30,324,138	74.8%
500,000 - 999,999	18,567,550	75.2%
1,000,000 +	23,583,739	89.7%
TOTAL	361,273,835	98.8%

Graph 14



Insurance plan

In this analysis, the data for issue ages 0-17 and all durations are being used. By count, permanent plans represent almost 70% of all exposure. By amount, permanent plans account for 59.1%, while term plans only account for 1.5%. UL and VL plans represent 37%.

Table 18

Mortality exposure (%)			A/E ratio with 2015 VBT			
Insurance plan	By count	By amount	Insurance plan	Number of death claims	A/E ratio by count	A/E ratio by amount
Permanent	69.8%	59.1%	Permanent	171,839	99.3%	105.8%
Term	1.5%	1.5%	Term	593	126.6%	117.5%
UL	14.5%	22.0%	UL	4,672	115.2%	109.7%
ULSG	0.9%	2.0%	ULSG	175	123.0%	92.4%
VL	3.3%	10.1%	VL	921	117.5%	121.8%
VLSG	0.7%	2.9%	VLSG	139	112.0%	67.8%
ET-RPU	9.1%	2.4%	ET-RPU	8,495	41.4%	54.2%
Other	0.1%	0.0%	Other	152	118.7%	127.9%
Total	100%	100%	Total	186,986	93.9%	104.7%

A/E ratios for permanent plans are close to 100%, being lower by count than by amount. At age 0, the A/E ratios by count and by amount are highest.

Table 19

PERMANENT PLANS	DATA BY COUNT				DATA BY AMOUNT				
	ISSUE AGE GROUP	Number of death claims	Exposure in policy years	Expected number of death claims	A/E ratio by count	Death claim amount	Exposure in amount years	Expected death claim amount	A/E ratio by amount
	0	21,526	10,698,767	18,009	119.5%	140,671,772	262,680,618,901	127,192,058	110.6%
	1-9	35,462	15,080,749	41,048	86.4%	284,331,268	492,833,713,890	278,412,926	102.1%
	10-14	51,287	5,820,543	52,606	97.5%	304,631,724	163,077,124,883	294,290,419	103.5%
	15-17	63,564	4,770,125	61,330	103.6%	390,244,286	107,994,220,165	359,057,754	108.7%
	0-17	171,839	36,370,183	172,993	99.3%	1,119,879,050	1,026,585,677,838	1,058,953,158	105.8%
	18-21	158,575	9,721,901	155,899	101.7%	990,297,738	208,068,287,978	949,515,966	104.3%
	22-24	126,960	7,423,004	122,201	103.9%	1,069,723,718	250,161,130,905	1,083,343,566	98.7%
	18-24	285,535	17,144,904	278,099	102.7%	2,060,021,456	458,229,418,883	2,032,859,532	101.3%
	TOTAL	457,374	53,515,088	451,092	101.4%	3,179,900,506	1,484,815,096,721	3,091,812,689	102.8%

The mortality exposure differs somewhat when the analysis is limited to the first 20 durations. There are less permanent plans and more UL and VL plans. A/E ratios by amount are all much higher for these durations except for VL and ET-RPU. The low level of A/E ratios for ET-RPU warrants watching and future review. Globally the A/E ratio by amount is 113% compared to 104.7% for all durations.

Table 20

DURATIONS 1-20 ONLY						
Mortality exposure (%)			A/E ratio with 2015 VBT			
Insurance plan	By count	By amount	Insurance plan	Number of death claims	A/E ratio by count	A/E ratio by amount
Permanent	61.1%	56.3%	Permanent	4,498	91.9%	113.5%
Term	3.3%	2.0%	Term	382	118.5%	152.9%
UL	22.5%	20.3%	UL	1,940	111.9%	115.3%
ULSG	2.2%	2.8%	ULSG	136	83.7%	121.5%
VL	6.8%	13.1%	VL	596	115.0%	113.2%
VLSG	1.5%	4.2%	VLSG	98	64.1%	104.7%
ET-RPU	2.6%	1.3%	ET-RPU	120	49.5%	47.8%
Other	0.0%	0.0%	Other	1	42.1%	222.7%
Total	100%	100%	Total	7,771	98.8%	113.0%

Smoker status

For ILEC purposes, the smoking status is set to Unknown for issue ages under 18. The present study examined the smoking status values actually submitted for issue ages under 18 to see to what extent there is valid information in this area. There are valid data for some companies and for some ages only. Data for issue ages 18 to 25 has been included in the database. This has been used to check consistency with the younger issue age information.

When companies began making a smoking status distinction, many companies set a smoking status indicator to a default value and this practice continued to the present day. The present analysis has identified the different practices used and changes in the practice over the years. To the extent that a company chose to set the default value to indicate “smoker” (vs. “unknown”), it has complicated subsequent analysis.

The analysis of the smoker status followed these steps:

- If a company lumped their issue age 0-17 policies into Nonsmoker or Smoker for X ages, those policies were changed to Unknown smoker status.
- The requirement for Nonsmokers needed to be very strict, because even 95% Nonsmoker is completely normal.
- The basis used was to compare each companies’ ratio of smoker to nonsmoker for issue ages 0-17 to the ratio for issue ages 18-24.
- Only 1 company was affected by this process.

The number of death claims, as shown in the following table, is concentrated in the unknown category for all issue age groups. The number of death claims in the nonsmoker categories are about 2.4 times the number in the smoker categories.

When looking at issue age groups 0-17, very few preferred smoker death claims are reported. The standard nonsmoker death claims are more than twice those of standard smoker.

A/E ratios by amount are very volatile in the preferred nonsmoker category, probably due to the scarcity of the data. In the standard nonsmoker category, the A/E ratios are under 100% for most of issue age groups 0-17. The A/E ratios in the standard smoker category are all near 130% for the issue age groups 0-17. This reflects the fact that the expected basis for these issue age groups is not smoker status distinct.

As for the unknown category, the A/E ratio is 105.6% for issue age groups 0-17 and are 100.6% for the older issue age groups.

Table 21

Issue age group	Number of death claims					
	Preferred Nonsmoker	Standard Nonsmoker	Preferred Smoker	Standard Smoker	Unknown	TOTAL
0	51	1,080	2	405	21,867	23,405
1-9	61	2,298	4	811	37,057	40,231
10-14	57	1,212	7	592	53,640	55,508
15-17	57	816	13	751	66,205	67,842
0-17	226	5,406	26	2,559	178,769	186,986
18-21	550	2,985	103	1,636	163,097	168,371
22-24	811	4,378	154	1,570	129,113	136,026
18-24	1,361	7,363	257	3,206	292,210	304,397
TOTAL	1,587	12,769	283	5,765	470,979	491,383

Table 22

Issue age group	A/E ratio by amount					
	Preferred Nonsmoker	Standard Nonsmoker	Preferred Smoker	Standard Smoker	Unknown	TOTAL
0	142.2%	91.6%	-	125.1%	108.0%	105.3%
1-9	71.8%	94.4%	-	132.8%	103.8%	102.2%
10-14	100.2%	83.4%	-	134.7%	105.2%	102.9%
15-17	114.4%	111.8%	-	134.5%	106.5%	108.4%
0-17	102.2%	94.3%	-	132.7%	105.6%	104.7%
18-21	103.1%	120.3%	141.1%	115.7%	103.5%	106.0%
22-24	91.3%	111.5%	133.2%	121.3%	97.8%	100.7%
18-24	95.4%	114.5%	135.9%	118.7%	100.6%	103.1%
TOTAL	96.1%	106.3%	137.6%	123.7%	102.4%	103.7%

2 other tables were developed. The first one represents the number of death claims for issue ages 0-17 only, at various attained age groups by smoking status.

Table 23

Attained age group	Number of death claims - ISSUE AGES 0-17					
	Preferred Nonsmoker	Standard Nonsmoker	Preferred Smoker	Standard Smoker	Unknown	TOTAL
0	24	5	0	15	90	134
1-4	34	17	1	20	158	230
5-9	18	50	2	27	153	250
10-14	18	91	3	74	324	510
15-17	28	223	0	131	635	1,017
0-17	122	386	6	267	1,360	2,141
18-19	18	324	2	182	702	1,228
20-24	45	1,269	8	417	2,050	3,789
25-29	23	1,244	4	403	2,264	3,938
30-39	12	1,645	5	688	6,021	8,371
18-39	98	4,482	19	1,690	11,037	17,326

The second table shows the number of death claims for all issue ages, at various attained age groups by smoking status.

Table 24

Attained age group	Number of death claims - ALL ISSUE AGES					
	Preferred Nonsmoker	Standard Nonsmoker	Preferred Smoker	Standard Smoker	Unknown	TOTAL
18-19	33	337	8	188	777	1,343
20-24	317	1,562	81	532	2,209	4,701
25-29	320	1,601	64	560	2,458	5,003
30-39	488	3,157	89	1,282	6,408	11,424
18-39	1,158	6,657	242	2,562	11,852	22,471

Preferred status

The preferred portion of the 2015 VBT begins at issue age 18. Some companies have noted that they issue policies on a preferred basis at younger issue ages. This study has examined the extent of this practice. Very few companies are using preferred basis under issue age 18 and those using it usually start at issue age 15.

The analysis of the preferred status followed these steps:

- Companies were filtered to look at only amounts under \$100,000.
- Then, if a company had over 90% of their policies issued in the residual standard class, their preferred data for policies under \$100,000 was changed to standard.

As shown in the tables on the following page, very few number of death claims will support a preferred status analysis. In fact, for issue age groups 0-17, there are 226 nonsmoker death claims and only 26 smoker death claims. The A/E ratio is 102.2% for nonsmokers and 106.7% for smokers. It is therefore not a common practice to issue policies on a preferred basis at issue ages under 18.

Table 25

Issue age group	Number of death claims					
	NS2	NS3	NS4	Nonsmoker	SM2	TOTAL
0	47	1	3	51	2	53
1-9	48	5	8	61	4	65
10-14	34	10	13	57	7	64
15-17	35	8	14	57	13	70
0-17	164	24	38	226	26	252
18-21	339	144	67	550	103	653
22-24	499	222	90	811	154	965
18-24	838	366	157	1,361	257	1,618
TOTAL	1,002	390	195	1,587	283	1,870

Table 26

Issue age group	A/E ratio by amount					
	NS2	NS3	NS4	Nonsmoker	SM2	TOTAL
0	153.0%	-	-	142.2%	-	139.7%
1-9	70.2%	-	-	71.8%	-	71.3%
10-14	82.3%	-	-	100.2%	-	105.2%
15-17	39.7%	-	-	114.4%	-	125.8%
0-17	78.4%	189.8%	115.8%	102.2%	153.3%	106.7%
18-21	132.9%	81.9%	79.2%	103.1%	141.1%	106.7%
22-24	90.7%	100.9%	75.5%	91.3%	133.2%	95.3%
18-24	104.3%	93.7%	76.8%	95.4%	135.9%	99.2%
TOTAL	100.4%	98.7%	79.2%	96.1%	137.6%	100.0%

MIB analyzed the database by company and came up with the following additional information:

- 6 companies have preferred data for only 1 class (within a specific class structure).
- 2 companies have only 1 class for nonsmoker preferred class structure of 2.
- All companies have more than 1 class for nonsmoker preferred class structure of 3.
- 1 company has only 1 class for nonsmoker preferred class structure of 4.
- 3 companies have only 1 class for smoker preferred class structure of 2.

This additional information makes it clear that It is not a common practice to issue policies on a preferred basis at issue ages under 18.

Appendix A

Data Base Elements

- Company code
- Smoking status indicator
- Preferred indicator
- Preferred class
- Gender
- Issue age (individual ages)
- Attained age (individual ages)
- Issue year (individual years)
- Duration (individual durations)
- Plan type
- Policy size group (<50k, 50-99k, 100-249k, 500-999k, 1.0-2.499M, 2.5M+)
- Exposure by count & amount
- Death claims by count & amount
- Mortality rates by count & amount
- A/E ratios by count & amount (S&U and ultimate only)

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