Taylor Fry

Motor Accident Insurance Commission

Compulsory Third Party vehicle class relativities for the underwriting year 2016/17

25 August 2016

Contrary to public interest

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1 EXECUTIVE SUMMARY

Vehicle class relativities are estimated in accordance with recent claims experienced as supplied by MAIC.

These relativities have been estimated separately for claim frequency and average claim size. The claim frequency relativity relates to claim frequency of the relevant vehicle class to the Class 1 (cars and station wagons) claim frequency and the average claim size relativity is defined similarly. We then combine the claim frequency and average size relativities to give risk premium relativities. These estimates are displayed below..

Vehicle class		Estimated relativity		
		Claim frequency	Average claim size	Risk premium
		%	%	%
1	Cars and station wagons	100	100	100
2	Motorised homes	37	130	48
3	Taxis	2224	90	2002
4	Hire vehicles	163	105	171
5	Vintage, veteran, historic or street rod motor vehicles	7	97	6
6	Trucks, utilities and vans 4.5t GVM or less	98	115	113
7	Trucks, utilities and vans more than 4.5t GVM	314	132	415
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use	146	158	231
9	Buses: school, therapy, rehabilitation, remedial or special education	158	97	154
10A	Buses: not class 8, 9 or 10B but used within 350 km of base	671	109	729
10B	Buses: Translink service contract other than school or restricted school service	2734	57	1545
11	Buses: not class 8, 9, 10A or 10B	476	108	517
12	Motorcycles: for driver only	11	210	23
13	Motorcycles: with pillion passenger/sidecar	27	183	50
14	Tractors	7	100	7
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles	85	165	141
16	Ambulances	254	107	273
17	Primary production vehicles	27	201	54
19	Motor vehicles conditionally registered - limited access	11	319	34
20	Motor vehicles conditionally registered - zoned access	7	56	4
21	Self-propelled machinery not class 14, 15, 19 or 20	11	241	26
23	Dealer's plate issued			
24	Supplementary trailer insurance including Federal/Interstate	23	72	17

The final column of the table is equal to the product of the preceding two columns. However, the reader may not be able to reproduce the calculations precisely due to rounding errors.

2 BACKGROUND AND SCOPE

Queensland Compulsory Third Party ("CTP") insurance is governed by the Motor Accident Insurance Act 1994, as amended ("the Act"). Section 10 of the Act outlines the functions of the Motor Accident Insurance Commission ("MAIC"). MAIC's functions include:

- The fixing of the range of **maximum and minimum premium rates** chargeable by insurers participating in the CTP Scheme
- The setting of **vehicle class premium relativities**.

The report titled "Queensland CTP Insurer Briefing: Review of the components of risk premium for the underwriting period 1 July to 30 September 2016", authored by Richard Brookes and Ashley Evans, dated 17 March 2016 (referred to subsequently as "the Risk Premium report"), provides advice intended to assist with the former. The present report addresses the latter.

Taylor Fry Consulting Actuaries ("TFCA") previously advised MAIC on relativities in a report dated 19 October 2015 and authored by Richard Brookes and Ashley Evans. It is the equivalent to this report but based on data from one year earlier (i.e. to 31 December 2014). This is referred to as the "previous Relativities report."

3 DATA

All data were provided by MAIC:

- The MAIC database, providing detail as at 31 December 2015 in respect of claims incurred on or after 1 September 1994
- Numbers of vehicles registered by month from 1 July 2014 to 31 December 2015 supplied by MAIC
- Data from the previous Relativities report (which is a product of data supplied by MAIC previously)
    - Numbers of vehicles registered by month and vehicle class (May 2000 to December 2014 inclusive)
    - Numbers of vehicles registered by class on each 31 October from 1994 to 2001
    - Estimates of the numbers of vehicles registered in classes 10A and 10B up to December 2006
    - The allocation of class 10 bus claims to class 10A and 10B to December 2010.

MAIC database

This provides unit record claim information on all claims since 1 September 1994, including:

- Date of accident
- Date of notification
- Quarterly claim payment history
- Quarterly claim status (open, closed, re-opened) history
- Quarterly case estimate history
- Vehicle class of vehicle at fault.

Numbers of registered vehicles

These numbers are used as measures of exposure and are summarised in Appendix A.

4 METHODOLOGY

4.1 Overview

The definition of vehicle class relativities (strictly **risk premium relativities**) is:

$$\text{Risk premium relativity for vehicle class } n = \frac{\text{Risk premium for vehicle class } n}{\text{Risk premium for vehicle class 1}} \quad (4.1)$$

Class 1 represents standard cars and station wagons.

A risk premium can be expressed by its components as:

$$\text{Risk premium} = \text{Claim frequency x average claim size} \quad (4.2)$$

Hence the relativities defined by (4.1) may also be expressed as:

$$\text{Risk premium relativity for vehicle class } n = \text{Claim frequency relativity for Class } n \times \text{Average claim size relativity for Class } n \quad (4.3)$$

where

$$\text{Claim frequency relativity for class } n = \frac{\text{Claim frequency for Class } n}{\text{Claim frequency for Class 1}}$$

and average claim size relativity is defined similarly.

Claim frequency and average claim size relativities are estimated separately and then combined using Equation (4.3). Claim frequencies are subject to considerably less stochastic disturbance than average claim sizes. Separate estimation of claim frequency and average claim size relativities takes advantage of this.

4.2 Claim frequency relativities

The data listed in Section 3 permit the estimation of a claim frequency for each combination of:

- Vehicle class
- Accident year (in financial years 1995/96 to 2014/15).

These were modelled as described in Appendix B. The model includes an accident year trend over all vehicle classes. Each vehicle class was also examined for accident year trends that differed from the general trend. Thirteen classes (2, 3, 4, 6, 7, 8, 10A, 12, 13, 15, 16, 19 and 21) were identified as having additional time related trends. These trends are plotted below in Figure 4.1 to Figure 4.13 (the red lines):

Figure 4.1 **Trends fitted to frequency relativities for class 2**

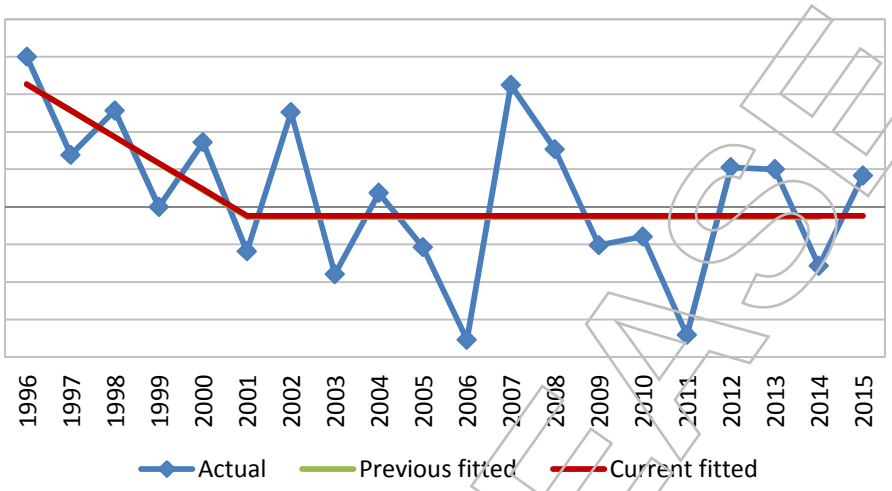


Figure 4.2 **Trends fitted to frequency relativities for class 3**

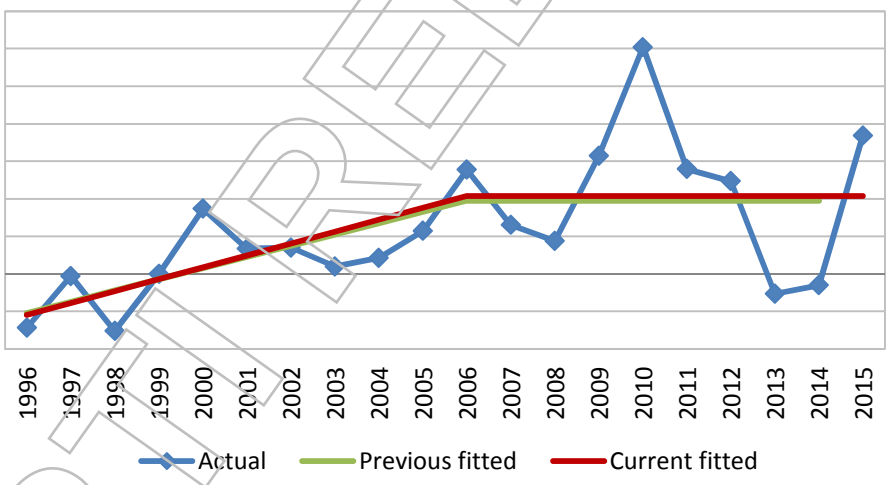


Figure 4.3 **Trends fitted to frequency relativities for class 4**

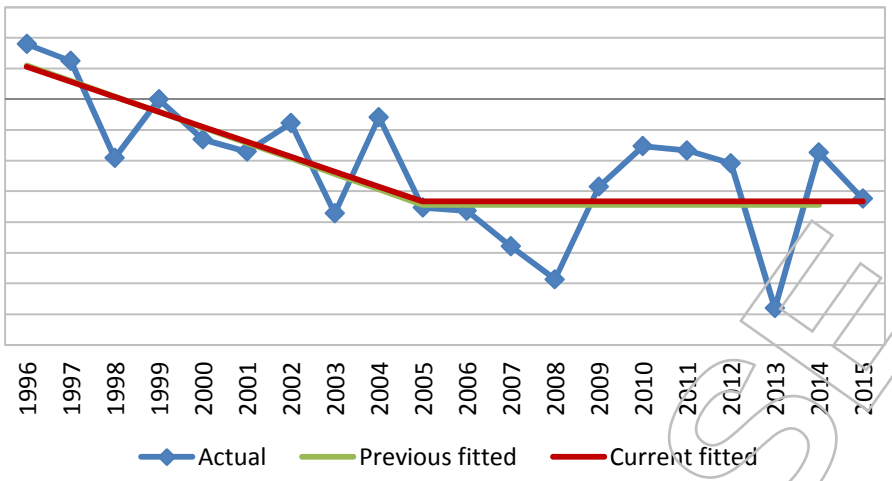


Figure 4.4 **Trends fitted to frequency relativities for class 6**

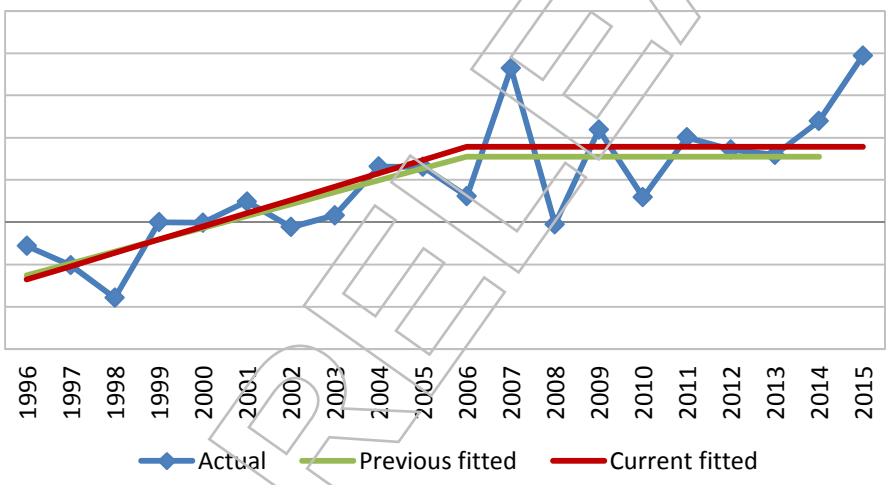


Figure 4.5 **Trends fitted to frequency relativities for class 7**

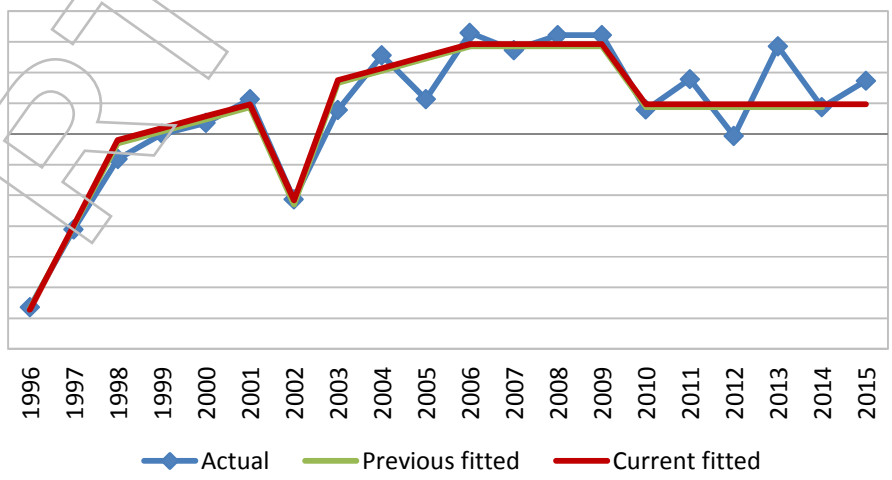


Figure 4.6 **Trends fitted to frequency relativities for class 8**

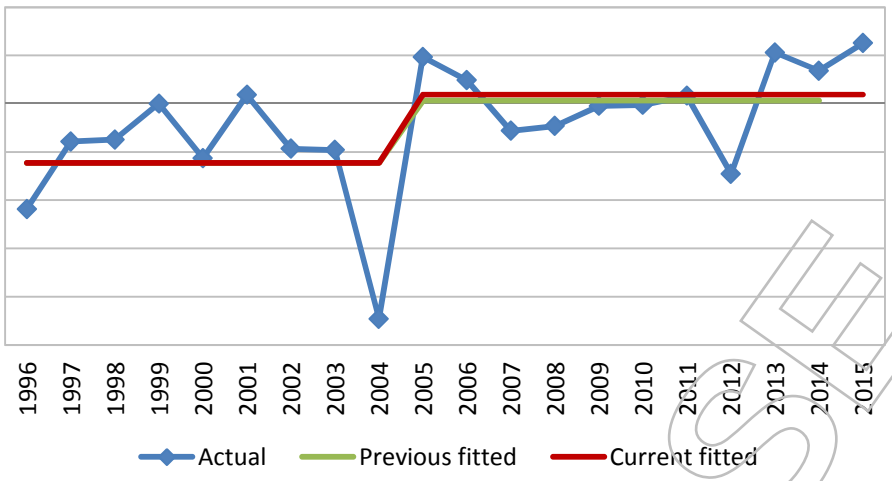


Figure 4.7 **Trends fitted to frequency relativities for class 10A**

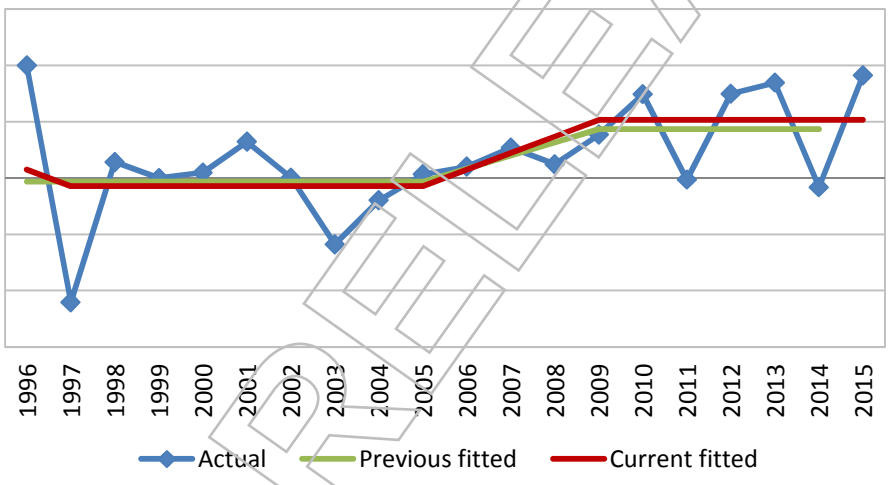


Figure 4.8 **Trends fitted to frequency relativities for class 12**

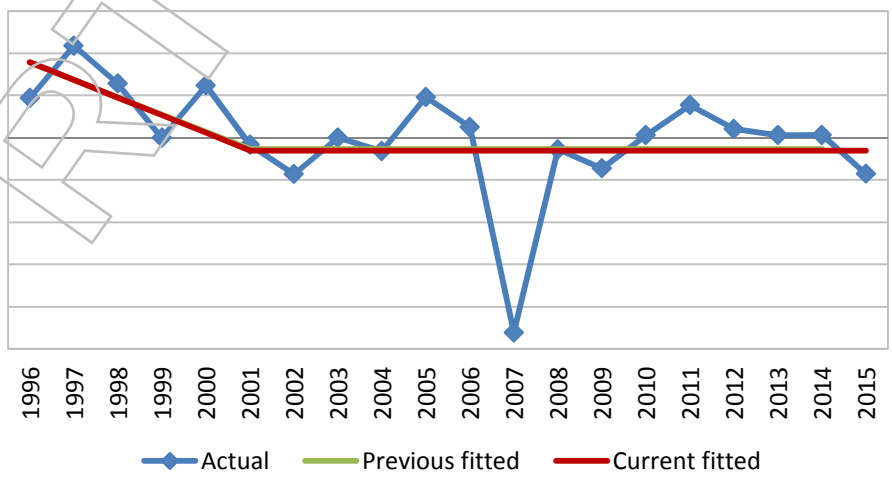


Figure 4.9 **Trends fitted to frequency relativities for class 13**

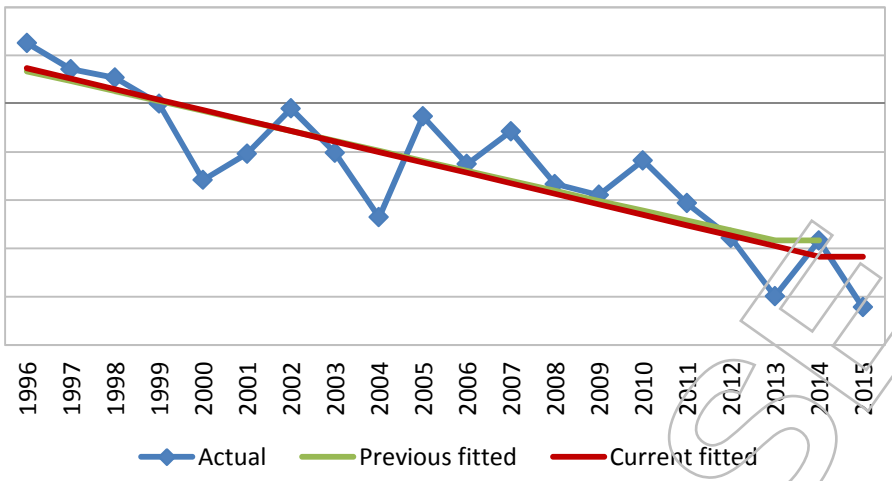


Figure 4.10 **Trends fitted to frequency relativities for class 15**

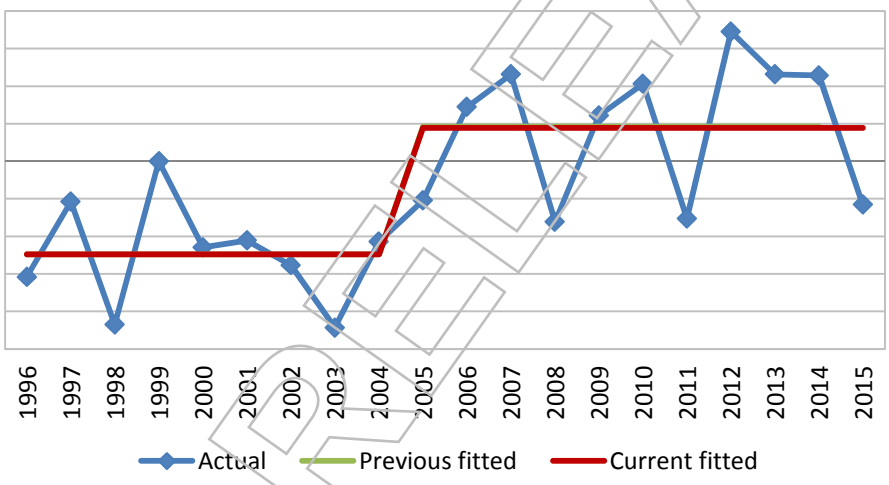


Figure 4.11 **Trends fitted to frequency relativities for class 16**

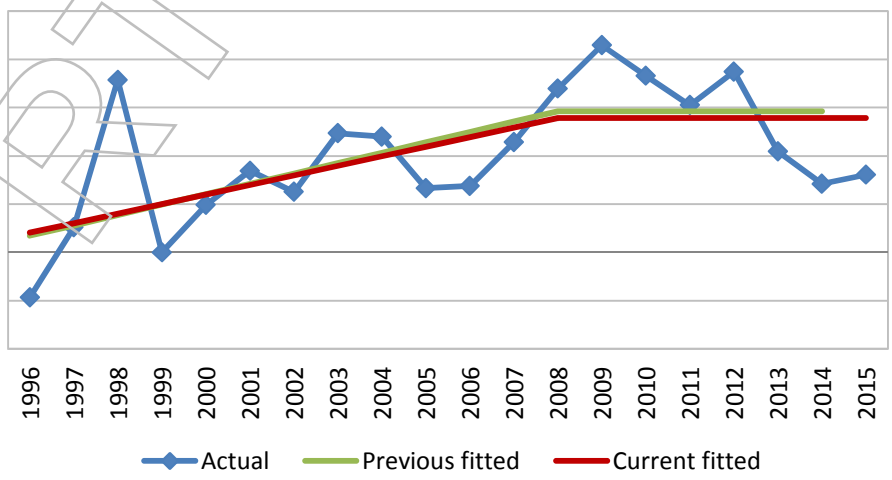


Figure 4.12 **Trends fitted to frequency relativities for class 19**

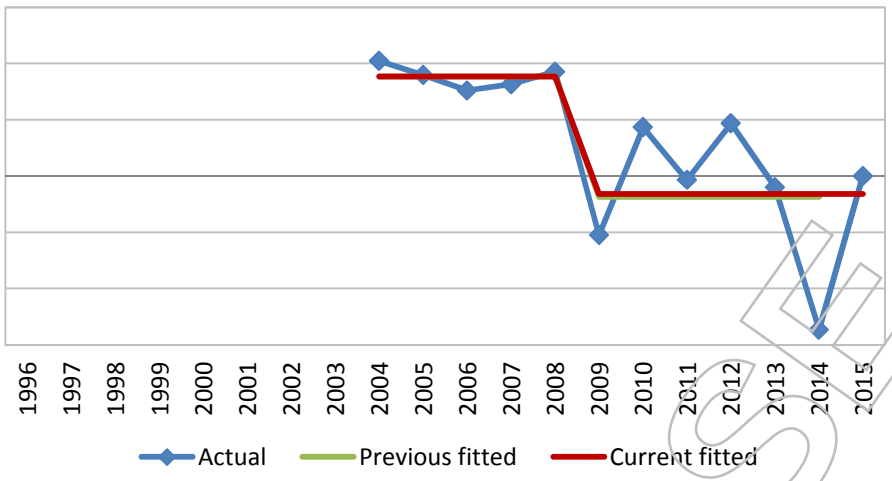
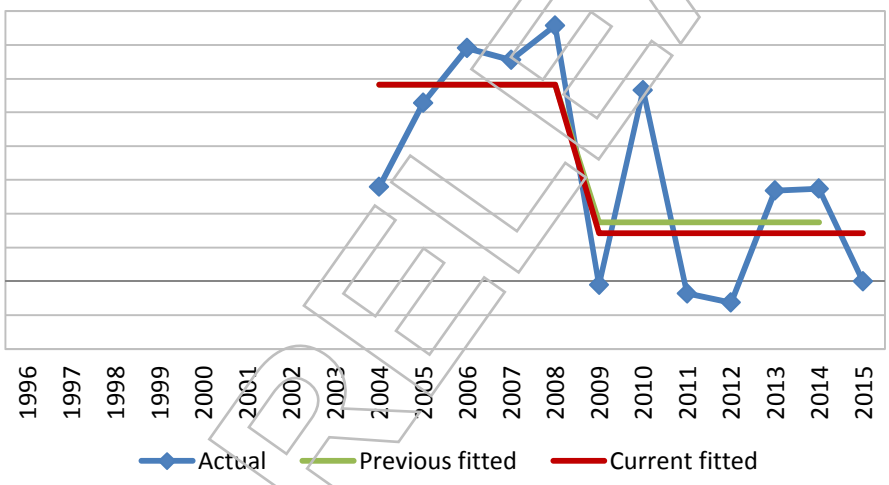


Figure 4.13 **Trends fitted to frequency relativities for class 21**



Figures 4.1 to 4.13 also show the trends fitted for the previous Relativities report (green line). The main changes compared to last year is the class 13 curve now flattens at 2013/14.

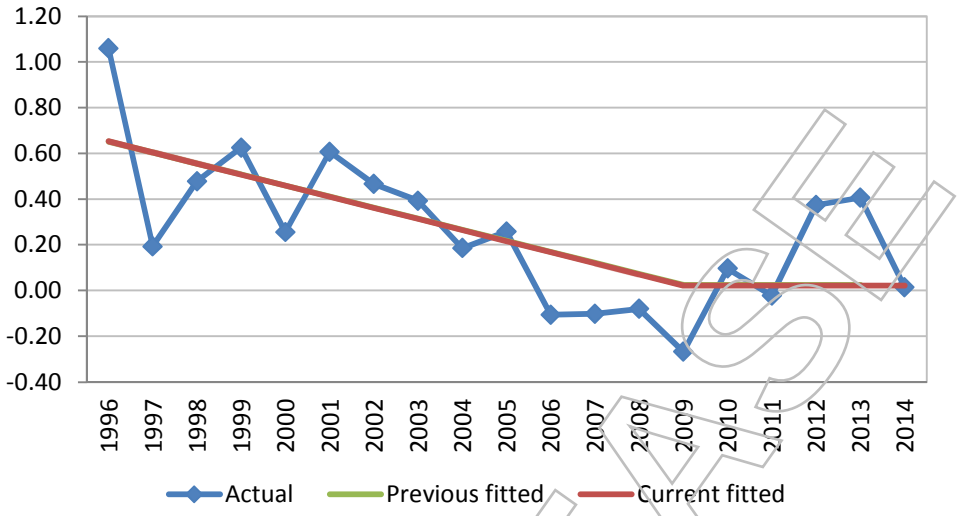
The results of the claim frequency analysis appear in Appendix B.2.

4.3 Average claim size relativities

A procedure parallel to that for claim frequencies was used for estimation of average claim size relativities, as described in detail in Appendix C. An overall accident year effect was fitted while the data was also examined for trends within classes relative to this overall accident year trend. However, claim sizes are considerably more volatile than frequencies and no evidence for new class-specific trends was found.

The previous Relativities report has a trend for class 4 that is maintained in this report. Figure 4.14 shows that the previous trend for class 4 has not been changed materially.

Figure 4.14 **Trend fitted to claim size of class 4**



The results of the average claim size analysis appear in Appendix C.2.

4.4 Risk premium relativities

The claim frequency and average claim size relativities of Sections 4.2 and 4.3 are combined to form estimated risk premium relativities according to Equation (4.3). Note that fitted trends for individual classes have not been extrapolated beyond June 2014.

Appendices B and C produce coefficients of variation associated with the estimated claim frequency and average claim size relativities. Appendix D describes how these may be combined to produce estimated coefficients of variation of the risk premium relativities relative to their estimated values.

The estimated risk premium relativities, together with their coefficients of variation, appear in Section 5.1.

5 RESULTS

5.1 Risk premium

Table 5.1, reproduced from Appendix D.2, lists estimates of risk premium relativities and coefficients of variation by vehicle class.

Table 5.1 **Risk premium relativities**

	Vehicle class	Estimate (%)	Coefficient of variation[3] (%)
1	Cars and station wagons	100	0
2	Motorised homes	48	26
3	Taxis	2002	7
4	Hire vehicles	171	10
5	Vintage, veteran, historic or street rod motor vehicles	6	49
6	Trucks, utilities and vans 4.5t GVM or less	113	2
7	Trucks, utilities and vans more than 4.5t GVM	415	4
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use	231	20
9	Buses: school, therapy, rehabilitation, remedial or special education	154	20
10A	Buses: not class 8, 9 or 10B but used within 350 km of base	729	17
10B	Buses: Translink service contract other than school or restricted school service	1545	8
11	Buses: not class 8, 9, 10A or 10B	517	10
12	Motorcycles: for driver only	23	20
13	Motorcycles: with pillion passenger/sidecar	50	11
14	Tractors	7	30
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles	141	21
16	Ambulances	273	37
17	Primary production vehicles	54	13
19[2]	Motor vehicles conditionally registered - limited access	34	35
20[2]	Motor vehicles conditionally registered - zoned access	4	65
21[2]	Self-propelled machinery other than a vehicle of class 14, 15, 19 or 20	26	59
22[1]	Unregistered vehicle permits		
23	Dealer's plate issued	17	40
24	Supplementary trailer insurance including Federal/Interstate	6	71

a. No exposure data
b. Based on data from 1/7/2003 only
c. The coefficient of variation (the standard error divided by the mean) is an indication of the variability of an estimate. Low numbers indicate that the estimate is reasonably reliable.

Table 5.2 produces a 90% confidence interval (from 5th percentile to 95th percentile) associated with each estimate in Table 5.1, using the methodology set out in Appendix D.1. The current relativity and that recommended in the previous Relativities report are also shown for comparison.

Table 5.2 **Confidence intervals for risk premium relativities**

Vehicle class	Estimate	90% confidence limit		In use by MAIC[3]	Previous relativities report
		Lower	Upper		
1	100			100	100
2	48	29	71	**100**	49
3	2002	1781	2233	2000	2005
4	171	144	200	180	170
5	6	2	12	12	7
6	113	108	117	115	112
7	415	386	446	420	412
8	231	160	312	**160**	219
9	154	106	209	140	151
10A	729	536	946	600	713
10B	1545	1354	1746	1700	1545
11	517	437	602	520	522
12	23	16	32	25	25
13	50	41	59	**80**	52
14	7	4	12	**15**	7
15	141	97	192	100	142
16	273	132	456	200	285
17	54	43	65	55	52
19[2]	34	17	56	50	34
20[2]	4	1	9	**15**	3
21[2]	26	7	56	30	28
22[1]					
23	17	7	29	**100**	16
24	6	1	15	**20**	7

a. No exposure data.
b. Based on data from 1/7/2003
c. Current relativities that lie outside the 90% confidence limit are highlighted in bold.

Figure 5.1 to Figure 5.3 show the estimated relativities and their confidence intervals in a series of three graphs on different scales to facilitate viewing of the full range of the estimated relativities. The MAIC adopted relativities are also shown on the graphs.

Figure 5.1 **Estimated vehicle class relativities with 90% confidence bands – large relativities**

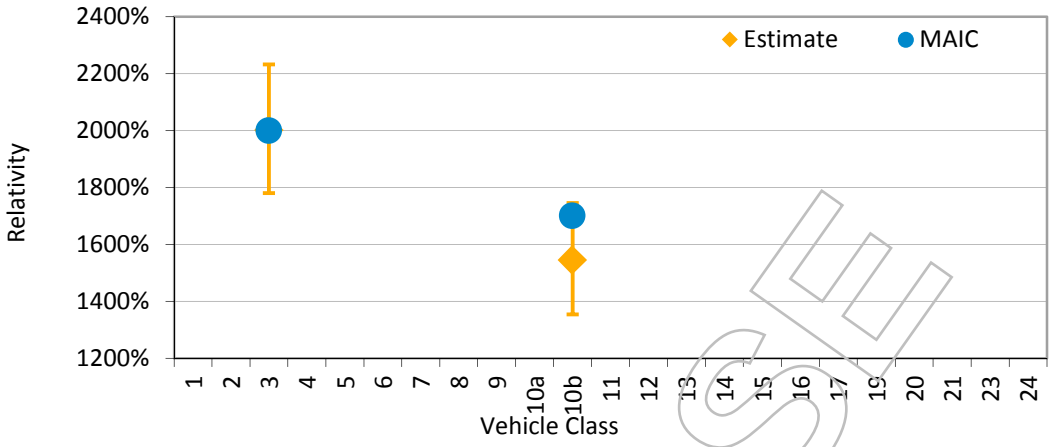


Figure 5.2 **Estimated vehicle class relativities with 90% confidence bands – medium relativities**

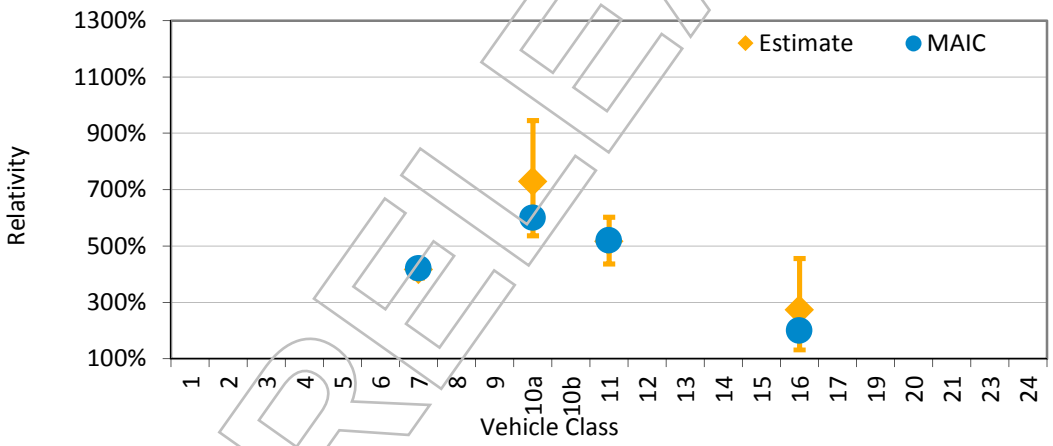
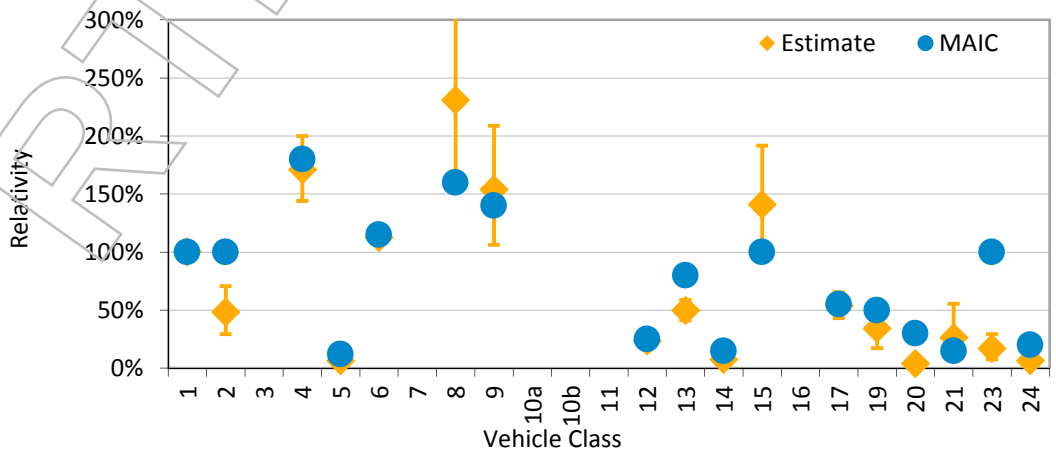


Figure 5.3 **Estimated vehicle class relativities with 90% confidence bands – small relativities**



5.2 Claim frequency

Classes 2, 3, 4, 6, 7, 8, 10A, 12, 13, 15, 16, 19 and 21 have time effects in claim frequency. The history of raw claim frequencies and relativities experienced by these classes is set out in Table 5.3 and Table 5.4 respectively. The relativities are extracted from Appendix A.2.

Table 5.3 **Claim frequency trends**

Accident	Raw claim frequency experienced in class														All
year	1	2	3	4	6	7	8	10A	12	13	15	16	19	21	classes
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
1995/96	0.391	0.311	5.938	1.030	0.334	0.850	0.161	N/A	0.070	0.250	0.141	0.138	0.000	0.000	0.389
1996/97	0.382	0.181	6.708	0.959	0.322	0.950	0.318	0.489	0.128	0.220	0.207	0.282	0.000	0.000	0.383
1997/98	0.401	0.239	6.052	0.731	0.323	1.112	0.339	1.778	0.085	0.222	0.112	1.355	0.000	0.000	0.400
1998/99	0.457	0.167	8.183	1.027	0.410	1.346	0.572	1.792	0.052	0.232	0.311	0.264	0.000	0.000	0.464
1999/00	0.424	0.219	9.087	0.841	0.383	1.279	0.303	1.756	0.090	0.158	0.183	0.402	0.000	0.000	0.433
2000/01	0.398	0.116	7.698	0.762	0.370	1.252	0.551	2.176	0.042	0.166	0.179	0.541	0.000	0.000	0.408
2001/02	0.389	0.232	7.384	0.800	0.343	1.017	0.301	1.513	0.028	0.191	0.150	0.414	0.000	0.000	0.391
2002/03	0.330	0.083	5.944	0.505	0.295	0.997	0.252	0.709	0.037	0.135	0.091	0.645	0.000	0.000	0.331
2003/04	0.268	0.106	5.063	0.574	0.260	0.907	0.036	0.872	0.026	0.086	0.120	0.518	0.083	0.036	0.275
2004/05	0.232	0.069	4.720	0.371	0.225	0.733	0.476	0.953	0.043	0.113	0.130	0.263	0.064	0.051	0.239
2005/06	0.208	0.038	4.951	0.327	0.194	0.727	0.334	0.909	0.027	0.083	0.190	0.240	0.050	0.062	0.213
2006/07	0.188	0.136	3.980	0.272	0.210	0.658	0.184	1.002	0.002	0.088	0.211	0.352	0.049	0.054	0.198
2007/08	0.188	0.092	3.632	0.232	0.166	0.643	0.184	0.823	0.018	0.068	0.092	0.584	0.052	0.063	0.189
2008/09	0.188	0.058	4.762	0.329	0.195	0.672	0.237	1.118	0.015	0.067	0.169	0.957	0.013	0.014	0.197
2009/10	0.175	0.055	5.774	0.340	0.163	0.540	0.217	1.455	0.021	0.071	0.181	0.633	0.030	0.041	0.179
2010/11	0.184	0.034	4.407	0.354	0.185	0.599	0.253	0.719	0.031	0.062	0.093	0.493	0.020	0.013	0.189
2011/12	0.181	0.081	4.137	0.329	0.177	0.530	0.109	1.496	0.023	0.052	0.245	0.678	0.032	0.012	0.184
2012/13	0.174	0.077	2.925	0.196	0.167	0.585	0.366	1.572	0.020	0.039	0.186	0.282	0.017	0.022	0.175
2013/14	0.169	0.044	2.854	0.310	0.166	0.505	0.289	0.593	0.019	0.047	0.177	0.193	0.005	0.021	0.168
2014/15	0.160	0.062	3.761	0.236	0.159	0.466	0.340	1.416	0.011	0.032	0.078	0.187	0.016	0.011	0.160

Table 5.4 **Claim frequency relativity trends**

Accident	Raw claim frequency relativity experienced in class													
year	1	2	3	4	6	7	8	10A	12	13	15	16	19	21
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
1995/96	100	79	1517	263	85	217	41	N/A	18	64	36	35	0	0
1996/97	100	47	1756	251	84	249	83	128	33	58	54	74	0	0
1997/98	100	60	1510	182	81	278	85	444	21	55	28	338	0	0
1998/99	100	36	1791	225	90	295	125	392	11	51	68	58	0	0
1999/00	100	52	2141	198	90	301	71	414	21	37	43	95	0	0
2000/01	100	29	1933	191	93	314	138	546	11	42	45	136	0	0
2001/02	100	60	1898	206	88	262	77	389	7	49	39	107	0	0
2002/03	100	25	1804	153	89	302	76	215	11	41	28	196	0	0
2003/04	100	40	1887	214	97	338	14	325	10	32	45	193	31	13
2004/05	100	30	2038	160	97	316	206	412	19	49	56	114	28	22
2005/06	100	18	2386	158	93	350	161	438	13	40	92	116	24	30
2006/07	100	72	2120	145	112	351	98	534	1	47	112	188	26	29
2007/08	100	49	1935	124	89	342	98	439	10	36	49	311	28	34
2008/09	100	31	2531	175	103	357	126	594	8	36	90	509	7	8
2009/10	100	31	3291	194	93	308	124	829	12	40	103	361	17	23
2010/11	100	19	2397	193	101	326	138	391	17	34	51	268	11	7
2011/12	100	45	2287	182	98	293	60	827	13	29	136	375	18	7
2012/13	100	44	1679	113	96	336	210	903	12	23	107	162	10	13
2013/14	100	26	1694	184	99	300	171	352	11	28	105	114	3	13
2014/15	100	39	2346	147	99	291	212	884	7	20	49	117	10	7

The time effects in the vehicle class frequencies that differ from the overall trend is best seen by reference to Table 5.4 which expresses the frequencies in Table 5.3 relative to the class 1 frequencies.

5.3 Claim size

As discussed in Section 4.3, an overall accident year effect was fitted to the claim size data. No evidence was found for differing accident year trends for the different classes except for class 4. Details of the fitted model and estimated claim size relativities are given in Appendix C.

6 RELIANCES AND LIMITATIONS

TFCA have relied upon historical data and other quantitative information drawn from various sources, without audit or independent verification. The accuracy of results is dependent upon the accuracy and completeness of this underlying data.

The most influential item of data is the MAIC database. This is the sole source of much of the data, with limited ability to conduct reconciliations to confirm accuracy. However, the analysis carried would likely to expose gross internal inconsistencies. None have come to light, and we have accepted the contents of the database at face value.

Vehicle class risk premium relativities are estimated by means of estimates of claim frequency relativities and average claim size relativities.

Claim frequency relativities are estimated from numbers of reported claims, and therefore rely on an assumption that claims incurred but not reported are not subject to different relativities. There is no apparent reason for this assumption to be materially false.

Average claim size relativities are estimated from costs of all known claims, and therefore rely on the estimates of outstanding amounts for unfinalised claims. Inaccuracies in current case estimates would be expected to mainly affect incurred sizes in recent years; since the results are based on averages over seventeen years, the effect of inaccuracies should be limited. Further, an assumption is also made that claims incurred but not reported are not subject to different relativities with respect to claim size. Again, there is no apparent reason for this assumption to be materially false.

This assignment is limited to the estimation of relativities for vehicle classes on the assumption that each class represents a homogeneous group of risks. In fact, the classes may be markedly heterogeneous due to various factors, but particularly:

- Geographical variations in risk (e.g. urban versus rural)
- The existence of sub-classes within vehicle classes (e.g. business vehicles within Class 1).

Some vehicle classes have relatively few registered vehicles. Estimates of relativities for these vehicle classes will be subject to substantial uncertainty.

Within this framework, we believe we have employed techniques and assumptions that are appropriate, and the conclusions presented herein are reasonable given the information currently available. However, it should be recognised that the actual vehicle class relativities may deviate, perhaps materially, from the estimates presented.

Detailed judgements about the methodology, analyses, assumptions and estimated relativities resulting from this actuarial report should be made only after considering the report in its entirety.

The report has been prepared for the Commission for the specific purpose stated in Section 2. No reliance should be placed on this report for any other purpose without confirming with us that such a purpose is appropriate. No other distribution of this report to parties outside of the Commission is permitted without the prior written permission of TFCA. This report is to be considered in its entirety, as parts of the report considered in isolation may be misleading. If any part of this report is to be distributed or provided to

other parties, then the entire report including all appendices and not excerpts must be distributed or provided.

APPENDIX A DATA

Appendix A
Data

A . 1 Claims and exposures

A . 1 . 1 Number of vehicles registered

Vehicle class	Number of registered vehicles in each year																				
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1	1,584,044	1,502,602	1,555,351	1,599,909	1,655,828	1,709,332	1,755,444	1,801,340	1,867,039	1,938,690	2,017,900	2,095,781	2,171,307	2,263,664	2,325,611	2,369,232	2,415,420	2,462,402	2,526,643	2,587,192	2,630,759
2	4,865	4,185	4,417	4,593	4,804	5,019	5,192	5,607	6,041	6,584	7,231	7,987	8,832	9,785	10,396	10,945	11,671	12,326	13,050	13,738	14,417
3	4,181	3,267	2,579	2,561	2,542	2,531	2,507	2,492	2,473	2,469	2,479	2,545	2,613	2,643	2,688	2,719	2,723	2,707	2,701	2,698	2,712
4	15,050	13,784	15,120	16,147	16,741	17,721	17,059	18,258	21,205	22,981	26,127	27,800	32,020	33,140	36,529	35,876	38,124	40,692	43,865	43,820	41,928
5	2,865	3,033	3,329	3,870	4,389	4,997	5,887	6,618	7,383	8,591	9,693	10,682	11,664	12,621	13,773	15,371	17,377	19,074	20,741	22,527	24,088
6	370,852	350,224	359,858	369,559	381,352	398,006	410,709	421,775	437,743	459,771	490,219	521,206	550,793	589,480	622,811	652,124	674,333	697,893	729,000	760,895	786,403
7	50,810	44,448	44,854	45,491	46,509	48,181	47,757	48,256	49,263	51,387	54,469	57,758	61,357	66,908	69,809	70,177	70,267	71,546	74,031	75,806	75,260
8	4,597	4,357	4,401	5,312	5,420	5,607	5,629	5,640	5,560	5,495	5,459	5,383	5,428	5,424	5,477	5,519	5,538	5,491	5,469	5,537	5,592
9	3,919	2,486	2,111	2,223	2,435	2,581	2,823	2,944	3,067	3,201	3,293	3,420	3,488	3,528	3,593	3,668	3,703	3,694	3,715	3,712	3,686
10A			1,839	2,193	2,399	2,563	2,482	2,512	2,540	2,409	2,309	2,310	2,296	2,429	2,594	2,612	2,644	2,674	2,735	2,696	2,683
10B			938	945	936	949	961	992	999	1,055	1,190	1,360	1,511	1,598	1,707	1,886	1,966	2,144	2,203	2,163	2,152
11	2,794	2,425	4,124	3,998	3,797	3,747	3,883	4,046	4,138	4,258	4,566	4,868	5,305	5,602	5,929	5,807	5,722	5,971	6,509	6,768	6,805
12	31,313	25,843	25,840	26,998	28,824	29,906	30,815	31,587	32,374	34,157	36,881	40,616	45,158	48,768	51,902	53,156	54,520	56,959	59,333	62,066	64,824
13	51,407	42,039	42,638	41,382	41,843	43,143	44,050	46,559	49,735	53,594	59,268	67,708	78,250	88,832	99,317	103,333	105,652	110,511	116,961	122,786	126,235
14	26,525	26,960	27,478	27,753	28,213	28,615	28,061	27,836	27,571	24,850	23,929	23,742	24,005	24,071	24,171	24,363	24,728	24,862	25,014	25,075	24,901
15	10,424	8,531	8,705	8,916	9,323	9,813	10,030	10,647	10,956	9,159	8,475	8,413	8,532	8,743	8,899	8,832	8,581	8,567	8,585	7,924	7,652
16	42	723	710	738	759	747	740	724	775	772	760	833	852	856	940	948	1,014	1,033	1,062	1,037	1,068
17	64,852	56,344	55,667	53,735	51,839	49,201	47,196	45,604	44,260	43,463	42,768	42,068	41,510	40,597	39,882	39,577	39,231	38,669	38,146	38,240	38,074
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	41	265	390	324	321	451	584	664	714	8,386	14,076	18,132	22,460	26,873	31,350	33,205	35,094	37,575	40,429	43,039	43,424
20	71	360	408	82	72	87	138	184	217	6,043	7,595	8,256	8,727	9,188	9,639	9,830	10,196	10,761	11,226	11,685	11,777
21	30	61	55	42	40	24	5	4	0	2,815	3,952	4,804	5,535	6,322	7,023	7,322	7,710	8,383	9,061	9,394	9,191
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	356	3,716	3,926	3,941	3,963	4,011	4,015	4,075	4,163	4,239	4,385	4,652	4,867	5,180	5,300	5,182	5,245	5,367	5,568	5,783	5,805
24	65	54	52	33	30	31	169	383	507	630	760	1,186	1,368	1,385	1,708	2,015	1,998	2,145	2,343	2,651	2,807
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,229,103	2,095,707	2,164,790	2,220,745	2,292,379	2,367,263	2,426,136	2,488,747	2,578,723	2,694,999	2,827,784	2,961,510	3,097,878	3,257,637	3,381,048	3,463,699	3,543,457	3,631,446	3,748,390	3,857,232	3,932,243

Notes: 1994-1999 data are taken from a previous Trowbridge report and are at 31 October in that year
2000-2014 data are taken from data provided by MAIC, ultimately sourced from Queensland Transport and are at 31 December of that year
Exposures for classes 10A and 10B to 2006 were taken from the Taylor Fry letter dated 17 January 2007 on Class 10 bus relativities
Exposures for classes 10A and 10B in 2007 were estimated based on partial exposure data from Queensland Transport

A . 1 . 2 Number of claims

Vehicle class	Number of claims occurring during																			
	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
1	5,880	5,943	6,412	7,563	7,256	6,993	7,007	6,153	5,201	4,672	4,349	4,077	4,249	4,376	4,157	4,440	4,454	4,401	4,360	4,217
2	13	8	11	8	11	6	13	5	7	5	3	12	9	6	6	4	10	10	6	9
3	194	173	155	208	230	193	184	147	125	117	126	104	96	128	157	120	112	79	77	102
4	142	145	118	172	149	130	146	107	132	97	91	87	77	120	122	135	134	86	136	99
5	0	0	0	8	1	0	2	2	0	3	2	4	0	2	1	2	2	2	2	0
6	1,171	1,157	1,194	1,565	1,523	1,519	1,448	1,290	1,195	1,105	1,011	1,158	981	1,212	1,063	1,246	1,233	1,221	1,265	1,249
7	378	426	506	626	616	598	491	491	466	399	420	404	430	469	379	421	379	433	383	351
8	7	14	18	31	17	31	17	14	2	26	18	10	10	13	12	14	6	20	16	19
9	21	7	18	28	8	18	15	11	13	7	12	15	8	14	7	15	12	10	8	12
10A	14	9	39	43	45	54	38	18	21	22	21	23	20	29	38	19	40	43	16	38
10B	104	99	97	114	125	119	114	100	97	80	78	74	103	121	77	91	90	89	63	69
11	34	85	91	58	81	94	68	55	56	56	37	45	47	56	39	62	56	69	54	39
12	18	33	23	15	27	13	9	12	9	16	11	1	9	8	11	17	13	12	12	7
13	105	94	92	97	68	73	89	67	46	67	56	69	60	67	73	66	58	46	58	40
14	7	5	16	10	8	2	8	6	5	9	4	3	3	9	1	6	1	0	2	3
15	12	18	10	29	18	18	16	10	11	11	16	18	8	15	16	8	21	16	14	6
16	1	2	10	2	3	4	3	5	4	2	2	3	5	9	6	5	7	3	2	2
17	46	69	63	65	66	39	44	37	18	41	32	18	15	10	14	19	17	27	16	22
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	7	9	9	11	14	4	10	7	12	7	2	7
20	0	0	0	0	2	0	0	0	1	4	1	0	0	2	2	1	1	0	0	3
21	0	0	0	0	0	0	0	0	1	2	3	3	4	1	3	1	1	2	2	1
22	4	0	2	1	0	1	3	0	0	0	0	0	0	0	0	1	0	0	0	2
23	3	0	3	3	3	5	7	0	2	4	0	1	3	5	9	1	4	1	1	2
24	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	2	0	0	0
25	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Total	8,154	8,287	8,879	10,646	10,257	9,910	9,723	8,530	7,419	6,754	6,304	6,140	6,151	6,676	6,204	6,701	6,665	6,577	6,495	6,299

Note: Table excludes those claims with negative or zero amounts of incurred costs

A . 1 . 3 Amounts incurred

Vehicle class	Amounts incurred ($'000) by accident year in 31 Dec 2015 values																			
	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
1	500,491	500,857	493,072	598,319	617,294	586,201	627,025	495,932	409,394	438,306	427,614	457,016	449,805	530,680	461,994	428,388	452,867	461,387	448,330	351,245
2	1,048	2,342	2,410	2,040	853	313	834	665	202	265	581	1,038	1,063	2,056	250	373	695	523	469	641
3	11,895	14,878	8,931	15,402	30,163	12,952	12,385	9,635	9,280	8,366	14,496	10,215	7,308	13,360	13,309	7,898	10,670	6,225	6,007	7,483
4	34,872	14,824	14,631	25,416	16,365	19,980	20,816	12,769	12,507	11,774	8,045	8,808	7,524	11,140	14,918	12,734	19,804	13,533	14,185	8,302
5	0	0	0	1,533	36	0	103	70	0	106	132	29	0	76	11	314	282	74	109	0
6	99,859	143,008	102,870	152,808	143,353	152,194	144,896	115,899	108,376	118,569	115,209	138,332	124,177	152,708	116,423	151,374	132,638	150,538	160,484	165,905
7	38,313	49,784	64,797	67,282	65,371	81,738	59,893	43,356	55,804	49,821	57,031	46,243	55,350	57,905	53,009	60,096	46,926	60,524	54,920	40,720
8	268	4,380	717	2,219	1,293	9,532	848	751	13	3,580	8,511	1,567	1,401	1,461	1,100	577	461	2,637	2,361	3,459
9	1,480	463	1,010	1,316	478	1,125	3,277	861	1,268	433	877	1,670	634	2,455	715	1,635	837	672	904	644
10A	405	464	1,462	4,029	9,878	4,871	4,208	1,429	2,644	1,746	2,761	3,199	1,943	3,772	5,824	1,635	4,936	2,241	894	3,762
10B	5,175	4,162	3,723	4,310	7,482	5,049	4,924	4,758	4,635	3,201	2,896	4,390	8,629	8,803	3,263	7,247	4,702	3,723	5,671	6,951
11	4,640	7,616	6,057	4,214	6,164	6,799	3,851	5,734	5,063	2,697	3,306	5,936	5,662	14,862	6,228	5,961	7,885	7,524	6,167	2,980
12	2,849	6,389	2,525	2,510	3,315	2,234	1,467	1,179	1,134	2,483	12,137	41	404	622	2,261	1,672	5,260	2,832	1,512	549
13	12,604	14,923	12,303	11,756	8,733	7,336	13,989	10,227	5,403	22,762	12,040	21,021	7,775	12,014	10,752	10,684	9,188	9,420	19,806	6,824
14	758	416	1,317	241	1,269	109	459	145	413	757	1,150	402	628	518	7	522	279	0	244	330
15	837	1,911	819	4,593	887	1,245	1,897	600	3,118	1,672	1,340	3,047	6,570	2,036	1,448	995	5,571	2,809	3,483	576
16	15	57	2,158	42	78	276	297	174	205	57	152	363	388	487	1,039	653	938	280	225	280
17	13,637	12,687	9,370	10,396	6,335	5,984	6,713	4,147	1,219	14,623	11,122	1,602	2,124	2,567	4,209	3,491	3,726	2,920	2,787	3,751
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	548	1,205	1,329	4,417	11,023	196	8,886	712	1,002	561	541	4,918
20	0	0	0	0	123	0	0	0	16	184	17	0	0	136	302	33	6	0	0	16
21	0	0	0	0	0	0	0	0	9	80	867	110	953	326	740	42	11	2,116	513	19
22	1,580	0	10	111	0	71	727	0	0	0	0	0	0	0	0	768	0	0	0	2,091
23	44	0	109	158	275	287	422	0	123	424	0	113	115	413	565	90	351	62	216	153
24	0	0	0	0	0	0	9	0	0	0	63	0	0	0	71	0	144	0	0	0
25	0	0	173	0	0	0	0	0	0	0	367	0	0	0	0	0	0	0	0	0
Total	730,771	779,160	728,466	908,696	919,745	898,297	909,040	708,332	621,374	683,108	682,041	709,559	693,478	818,594	707,323	697,896	709,180	730,600	729,829	611,601

Note: Data as described in Section 3 of the main body of the report. Table excludes those claims with negative or zero amounts of incurred costs.

A . 2 Raw relativities

A . 2 . 1 Frequency relativities

Vehicle class	Raw Frequency Relativities by Accident Year																				
	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2	952%	79%	47%	60%	36%	52%	29%	60%	25%	40%	30%	18%	72%	49%	31%	31%	19%	45%	44%	26%	39%
3	1077%	1517%	1756%	1510%	1791%	2141%	1933%	1898%	1804%	1887%	2038%	2386%	2120%	1935%	2531%	3291%	2397%	2287%	1679%	1694%	2346%
4	149%	263%	251%	182%	225%	198%	191%	206%	153%	214%	160%	158%	145%	124%	175%	194%	193%	182%	113%	184%	147%
5					40%	5%		8%	8%		13%	9%	18%		8%	4%	6%	6%	6%	5%	
6	55%	85%	84%	81%	90%	90%	93%	88%	89%	97%	97%	93%	112%	89%	103%	93%	101%	98%	96%	99%	99%
7	144%	217%	249%	278%	295%	301%	314%	262%	302%	338%	316%	350%	351%	342%	357%	308%	326%	293%	336%	300%	291%
8	69%	41%	83%	85%	125%	71%	138%	77%	76%	14%	206%	161%	98%	98%	126%	124%	138%	60%	210%	171%	212%
9	32%	216%	87%	202%	252%	73%	160%	131%	109%	151%	92%	169%	229%	121%	207%	109%	220%	180%	155%	128%	203%
10A			128%	444%	392%	414%	546%	389%	215%	325%	412%	438%	534%	439%	594%	829%	391%	827%	903%	352%	884%
10B			2762%	2561%	2667%	3103%	3108%	2954%	3037%	3427%	2904%	2764%	2603%	3433%	3767%	2327%	2518%	2321%	2319%	1728%	2000%
11	868%	358%	539%	568%	334%	509%	608%	432%	403%	490%	530%	366%	452%	447%	502%	383%	589%	519%	609%	473%	358%
12	59%	18%	33%	21%	11%	21%	11%	7%	11%	10%	19%	13%	1%	10%	8%	12%	17%	13%	12%	11%	7%
13	36%	64%	58%	55%	51%	37%	42%	49%	41%	32%	49%	40%	47%	36%	36%	40%	34%	29%	23%	28%	20%
14	4%	7%	5%	14%	8%	7%	2%	7%	7%	8%	16%	8%	7%	7%	20%	2%	13%	2%		5%	8%
15	27%	36%	54%	28%	68%	43%	45%	39%	28%	45%	56%	92%	112%	49%	90%	103%	51%	136%	107%	105%	49%
16	1500%	35%	74%	338%	58%	95%	136%	107%	196%	193%	114%	116%	188%	311%	509%	361%	268%	375%	162%	114%	117%
17	8%	21%	32%	29%	27%	32%	21%	25%	25%	15%	41%	37%	23%	20%	13%	20%	26%	24%	41%	25%	36%
18																					
19										31%	28%	24%	26%	28%	7%	17%	11%	18%	10%	3%	10%
20						542%				6%	23%	6%			11%	12%	5%	5%			16%
21										13%	22%	30%	29%	34%	8%	23%	7%	7%	13%	13%	7%
22																					
23		21%		19%	17%	18%	31%	44%		18%	39%		11%	31%	50%	99%	10%	41%	10%	10%	21%
24								67%				41%				28%		52%			
25																					

Notes: Relativities calculated by calculating frequency and size for each year, relative to Class 1, set to 100%.

A . 2 . 2 Size relativities

Vehicle class	Raw Size Relativities by Accident Year																			
	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2	95%	347%	285%	322%	91%	62%	72%	165%	37%	56%	197%	77%	112%	283%	38%	97%	68%	50%	76%	85%
3	72%	102%	75%	94%	154%	80%	75%	81%	94%	76%	117%	88%	72%	86%	76%	68%	94%	75%	76%	88%
4	289%	121%	161%	187%	129%	183%	159%	148%	120%	129%	90%	90%	92%	77%	110%	98%	145%	150%	101%	101%
5				242%	43%		57%	43%		38%	67%	6%		31%	10%	163%	139%	35%	53%	
6	100%	147%	112%	123%	111%	120%	112%	111%	115%	114%	116%	107%	120%	104%	99%	126%	106%	118%	123%	159%
7	119%	139%	167%	136%	125%	163%	136%	110%	152%	133%	138%	102%	122%	102%	126%	148%	122%	133%	139%	139%
8	45%	371%	52%	90%	89%	367%	56%	67%	8%	147%	481%	140%	132%	93%	82%	43%	76%	126%	144%	219%
9	83%	79%	73%	59%	70%	75%	244%	97%	124%	66%	74%	99%	75%	145%	92%	113%	69%	64%	110%	64%
10A	34%	61%	49%	118%	258%	108%	124%	99%	160%	85%	134%	124%	92%	107%	138%	89%	121%	50%	54%	119%
10B	58%	50%	50%	48%	70%	51%	48%	59%	61%	43%	38%	53%	79%	60%	38%	83%	51%	40%	88%	121%
11	160%	106%	87%	92%	89%	86%	63%	129%	115%	51%	91%	118%	114%	219%	144%	100%	138%	104%	111%	92%
12	186%	230%	143%	212%	144%	205%	182%	122%	160%	165%	1122%	36%	42%	64%	185%	102%	398%	225%	123%	94%
13	141%	188%	174%	153%	151%	120%	176%	189%	149%	362%	219%	272%	122%	148%	133%	168%	156%	195%	332%	205%
14	127%	99%	107%	31%	186%	65%	64%	30%	105%	90%	292%	119%	198%	47%	6%	90%	275%		119%	132%
15	82%	126%	106%	200%	58%	83%	132%	74%	360%	162%	85%	151%	776%	112%	81%	129%	261%	167%	242%	115%
16	18%	34%	281%	27%	31%	82%	111%	43%	65%	30%	77%	108%	73%	45%	156%	135%	132%	89%	109%	168%
17	348%	218%	193%	202%	113%	183%	170%	139%	86%	380%	353%	79%	134%	212%	271%	190%	216%	103%	169%	205%
18																				
19									93%	143%	150%	358%	744%	40%	800%	105%	82%	76%	263%	844%
20					72%				20%	49%	18%			56%	136%	34%	6%			6%
21									12%	43%	294%	33%	225%	269%	222%	44%	11%	1009%	250%	23%
22	464%		7%	140%		85%	271%									796%				1255%
23	17%		47%	67%	108%	69%	67%		78%	113%		101%	36%	68%	56%	93%	86%	59%	210%	92%
24							10%				64%				64%		71%			
25			226%								373%									

Notes: Relativities calculated by calculating frequency and size for each year, relative to Class 1, set to 100%

A . 3 Current MAIC relativities

Vehicle class	Existing risk premium relativity
1	100%
2	100%
3	2000%
4	180%
5	12%
6	115%
7	420%
8	160%
9	140%
10A	600%
10B	1700%
11	520%
12	25%
13	80%
14	15%
15	100%
16	200%
17	55%
19	50%
20	15%
21	30%
23	100%
24	20%

A . 4 Observed Scheme claim frequencies by accident year

Accident year	Exposure	Claims	Frequency
1995/96	2,095,707	8,154	0.39%
1996/97	2,164,790	8,287	0.38%
1997/98	2,220,745	8,879	0.40%
1998/99	2,292,379	10,646	0.46%
1999/00	2,367,263	10,257	0.43%
2000/01	2,426,136	9,910	0.41%
2001/02	2,488,747	9,723	0.39%
2002/03	2,578,723	8,530	0.33%
2003/04	2,694,999	7,419	0.28%
2004/05	2,827,784	6,754	0.24%
2005/06	2,961,510	6,304	0.21%
2006/07	3,097,878	6,140	0.20%
2007/08	3,257,637	6,151	0.19%
2008/09	3,381,048	6,676	0.20%
2009/10	3,463,699	6,204	0.18%
2010/11	3,543,457	6,701	0.19%
2011/12	3,631,446	6,665	0.18%
2012/13	3,748,390	6,577	0.18%
2013/14	3,857,232	6,495	0.17%
2014/15	3,932,243	6,299	0.16%

A . 5 Class definitions

Vehicle class	Definition
1	Cars and station wagons
2	Motorised homes
3	Taxis
4	Hire vehicles
5	Vintage, veteran, historic or street rod motor vehicles
6	Trucks, utilities and vans 4.5t GVM or less
7	Trucks, utilities and vans more than 4.5t GVM
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use
9	Buses: school, therapy, rehabilitation, remedial or special education
10A	Buses: not class 8, 9 or 10B but used within 350 km of base
10B	Buses: Translink service contract other than school or restricted school service
11	Buses: not class 8, 9, 10A or 10B
12	Motorcycles: for driver only
13	Motorcycles: with pillion passenger/sidecar
14	Tractors
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles
16	Ambulances
17	Primary production vehicles
19	Motor vehicles conditionally registered - limited acccess
20	Motor vehicles conditionally registered - zoned access
21	Self-propelled machinery other than a vehicle of class 14, 15, 19 or 20
22	Unregistered vehicle permits
23	Dealer's plate issued
24	Supplementary trailer insurance including Federal/Interstate

Notes: Class definitions as per the 2004 Motor Accident Insurance Regulation.

APPENDIX B CLAIM FREQUENCY RELATIVITIES

B.1 Model

Let

E_{it} = exposure in Class i in year t (taken as number of vehicles registered in the middle of year t)

(t = 1, 2, …, 19 with t = 1 denoting 1995/96)

N_{it} = number of claims reported to 31 December 2015 for accident year t and Class i

F_{it} = N_{it}/E_{it}

= claim frequency in Class i, developed to 31 December 2013 in respect of accident year t.

Assume that N_{it} is distributed as a quasi-Poisson random variable with

$E[N_{it}]$ = $\lambda_{it}E_{it}$

$V[N_{it}]$ = $\Phi\lambda_{it}E_{it}$

where

$E[F_{it}]$ = λ_{it}

Equivalently, assume that F_{it} is distributed as a quasi-Poisson random variable with

$V[F_{it}]$ = $\Phi\lambda_{it}/E_{it}$

Further assume that

$$\lambda_{it} = \exp\left[\begin{array}{c} \alpha \\ +\beta_i \\ +\gamma_2 \min\{t,6\} I(i=2) \\ +\gamma_3 \min\{t,11\} I(i=3) \\ +\gamma_4 \min\{t,10\} I(i=4) \\ +\gamma_6 \min\{t,11\} I(i=6) \\ +\gamma_7 \min\{t,3\} I(i=7) + \delta_7 \min\{t,11\} I(i=7) \\ +\varepsilon_7 I(t=7) I(i=7) + \theta_7 I(t>14) I(i=7) \\ +\delta_8 I(t<10)\ I(i=8) \\ +\gamma_{10A} \min\{\max(t-10,0),4\} I(i=10A) \\ +\gamma_{12} \min\{t,6\} I(i=12) \\ +\delta_{13} \min\{t,19\} I(i=13) \\ +\delta_{15} I(t<10)\ I(i=15) \\ +\gamma_{16} \min\{t,13\} I(i=16) \\ +\delta_{19} I(t>13)\ I(i=19) \\ +\delta_{21} I(t>13)\ I(i=21) \end{array}\right] \quad \text{(B.1)}$$

Offsets

The parameters π_t were chosen as offsets as follows to reflect changes in the Scheme frequencies derived from Appendix A.4.

Year	t	Frequency	exp π_t
1995/96	1	0.389%	2.0574
1996/97	2	0.383%	2.0243
1997/98	3	0.400%	2.1142
1998/99	4	0.464%	2.4558
1999/00	5	0.433%	2.2912
2000/01	6	0.408%	2.1600
2001/02	7	0.391%	2.0659
2002/03	8	0.331%	1.7492
2003/04	9	0.275%	1.4559
2004/05	10	0.239%	1.2630
2005/06	11	0.213%	1.1256
2006/07	12	0.198%	1.0481
2007/08	13	0.189%	0.9985
2008/09	14	0.197%	1.0441
2009/10	15	0.179%	0.9472
2010/11	16	0.189%	1.0000
2011/12	17	0.184%	0.9705
2012/13	18	0.175%	0.9278
2013/14	19	0.160%	0.8471

Parameter estimates

Maximum likelihood estimates of the parameters from the model above are as follows:

Parameter	Estimate	Standard error
α	-6.2823	0.0044
β_1	0	
β_2	-0.2314	0.3603
β_3	2.7407	0.0621
β_4	0.9565	0.0741
β_5	-2.7160	0.2468
β_6	-0.1962	0.0237
β_7	0.6674	0.1010
β_8	0.3772	0.1108
β_9	0.4601	0.0882
β_{10A}	1.3102	0.0812
β_{10B}	3.3082	0.0337
β_{11}	1.5608	0.0415
β_{12}	-1.1080	0.2406
β_{13}	-0.4928	0.0725
β_{14}	-2.5963	0.1365
β_{15}	-0.1572	0.1162
β_{16}	-0.1666	0.4162
β_{17}	-1.3209	0.0546
β_{19}	-1.3262	0.2005
β_{20}	-2.6699	0.3660
β_{21}	-1.3417	0.3932
β_{23}	-1.4508	0.1878
β_{24}	-2.1502	0.6340
γ_2	-0.1269	0.0681
γ_3	0.0328	0.0075
γ_4	-0.0470	0.0092
γ_6	0.0159	0.0027
γ_7	0.1048	0.0420
γ_8	-0.5579	0.1599
γ_{10A}	0.1485	0.0314
γ_{12}	-0.1806	0.0475
γ_{13}	-0.0427	0.0066
γ_{15}	-0.6803	0.1662
γ_{16}	0.0846	0.0403
γ_{19}	-0.9087	0.2850
γ_{21}	-0.8739	0.5807
δ_7	0.022	0.006
δ_{12}	1.418	0.000
ε_7	-0.164	0.067
θ_7	-0.077	0.041

B.2 Relativities

Vehicle class	Frequency relativity			
	2015 Model - 2015 Data		2014 Model - 2014 Data	
	Estimate (a)	Coefficient of variation (a)	Estimate (b)	Coefficient of variation (b)
1	100%		100%	
2	37%	13%	37%	13%
3	2224%	4%	2213%	4%
4	163%	4%	162%	4%
5	7%	24%	7%	23%
6	98%	1%	97%	1%
7	314%	3%	312%	6%
8	146%	11%	138%	11%
9	158%	9%	157%	9%
10A	671%	9%	643%	38%
10B	2734%	3%	2767%	3%
11	476%	4%	479%	4%
12	11%	10%	11%	10%
13	27%	7%	29%	7%
14	7%	14%	7%	13%
15	85%	12%	85%	12%
16	254%	21%	271%	20%
17	27%	5%	26%	5%
18	(c)	(c)	(c)	(c)
19	11%	20%	11%	21%
20	7%	34%	6%	37%
21	11%	39%	12%	40%
22	(c)	(c)	(c)	(c)
23	23%	18%	24%	18%
24	12%	53%	13%	52%
25	(c)	(c)	(c)	(c)

Notes: (a) From the model set out in Appendix B.1
(b) From the model set out in Appendix B.1 of the previous relativities report
(c) No exposure data
(d) Estimates for classes 10A and B ignored claims in 1995/96 and 1996/97 since exposure estimates were considered unreliable

APPENDIX C AVERAGE CLAIM SIZE RELATIVITIES

C.1 Model

Let

S_{itk} = incurred claim size of claim *k* in Class *i* in accident year *t*. Again let 1995/96 correspond to *t*=1 etc.

The S_{itk} are modelled as follows.

S_{itk} ~ EDF(1.9)

where EDF(p) denotes the sub-family of the exponential dispersion family with variance power p. ie, if *S*= claim size, $V(S) = \phi E^{p}(S)$, with ϕ constant.

$$E[S_{itk}] = \mu_{it} = exp\begin{bmatrix} \alpha + \beta_i + \gamma_0 I(t \le 9) \\ +\gamma_4 I(i = 4)\min(t, 14) \\ +\delta_{10A} I(i = 10A) I(t \le 5) \\ +\delta_{20} I(i = 20) I(t \le 8) \end{bmatrix} \quad \text{(C.1)}$$

for suitable constants $\alpha, \beta_i, \gamma_0, \gamma_4, \delta_{10A}$ and δ_{20}.

Parameter estimates

Maximum likelihood estimates of the parameters from the model in (C.1) are as follows:

Parameter	Estimate	Standard error
α	11.5542	0.0129
β_1	0	
β_2	0.2642	0.2391
β_3	-0.1054	0.0574
β_4	0.7369	0.1300
β_5	-0.0351	0.5146
β_6	0.1394	0.0214
β_7	0.2813	0.0330
β_8	0.4590	0.1720
β_9	-0.0291	0.1883
β_{10A}	0.0821	0.1477
β_{10B}	-0.5705	0.0696
β_{11}	0.0815	0.0879
β_{12}	0.7421	0.1805
β_{13}	0.6045	0.0810
β_{14}	0.0008	0.2886
β_{15}	0.4998	0.1753
β_{16}	0.0717	0.3348
β_{17}	0.7005	0.1158
β_{19}	1.1592	0.3084
β_{20}	-0.5823	0.8533
β_{21}	0.8784	0.6164
β_{22}	1.1391	0.8531
β_{23}	-0.3271	0.3987
β_{24}	-0.5898	1.3219
β_{25}	1.0317	2.0900
γ_0	-0.2284	0.0157
γ_4	-0.0491	0.0131
δ_{10A}	0.1843	0.2830
δ_{20}	0.2858	2.2575

C.2 Relativities

Vehicle class	Claim size relativity			
	2015 Model - 2015 Data		2014 Model - 2014 Data	
	Estimate (a)	Coefficient of variation (a)	Estimate (b)	Coefficient of variation (b)
1	100%		100%	0%
2	130%	23%	132%	23%
3	90%	6%	91%	6%
4	105%	9%	105%	10%
5	97%	45%	99%	46%
6	115%	2%	115%	2%
7	132%	3%	132%	3%
8	158%	17%	159%	17%
9	97%	19%	96%	18%
10A	109%	15%	111%	15%
10B	57%	7%	56%	7%
11	108%	9%	109%	9%
12	210%	18%	215%	18%
13	183%	8%	180%	8%
14	100%	28%	100%	27%
15	165%	17%	168%	17%
16	107%	32%	106%	32%
17	201%	12%	197%	11%
18	(c)	(c)	(c)	(c)
19	319%	29%	317%	29%
20	56%	63%	56%	62%
21	241%	52%	242%	53%
22	312%	63%	328%	62%
23	72%	37%	69%	37%
24	55%	71%	56%	70%
25	281%	66%	282%	66%

Notes: (a) From the model set out in Appendix C.1
(b) From Appendix C.1 in the previous relativities report
(c) No exposure data

APPENDIX D RISK PREMIUM RELATIVITIES

D.1 Methodology

D.1.1 Notation

Let

$R_i^{(f)}$ = claim frequency relativity of Class *i*

$R_i^{(s)}$ = average claim size relativity of Class *i*

$R_i^{(p)}$ = risk premium relativity of Class *i*

These quantities are defined in Section 4.1. If those definitions are written in terms of the notation introduced in Appendices B.1 and C.1, they lead to the following estimates:

$$\hat{R}_i^{(f)} = \hat{\lambda}_{i,18}/\hat{\lambda}_{1,18} \quad \text{(D.1)}$$

$$\hat{R}_i^{(s)} = \hat{\mu}_{i,18}/\hat{\mu}_{1,18} \quad \text{(D.2)}$$

$$\hat{R}_i^{(p)} = \hat{\lambda}_{i,18}\hat{\mu}_{i,18}/\hat{\lambda}_{1,18}\hat{\mu}_{1,18} = \hat{R}_i^{(f)}\hat{R}_i^{(s)} \quad \text{(D.3)}$$

where

- $\hat{\lambda}_{it}, \hat{\mu}_{it}$ are estimators of λ_{it}, μ_{it} respectively, as given in Appendices B and C; and
- the case *t* = 18 is used in (D.1) to capture the most recent claim frequency relativities for those cases (*i* = 2, 3, 4, 6, 7, 8, 10A, 12, 13, 15, 16, 19 and 21) in which they have been changing over time, and similarly for the case (*i*=4) in the size model.

Equation (D.3), a symbolic representation of Equation (4.3), shows how risk premium relativities are constructed.

D.1.2 Standard error of relativity

Let

$$\sigma_i^2 = V\left[\hat{R}_i^{(f)}\right] \quad \text{(D.4)}$$

$$\nu_i^2 = V\left[\hat{R}_i^{(s)}\right] \quad \text{(D.5)}$$

$$\tau_i^2 = V\left[\hat{R}_i^{(p)}\right] \quad \text{(D.6)}$$

Claim frequency

By (D.1) and (D.4),

$$\sigma_i^2 = V\left[\hat{\lambda}_{i,18} \Big/ \hat{\lambda}_{1,18}\right] \qquad (D.7)$$
$$= V[\exp \hat{\beta}_i]$$

for $i \neq 2, 3, 4, 6, 7, 10A, 12, 13, 15$ or 16 [by (B.1)]. For i =2, 3, 4, 6, 7, 10A, 12, 13, 15 or 16, (D.7) requires modification to recognise the influence of $\gamma_2, \gamma_3, \ldots$ in (B.1) by taking account of the correlations between the $\{\hat{\beta}_i\}$ and $\{\hat{\gamma}_t\}$.

Denote

$$E\left[\hat{\beta}_i\right] = \eta_i \qquad (D.8)$$

$$V\left[\hat{\beta}_i\right] = \omega_i^2 \qquad (D.9)$$

Apply the approximations:

$$E\left[f\left(\hat{\beta}_i\right)\right] = f(\eta_i) + \tfrac{1}{2}\omega_i^2 f''(\eta_i) \qquad (D.10)$$

$$V\left[f\left(\hat{\beta}_i\right)\right] = \omega_i^2 \left[f'(\eta_i)\right]^2 \qquad (D.11)$$

with $f(X) = \exp X$.

This yields

$$V\left[R_i^{(f)}\right] = V\left[\hat{\lambda}_{i,18} \Big/ \hat{\lambda}_{1,18}\right] = V\left[\exp \hat{\beta}_i\right] \text{ [by (D.7)]} \qquad (D.12)$$
$$= \omega_i \Big/ \left(1 + \tfrac{1}{2}\omega_i^2\right)$$

where $V[.]$ denotes coefficient of variation.

Relation (D.12) shows how coefficients of variation of claim frequency relativities are estimated from the standard errors of parameter estimates set out in Appendix B.2.

Average claim size

The reasoning applied to claim frequency relativities applies equally to average claim size relativities. Thus

$$V\left[R_i^{(s)}\right] = V\left[\hat{\mu}_{i,18} \Big/ \hat{\mu}_{1,18}\right] = V\left[\exp\hat{\beta}_i\right] \qquad \text{(D.13)}$$
$$= \omega_i \Big/ \left(1 + \tfrac{1}{2}\omega_i^2\right)$$

where β_i now comes from (C.1). The standard error for the case *i* = 4 is treated in a similar way to those cases in claim frequency with linear spline terms.

Risk premium

By (D.3),

$$V\left[R_i^{(p)}\right] = V\left[\exp\left(\log\hat{\lambda}_{i,18} + \log\hat{\mu}_{i,18}\right)\right] = V\left[\exp\hat{\beta}_i\right] \qquad \text{(D.14)}$$
$$= V\left[\exp\left(\hat{\beta}_i^{(f)} + \hat{\beta}_i^{(s)}\right)\right]$$

where the superscripts *f, s* refer to frequency and size relativities.

Application of the approximations (D.10) and (D.11) to (D.14) yields:

$$v\left[\hat{R}_i^{(p)}\right] = \frac{\omega_i}{1 + \frac{1}{2}\omega_i^2} \qquad \text{(D.15)}$$

with

$$\omega_i^2 = \omega_i^{2(f)} + \omega_i^{2(s)} \qquad \text{(D.16)}$$

assuming that frequency and size relativities are stochastically independent.

D.1.3 Confidence interval on relativity

The risk premium relativity is assumed closely related to a compound Poisson claims process, which is known to be approximated by a gamma distribution. Hence it is assumed that $\hat{R}_i^{(p)}$ has gamma p.d.f, i.e.

$$\propto r^{\gamma-1}e^{-cr}, r > 0. \qquad \text{(D.17)}$$

Then

$$E\left[\hat{R}_i^{(p)}\right] = \gamma / c \qquad \text{(D.18)}$$

$$v^2\left[\hat{R}_i^{(p)}\right] = 1/\gamma. \qquad \text{(D.19)}$$

Solution of (D.18) and (D.19) for γ, c yields

$$\gamma = 1/v^2 \left[\hat{R}_i^{(p)} \right] \qquad \text{(D.20)}$$

$$c = \gamma / E\left[\hat{R}_i^{(p)} \right] \qquad \text{(D.21)}$$

Thus γ, c may be calculated from the estimated risk premium relativity and its estimated coefficient of variation (see Appendix D.2).

This defines the gamma p.d.f (D.17) which may then be used to calculate confidence intervals on $\left[\hat{R}_i^{(p)} \right]$. This is done in the second table of Appendix D.2.

D.2 Relativities

Vehicle class	Risk premium relativity			
	2015 Model - 2015 Data		2014 Model - 2014 Data	
	Estimate (a)	Coefficient of variation (a)	Estimate (c)	Coefficient of variation (c)
1	100%		100%	0%
2	48%	26%	49%	26%
3	2002%	7%	2005%	7%
4	171%	10%	170%	10%
5	6%	49%	7%	49%
6	113%	2%	112%	3%
7	415%	4%	412%	7%
8	231%	20%	219%	20%
9	154%	20%	151%	20%
10A	729%	17%	713%	40%
10B	1545%	8%	1545%	8%
11	517%	10%	522%	10%
12	23%	20%	25%	20%
13	50%	11%	52%	11%
14	7%	30%	7%	30%
15	141%	21%	142%	21%
16	273%	37%	285%	36%
17	54%	13%	52%	13%
18	(b)	(b)	(b)	(b)
19	34%	35%	34%	35%
20	4%	65%	3%	65%
21	26%	59%	28%	59%
22	(b)	(b)	(b)	(b)
23	17%	40%	16%	40%
24	6%	71%	7%	71%
25	(b)	(b)	(b)	(b)

Notes: (a) Product of the relativities set out in Appendices B.2 and C.2
(b) No exposure data
(c) From Appendix D.2 in the previous relativities report

D.3 Comparison of relativities with existing ones and those previously estimated by TFCA

Vehicle class	Risk premium relativity 2015 Model - 2015 Data			Existing	Risk premium relativity 2014 Model - 2014 Data		
	Estimate	90% confidence limits			Estimate	90% confidence limits	
		lower	upper			lower	upper
1	100%	100%	100%	100%	100%	100%	100%
2	48%	29%	71%	**100%**	49%	30%	72%
3	2002%	1781%	2233%	2000%	2005%	1784%	2236%
4	171%	144%	200%	180%	170%	142%	200%
5	6%	2%	12%	12%	7%	2%	14%
6	113%	108%	117%	115%	112%	107%	117%
7	415%	386%	446%	420%	412%	366%	461%
8	231%	160%	312%	**160%**	219%	151%	297%
9	154%	106%	209%	140%	151%	104%	205%
10A	729%	536%	946%	600%	713%	320%	1231%
10B	1545%	1354%	1746%	1700%	1545%	1355%	1745%
11	517%	437%	602%	520%	522%	441%	608%
12	23%	16%	32%	25%	25%	17%	33%
13	50%	41%	59%	**80%**	52%	43%	61%
14	7%	4%	12%	**15%**	7%	4%	11%
15	141%	97%	192%	100%	142%	98%	194%
16	273%	132%	456%	200%	285%	138%	475%
17	54%	43%	65%	55%	52%	42%	63%
19	34%	17%	56%	50%	34%	17%	55%
20	4%	1%	9%	**15%**	3%	1%	8%
21	26%	7%	56%	30%	28%	7%	60%
23	17%	7%	29%	**100%**	16%	7%	28%
24	6%	1%	15%	**20%**	7%	1%	17%

Notes: The 90% confidence interval relates to a gamma distribution with the parameters shown in the previous table

Bold existing relativities (from A.3) lie outside the new model confidence interval

The 2014 relativities are taken from Appendix D.2 in the previous relativities report

Queensland CTP Insurer Briefing

Review of the components of risk premium for the underwriting period 1 July to 30 September 2016

17 March 2016

Contrary to public interest

Richard Brookes

Fellow of the Institute of Actuaries of Australia

Contrary to public interest

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1 BACKGROUND

Taylor Fry Consulting Actuaries ("TFCA") advised the Queensland Motor Accident Insurance Commission ("MAIC") on components of the risk premium for Compulsory Third Party ("CTP") insurance policies underwritten in the quarter 1 July to 30 September 2015. The advice was based on data to 31 December 2014.

An abridged version of that advice, for circulation to insurers, appeared as a "Review of the components of risk premium for the underwriting period 1 July to 30 September 2015", dated 20 March 2015, by Richard Brookes and Ashley Evans. This will be referred to subsequently as "the previous annual review".

Subsequent to that report, claims data from the Queensland CTP insurance scheme are subject to quarterly actuarial review. The most recent of these reviews was discussed in the report dated 16 December 2015 on "Review of the components of risk premium for the underwriting period 1 April to 30 June 2016", authored by Richard Brookes and Ashley Evans. This will be referred to subsequently as "the previous quarterly review".

The present report continues the series of quarterly reviews. However, it reports on the annual review of experience, where we recalibrate all of our analysis and assumptions. Therefore it is more extensive than the preceding quarterly reviews. Its purpose is:

- To review claims experience over the calendar year relative to the predictions made in earlier reports
- To analyse the totality of Scheme data and to advise on the components of risk premium and premium relativities for the underwriting quarter beginning 1 July 2016.

One submission was received from a licensed insurer that commented on issues related to the subject matter of this report.

2 CLAIM FREQUENCY

Throughout this report references to claim "notifications" will be to all claims recorded as notified in the Scheme data, other than Nominal Defendant claims, but specifically including those for nil or trivial amounts. Claim frequency is expressed as claims per registered vehicle.

2.1 Modelling of workers compensation recovery, interstate sharing and other claims

2.1.1 Definitions

Workers' compensation recovery ("WC") claims are those notified to insurers by a workers' compensation insurer/authority. They have been identified separately in the database since 2009Q1 by means of a specific injury code.

Interstate sharing ("IS") claims involve one party from Queensland and another from a different state. In some of these cases claim cost is shared between the respective state schemes. These claims are managed by an interstate insurer. They are identified in the database by means of a specific injury code.

Both WC and IS notifications have been numerous and erratic. We have found that these notifications distort our notification models. As a consequence, WC, IS and other ("core") claims are modelled separately.

2.2 Recent experience for core claims

Figure 2.1 displays forecasts of numbers of core notifications from the previous annual review and compares them with actual experience for the Dec-15 notification quarter. Actual notifications in the quarter were 8% higher than forecast. Figure 2.2 shows the equivalent but based on experience in the 2015 calendar year. Actual notifications in the year were 7% higher than forecast. This higher than expected number of notifications was driven by the 2015 accident year.

Figure 2.1 **Number of claims notified in the Dec-15 quarter (excl WC & IS claims)**

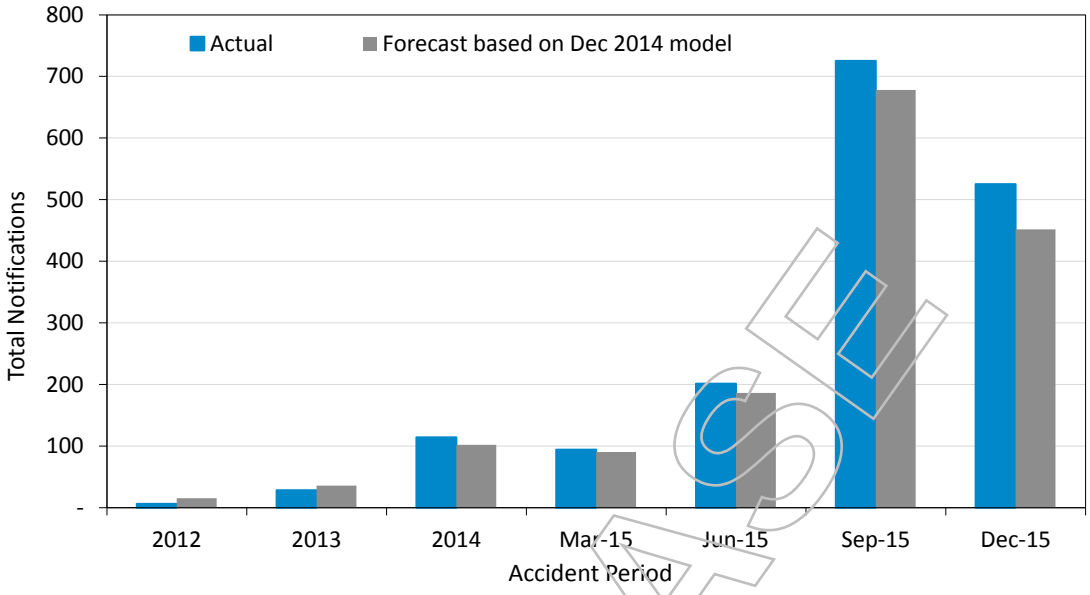
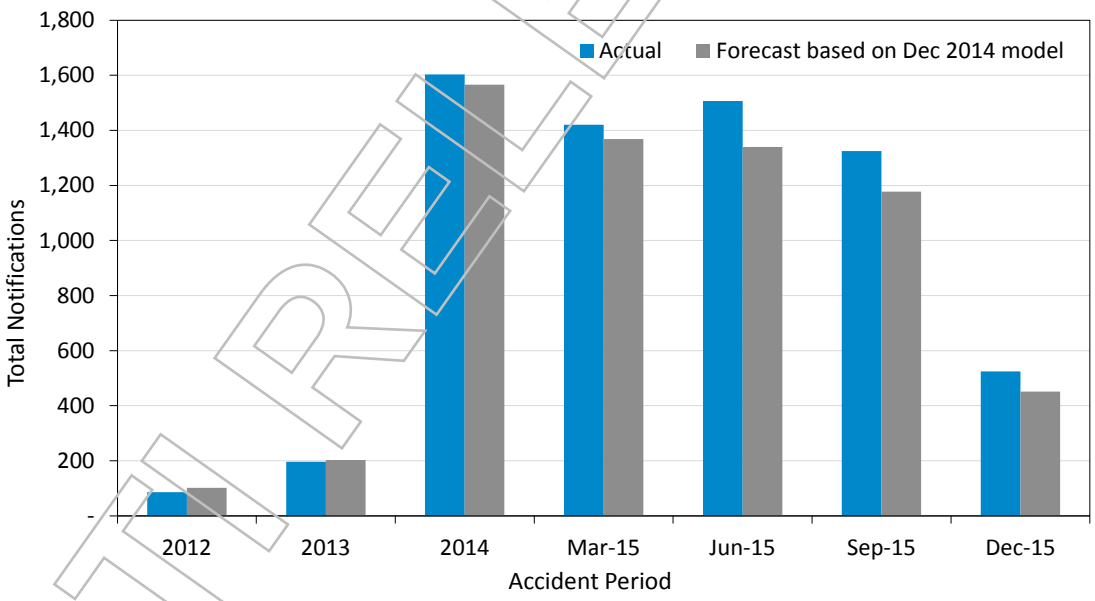


Figure 2.2 **Number of claims notified in the 2015 calendar year (excl WC & IS claims)**



2.3 Previous review's claim frequency forecasts

Figure 2.3 shows our estimates of core claim frequency as detailed in the previous annual review (orange line) and estimates adjusted for year to date experience (blue line). We estimate the frequency adjusted for year to date experience by assuming that future claim notification numbers are as expected. Figure 2.3 also shows:

- Our baseline core claim frequency estimated at the previous annual review (0.158%)

- The "average adjusted" claim frequency for the 2013 accident year (0.161%), 2014 accident year (0.160%) and 2015 accident year (0.170%) assuming that future claim notification numbers are as expected
- An alternative "average" claim frequency for the 2015 accident year where future core claim notification numbers are 10% above expectations (0.175%)
- The expected proportion of claims yet to be notified as at Dec-15 (the histogram).

Note that the model forecasts of ultimate claim frequency for the most recent accident quarters are based on comparatively little data, and are therefore of lower reliability than those of earlier periods.

Figure 2.3 **Estimates of claim frequency using previous review's forecasts**

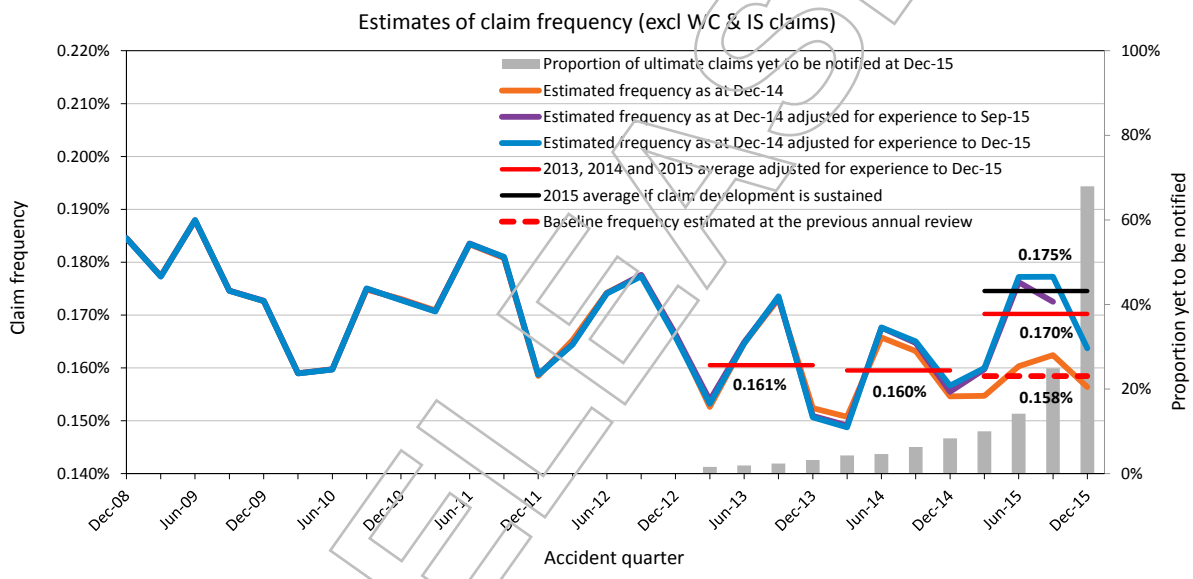


Figure 2.3 shows that the estimated core claim frequencies for recent accident quarters have generally been revised upwards while older quarters remain stable.

2.4 Modelling of core claims

A Generalised Linear Model ("GLM") has been used to model the entire history of Scheme notifications. In this model, the ultimate number of core claim notifications for an accident month is taken as a multiple of the number of registered vehicles for the month. This multiple varies with development month of notification, and is subject to various adjustments, including:

- The effect of the "New Scheme" resulting from the introduction of the *Motor Accident Insurance Amendment Act 2000*
- Some trends over accident and notification months
- Seasonality over accident and notification months.

The structure of the model has changed since the previous annual review. At the previous annual review, core claim notifications for an accident month is taken as a multiple of the estimated number of serious road casualties in the month rather than registered vehicles. The change was made since the reporting of hospitalisations is slow and it can take as

much as two years after the accident month before the data becomes mature. While the number of serious road casualties is no longer used directly in our modelling, we continue to estimate and monitor the casualty rate in a separate exercise to access the adequacy of the new structure.

2.4.1 Significant changes to model terms

Our core claim notifications model is calibrated to recent experience for early development months and a longer term view for later development months. Consequently, the first year of development is consistent with actual experience over the past two years. Beyond the first year of development, we take a longer term view of historical experience when setting projection assumptions.

We show the actual versus expected notifications over the last two years for the fitted model. For a well-fitting model, expected notifications should remain close to actual notifications. There are two figures:

- Figure 2.4 shows the results for development months up to 11
- Figure 2.5 shows the results for development months from 12 to 23.

Development months 23 or less accounted for 97% of all notifications in the last two years.

Figure 2.4 **The actual versus expected notifications in development months 0 to 11 for 2014 and 2015**

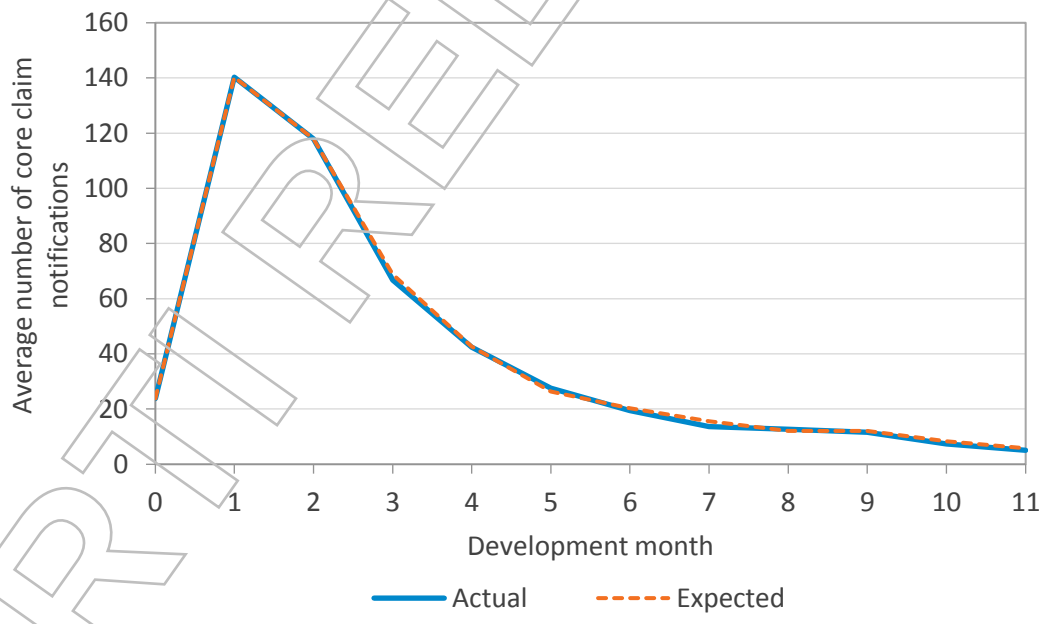
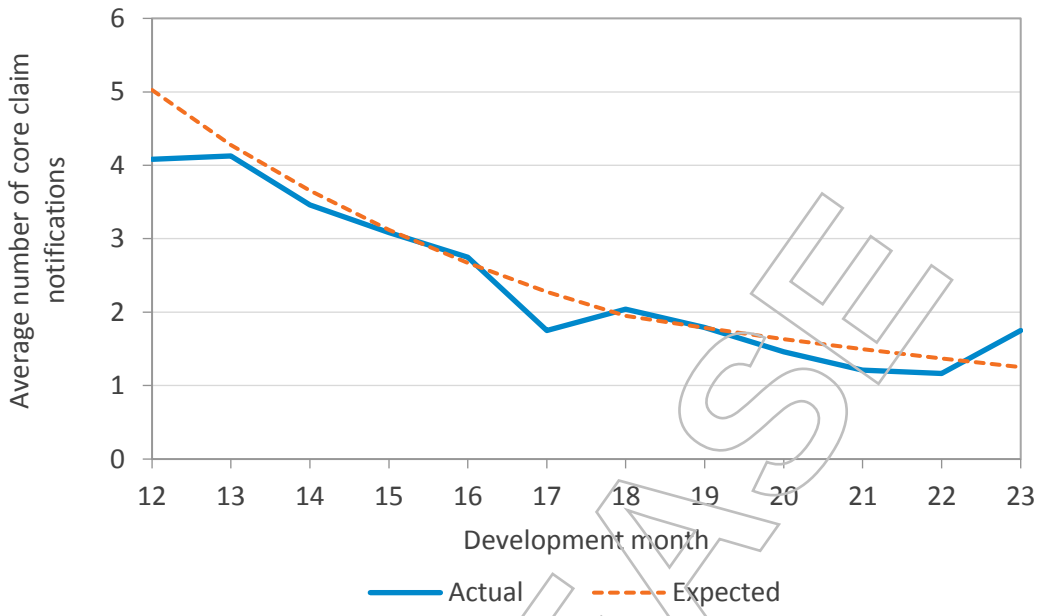


Figure 2.5 **The actual versus expected notifications in development months 12 to 23 for 2014 and 2015**



2.5 Estimated ultimate core claim frequency

Figure 2.6 shows the current and previous forecast of ultimate frequency for core claims, for each accident quarter. High core claim notification experience in 2015 has resulted in an increase in the projected core claim frequency when compared to the previous levels.

Figure 2.6 **Comparison of claim frequency per vehicle forecast**

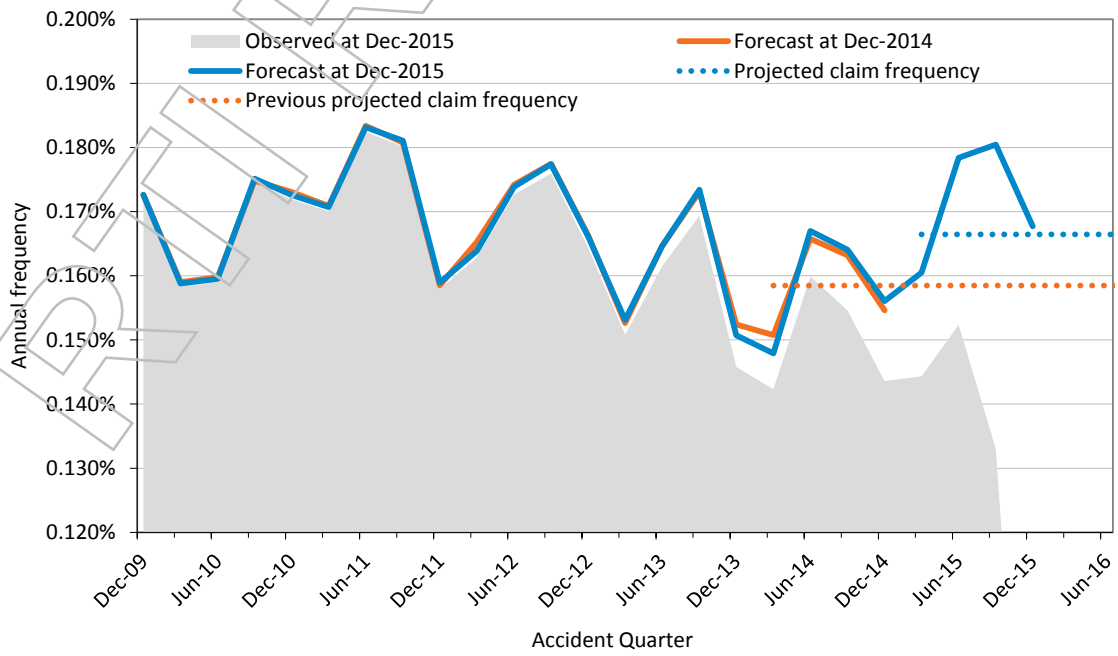


Table 2.1 displays the numerical values of the forecasts illustrated in Figure 2.6 along with frequencies that include WC and IS.

Our scope is to produce a claim frequency based on the conditions and environment as at 31 December 2015. This is our baseline projected claim frequency. MAIC will use this as part of their deliberations in setting the claim frequency used for the floor and ceiling calculations for future underwriting quarters.

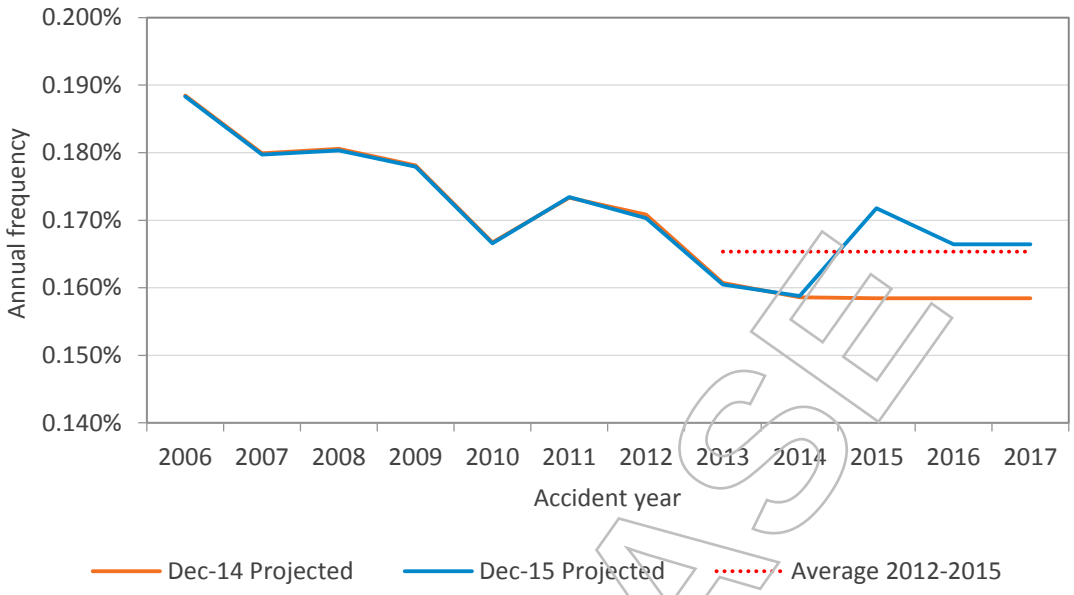
Table 2.1 **Estimated claim frequency**

Accident period	Excluding WC & IS	Including WC & IS
	%	%
2010	0.167	0.186
2011	0.173	0.192
2012	0.170	0.188
2013	0.160	0.177
2014		
March quarter	0.148	0.165
June quarter	0.167	0.186
September quarter	0.164	0.184
December quarter	0.156	0.171
Whole year	0.159	0.177
2015		
March quarter	0.160	0.180
June quarter	0.178	0.197
September quarter	0.180	0.198
December quarter	0.168	0.186
Whole year	0.172	0.190
Base scenario frequency for the future underwriting quarter beginning 1 July 2016	**0.166**	**0.184**

We note that there has been a consistent downward trend in claim frequency for a number of years, as shown below in Figure 2.7, until 2015.

Figure 2.7 shows the estimated core claim frequency by accident year. The baseline scenario frequency of 0.166% is very slightly higher than the average frequency of the periods from 2012 to 2015 and from 2014 to 2015, both approximately 0.165%.

Figure 2.7 **Estimated core claim frequency by accident year**



2.6 WC and IS claim frequency

WC and IS claim frequency are modelled separately using a chain-ladder model. Assumptions about the future are based on experience over the last three years. Note that our approach assumes that there is no material progression of core claims to WC or IS claims. To the extent that there is such a progression it is likely that our estimates of total claim numbers and frequency will be conservative.

Figure 2.8 shows, for each past accident quarter, the frequency of WC claims notified to date as well as current and previous assumptions for ultimate frequency. The red dotted line represents the ultimate frequency that has been adopted for the underwriting quarter beginning 1 July 2016. Figure 2.9 shows the equivalent for IS claims. The ultimate frequency that has been adopted for the underwriting quarter beginning 1 July 2016 is:

- 0.01400% for WC
- 0.00412% for IS.

Figure 2.8 **Developed annual frequency of WC claim notification**

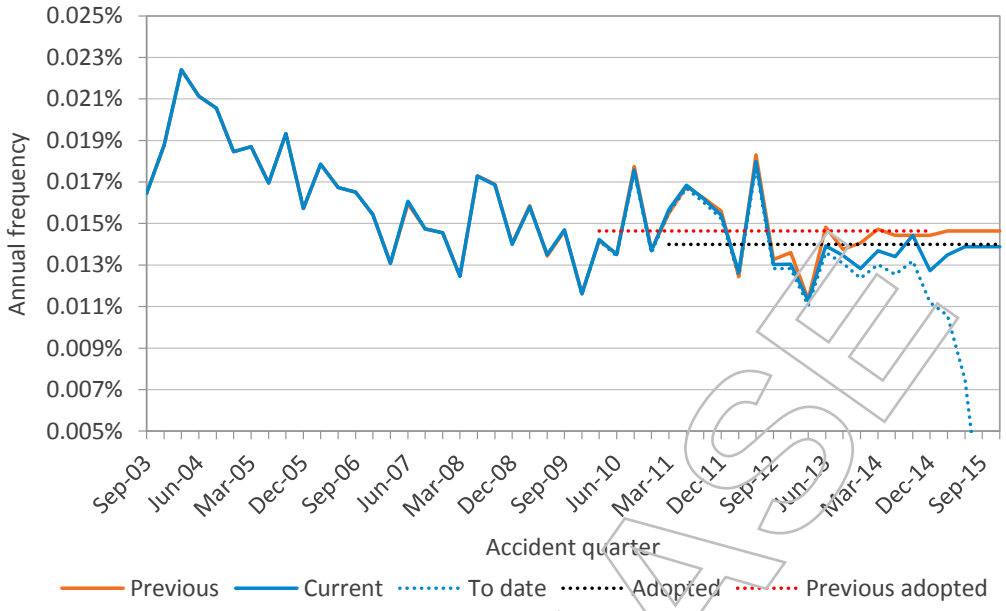
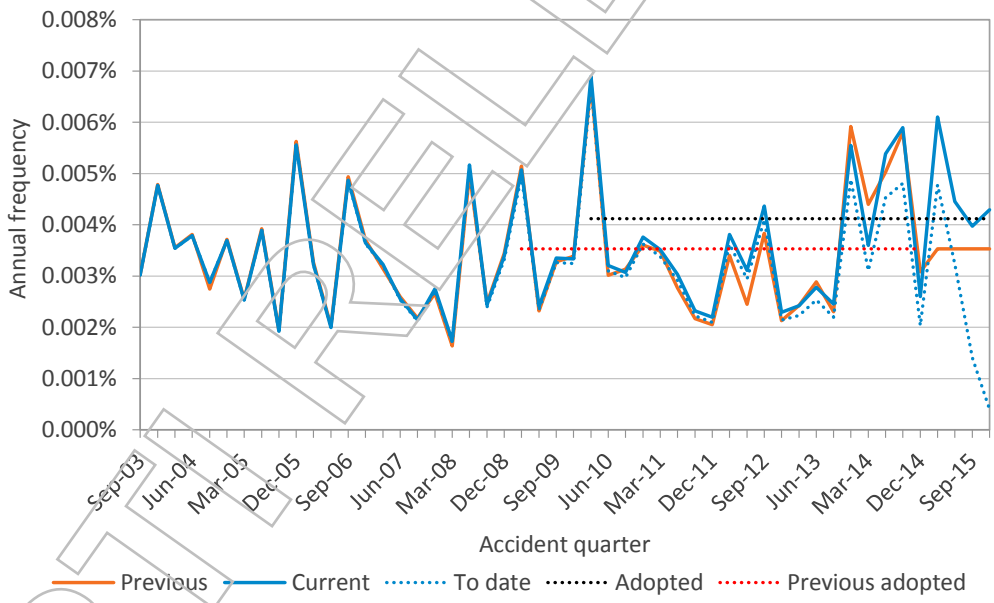


Figure 2.9 **Developed annual frequency of IS claim notifications**



3 CLAIM FREQUENCY BY SEVERITY

Our claim size model depends on the severity of the claim at finalisation. Therefore, we need to estimate the severity at finalisation for all open claims, including those yet to be reported. We build a chain ladder model on the notifications and severity transitions for each severity, with severity 1 divided into with legal representation ("1Y") and without legal representation ("1N"). The resulting severity-specific claim frequencies are scaled to sum to the overall claim frequency model.

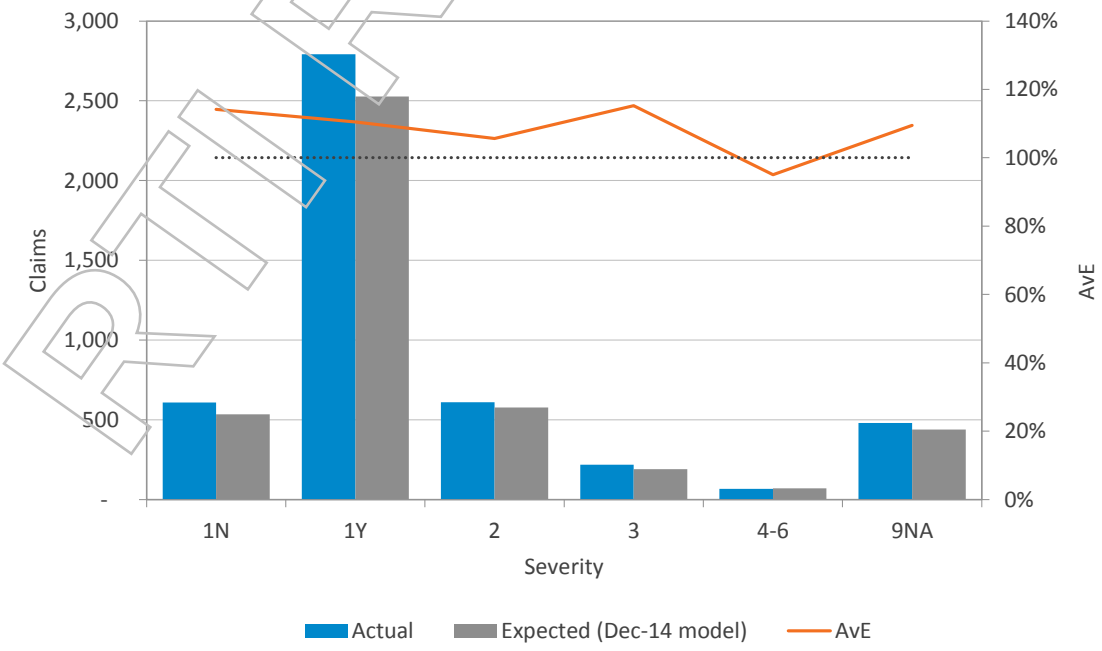
In February 2012, MAIC introduced the lifetime injury coding requirement meaning that insurers are now required to update the injury severity of a claim throughout its lifetime and not just at finalisation.

Note that we only consider the severity profile of core claims in this section. We have not modelled WC and IS claims by severity since most WC claims are low severity (1N, 9NA) while the severities recorded for IS claims and the legal representation flag are not considered sufficiently reliable to use.

3.1 Severity at report

Figure 3.1 shows the actual number of claims notified to date for the accident year 2015 by severity compared to what was forecast at the previous annual review. The higher than expected number of notifications outlined in Section 2.2 does not appear to be disproportionately concentrated in low severities – both severities 2 and 3 have more claims notified to date than expected.

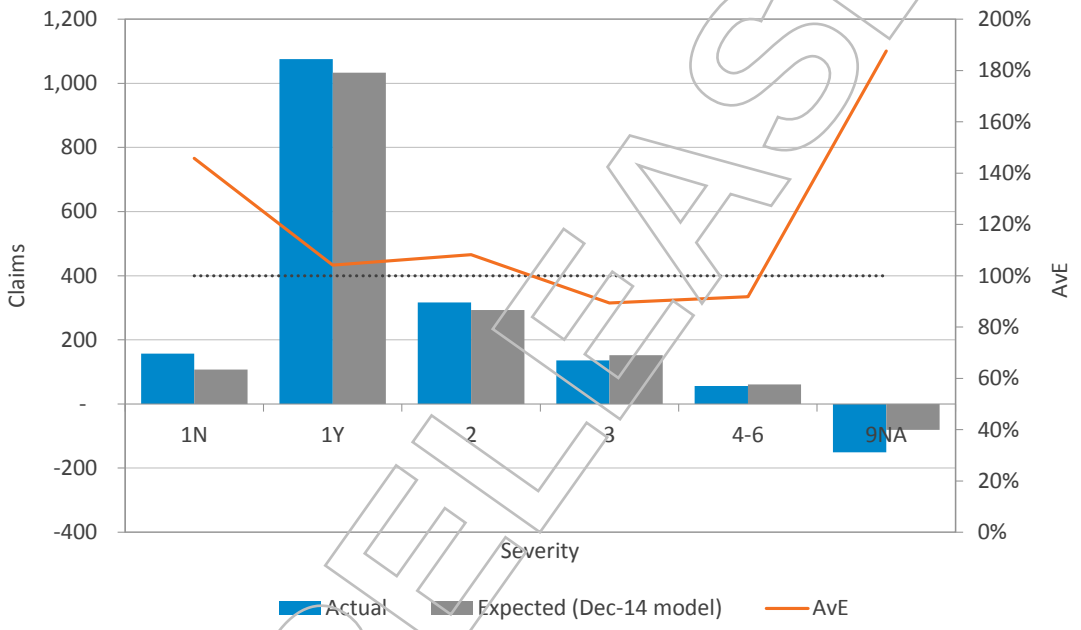
Figure 3.1 **Number of claims notified to date in the** 2015 **accident year**



Note: "N" and "Y" relate to legal representation status.

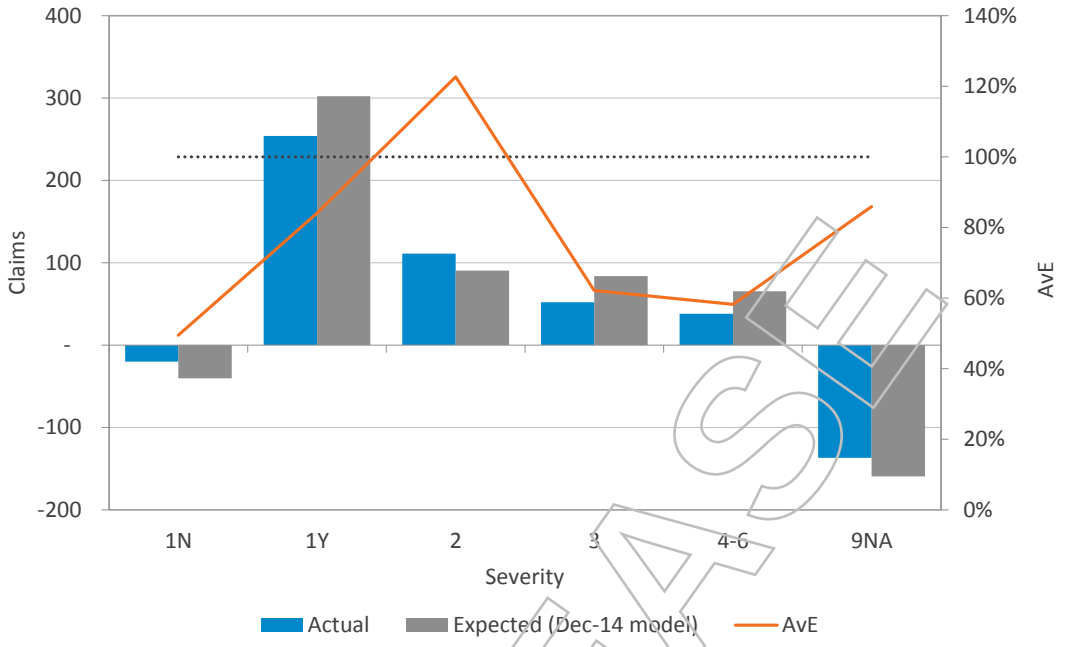
Figure 3.2 shows the actual movement of claim numbers, either due to new claim reports or transitions, by severity compared to what was forecast at the previous annual review for accident year 2014. Figure 3.3 shows the equivalent graph but for pre 2014 accident years. As mentioned in the March quarterly review, an operational issue of one licensed insurer resulted to a large number of claims reported as severity 9. Most of these claims have since been recoded. However, this has led to a temporarily high transition rate out of severity 9 that is beyond what was forecast at the previous annual review. Even so, it can be seen that actual claim development in higher severities has generally been less than expected. Also, fewer claims have transitioned from severity 1N than expected.

Figure 3.2 **Claim movements in 2015 for accident year 2014**



Note: "N" and "Y" relate to legal representation status.

Figure 3.3 **Claim movements in 2015 for pre 2014 accident years**



Note: "N" and "Y" relate to legal representation status.

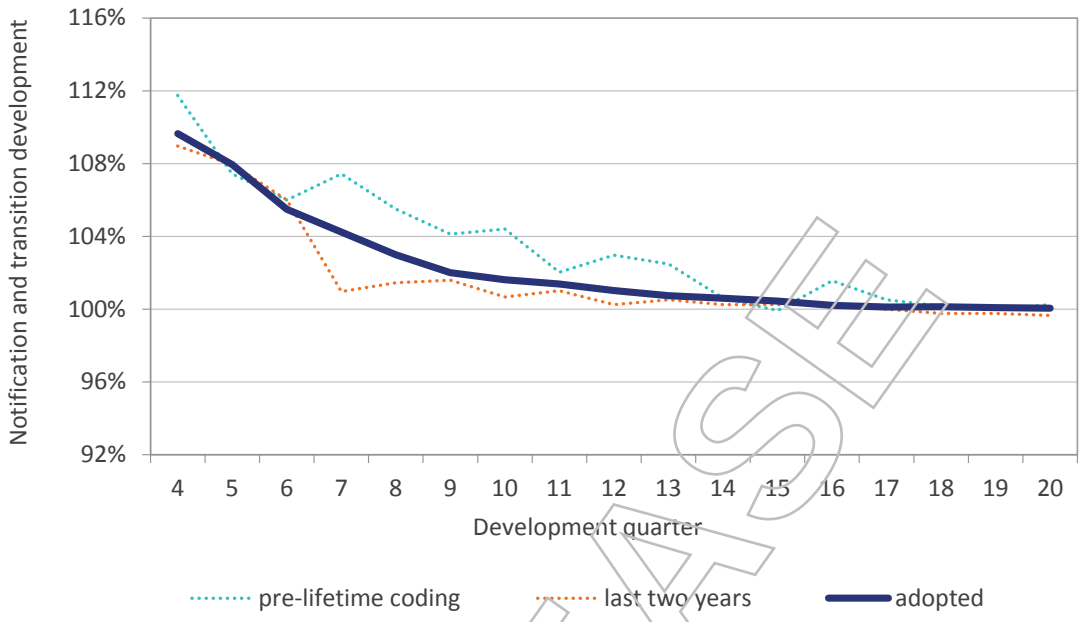
3.2 Severity-specific notification development

In February 2012 MAIC introduced the Lifetime Injury Coding Requirement meaning that insurers are now required to update the injury severity of a claim throughout its lifetime and not just at finalisation. This resulted in a higher than usual volume of transitions as insurers worked through their portfolios, recoding the claims, which has since settled down to a lower volume of transitions.

There is now around 30 months of stable post lifetime coding experience. It is apparent that the development factors for severities 2 and above are much lower than they were before lifetime coding.

For example, Figure 3.4 shows the development factors for severity 3. This illustrates that fewer claims have been notified as or transitioned into severity 3 since the lifetime injury coding requirement was introduced.

Figure 3.4 **Development factors for severity 3**



At the previous annual review, we developed severity-specific notifications to ultimate using 100% post lifetime injury coding experience for severities 1N and 1Y but used a 50:50 blend of pre and post lifetime injury coding experience for severities 2 and above. This was done to recognise the relative uncertainty associated with recent experience for less-frequent severities. Claim development over 2015 for these higher severities has been lower than implied by the 50:50 blend as outlined in Section 3.1. This has provided additional confidence in the post lifetime injury coding experience. In response, there has been a change to using a 25:75 blend of pre and post lifetime injury coding experience.

Table 3.1 shows the weights applied to pre and post lifetime injury coding experience to develop the severity-specific notifications-to-date to ultimate notifications.

Table 3.1 **Weights used to develop severity-specific notifications to ultimate**

Severity	Pre lifetime injury coding	Post lifetime injury coding
1N	0%	100%
1Y	0%	100%
2	25%	75%
3	25%	75%
4	25%	75%
5	25%	75%
6	25%	75%
9 & NA	25%	75%

3.3 Revision of severity-specific frequency to Dec-14 accident quarter

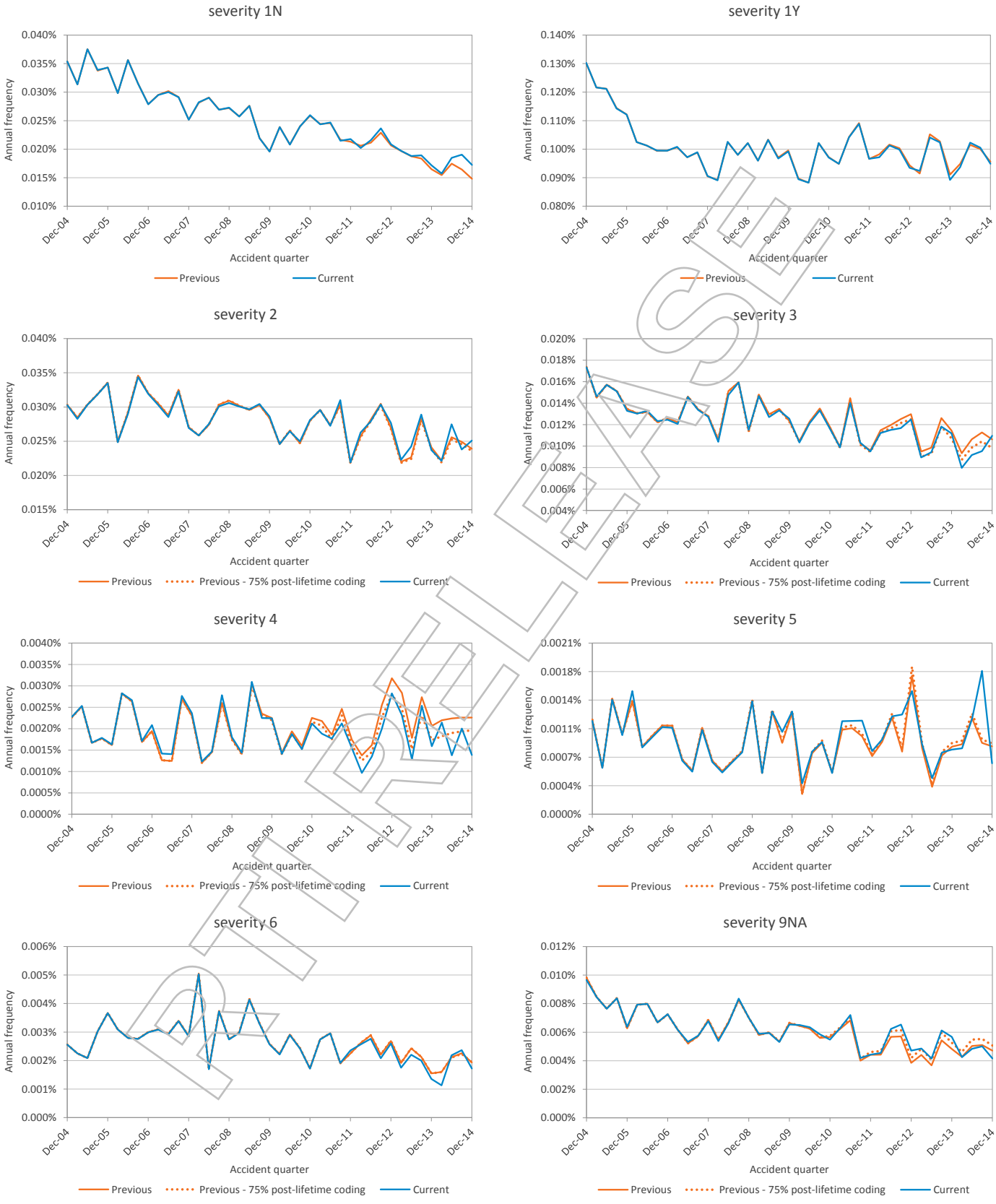
Severity-specific frequency up to accident quarter Dec-14 has been revised from the estimates at the last annual review due to claim development experience over the year as well as the change in weighting towards post lifetime injury coding experience. In Figure 3.5:

- The solid blue line represents the modelled severity-specific claim frequency for each accident quarter as at 31 December 2015
- The solid orange line represents the modelled severity-specific claim frequency for each accident quarter as at 31 December 2014
- The dotted orange line represents what the modelled severity-specific claim frequency would have been as at 31 December 2014 had the revised weights in Table 3.1 been applied.

Figure 3.5 shows that:

- For severity 1N, the downward claim frequency trend has been revised to be less steep partly in recognition that fewer claims are transitioning out of the severity than previously allowed for
- For severity 1Y, claim frequency is largely unchanged
- For severity 2, claim frequency has been adjusted upwards slightly
- For severities 3 and 4, claim frequency has been revised downwards in recognition that claim development in these severities has been relatively low. A significant part of the revision is due to the change to using a higher weighting towards post lifetime injury coding experience
- For severity 5, claim frequency has been adjusted upwards slightly
- For severity 6, the claim frequency has been revised downwards. The falling frequency is consistent with the reduction in road fatalities.

Figure 3.5 **Ultimate severity-specific frequency up to Dec-14**



The revision of severity-specific frequencies outlined above means that the severity profile trended to accident year 2014 has also changed. Specifically, the severity profile has weakened with a lower proportion of claims estimated to be in severity 3, 4 and 6, and a higher proportion of claims in severity 1N. The difference in the trended severity profile of 2014 between the previous annual review and the current review is shown in Table 3.2.

Table 3.2 **Severity profile trended to 2014**

Severity	Proportion of core claims	
	Previous annual review	Current review
	%	%
1N	9.6	10.8
1Y	61.8	61.7
2	15.5	15.4
3	6.9	6.4
4	1.5	1.1
5	0.5	0.6
6	1.3	1.1
9 & NA	3.0	2.9

Table 3.3 shows the estimates of historical claim frequency for each severity as shown in Figure 3.5 but by accident year and including accident year 2015.

Table 3.3 **Estimates of historical claim frequency by severity**

Accident Year	Ultimate Claim Frequency (per annum) excluding WC & IS								
	Severity								
	1N	1Y	2	3	4	5	6	9NA	Overall
	%	%	%	%	%	%	%	%	%
2005	0.034	0.117	0.031	0.015	0.0019	0.0011	0.0028	0.0077	0.211
2006	0.031	0.101	0.030	0.013	0.0023	0.0010	0.0029	0.0075	0.188
2007	0.028	0.097	0.030	0.013	0.0020	0.0007	0.0031	0.0060	0.180
2008	0.028	0.098	0.029	0.013	0.0018	0.0008	0.0033	0.0069	0.180
2009	0.024	0.099	0.030	0.013	0.0023	0.0010	0.0032	0.0059	0.178
2010	0.024	0.094	0.026	0.012	0.0017	0.0006	0.0023	0.0060	0.167
2011	0.023	0.101	0.027	0.011	0.0018	0.0011	0.0025	0.0055	0.173
2012	0.022	0.098	0.028	0.012	0.0018	0.0012	0.0025	0.0055	0.170
2013	0.019	0.097	0.025	0.010	0.0019	0.0007	0.0018	0.0052	0.160
2014	0.018	0.098	0.025	0.009	0.0017	0.0011	0.0019	0.0046	0.159
2015	0.018	0.107	0.026	0.011	0.0019	0.0010	0.0017	0.0048	0.172

3.4 Severity profile for the future underwriting quarter

We set assumed severity proportions for the future underwriting quarter at each annual review. These severity proportions are based on:

- Past experience, specifically that detailed in Sections 3.1 to 3.3
- Our expected claim frequency for the future underwriting quarter.

For this underwriting quarter, the main issue is how the severity profile will change in response to the increased claim frequency. In the recent past, reductions in claim frequency have been accompanied by more severe claim profiles – a consequence of the frequency reductions being driven by disproportionate reductions in less severe claims. Figure 3.6 shows three severity profile scenarios for 2015. The purple line assumes that the severity profile is unchanged from Table 3.2, the red line assumes that the increase in frequency in 2015 will ultimately be severity 1Y claims, and the orange line assumes a reversal of recent trends in severity-specific frequencies. These are compared to the blue line which is our unmodified "chain ladder" projection of the ultimate severity-specific frequency for each accident quarter.

An increase in frequency tends to weaken the severity profile as additional claim notifications are generally concentrated at lower severities. However, there is no clear evidence of this in Figure 3.6, with the orange line very different from the projected 2015 frequencies (blue line) for severities 1N and 1Y. Assuming that the increase in frequency is concentrated in severity 1Y (red line) is very different to projected 2015 frequencies as well, particularly for severities 2 and 3.

The unchanged severity profile assumption (purple line) is most consistent with the projected 2015 frequencies.

Figure 3.6 **Severity profile scenarios for 2015**

The severity profile recommended for the underwriting quarter starting 1 July 2016 is equal to the severity profile trended to 2014 as shown in Table 3.2.

We display the assumed severity proportions in Table 3.4 below.

Table 3.4 **Estimated ultimate proportion of claims (by number) in future underwriting quarter**

Severity	Proportion of core claims Core claim frequency = 0.166%	
	Previous annual review	Current review
	%	%
1N	9.4	10.8
1Y	62.0	61.7
2	15.4	15.4
3	6.9	6.4
4	1.5	1.1
5	0.5	0.6
6	1.2	1.1
9 & NA	3.1	2.9

Table 3.5 shows the projected baseline claim frequency for each severity obtained by applying the severity profile in Table 3.4.

Table 3.5 **Estimated normal baseline claim frequency in future underwriting quarter**

Severity	Core claim frequency	
	Previous annual review	Current review
	%	%
1N	0.015	0.018
1Y	0.098	0.102
2	0.024	0.026
3	0.011	0.011
4	0.0023	0.0019
5	0.0009	0.0010
6	0.0020	0.0018
9 & NA	0.005	0.005
Overall	**0.158**	**0.166**

4 AVERAGE CLAIM SIZE

4.1 Form of claim size model for core claims

The claim size model is formulated as a single Generalised Linear Model of individual positive claim size at finalisation, dependent on:

- Severity at finalisation
- In the case of Severity 1, the legal representation status (represented or unrepresented, denoted Severities "1Y" and "1N" respectively)
- Operational time ("OT") at finalisation
- Legislative effects, due separately to:
  - The "New Scheme" resulting from amendments to the *Motor Accident Insurance Act 1994* introduced in 2000
  - The *Civil Liability Act 2003* ("CLA"). Effects of this legislation recognised in the model include:
    - Initial reductions in claim sizes
    - Some subsequent increases in claim sizes due to the selective elimination of small claims by supposedly CLA-induced reductions in claim frequency
    - Further increases in claim sizes with increasing accident quarter that may represent the gradual erosion of the CLA savings
- Superimposed inflation ("SI") increases in claim sizes with increasing finalisation quarter (in addition to the accident quarter increases just mentioned), whose rate varies with:
  - Severity
  - OT.

4.2 Effect of movement in claim frequency

An analysis of the past correlation of severity specific claim frequency with movement in overall claim frequency shows that, in general, any reduction in overall claim frequency can be partly attributed to the removal of relatively smaller claims which have tended to be concentrated at lower severities. Similarly, an increase in claim frequency can be partly attributed to the addition of relatively smaller claims.

Between annual reviews, it is not practical to carry out a full re-estimation of the severity distribution to reflect changes in the estimated frequency. In the past, we approximated the effect of changes to claim frequency to our baseline expected claim size by increasing the expected claim size by approximately 50% of any decrease in claim frequency (and vice versa).

As discussed in Section 3.2 there is no clear evidence at this point in time that the increase in frequency in accident year 2015 is driven by lower severity claims. It is reasonable to

assume that average claim size is independent of overall claim frequency until there is greater certainty around the severity profile of accident year 2015.

4.3 Experience

4.3.1 Average claim sizes

Figure 4.1 compares claim sizes observed in in the Dec-15 quarter with the forecasts made on the basis of the model adopted for the previous quarterly review. The left hand vertical scale (claim size) in this figure is logarithmic.

Figure 4.1 **Average claim sizes for positive finalisations in the Dec-15 quarter**

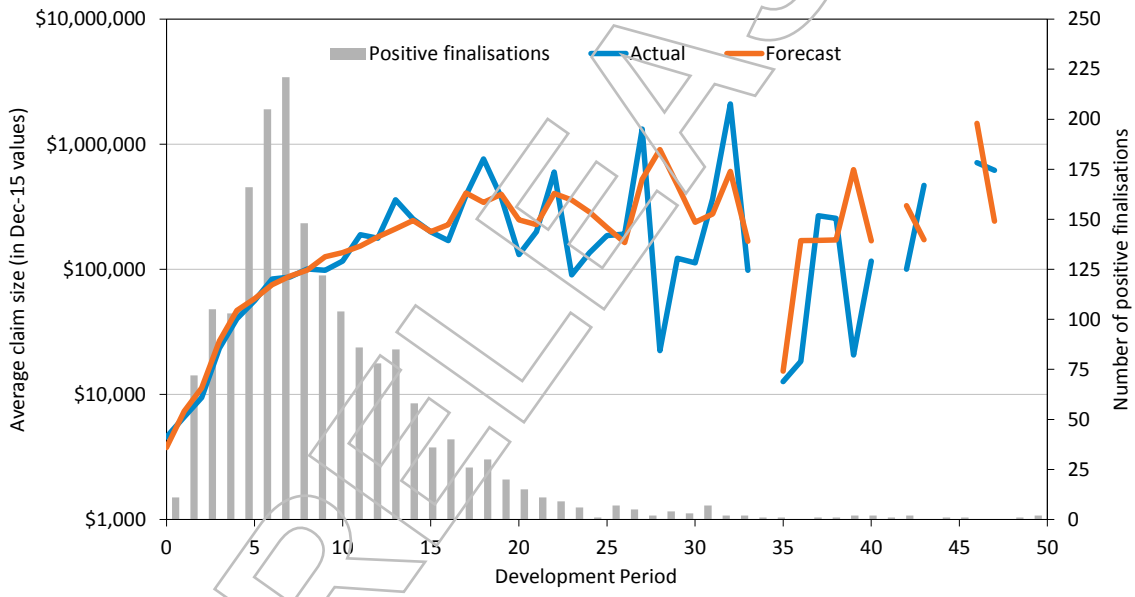


Figure 4.2 shows the comparison in terms of total finalised claim cost during the Dec-15 quarter.

Figure 4.2 **Total cost by accident year in the Dec-15 quarter**

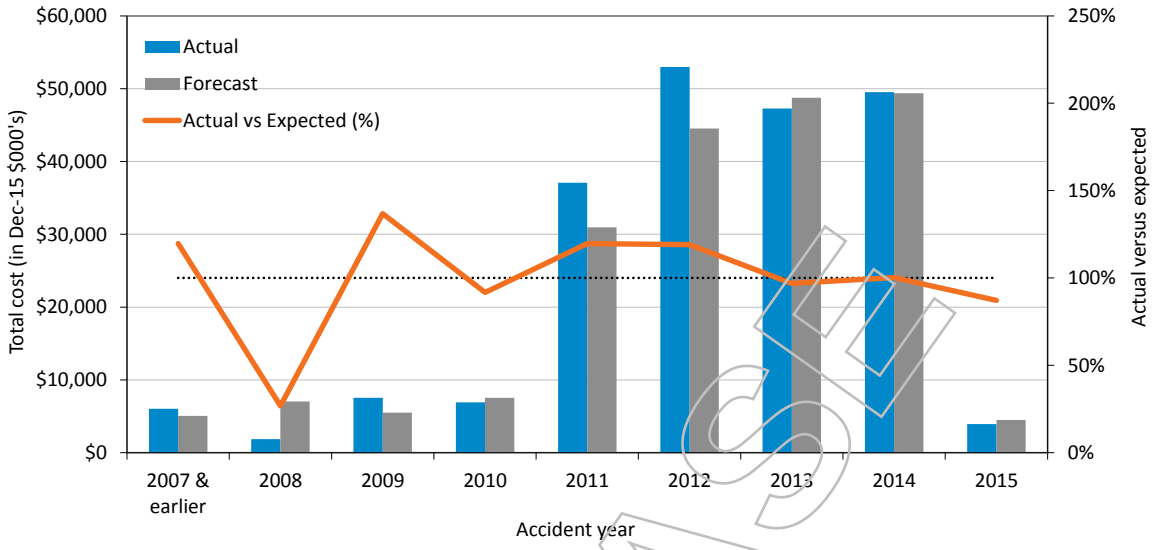


Table 4.1 displays the numerical values of the ratio of actual to forecast claim payments depicted in Figure 4.2. Actual claim payments to claims finalised in the quarter is 5% higher than expected.

Table 4.1 **Ratio of actual to forecast claim payments in the Dec-15 quarter**

Accident periods	Ratio of actual/forecast claim payments
	%
2007 & earlier	120
2008	27
2009	137
2010	92
2011	120
2012	119
2013	97
2014	100
2015	87
Total	**105**

It is helpful to compare total cost by the major severities. This is shown in Figure 4.3 below.

Figure 4.3 **Total cost by severity in the Dec-15 quarter**

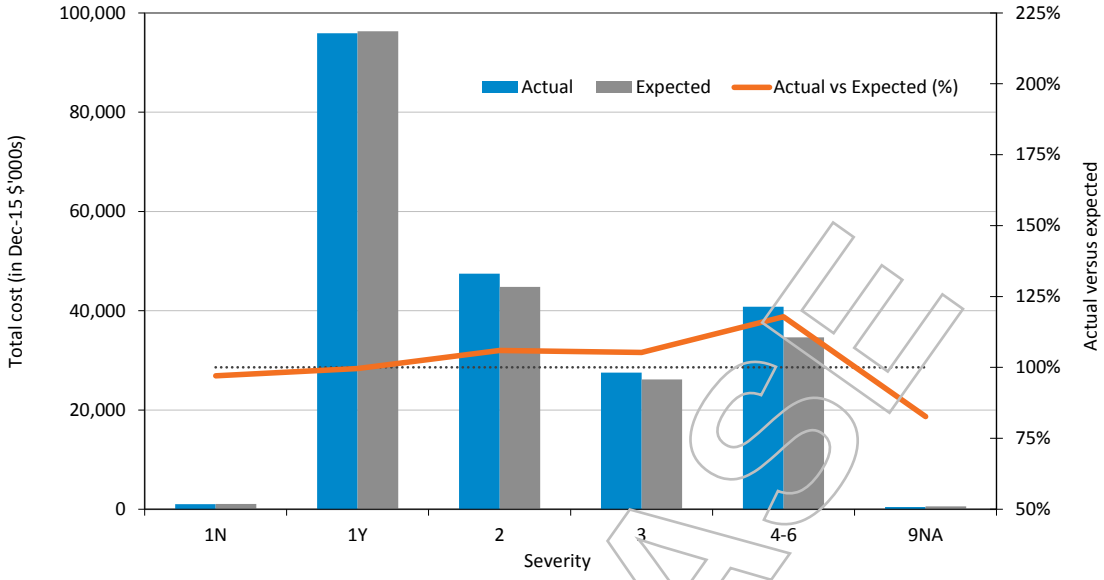


Table 4.2 displays the numerical values of the experience illustrated in Figure 4.3.

Table 4.2 **Ratio of actual/forecast claim payments in the Dec-15 quarter**

Accident periods	Severity 1N	Severity 1Y	Severity 2	Severity 3	Severity 4-6	Severity 9NA
	%	%	%	%	%	%
2010 & earlier	49	102	94	71	85	NA
2011	NA	85	110	172	125	36
2012	131	111	114	92	172	38
2013	34	107	88	77	84	8
2014	102	93	124	145	37	143
2015	101	85	101	23	17	114
Total	**97**	**100**	**106**	**105**	**118**	**83**

4.3.2 Calendar year 2015 average claim sizes

Figure 4.4 compares calendar year 2015 experience with the forecasts made on the basis of the model adopted for the previous annual review. The left hand vertical scale (claim size) in this figure is logarithmic.

Figure 4.4 **Average claim sizes for positive finalisations in the 12 months to Dec-15**

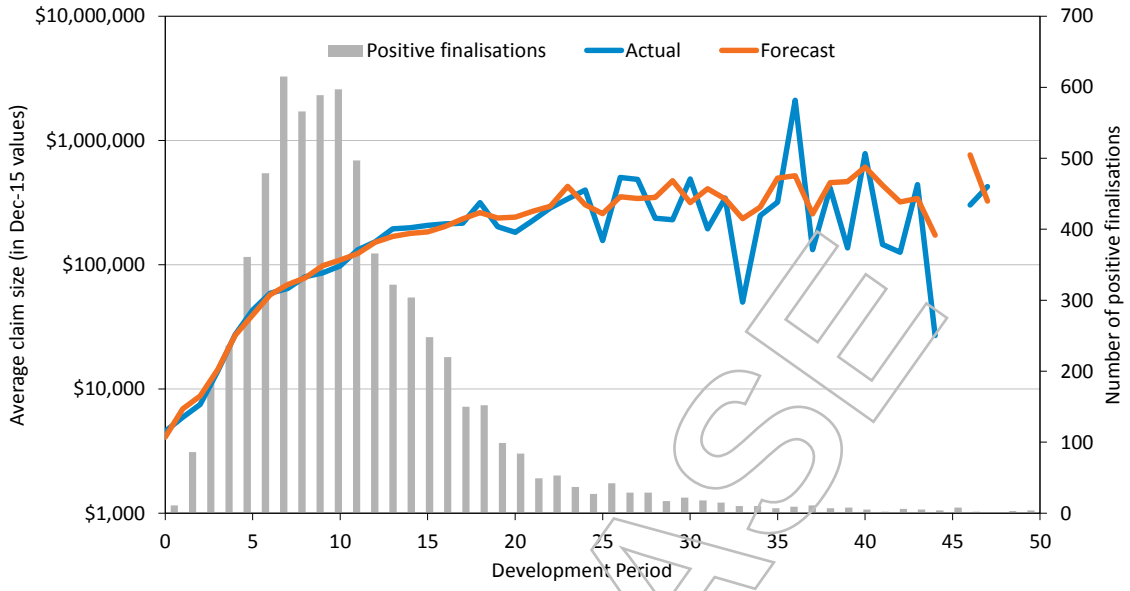


Figure 4.5 shows the comparison in terms of total finalised claim cost.

Figure 4.5 **Total cost by accident year in the 12 months to Dec-15**

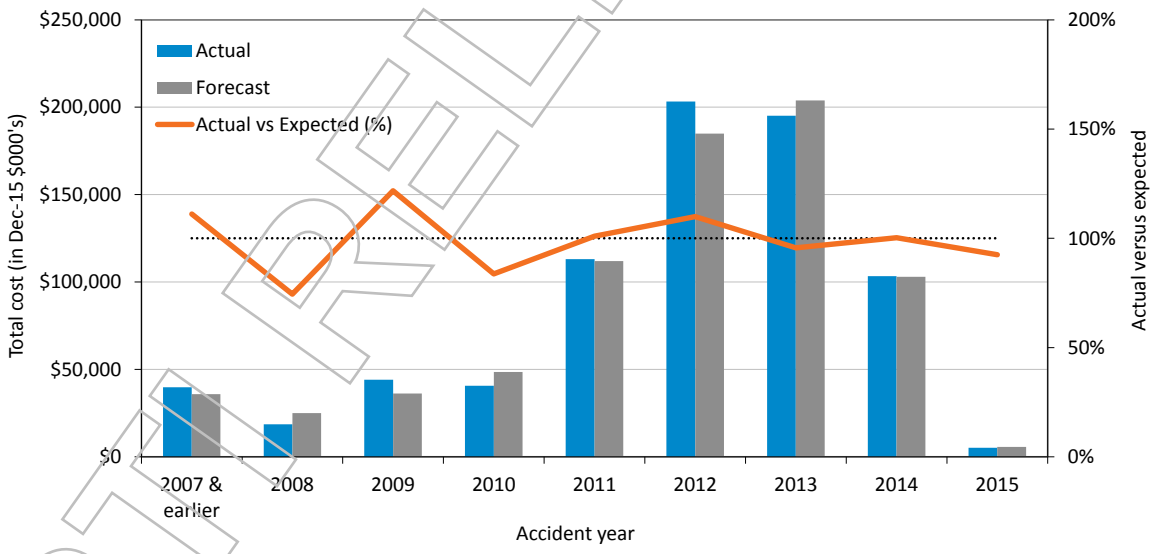


Table 4.3 displays the numerical values of the ratio of actual to forecast claim payments depicted in Figure 4.5. Actual claim payments to claims finalised in the year to date is 1% higher than expected.

Table 4.3 **Ratio of actual to forecast claim payments in the 12 months to Dec-15**

Accident periods	Ratio of actual/forecast claim payments
	%
2007 & earlier	111
2008	75
2009	122
2010	84
2011	101
2012	110
2013	96
2014	100
2015	93
Total	**101**

It is helpful to compare total cost by the major severities. This is shown in Figure 4.6 below.

Figure 4.6 **Total cost by severity in the 12 months to Dec-15**

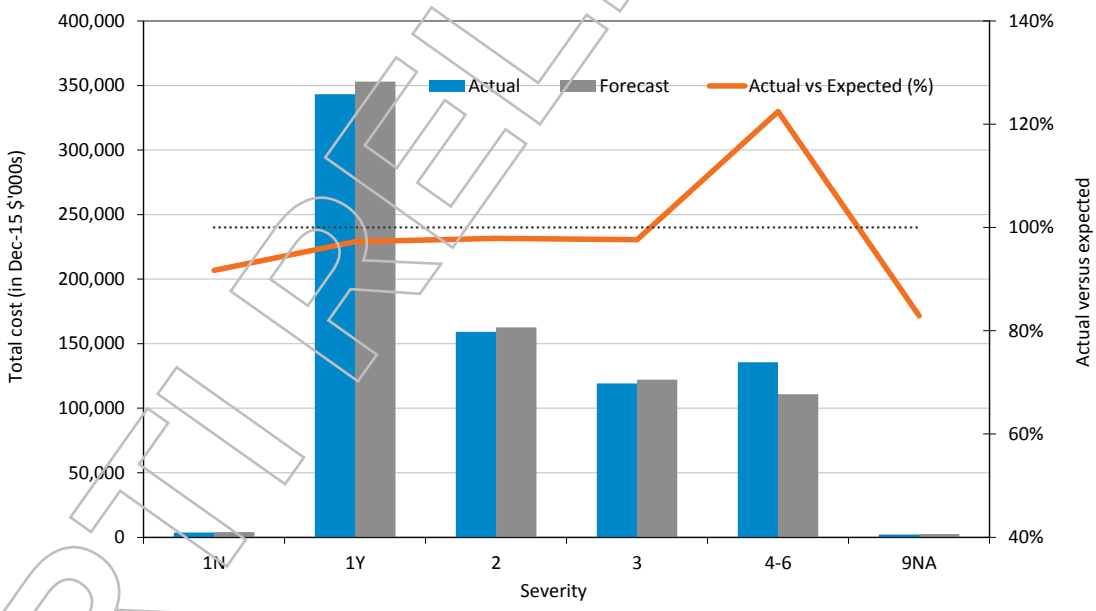


Table 4.4 displays the numerical values of the experience illustrated in Figure 4.6.

Table 4.4 **Ratio of actual/forecast claim payments in the 12 months to Dec-15**

Accident periods	Severity 1N	Severity 1Y	Severity 2	Severity 3	Severity 4-6	Severity 9NA
	%	%	%	%	%	%
2010 & earlier	85	95	86	68	127	76
2011	116	88	87	151	93	144
2012	91	107	104	103	146	41
2013	86	96	99	77	124	38
2014	87	95	111	120	115	153
2015	103	91	101	35	76	107
Total	**92**	**97**	**98**	**98**	**122**	**83**

4.3.3 Case estimate development

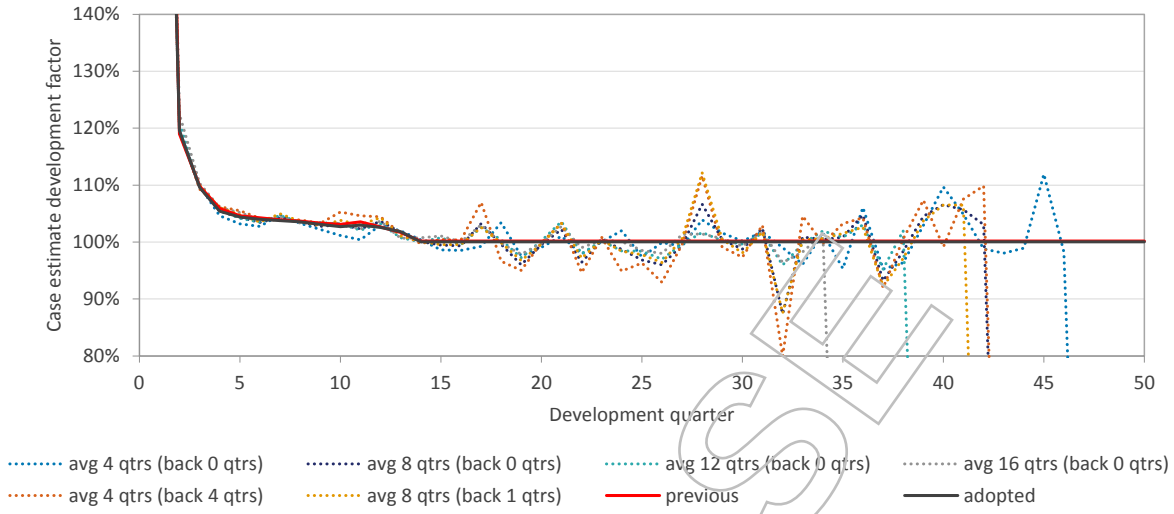
Figure 4.7 illustrates recent changes in the experience of case estimate development ("CED"). The figure plots CED factors, defined for each combination of accident quarter and development quarter. These are defined as follows:

$$\frac{\text{Quarter's closing case estimates + claim payments in the quarter}}{\text{Quarter's opening case estimates}}$$

where all quantities are expressed in constant dollar values.

The numerator of the factor is a hindsight estimate of the denominator, and so the factor represents insurers' change in opinion of the denominator over the quarter. The relevance of case estimates is that they can provide a valuable indication of claim sizes at high operational times.

Figure 4.7 **Case estimate development**



The model CED factor for future development is taken to be the average over the two years ending Dec-15. This leads to a modelled quarterly CED factor of 100.5% in development quarters 14 and later.

We have compared the results of the Projected Case Estimate (PCE) model with our finalised claims model for claims with substantial delay since the accident date. There is no indication that the finalised claims model is insufficient.

The PCE model has not been directly used in our estimate of risk premium.

4.4 Estimated average claim size

4.4.1 Recalibration of the full severity model

We have updated the full severity model to reflect experience. The full severity model:

- Responds to recent experience at low operational times and low severities
- Adapts more slowly to emerging experience at higher operational times and high severities, reflecting the greater variability in these cohorts.

For example, severity 1N matches recent experience very closely whereas severity 4 and 5 take a longer-term view of average claim size. Severity 1Y responds to recent experience at low operational times, but takes a longer-term view at higher operational times.

Operational time is measured at a severity level. This approach substantially reduces the vulnerability of average claim size estimates to changes in finalisation behaviour. The speed of finalisation of claims of one severity does not affect the average claim size of claims of other severities. This feature, in addition to using a long time window when estimating average claim sizes for higher operational time finalisations, means that average claim size estimates are not likely to be unduly affected by temporary changes in finalisation behaviour.

We demonstrate this philosophy by showing model diagnostics for severities 1Y, 2 and 3. These contribute 80% of the normal claims risk premium.

Severity 1Y

Figure 4.8 shows the actual versus projected average claim size by operational time for severity 1Y for the last two years. Figure 4.9 shows the actual versus projected average claim size by finalisation year for operational time above 90%. The model follows the experience of the last two years quite closely. As the operational time increases, we depart from fitting to recent experience (2013 and 2014 finalisation years) and take a longer-term view. The fit of this longer-term view can be seen in Figure 4.9.

Figure 4.8 **Actual versus projected average claim size for severity 1Y for 2013 and 2014 finalisation years**

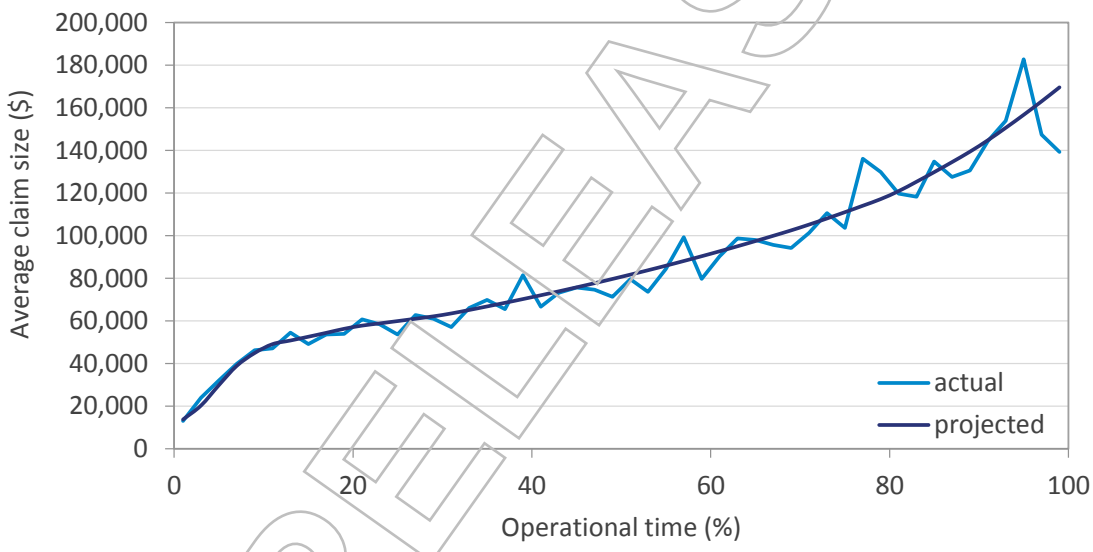
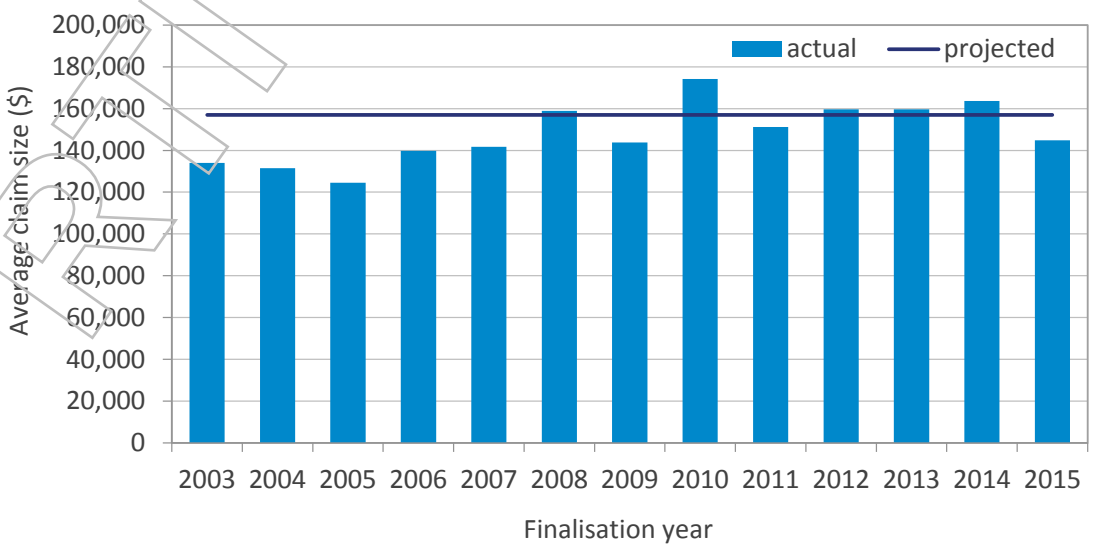


Figure 4.9 **Actual versus projected average claim size for operational times above 90% for severity 1Y**



4.4.1 Severity 2

Figure 4.10 shows the actual versus projected average claim size by operational time for severity 2 for the last two years. Figure 4.11 shows the actual versus projected average claim size by finalisation year for operational time above 70%. The model follows the experience of the last two years quite closely up to operational time 70%. As the operational time increases, we depart from fitting to recent experience (2013 and 2014 finalisation years) and take a longer-term view. This happens earlier along the operational time curve for severity 2 than we saw in severity 1Y because the claim experience is more volatile. The fit of this longer-term view can be seen in Figure 4.11.

Figure 4.10 **Actual versus projected average claim size for severity 2 for 2013 and 2014 finalisation years**

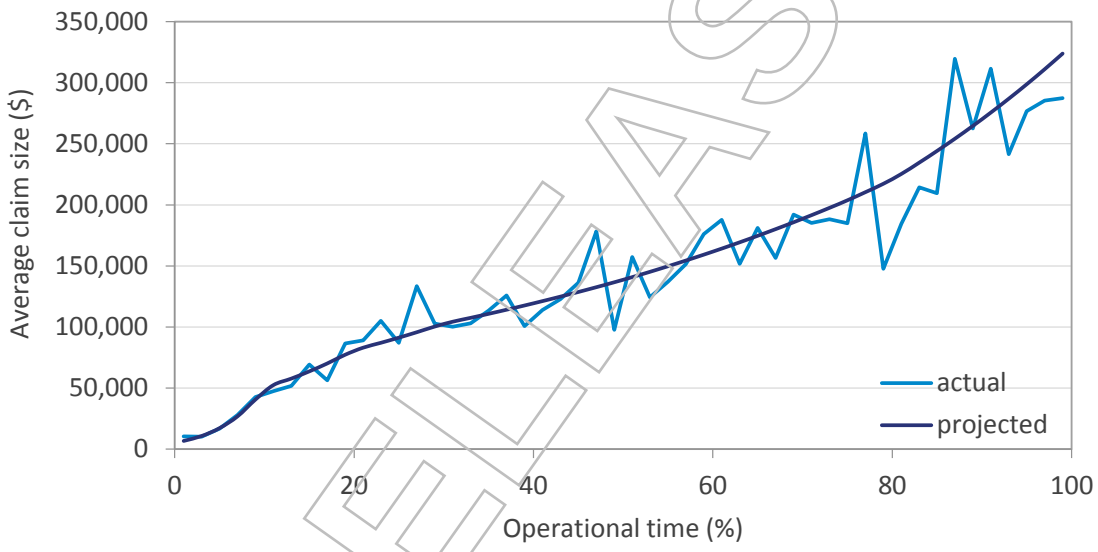
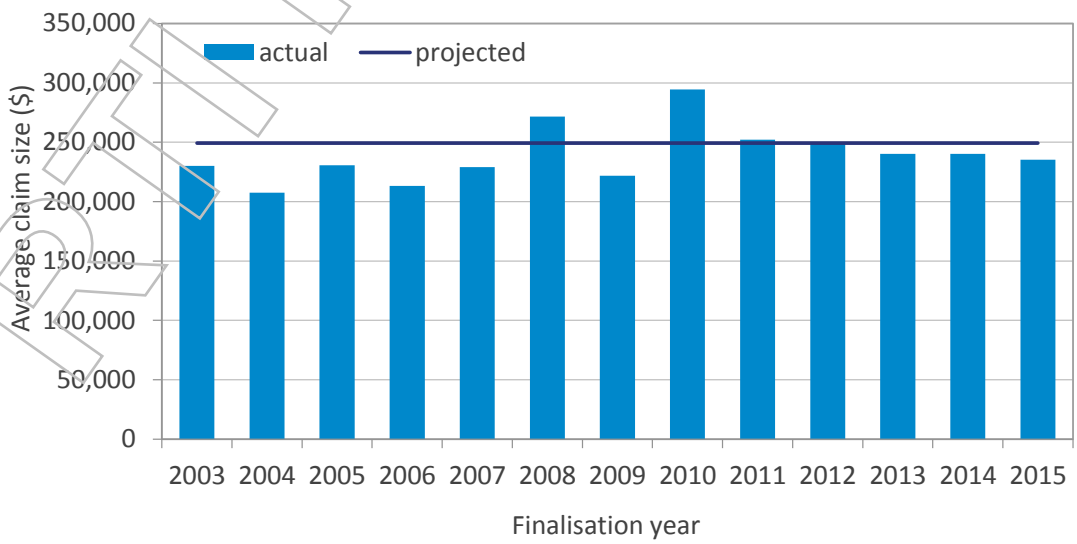


Figure 4.11 **Actual versus projected average claim size for operational times above 70% for severity 2**



4.4.2 Severity 3

Figure 4.12 shows the actual versus projected average claim size by operational time for severity 3 for the last two years. Figure 4.13 shows the actual versus projected average claim size by finalisation year for operational time above 30%. The model fits adequately at earlier operational times. As the operational time increases, we depart from fitting to recent experience (2013 and 2014 finalisation years) and take a longer-term view. This happens earlier along the operational time curve for severity 3 than we saw in severities 1Y and 2 because the claim experience is more volatile. The fit of this longer-term view can be seen in Figure 4.13.

Figure 4.12 **Actual versus projected average claim size for severity 3 for 2013 and 2014 finalisation years**

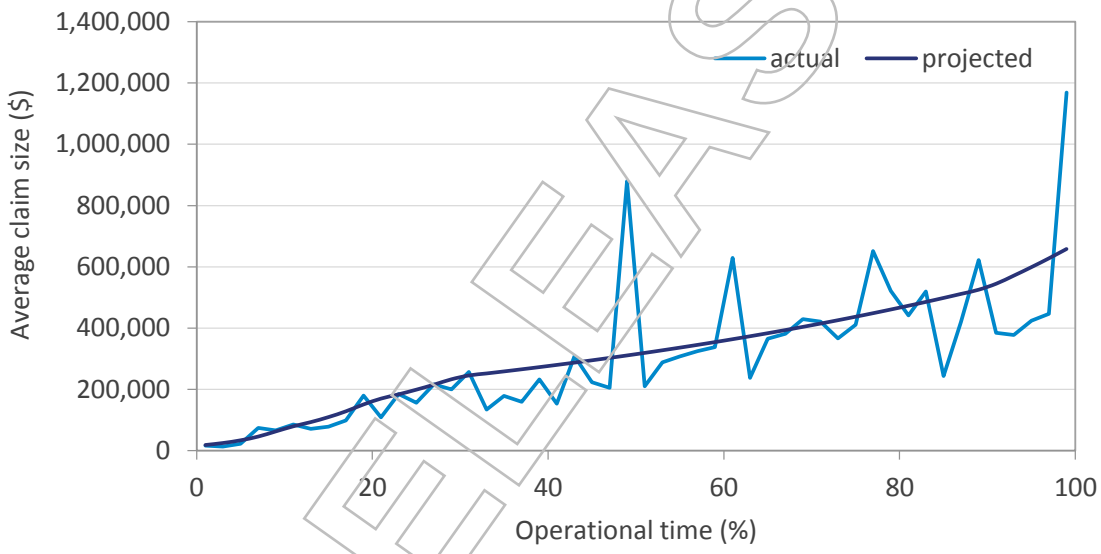
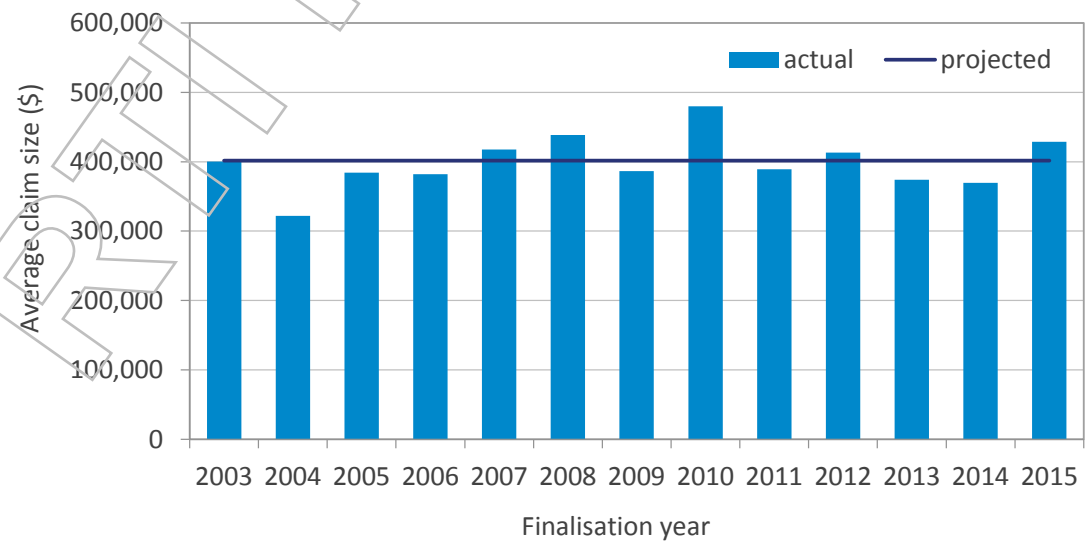


Figure 4.13 **Actual versus projected average claim size for operational times above 30% for severity 3**



4.4.2 Model structure detail for each severity

Table 4.5 provides a brief description of the model structure assumed for each severity, with a focus on the last 10 years of experience. The steepness of the OT curve describes how sensitive average claim size is to changes in operational time. Note that the shape of the OT curve shows how predictive operational time is *within* a severity and not *between* severities. We describe how the OT shape differs from average.

Table 4.5 **Model structure**

Severity	Operational time shape	Superimposed inflation (by finalisation quarter)
1N	The OT curve is flatter than average, indicating less discrimination by OT The OT curve is steeper between OT 70% and OT 100%	A one-off reduction in average claim size from 2009Q3 From 2011Q2, the average claim size for smaller 1N claims decreased, reducing linearly to zero at OT 30%
1Y	The OT curve is steeper than average, indicating more discrimination by OT The OT curve is steeper below OT 6% and above OT 70%	From end of 2004Q4 till 2008Q4, rate of SI increases linearly with increasing OT A decrease in claim size from 2013Q1, decreasing linearly with OT
2	The OT curve is steeper than average, indicating more discrimination by OT The OT curve is steeper below OT 50% and above OT 80%	From end of 2006Q4 till 2008Q4. Rate of SI increases linearly with decreasing OT A decrease in claim size from 2013Q1, decreasing linearly with OT
3	The OT curve is shallower than average below OT 20%, and steeper than average above OT 90%	A decrease in claim size from 2013Q1, decreasing linearly with OT up to OT 70%
4	The OT curve is shallower than average between OT 10% and OT 50%	None
5	None	None
6	The OT curve is steeper than average between OT 10% and OT 35%	A gradual flattening of the OT curve between 2008Q1 and 2010Q1, before reversing between 2010Q1 and 2012Q1
9 & NA	The OT curve is flat from OT 50% to 90% and steeper above OT 90%	A decrease in claim size between 2008Q1 to 2010Q1, decreasing linearly from OT 50% and OT 100%

4.5 Forecast gross non-ITC average claim size for core claims

Table 4.6 displays for the underwriting quarter beginning 1 July 2016:

- The inflation adjusted estimated claim sizes from the previous quarterly review
- The projected average claim sizes using the model as described in Section 4.4.2.

Table 4.6 **Estimated average claim size in Dec-15 dollars, excludes WC & IS and CLAA and tax loadings**

Severity	Previous review	Current review	Change
	$	$	%
1N	5,188	5,270	+1.6
1Y	86,588	86,477	-0.1
2	147,920	148,429	+0.3
3	317,229	315,042	-0.7
4	830,091	827,934	-0.3
5	1,648,958	1,698,138	+3.0
6	192,566	191,428	-0.6
9 & NA	15,402	15,289	-0.7
All	**122,718**	**119,207**	**-2.9**

The 2.9% reduction is overall average claim size is driven by the weaker severity profile described in Section 3.4. The average claim size within each severity remains largely unchanged.

Figure 4.14 shows current estimates of average claim size by accident quarter compared to estimates at the last quarterly review in Dec-15 dollars. It also shows what the previous estimates would have been if the revised severity profile had been applied.

Figure 4.14 **Comparison of overall average claim size by accident quarter in Dec-15 dollars**

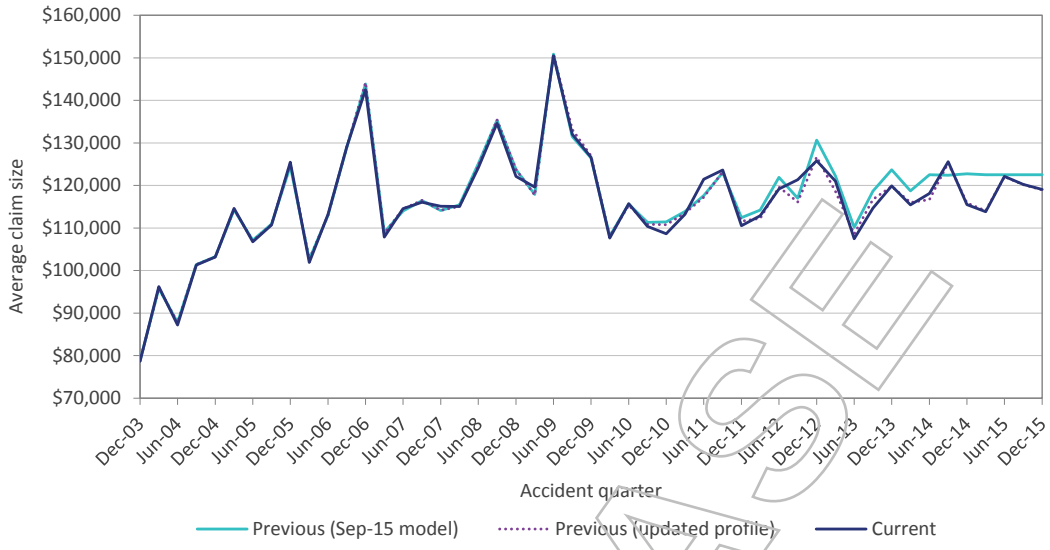
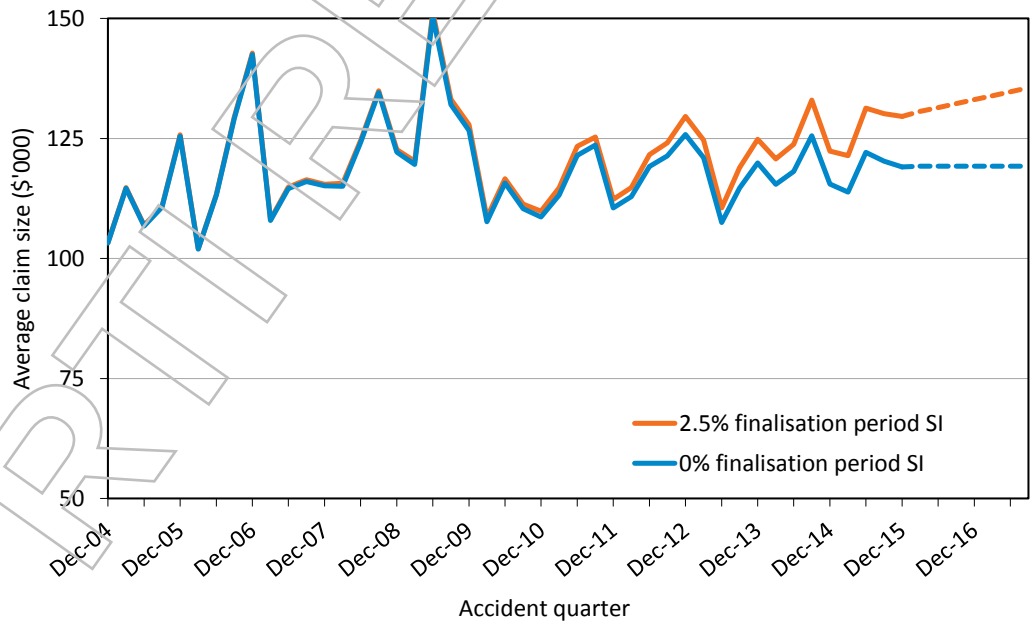


Figure 4.15 plots the estimated average core claim size by accident quarter in Dec-15 dollars. We show the average claim size under the 0.0% and 2.5% finalisation period superimposed inflation scenarios. For accident periods up to Dec-15, Figure 4.15 shows the average claim size. For future periods the average claim size is estimated assuming a core claim frequency of 0.166%.

Figure 4.15 **Average claim size in Dec-15 dollars**



4.6 Average claim size for WC and IS claims

Simple aggregate payments per claim finalised models were separately fitted to the WC and IS claims experience leading to average claim sizes of:

- $10,481 for WC
- $47,611 for IS claims.

5 RISK PREMIUM

The risk premium is composed of:

- The cost of normal claims (Sections 2.5, 3.4 and 4.5)
- The cost of WC and IS claims (Sections 2.6 and 4.6)
- Loadings for:
  - CLAA
  - 2012 tax cuts.

Each of these is discussed below.

5.1 Risk Premium for core claims

Combining our claim frequency and claim size projections for core claims gives an uninflated, undiscounted, gross, non-ITC risk premium estimate for the underwriting quarter beginning 1 July 2016, excluding any allowance for future superimposed inflation, CLAA, 2012 tax changes or WC and IS claims of $197.88.

Table 5.1 show the changes between this estimate and the corresponding estimate from the Sep-15 quarterly review.

Table 5.1 **Changes in risk premium from the previous quarterly review**

Severity	Risk premium (core claims) as at Sep-15 (Dec-15 $s)[1]	Change in risk premium due to experience ($s)			Risk premium (core claims) as at Dec-15 (Dec-15 $s)
		Overall frequency	Severity profile	Claim size	
1N	0.77	+0.04	+0.12	+0.01	0.94
1Y	84.81	+4.27	-0.39	-0.11	88.58
2	36.11	+1.83	-0.04	+0.12	38.02
3	34.41	+1.63	-2.16	-0.24	33.64
4	19.21	+0.74	-4.57	-0.05	15.33
5	14.06	+0.81	+1.92	+0.42	17.21
6	3.78	+0.17	-0.50	-0.02	3.43
9 & NA	0.74	+0.04	-0.05	-0.01	0.72
All severities	**193.89**	**+9.53**	**-5.67**	**+0.13**	**197.88**

Notes: 1. Risk premium for September based on baseline frequency of 0.158%

5.2 Risk premium for WC and IS claims

The risk premium for WC claims is calculated as $1.47, based on:

- A claim frequency of 0.0140%
- An average claim size of $10,481.

The risk premium for IS claims is calculated as $1.96, based on:

- A claim frequency of 0.0041%
- An average claim size of $47,611.

5.3 Loadings

5.3.1 CLAA

We continue to run off the Civil Liability and Other Legislation Amendment Act 2010 (CLAA) loading in equal annual instalments of $1.49 in recognition of the fact that the claim size experience will increasingly include more post-CLAA experience. This leads to a loading of $1.49 for the 2016Q3 – 2017Q2 underwriting quarters.

5.3.2 2012 tax cuts

We continue to run off the loading for the tax cuts over several years to 2012 in equal annual instalments of $1.17. This leads to a loading of $1.17 for the 2016Q3 – 2017Q2 underwriting quarters.

5.4 Total risk premium

Combining the results from Sections 5.1 to 5.3 leads to the following components of risk premium for the underwriting quarter beginning 1 July 2016 (based on a baseline claim frequency of 0.166%):

Table 5.2 **Components of risk premium**

	($)
Risk premium for core claims	197.88
WC claims	1.47
IS claims	1.96
Tax cut loading	1.17
CLAA loading	1.49
Total	**203.97**

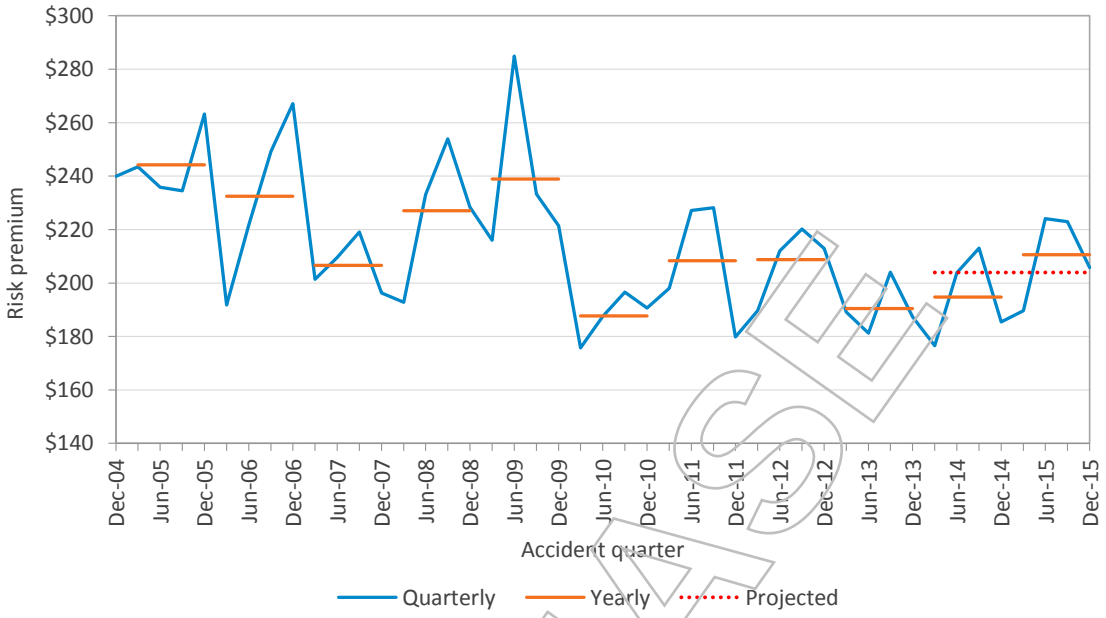
Table 5.3 presents the quarterly reconciliation of all components of risk premium.

Table 5.3 **Quarterly reconciliation of risk premium**

	($)
Risk premium at 30 September 2015	**203.85**
Changes due to	
AWE	*-1.54*
Core claim frequency	*9.53*
Severity profile	*-5.67*
Claim size	*0.13*
WC and IS	*0.34*
Loadings	*-2.66*
Total	***0.13***
Risk premium at 31 December 2015	**203.97**

Figure 5.1 displays the estimated risk premiums for each accident quarter (blue) and accident year (orange), before any adjustment for future finalisation period superimposed inflation. The dotted red line shows our projected risk premium. Note that the risk premiums include WC, IS, CLAA and 2012 tax changes loadings.

Figure 5.1 **Risk premiums in Dec-15 dollars**



5.5 Sensitivity

We give a table showing the effect of some of the uncertainties and scenarios discussed in the text of this report. This table is illustrative only and should not be understood as giving a range of possible outcomes for the risk premium, nor to exhaustively cover the sources of uncertainty which impact on these possible outcomes.

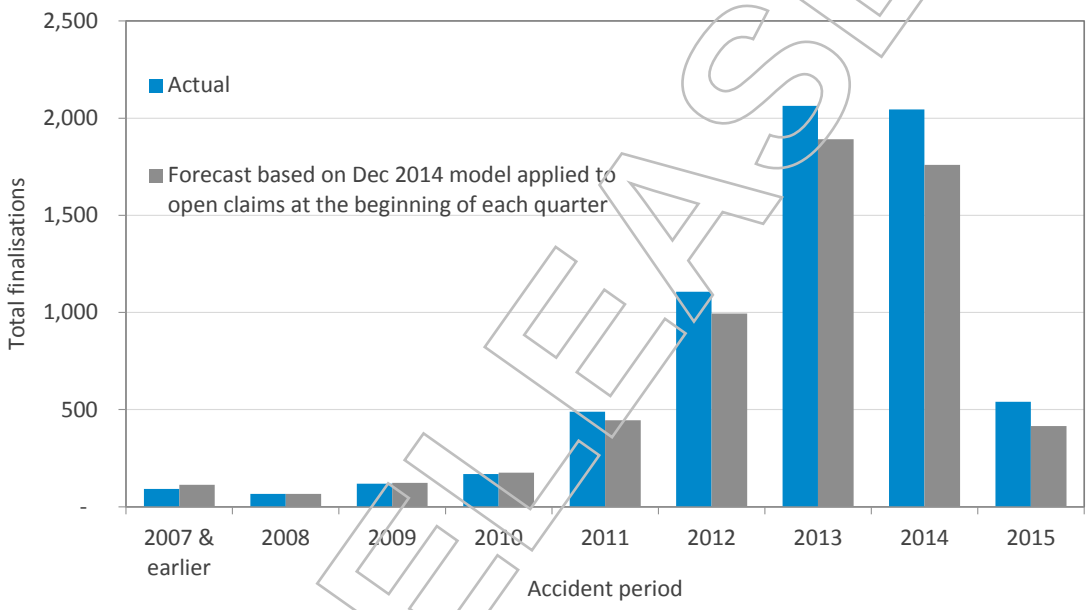
Table 5.4 **Sensitivity to important assumptions**

		Change in risk premium ($)
Overall frequency	Consistent with AY2014 (0.159%)	*-9*
	Consistent with AY2015 (0.172%)	*+7*
Severity profile	Post LTC experience only	*-1*
	Pre LTC experience only	*+5*
	Reversion of historical frequency trends	*-5*
	Increase in frequency entirely due to severity 1Y	*-2*

6 PAYMENT PATTERN

Figure 6.1 shows the number of claim finalisations compared to expected numbers based on the model from the previous annual review. Overall, finalisation experience in 2015 has been significantly higher than previous years, with actual numbers being 12% above expected.

Figure 6.1 **Actual versus expected finalisations in calendar year** 2015



The term "payment pattern" is used to describe the distribution of an underwriting quarter's claim costs over development periods. It is determined mainly by reference to the models of finalisation rates and finalisation sizes. Table 6.1 sets out the payment pattern that follows from the models of the present report, and compares it with that used by MAIC in calculating Floor and Ceiling premium rates over the past four quarters. The payment pattern is a little shorter than previous assumptions, in partial recognition of the increase in finalisation rates observed over the year as well as the weaker severity profile. Note that the payment pattern is in current dollar values, and excludes both future wage and superimposed inflation.

Table 6.1 **Payment pattern**

Development year (from underwriting)	Previous review	Current review
	%	%
1	0.8	0.9
2	11.2	12.7
3	26.8	27.8
4	22.9	24.2
5	15.1	13.8
6	8.4	7.8
7	5.0	4.3
8	3.2	2.6
9	2.0	1.8
10	1.3	1.3
11	0.9	0.9
12 & later	2.4	1.9
Total	**100.0**	**100.0**
Mean term	**4.01**	**3.85**

7 ECONOMIC ASSUMPTIONS

7.1 Past inflation

Our model of average claim size relies upon quarterly indexing of historical claim payments up to the date of review. We index historical claim payments using the Australian Bureau of Statistics ("ABS") publication of Average Weekly Earnings ("AWE"), index 6302.0, QLD seasonally adjusted, all employees total earnings series and the Deloitte Access Economics forecasted Queensland AWE rates.

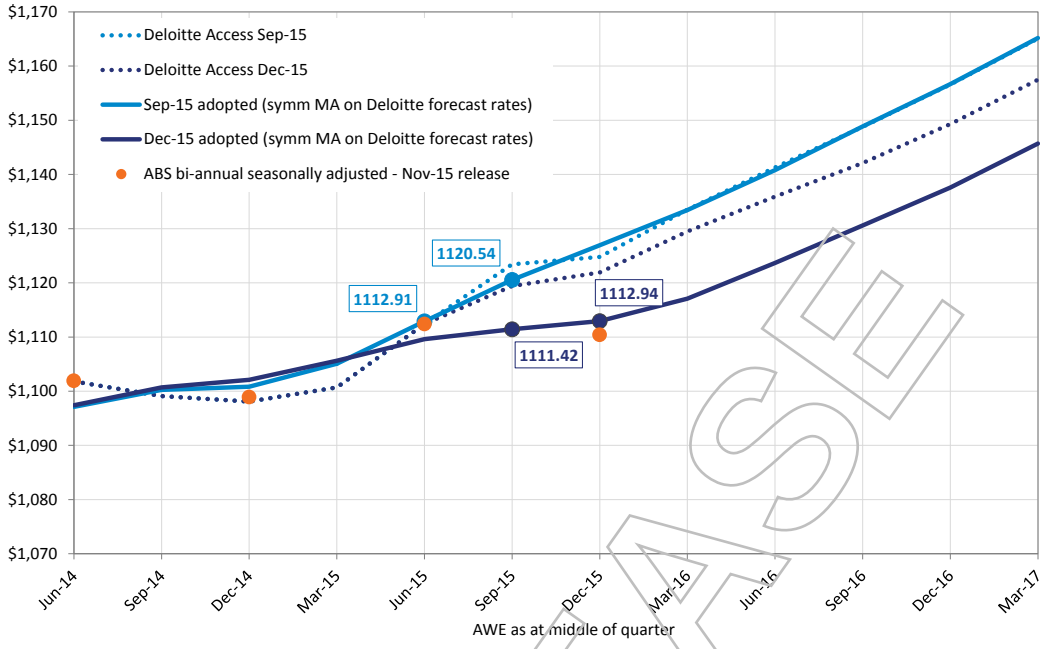
In 2012, the ABS changed the frequency of their publication of past AWE from a quarterly series to a half yearly series. As a result, the ABS does not publish an AWE series for the September and March quarters. The latest available series published by the ABS is the November 2015 series, published in February 2016.

We have elected to combine the published ABS seasonally adjusted series together with the latest available forecasted rates from Deloitte Access Economics to produce an augmented ABS seasonally adjusted series up to December 2015. We then apply the ABS trending methodology to estimate the eventual values of the ABS trended series.

Figure 7.1 shows the comparison between:

- The November 2015 ABS seasonally adjusted series (orange markers)
- The September 2015 Deloitte Access Economics series (dotted light blue line)
- The December 2015 Deloitte Access Economics series (dotted dark blue line)
- Our adopted forecasts at September 2015 (solid light blue line)
- Our adopted forecasts at December 2015 (solid dark blue line).

Figure 7.1 **Queensland AWE estimates for December 2015 quarter**



As shown in Figure 7.1:

- Our previous adopted AWE estimate for the middle of the September 2015 quarter was $1,120.54
- Our current adopted AWE estimate for the middle of the December 2015 quarter is $1,112.94, representing a decrease of 0.7% over the quarter.

Historical claim payments are inflated to the date of review:

- Our previous adopted AWE estimate for 30 September 2015 was $1,123.73
- Our current adopted AWE estimate for 31 December 2015 is $1,115.02, representing a decrease of 0.8% over the quarter.

7.2 Future inflation

Forecasts of future inflation and bond yields have changed since the previous quarterly review. Both have been estimated period by period into the future. The inflation projections are for QLD AWE inflation and sourced from Deloitte Access Economics. The bond yields are derived from market yields as at 8 March 2016. References to the previous quarterly review in the tables below refer to the rates based on yields as at 7 December 2015.

Table 7.1 shows the economic assumptions by future year.

Table 7.1 **Future economic assumptions by year**

Future Year	Wage inflation (%pa)		Investment return (%pa)	
	Previous quarterly review	Current review	Previous quarterly review	Current review
Up to underwriting quarter	2.4	2.2		
1	2.9	2.9	2.1	1.9
2	3.4	3.7	2.2	2.0
3	3.6	3.9	2.5	2.2
4	3.6	4.0	2.8	2.4
5	3.7	4.1	3.1	2.6
6	3.9	4.1	3.4	2.8
7	3.6	3.7	3.7	3.0
8	3.6	3.7	3.9	3.2
9	3.6	3.7	4.1	3.4
10	3.6	3.7	4.2	3.5
11	3.6	3.7	4.3	3.7
12	3.6	3.7	4.3	3.8

The inflation rates have been reduced to a constant "flat" rate over all future years equivalent in its effect to the estimated variable rates. Similarly, a constant flat rate of discount has been estimated.

Table 7.2 shows the flat rates and the resulting "gap".

Table 7.2 **Economic gap**

Parameter	Estimate (pa)	
	Previous quarterly review	Current review
Wage inflation	3.32	3.49
Investment return	2.62	2.27
Gap	**-0.70**	**-1.21**

Table 7.3 shows the adopted payment pattern, as well as the derived inflation factors based on both the variable rates shown in Table 7.1 and the flat rates shown in Table 7.2. The adopted payment pattern was outlined in Section 6. The inflation factors include 2.5% superimposed inflation and allow for inflation from 31 December 2015 to the middle of each development year. The inflated payment pattern shows the variable inflation rate is equivalent to a flat rate of 3.49%.

Table 7.3 **Payment pattern and inflation factors**

Development year	Payment pattern (%)	Inflation factor (%)		Inflated payment pattern (%)	
		Variable rate	Flat rate	Variable rate	Flat rate
1	0.9	106	107	1.0	1.0
2	12.7	112	113	14.2	14.4
3	27.8	119	120	33.2	33.4
4	24.2	127	128	30.8	30.9
5	13.8	136	135	18.7	18.7
6	7.8	145	144	11.3	11.2
7	4.3	154	152	6.6	6.5
8	2.6	164	161	4.3	4.2
9	1.8	174	171	3.1	3.1
10	1.3	185	182	2.4	2.4
11	0.9	196	193	1.8	1.7
12 & later	1.9	209	204	4.0	3.9
Total inflation adjustment				**131.3**	**131.3**

Table 7.4 shows the same analysis with inflation and discounting. The inflated and discounted payment pattern shows the variable rates are equivalent to a gap of -1.21%.

Table 7.4 **Payment pattern and inflation and discount factors**

Development year	Payment pattern (%)	Inflation and discount factor (%)		Inflated and discounted payment pattern (%)	
		Variable rate	Flat rate	Variable rate	Flat rate
1	0.9	105	106	0.9	1.0
2	12.7	109	110	13.8	13.9
3	27.8	114	114	31.6	31.6
4	24.2	118	118	28.6	28.5
5	13.8	123	122	17.0	16.9
6	7.8	128	127	10.0	9.9
7	4.3	132	132	5.7	5.7
8	2.6	136	136	3.5	3.5
9	1.8	140	141	2.5	2.5
10	1.3	144	147	1.9	1.9
11	0.9	148	152	1.3	1.4
12 & later	1.9	151	158	2.9	3.0
Total inflation and discount adjustment				**119.8**	**119.8**

8 SUPERIMPOSED INFLATION

Observed changes in average claim size since the introduction of the CLA reflect two effects, namely:

- The decrease in claim frequency for low severity claims, causing a shift in the proportions by severity towards higher severity claims and hence an increase in average claim size
- The remaining changes, which represent superimposed inflation.

In estimating superimposed inflation, we have removed the first component by estimating average claim size for each post-CLA accident quarter as if the claim proportions from 2002Q4 remained constant thereafter. We have estimated the second component, superimposed inflation, over seven time periods:

1. The period from September 1996 to December 2002 (introduction of the CLA)
2. The one-quarter period from December 2002 to March 2003
3. The period from March 2003 to December 2015 (the most recent quarter)
4. The period from March 2003 to December 2010
5. The period from December 2010 to December 2015 (the last five years)
6. The entire period from September 1996 to December 2015
7. The 4 quarter moving average for the entire period (from June 1997 to December 2015).

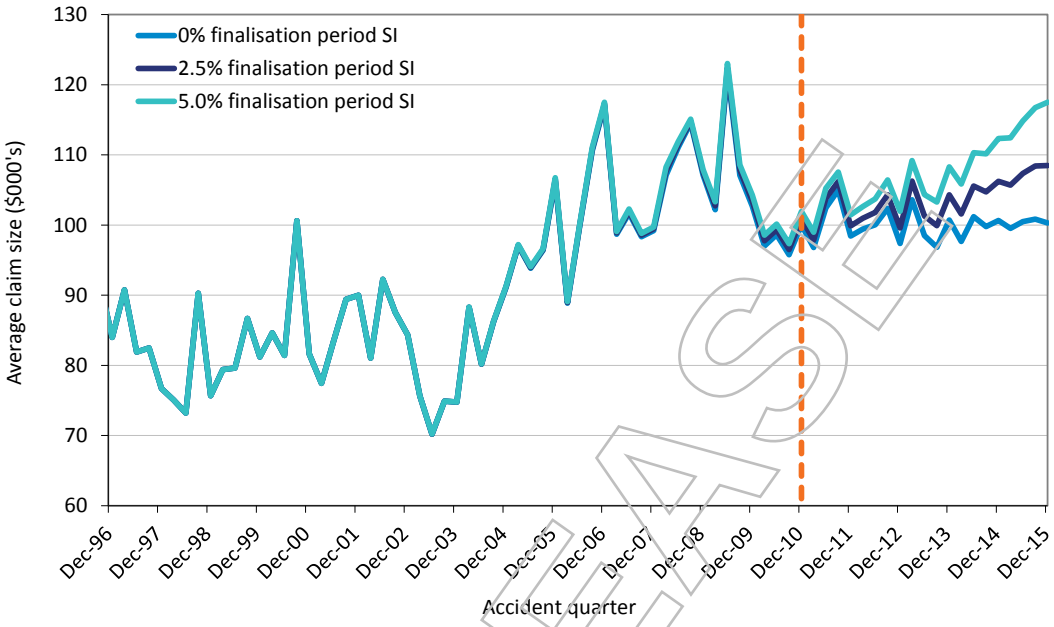
Our estimates are for superimposed inflation in the claim size across accident periods. The estimates depend on any finalisation period superimposed inflation which occurs between now and when the claims for each past accident period are all finalised. Our estimates of accident period superimposed inflation therefore depend on assumptions for future finalisation period superimposed inflation. Current recent finalisation period superimposed inflation is zero. Our estimates are as follows:

Table 8.1 **Accident year superimposed inflation**

Period (accident quarter)	Superimposed inflation (per annum) Assuming future finalisation period SI of:		
	0.0%	2.5%	5.0%
Sep-96-Dec-02	-1.7%	-1.7%	-1.7%
Dec-02-Mar-03	-10.3%	-10.3%	-10.3%
Mar-03-Dec-15	2.2%	2.9%	3.5%
Mar-03-Dec-10	3.7%	3.8%	3.9%
Dec-10-Dec-15	0.1%	1.5%	2.9%
Sep-96-Dec-15	**0.3%**	**0.7%**	**1.2%**
Jun-97-Dec-15 (4-qtr moving average)	**0.7%**	**1.2%**	**1.6%**

The figure below displays the average claim sizes which underlie Table 8.1.

Figure 8.1 **Claim size in current values: 0% p.a., 2.5% p.a. and 5.0% p.a. future SI[1,2]**



1. Post Dec-02 quarters adjusted to Dec-02 severity mix
2. Including WC & IS and loadings for CLAA and 2012 tax changes.

9 VEHICLE CLASS RELATIVITIES

Registered vehicles are assigned to vehicle classes for CTP premium purposes. The premium rate payable in respect of a vehicle class is related to the premium payable under Class 1 (cars and station wagons) through the relativity for that class. The scope of the analysis was limited to existing vehicle classes only, and consideration of possible cross-subsidy within classes (geographic or other) was regarded as beyond scope.

The MAIC database has been used to produce separate estimates of claim frequency and average claim size relativities. GLM methodology has been used in each case. The GLM leading to the average claim size model is based on the incurred cost for individual claims in respect of accident periods 1 July 1996 up to 30 June 2014 while the claim frequency GLM is based on claim notifications in respect of accident periods 1 July 1996 up to 30 June 2015.

No assessment was made of the representativeness of that database with respect to catastrophic claims. Hence the relativities below include no specific allowance for catastrophe potential beyond that reflected in the data.

The modelling of claim frequency sought any trends, relative to Scheme average frequency, over time. Statistically significant trends were detected in respect of:

- Class 2 (motorised homes) – a decreasing trend which has flattened at 2001
- Class 3 (taxis) – an increasing trend which has flattened at 2006
- Class 4 (hire vehicles) – a decreasing trend which has flattened at 2009
- Class 6 (trucks, utes and vans) – an increasing trend which has flattened at 2006
- Class 7 (heavy trucks) – an increasing trend which has stepped down at 2010
- Class 8 (Buses: charitable, community service, driver tuition, not otherwise for business or commercial use) – an upwards step at 2005
- Class 10A (Buses: not class 8, 9 or 10B but used within 350 km of base) - an increasing trend since 2005 which has flattened at 2009
- Class 12 (driver only motor cycles) – a decreasing trend which flattened at 2001
- Class 13 (passenger carrying motor cycles) – a decreasing trend which flattened at 2014
- Class 15 (self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles) – an upwards step at 2005
- Class 16 (ambulances) – an increasing trend which has flattened at 2008
- Class 19 (motor vehicles conditionally registered) – a step downwards at 2009
- Class 21 (self-propelled machinery) – a step downwards at 2009.

Class 4 (hire vehicles) is the only class which was found to have a significant trend relative to Scheme average claim size; the trend is a decreasing trend which flattens at 2009.

Since the GLMs for frequency and size relativities are stochastic, they generate confidence intervals in each case. These confidence intervals were combined to produce a confidence interval for the risk premium relativity in respect of each vehicle class. These are set out in Table 9.1, where existing relativities adopted by MAIC are also displayed.

Table 9.1 **Risk premium relativities**

	Vehicle class	Risk premium relativity (%)		
		Central estimate	90% confidence interval	Existing
		%	%	%
1	Cars and station wagons	100	-	100
2	Motorised homes	48	29 - 71	100
3	Taxis	2002	1781 - 2233	2000
4	Hire vehicles	171	144 - 200	180
5	Vintage, veteran, historic or street rod motor vehicles	6	2 - 12	12
6	Trucks, utilities and vans 4.5t GVM or less	113	108 - 117	115
7	Trucks, utilities and vans more than 4.5t GVM	415	386 - 446	420
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use	231	160 - 312	160
9	Buses: school, therapy, rehabilitation, remedial or special education	154	106 - 209	140
10A	Buses: not class 8, 9 or 10B but used within 350 km of base	729	536 - 946	600
10B	Buses: Translink service contract other than school or restricted school service	1545	1354 - 1746	1700
11	Buses: not class 8, 9, 10A or 10B	517	437 - 602	520
12	Motorcycles: for driver only	23	16 - 32	25
13	Motorcycles: with pillion passenger/sidecar	50	41 - 59	80
14	Tractors	7	4 - 12	15
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles	141	97 - 192	100
16	Ambulances	273	132 - 456	200
17	Primary production vehicles	54	43 - 65	55
19	Motor vehicles conditionally registered - limited access	34	17 - 56	50
20	Motor vehicles conditionally registered - zoned access	4	1 - 9	15
21	Self-propelled machinery other than a vehicle of class 14, 15, 19 or 20	26	7 - 56	30
23	Dealer's plate issued	17	7 - 29	100
24	Supplementary trailer insurance including Federal/Interstate	6	1 - 15	20

Taylor Fry

Queensland CTP Insurer Briefing

Review of the components of risk premium for the underwriting period 1 July to 30 September 2017

21 March 2016

Contrary to public interest

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1 BACKGROUND

Taylor Fry Consulting Actuaries ("TFCA") advised the Queensland Motor Accident Insurance Commission ("MAIC") on components of the risk premium for Compulsory Third Party ("CTP") insurance policies underwritten in the quarter 1 July to 30 September 2016. The advice was based on data to 31 December 2015.

An abridged version of that advice, for circulation to insurers, appeared as a "Review of the components of risk premium for the underwriting period 1 July to 30 September 2016", dated 17 March 2016, by Richard Brookes and Ashley Evans. This will be referred to subsequently as "the previous annual review".

Subsequent to that report, claims data from the Queensland CTP insurance scheme are subject to quarterly actuarial review. The most recent of these reviews was discussed in the report dated 20 December 2016 on "Review of the components of risk premium for the underwriting period 1 April to 30 June 2017", authored by Richard Brookes and Ashley Evans. This will be referred to subsequently as "the previous quarterly review".

There was an update to claim frequency by severity as at 30 June 2016. This update was discussed in the report dated 19 September 2016 on "Review of the components of risk premium for the underwriting period 1 January to 31 March 2017", authored by Richard Brookes, Ashley Evans and Kevin Fong. This will be referred to subsequently as "the June quarterly review".

The present report continues the series of quarterly reviews. It is, however, an abridged preview of the forthcoming Risk Premium report based on data to 31 December 2016. Therefore it is more extensive than the preceding quarterly reviews in both its underlying analysis and reporting. Its purpose is:

- To review claims experience over the calendar year relative to the predictions made in earlier reports
- To analyse the totality of Scheme data and to advise on the components of risk premium and premium relativities for the underwriting quarter beginning 1 July 2017.

Three submissions were received from licensed insurers that commented on issues related to the subject matter of this report.

2 CLAIM FREQUENCY

Throughout this report references to claim "notifications" will be to all claims recorded as notified in the Scheme data, other than Nominal Defendant claims, but specifically including those for nil or trivial amounts. Claim frequency is expressed as claims per registered vehicle.

2.1 Modelling of workers compensation recovery, interstate sharing and other claims

2.1.1 Definitions

Workers' compensation recovery ("WC") claims are those notified to insurers by a workers' compensation insurer/authority. They have been identified separately in the database since 2009Q1 by means of a specific injury code.

Interstate sharing ("IS") claims involve one party from Queensland and another from a different state. In some of these cases claim cost is shared between the respective state schemes. These claims are managed by an interstate insurer. They are identified in the database by means of a specific injury code.

Both WC and IS notifications have been numerous and erratic. We have found that these notifications distort our notification models. As a consequence, WC, IS and other ("core") claims are modelled separately.

2.2 Recent experience for core claims

Figure 2.1 displays forecasts of numbers of core notifications from the previous annual review and compares them with actual experience for the Dec-16 notification quarter. Actual notifications in the quarter were 7% higher than forecast. Figure 2.2 shows the equivalent but based on experience in the 2016 calendar year. Actual notifications in the year were 5% higher than forecast.

Figure 2.1 **Number of claims notified in the Dec-16 quarter (excl WC & IS claims)**

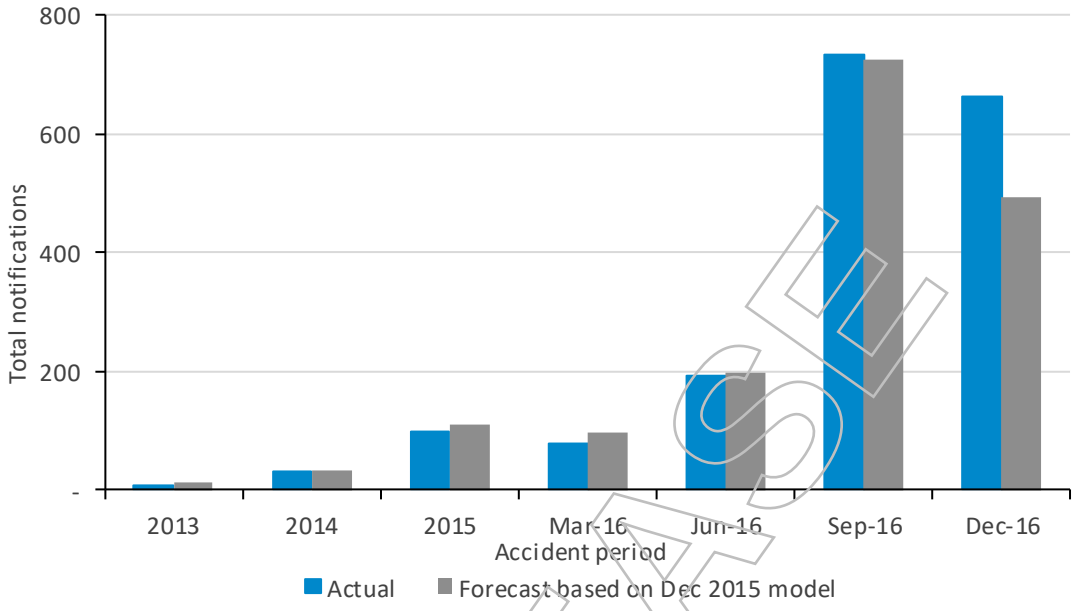
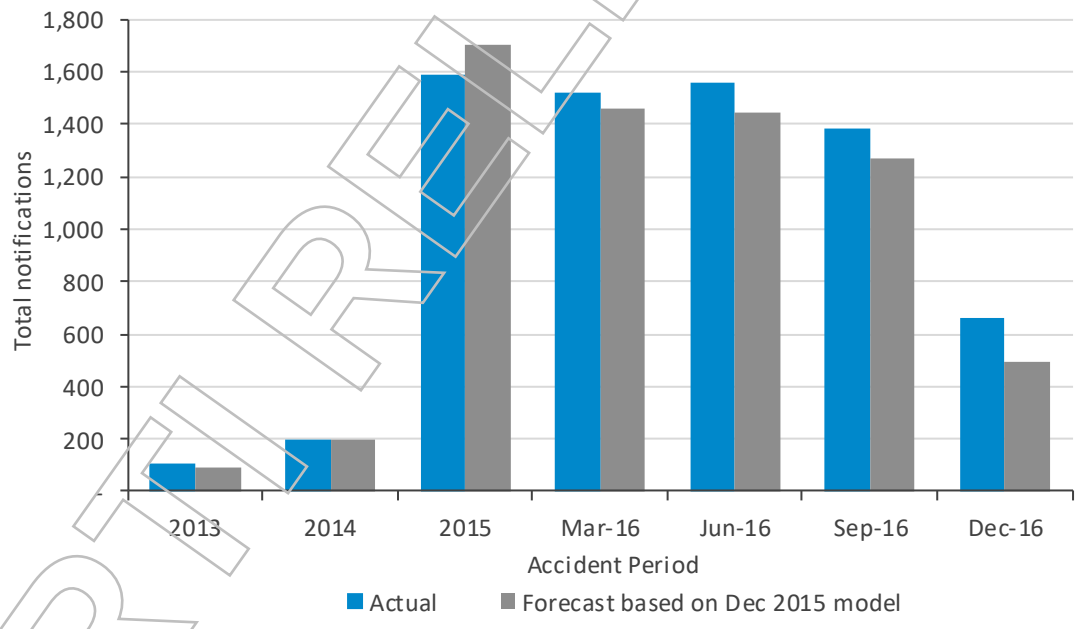


Figure 2.2 **Number of claims notified in the 2016 calendar year (excl WC & IS claims)**



2.3 Previous review's claim frequency forecasts

Figure 2.3 shows our estimates of core claim frequency as detailed in the previous annual review (teal line) and estimates adjusted for year to date experience (blue line). We estimate the frequency adjusted for year to date experience by assuming that future claim notification numbers are as expected. Figure 2.3 also shows:

- Our baseline core claim frequency estimated at the previous annual review (0.166%)
- The "average adjusted" claim frequency for the 2014 accident year (0.159%), 2015 accident year (0.169%) and 2016 accident year (0.178%) assuming that future claim notification numbers are as expected **at the previous annual review**
- The expected proportion of claims yet to be notified as at Dec-16 (the histogram).

Note that the model forecasts of ultimate claim frequency for the most recent accident quarters are based on comparatively little data, and are therefore of lower reliability than those of earlier periods.

Figure 2.3 **Estimates of claim frequency using previous review's forecasts**

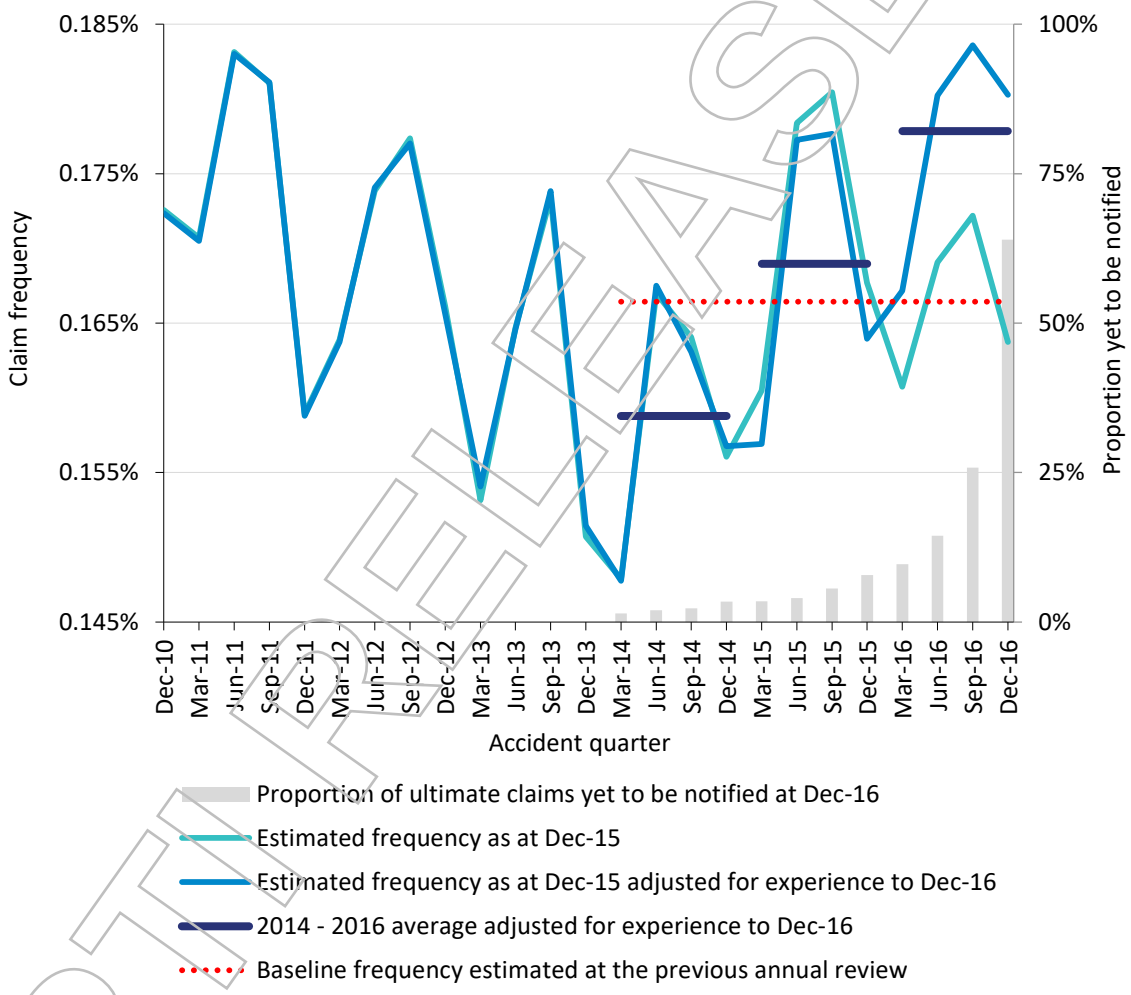


Figure 2.3 shows that the estimated core claim frequencies for 2016 accident quarters have exceeded projected frequencies, while 2015 accident quarters have resolved below expectations. We have adjusted our core claim notification model accordingly.

2.4 Modelling of core claims

A Generalised Linear Model ("GLM") has been used to model the entire history of Scheme notifications. In this model, the ultimate number of core claim notifications for an accident

month is taken as a multiple of the number of registered vehicles for the month. This multiple varies with development month of notification, and is subject to various adjustments, including:

- The effect of the "New Scheme" resulting from the introduction of the *Motor Accident Insurance Amendment Act 2000*
- Some trends over accident and notification months
- Seasonality over accident and notification months.

The number of serious road casualties is not used directly in our modelling but we estimate and monitor the casualty rate in a separate exercise.

2.4.1 Significant changes to model terms

For past accident quarters, our core claim notifications model is calibrated to recent experience. We set the projected notifications for future accident quarters equal the average projected ultimate frequency over the past two years, allowing for any recent changes in notification development. In practice, this means that the projected core claim frequency reflects an up-to-date notification pattern despite being based on a longer term view of ultimate core claim frequency.

We show the expected notifications over development months for varying lengths of averaging periods. We observe an increase in notifications in the earlier development months for the shorter averaging periods. This captures acceleration of core claim notification. There are two figures:

- Figure 2.4 shows the results for development months up to 11
- Figure 2.5 shows the results for development months from 12 to 23.

Development months 23 or less accounted for 98% of all notifications in the last two years.

Figure 2.4 **The modelled notifications in development months 0 to 11**

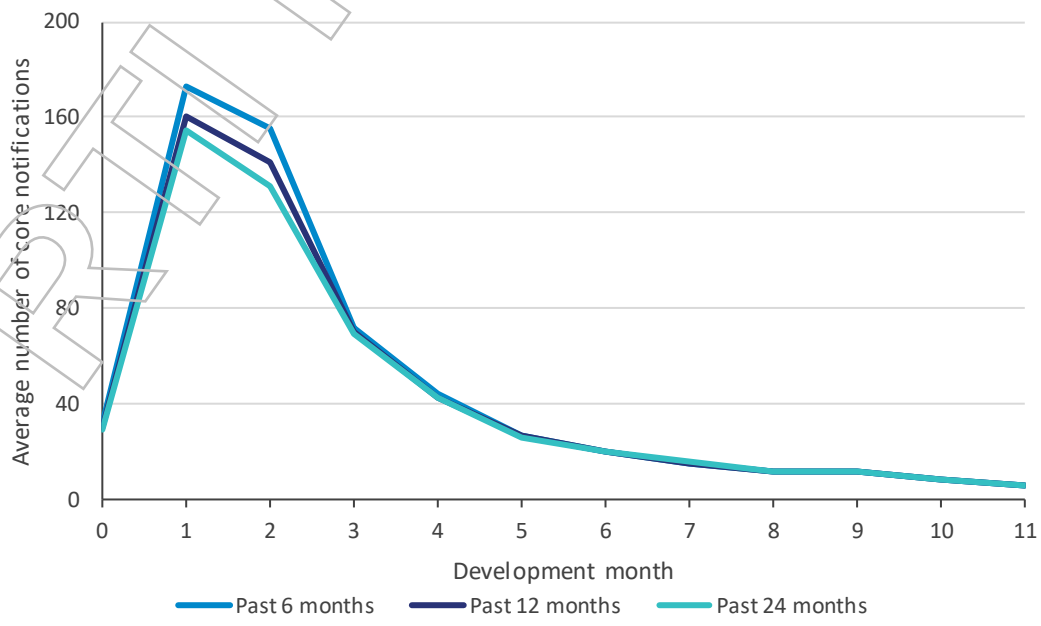
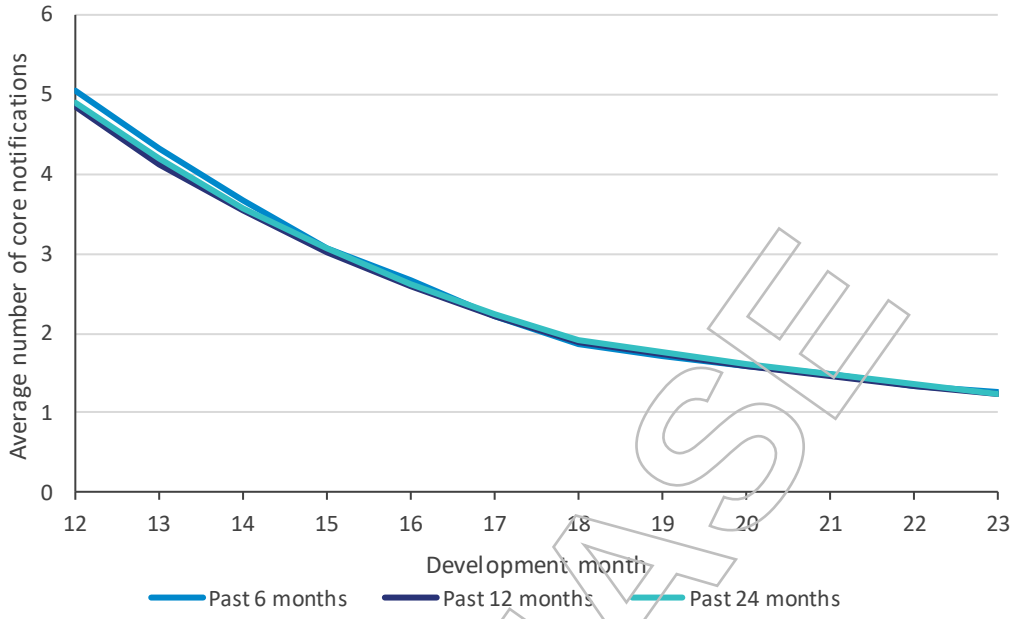


Figure 2.5 **The modelled notifications in development months 12 to 23**



2.5 Estimated ultimate core claim frequency

Figure 2.6 shows the current and previous forecast of ultimate frequency for core claims, for each accident year. High core claim notification experience in 2016 has resulted in an increase in the projected core claim frequency when compared to the previous levels.

Figure 2.6 **Comparison of claim frequency per vehicle forecast**

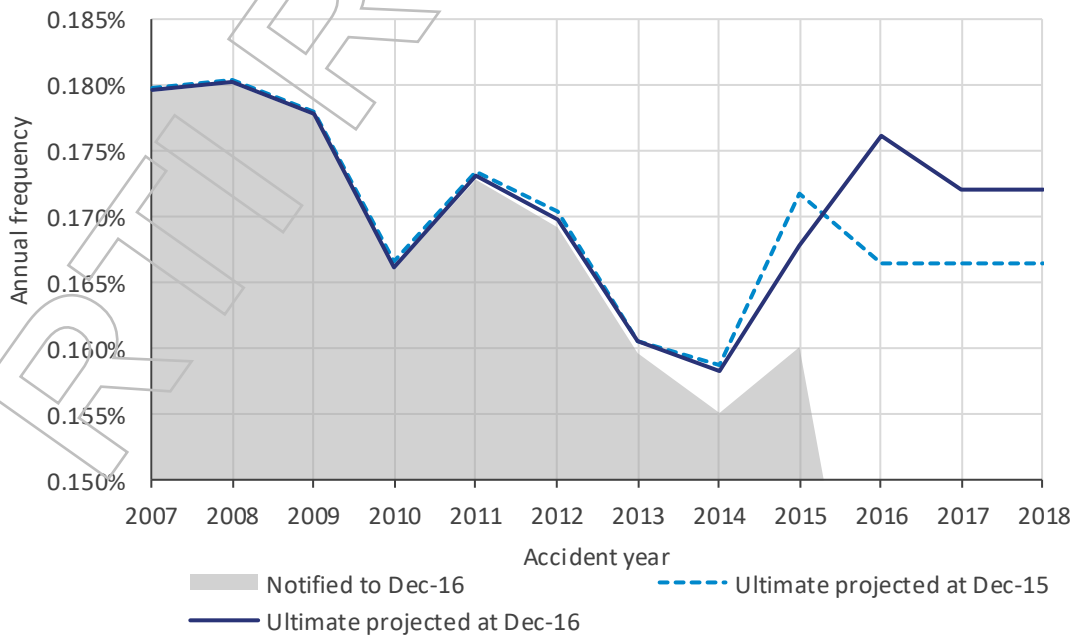


Table 2.1 displays the numerical values of the forecasts illustrated in Figure 2.6 along with frequencies that include WC and IS.

Our scope is to produce a claim frequency based on the conditions and environment as at 31 December 2016. This is our baseline projected claim frequency. MAIC will use this as part of their deliberations in setting the claim frequency used for the floor and ceiling calculations for future underwriting quarters.

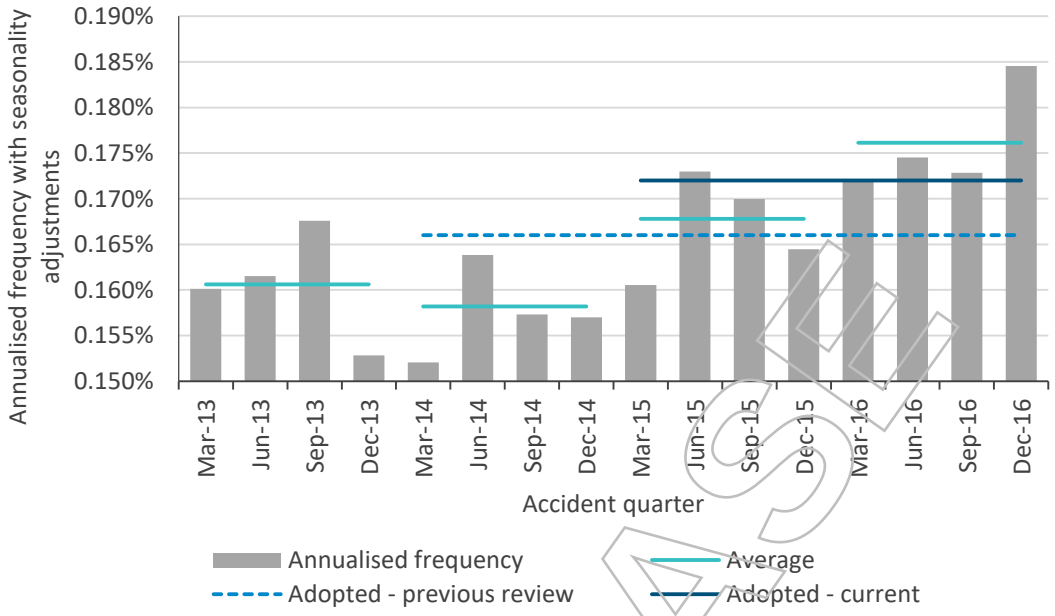
Table 2.1 **Estimated claim frequency**

Accident period	Excluding WC & IS	Including WC & IS
	%	%
2011	0.173%	0.189%
2012	0.170%	0.185%
2013	0.167%	0.183%
2014	0.158%	0.174%
2015		
March quarter	0.156%	0.172%
June quarter	0.176%	0.192%
September quarter	0.176%	0.192%
December quarter	0.162%	0.178%
Whole year	0.168%	0.184%
2016		
March quarter	0.166%	0.181%
June quarter	0.178%	0.193%
September quarter	0.180%	0.195%
December quarter	0.182%	0.197%
Whole year	0.176%	0.192%
Base scenario frequency for the future underwriting quarter beginning 1 July 2017	**0.172%**	**0.188%**

Until 2015, there was a consistent downward trend in claim frequency for a number of years, as shown in Figure 2.6.

Figure 2.7 shows the estimated annualised core claim frequency with seasonal adjustments. We see that Dec-16 is an exceptionally high quarter. However, Dec-16 result is very uncertain given only one quarter of development. We estimate fewer than 40% of eventual claims for the quarter have been notified to date.

Figure 2.7 **Estimated core claim frequency by accident year**



2.6 WC and IS claim frequency

WC and IS claim frequency are modelled separately using a chain-ladder model. Assumptions about the future are based on experience over the last 3-4 years. Note that our approach assumes that there is no material progression of core claims to WC or IS claims. To the extent that there is such a progression it is likely that our estimates of total claim numbers and frequency will be conservative.

Figure 2.8 shows, for each past accident year, the frequency of WC claims notified to date, the frequency of IBNR, as well as current and previous assumptions for ultimate frequency. The dark blue dotted line represents the ultimate frequency that has been adopted for the underwriting quarter beginning 1 July 2017. Figure 2.9 shows the equivalent for IS claims. The ultimate frequency that has been adopted for the underwriting quarter beginning 1 July 2017 is:

- 0.0113% for WC
- 0.0044% for IS.

There has been a material downward revision in the adopted frequency for worker's compensation claims in light of the lower claims experience in 2015 and 2016. The decrease in notified claims from 2015 was a conscious decision by WorkCover to deprioritise pursuing recoveries. However, we have not fully reflected this in our frequency estimate as these recoveries may be pursued by WorkCover at a later date.

Figure 2.8 **Developed annual frequency of WC claim notification**

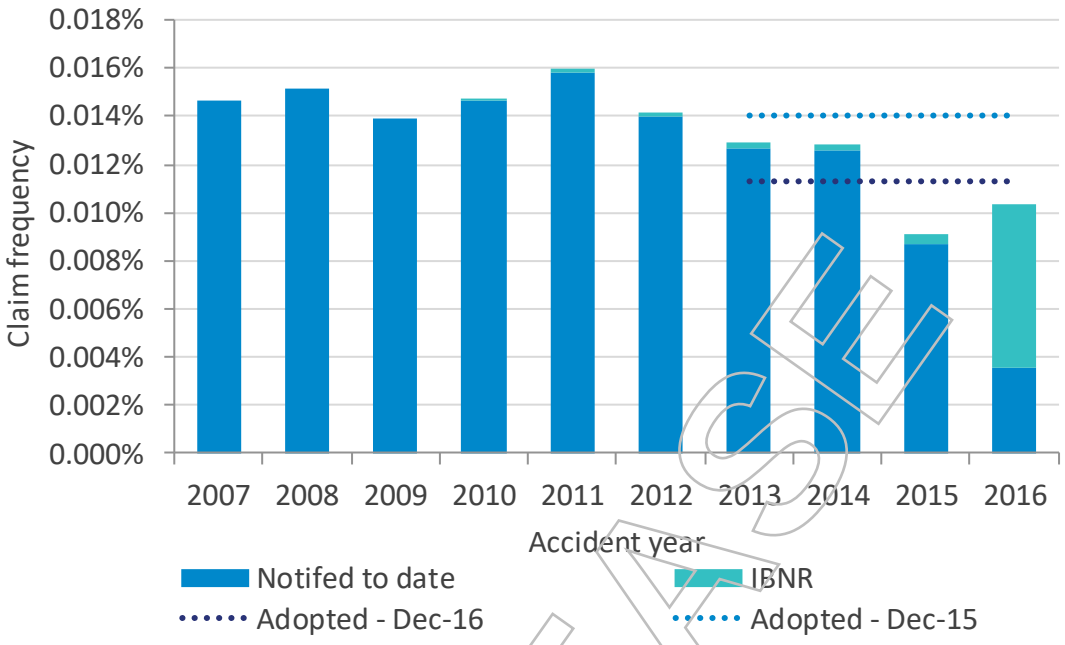
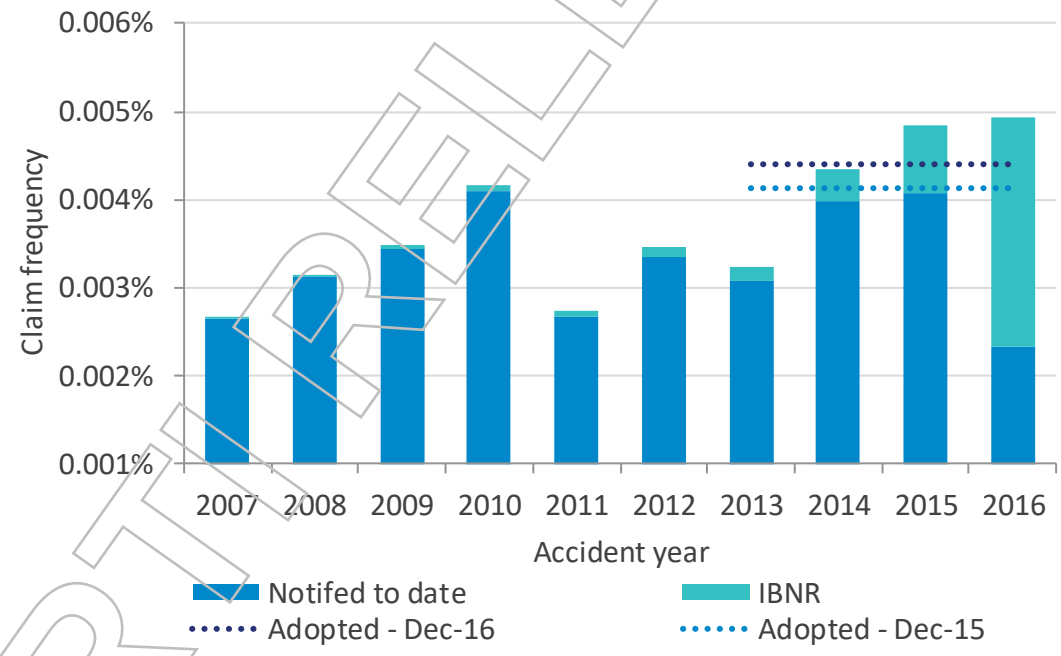


Figure 2.9 **Developed annual frequency of IS claim notifications**



3 CLAIM FREQUENCY BY SEVERITY

Our claim size model depends on the severity of the claim at finalisation. Therefore, we need to estimate the severity at finalisation for all open claims, including those yet to be reported. We build a chain ladder model on the notifications and severity transitions for each severity, with severity 1 divided into with legal representation ("1Y") and without legal representation ("1N"). The resulting severity-specific claim frequencies are scaled to sum to the overall claim frequency model.

Note that we only consider the severity profile of core claims in this section. We have not modelled WC and IS claims by severity since most WC claims are low severity (1N, 9NA) while the severities recorded for IS claims and the legal representation flag are not considered sufficiently reliable to use.

3.1 Severity-specific notification and transition development

In February 2012 MAIC introduced the Lifetime Injury Coding Requirement (lifetime coding) meaning that insurers are now required to update the injury severity of a claim throughout its lifetime and not just at finalisation. This resulted in a higher than usual volume of transitions as insurers worked through their portfolios, recoding the claims, which has since settled down to a lower level.

At the previous annual review it was uncertain whether this low development experience for high severities post lifetime coding would be sustained, or if it would return to a level more consistent with pre lifetime coding experience. Hence our estimates of ultimate notifications by severity for severity 2 and above used a 25:75 blend of pre and post lifetime coding experience.

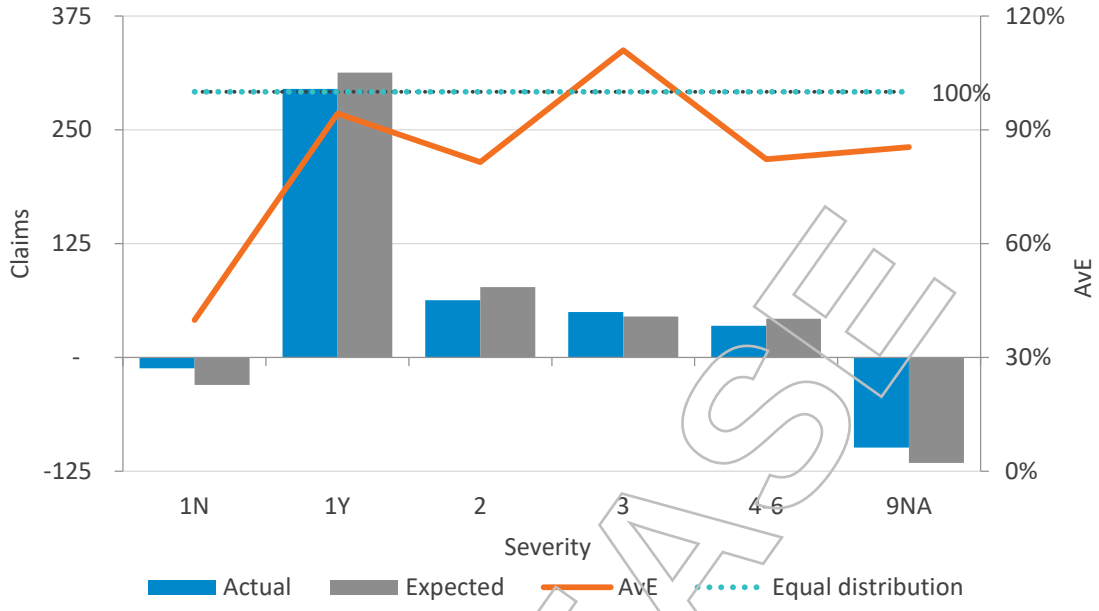
After claim development since the previous annual review for higher severities being materially lower than implied by the 25:75 blend, our estimates of ultimate notifications by severity were revised to be completely based on post lifetime coding experience in the June quarterly review.

We continue to base our estimates on post-lifetime coding experience.

3.2 Emerging severity profile

Figure 3.1 shows the actual versus expected movement in claim numbers by severity for the 2010-2014 accident years in the year to 31 December 2016. Movement in claims numbers represent transitions to higher severities for mature claims.

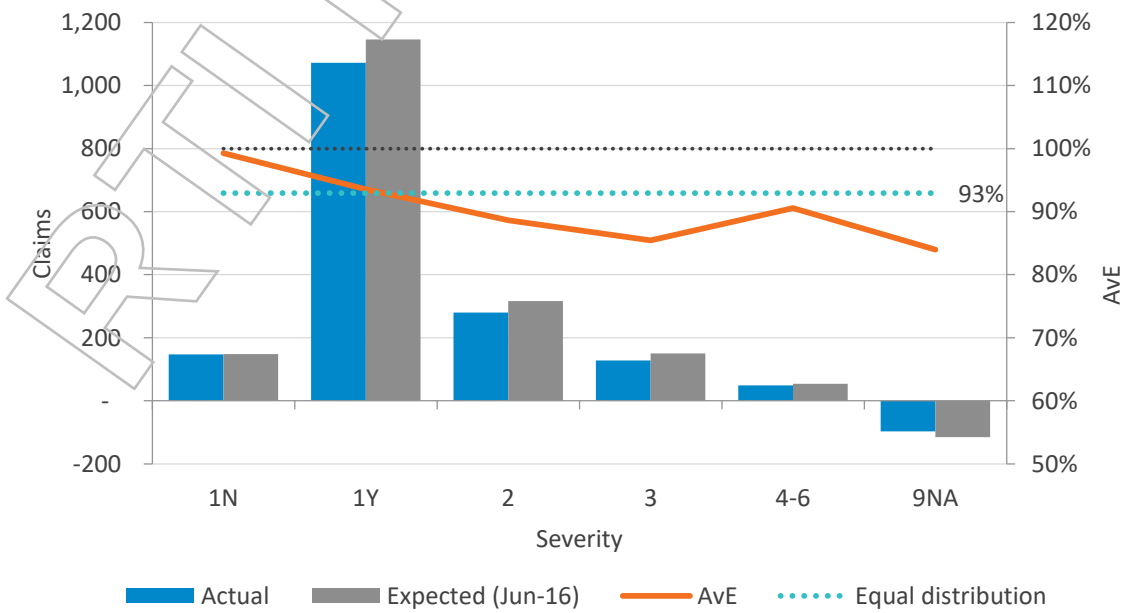
Figure 3.1 **Movement in claim numbers by severity in 2016 for the 2010-2014 accident years**



There are fewer than expected claims transitioning into higher severities and out of severity 9NA. This is consistent with the post-lifetime coding trend of claims arriving at their ultimate severity earlier.

Figure 3.2 shows the actual movements in claim numbers, either due to new claim reports or transitions, by severity compared to what was forecast at the June quarterly review for accident year 2015. Movements in claim numbers represent late notifications and transitions to higher severities. The number of core claim notifications for the 2015 accident year was 7% lower than expected. This corroborates that claim notification has been accelerating.

Figure 3.2 **Movements in claim numbers by severity in 2016 for the 2015 accident year**



We observe fewer than expected claims moving into higher severities and out of severity 9NA. This is consistent with the post-lifetime coding trend of claims arriving at their ultimate frequency earlier.

3.3 Revision of severity-specific frequency

Severity-specific frequency has been revised from the estimates at the June quarterly review due to claim development experience. The ultimate frequency for each severity is estimated using a chain ladder model. This is used to calculate the proportion of core claims formed by each severity.

We attribute the change in severity specific frequency to:

- Earlier maturing of claim severity, observed through fewer transitions into higher severities for claims up to the Mar-15 accident quarter
- Substitution of severity 1N claims for 1Y claims
- Increased prevalence of severity 9NA claims
- A weakening severity profile from the Mar-15 to Dec-15 accident quarter.

Earlier maturing of claims severity

For earlier maturing of claim severity, the proportion of claims expected to finalise in severities 3 and 5 affect the severity profile the most.

Figure 3.3 and Figure 3.4 show:

- We have adopted a decreasing trend for severity 3 since the previous review
- Fewer transitions into severity 5 than expected have led to a decrease in our assumption.

"Actual" amounts have severity-specific development factors applied to arrive at the ultimate proportion of core claims in each severity.

Figure 3.3 **Ultimate proportion of core claims in severity 3**

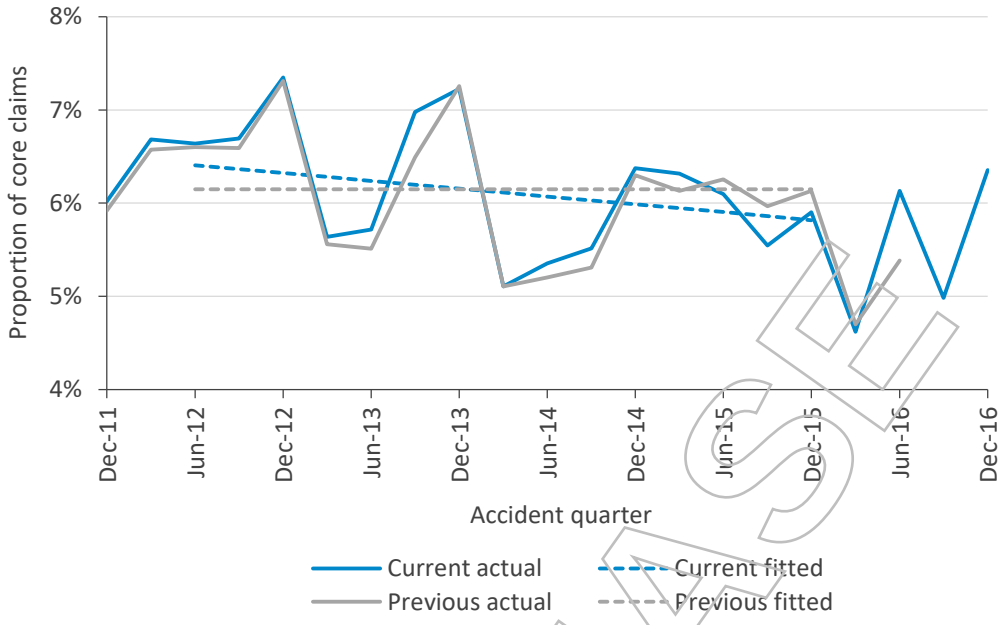
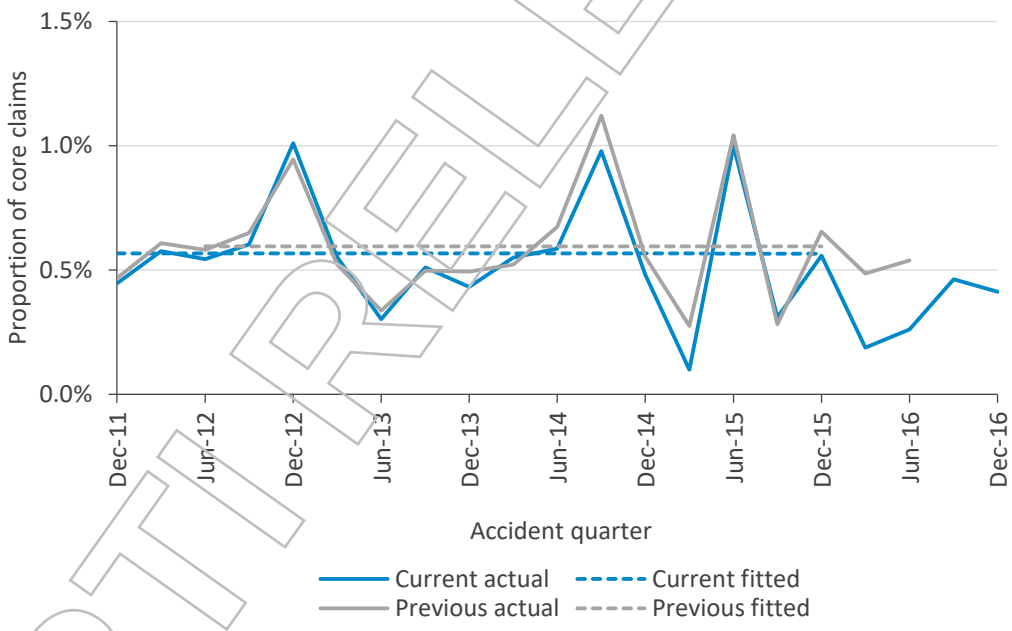


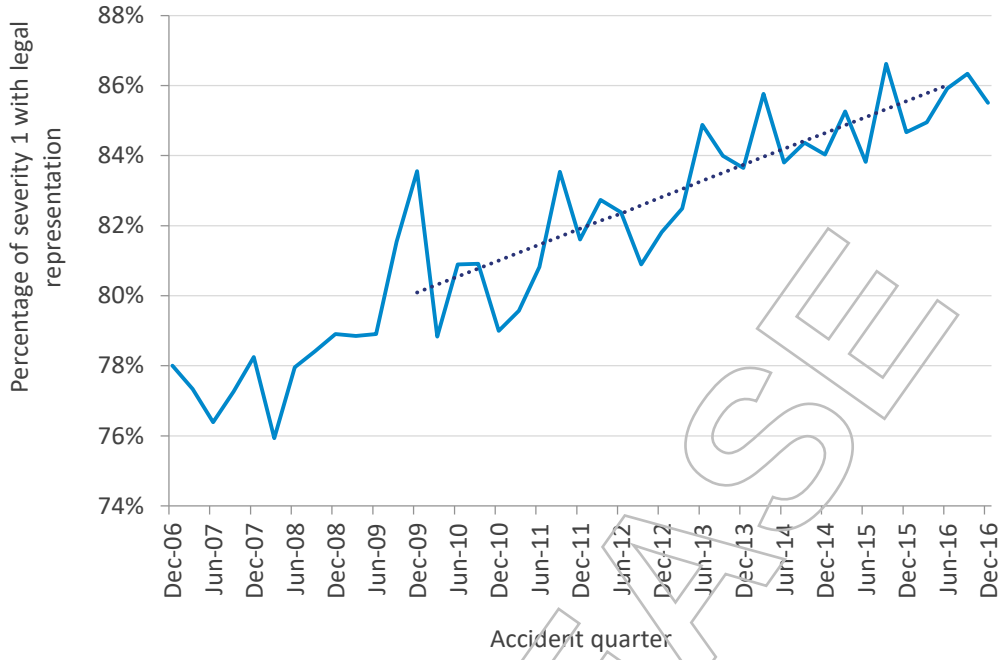
Figure 3.4 **Ultimate proportion of core claims in severity 5**



Substitution of severity 1N to 1Y claims

Figure 3.5 shows that the proportion of severity 1 claims that are legally represented ("1Y") has grown over the past decade. It is not certain that otherwise direct claims are seeking legal representation or that the mixture of claims has changed.

Figure 3.5 **Percentge of severity 1Y with legal representation**

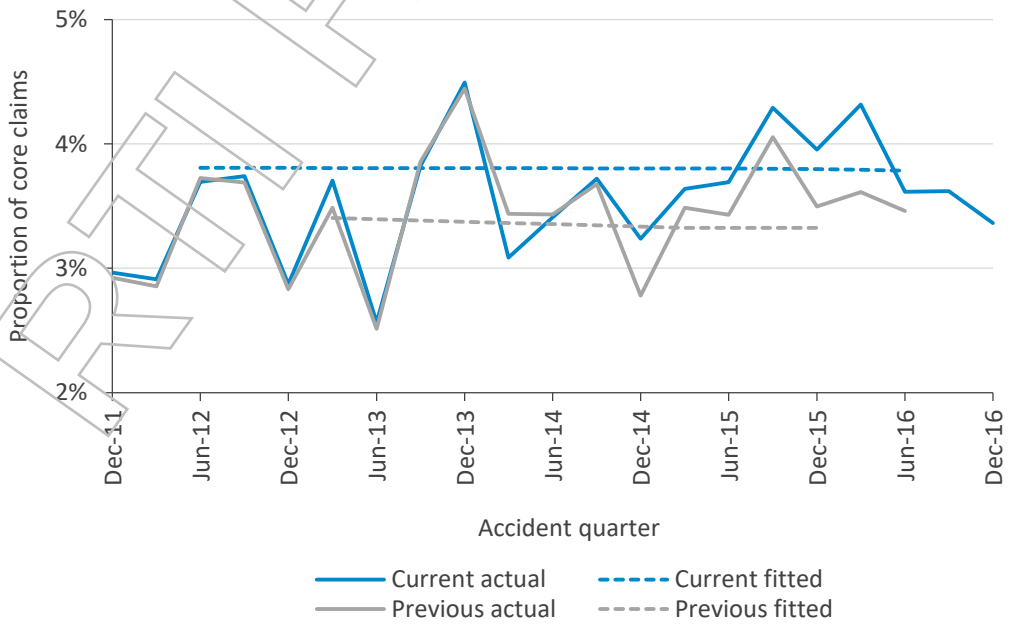


We adopted this increasing trend in legally represented severity 1 claims up to Jun-16.

Severity 9NA claims

The proportion of core claims in severity 9NA has increased in recent years. Figure 3.6 shows the upward revision in the ultimate proportion of core claims in severity 9NA for 2015 and 2016. We have adjusted the severity 9NA frequency accordingly.

Figure 3.6 **Ultimate proportion of core claims in severity 9NA**



A weakening severity profile from the Mar-15 to Dec-15 accident quarter

The June quarterly review set the severity profile on trends up to Mar-15. Where these trends persist, we extend these trends up to Dec-15.

Figure 3.7 and Figure 3.8 and shows the persistent trends for severity 2 and 3. Severities 2 and 3 have the biggest impact on the severity profile (aside from the severity 1Y trend shown in Figure 3.5). Severity 6 has a downwards trend as well, although this has a negligible effect on the risk premium.

Figure 3.7 **Ultimate proportion of core claims in severity 2**

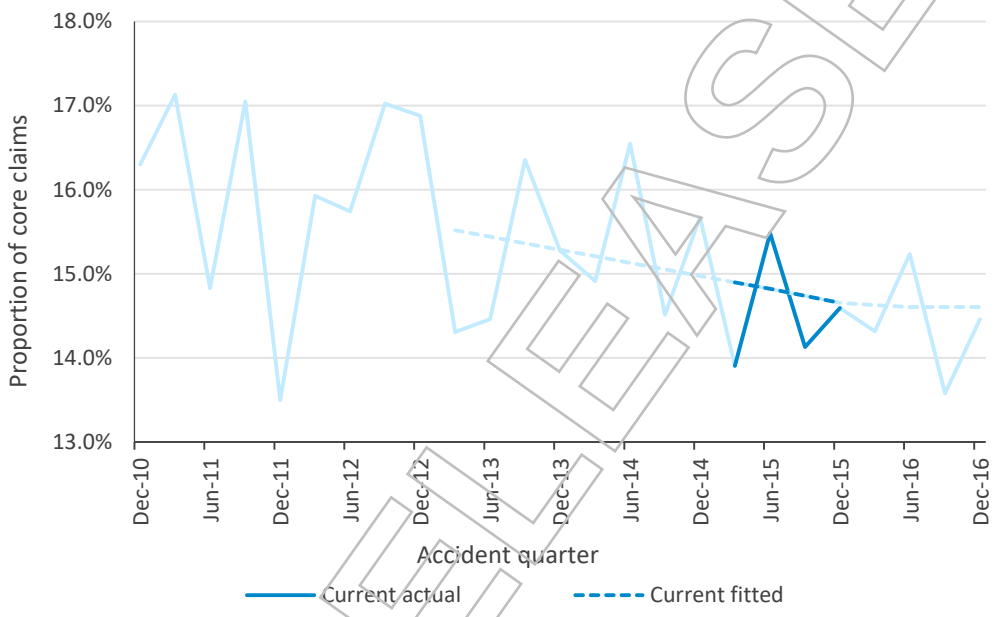
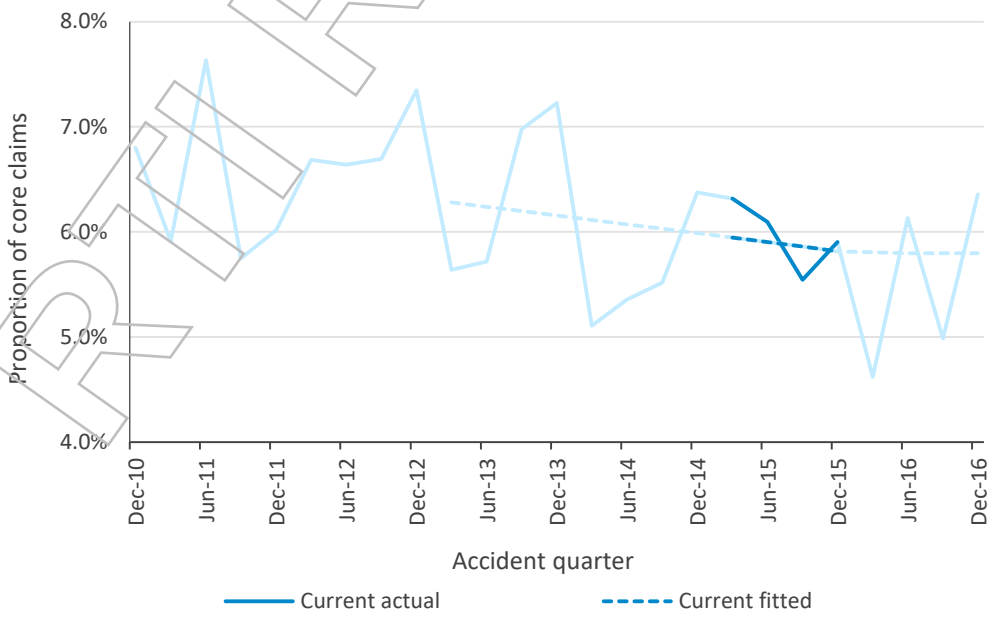


Figure 3.8 **Ultimate proportion of core claims in severity 3**

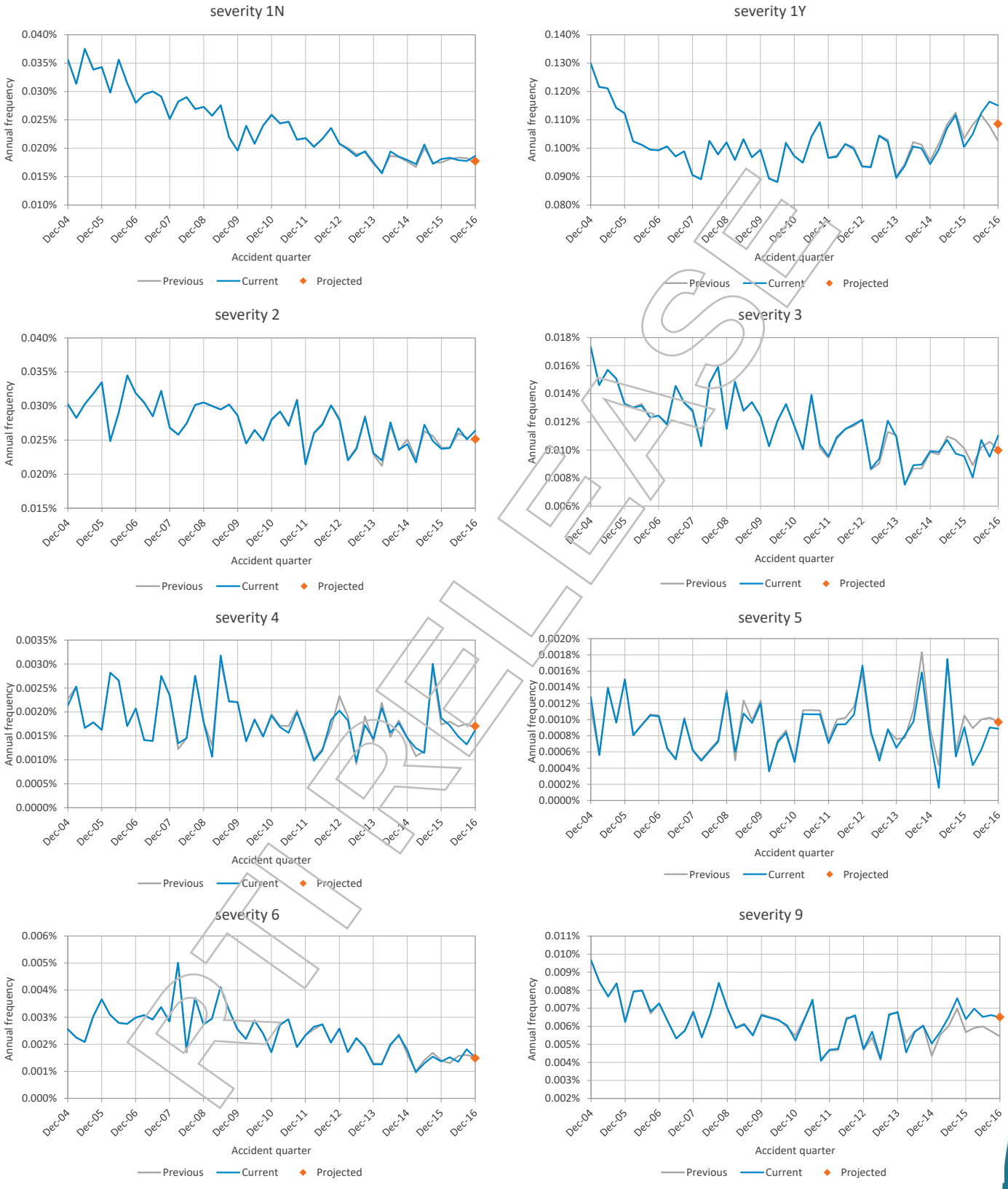


Ultimate severity-specific frequencies

In Figure 3.9:

- The blue line represents the modelled severity-specific claim frequency for each accident quarter as at 31 December 2016
- The grey line represents the modelled severity-specific claim frequency for each accident quarter as at 30 June 2016
- The orange diamond represents the projected core claim frequency by severity.

Figure 3.9 **Ultimate severity-specific frequency**



Overall, the severity profile has weakened with a lower proportion of claims estimated to be in high severities, and a higher proportion of claims in severity 1Y and 9NA. Table 3.1 shows the difference between the adopted severity profile and the previous reviews.

Table 3.1 **Adopted severity profile**

Severity	Proportion of core claims		
	Previous annual review	June quarterly update	Current review
	%	%	%
1N	10.8	10.6	10.3
1Y	61.7	62.7	63.1
2	15.4	14.7	14.6
3	6.4	6.1	5.8
4	1.1	1.0	1.0
5	0.6	0.6	0.6
6	1.1	0.9	0.9
9NA	2.9	3.3	3.8

Table 3.2 shows the estimates of historical claim frequency for each severity by accident year.

Table 3.2 **Estimates of historical claim frequency by severity**

Accident Year	Ultimate Claim Frequency (per annum) excluding WC & IS								
	Severity								
	1N	1Y	2	3	4	5	6	9NA	Overall
	%	%	%	%	%	%	%	%	%
2006	0.031	0.101	0.030	0.013	0.002	0.001	0.003	0.007	0.188
2007	0.028	0.097	0.029	0.013	0.002	0.001	0.003	0.006	0.180
2008	0.028	0.098	0.028	0.013	0.002	0.001	0.003	0.007	0.180
2009	0.024	0.099	0.030	0.013	0.002	0.001	0.003	0.006	0.178
2010	0.024	0.094	0.026	0.012	0.002	0.001	0.002	0.006	0.166
2011	0.023	0.101	0.027	0.011	0.002	0.001	0.002	0.006	0.173
2012	0.022	0.098	0.028	0.012	0.002	0.001	0.003	0.006	0.170
2013	0.019	0.097	0.024	0.010	0.001	0.001	0.002	0.006	0.161
2014	0.018	0.097	0.024	0.009	0.002	0.001	0.002	0.005	0.158
2015	0.018	0.105	0.024	0.010	0.002	0.001	0.001	0.007	0.168
2016	0.018	0.112	0.026	0.010	0.002	0.001	0.002	0.007	0.176

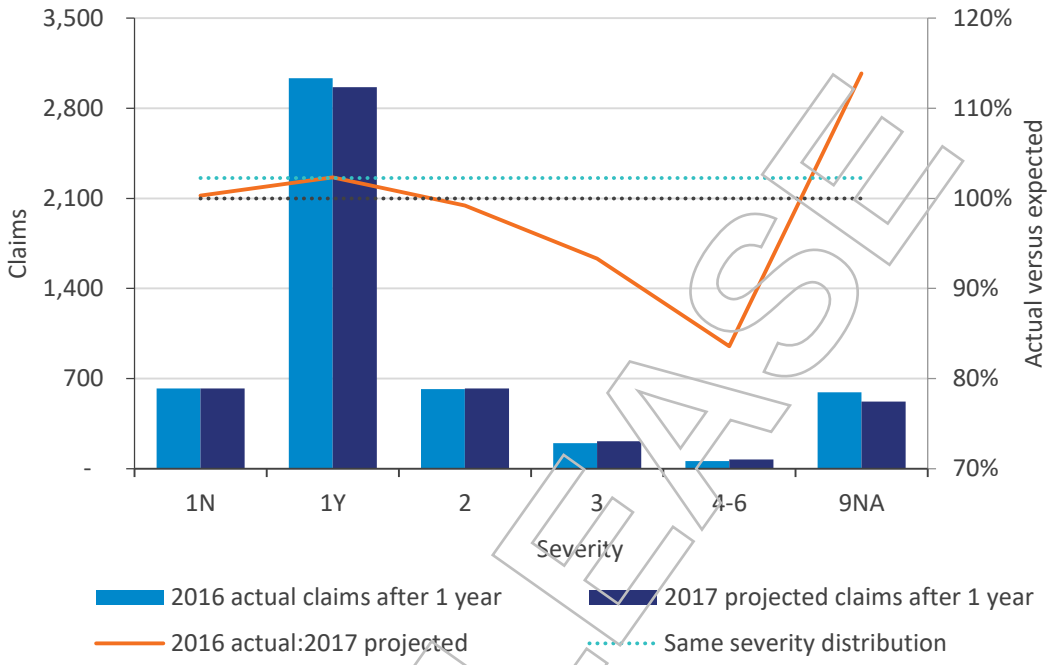
3.4 Severity profile for the 2016 accident year

The estimated ultimate severity profile is very uncertain for higher severities in the 2016 accident year. As such, we continue high severity trends to 31 December 2015 only.

Figure 3.10 shows the actual number of claims notified to date for the accident year 2016 by severity compared to the projected profile after one year of development for the current review. Notifications to date for AY2016 are 2% higher than our advised core claim

frequency. While severity 1Y claims are "as expected", high severities claims are abnormally few to date in AY2016. This may indicate further weakening of the severity profile in future reviews.

Figure 3.10 **2016 actual claims versus 2017 projected claims after 1 year of development**



4 AVERAGE CLAIM SIZE

4.1 Form of claim size model for core claims

The claim size model is formulated as a single Generalised Linear Model ("GLM") of individual positive claim size at finalisation, dependent on:

- Severity at finalisation
- In the case of Severity 1, the legal representation status (represented or unrepresented, denoted Severities "1Y" and "1N" respectively)
- Operational time ("OT") at finalisation
- Legislative effects, due separately to:
  - The "New Scheme" resulting from amendments to the *Motor Accident Insurance Act 1994* introduced in 2000
  - The *Civil Liability Act 2003* ("CLA"). Effects of this legislation recognised in the model include initial reductions in claim sizes, some subsequent increases in claim sizes due to the selective elimination of small claims by supposedly CLA-induced reductions in claim frequency, further increases in claim sizes with increasing accident quarter that may represent the gradual erosion of the CLA savings
- Superimposed inflation ("SI") increases/decreases in claim sizes with increasing finalisation quarter (in addition to the accident quarter increases just mentioned), whose rate varies with:
  - Severity
  - OT.

4.2 Experience

4.2.1 Average claim sizes

Figure 4.1 compares claim sizes observed in the Dec-16 quarter with the forecasts made on the basis of the model adopted for the previous quarterly review. The left hand vertical scale (claim size) in this figure is logarithmic.

Figure 4.1 **Average claim sizes for positive finalisations in the Dec-16 quarter**

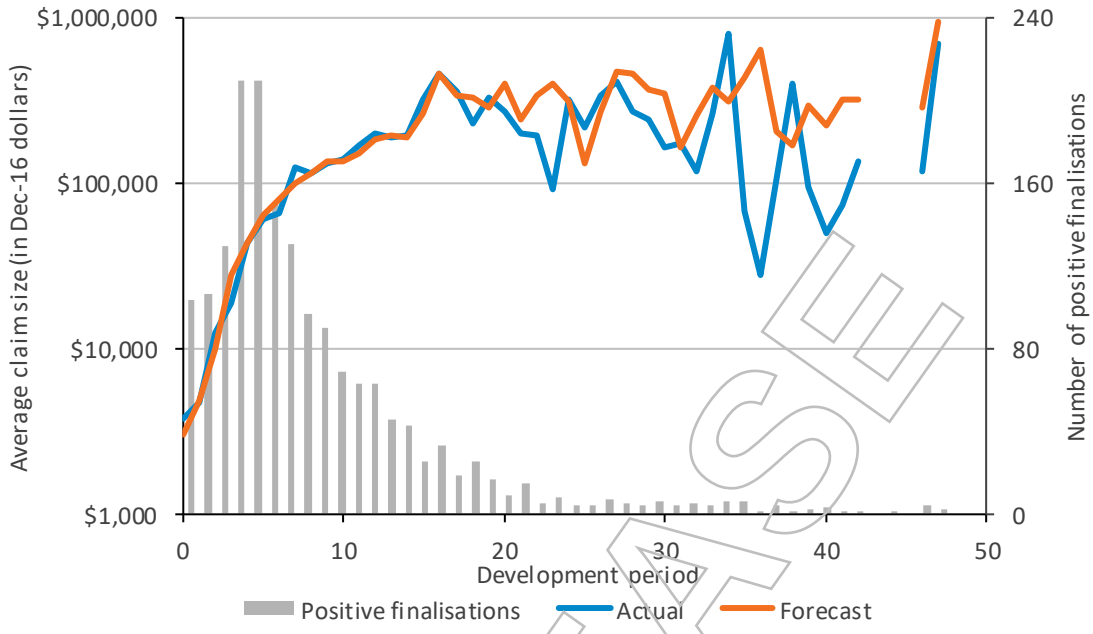


Figure 4.2 shows the comparison in terms of total finalised claim cost during the Dec-16 quarter.

Figure 4.2 **Total cost by accident year in the Dec-16 quarter**

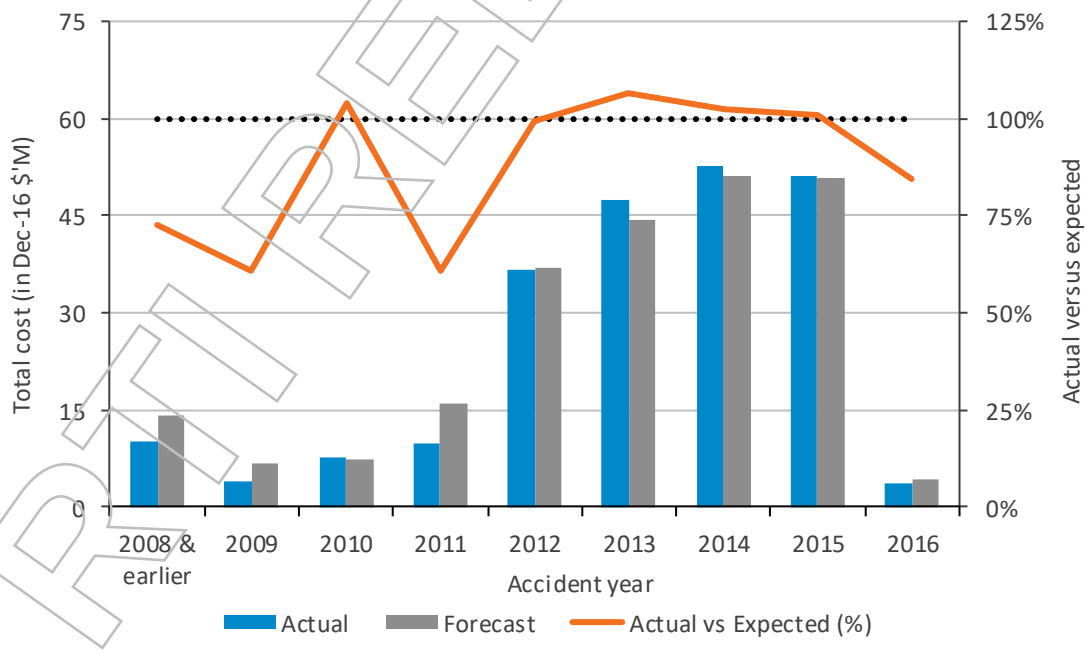


Table 4.1 displays the numerical values of the ratio of actual to forecast claim payments depicted in Figure 4.2. Actual claim payments to claims finalised in the quarter is 4% lower than expected.

Table 4.1 **Ratio of actual to forecast claim payments in the Dec-16 quarter**

Accident periods	Ratio of actual/forecast claim payments
	%
2008 & earlier	73
2009	61
2010	104
2011	61
2012	99
2013	107
2014	103
2015	101
2016	84
Total	**96**

It is helpful to compare total cost by the major severities. This is shown in Figure 4.3 below.

Figure 4.3 **Total cost by severity in the Dec-16 quarter**

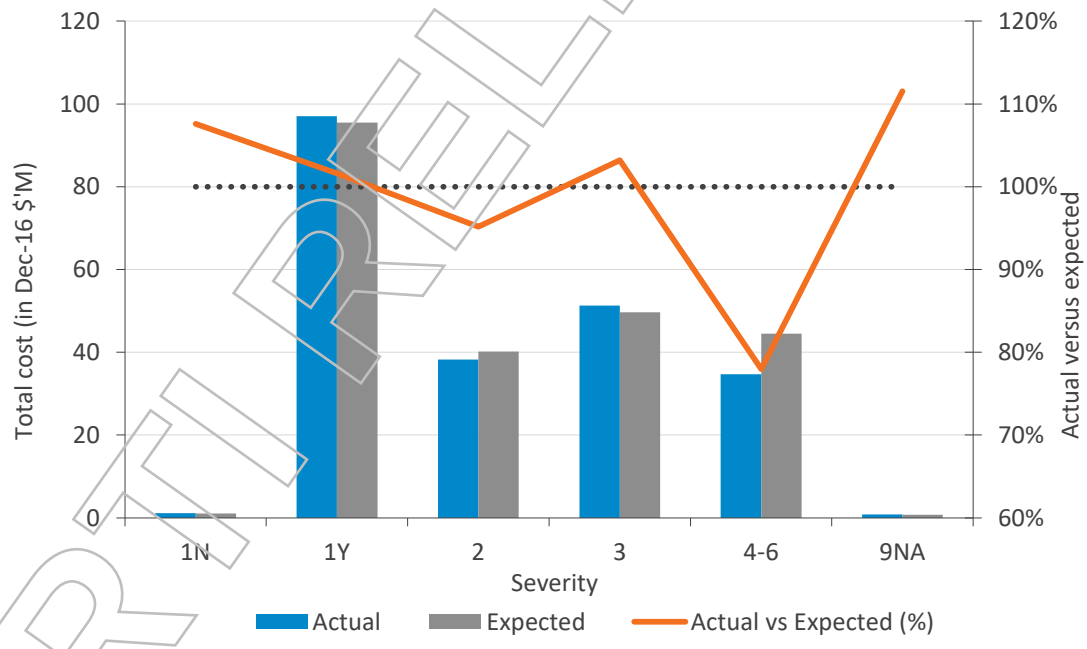


Table 4.2 displays the numerical values of the experience illustrated in Figure 4.3.

Table 4.2 **Ratio of actual/forecast claim payments in the Dec-16 quarter**

Accident periods	Severity 1N	Severity 1Y	Severity 2	Severity 3	Severity 4-6	Severity 9NA
	%	%	%	%	%	%
2011 & earlier	NA	85	51	76	66	37
2012	304	128	96	134	71	27
2013	155	109	100	133	75	43
2014	32	99	123	86	124	115
2015	101	99	89	108	147	264
2016	107	96	67	47	5	174
Total	**108**	**102**	**95**	**103**	**78**	**112**

4.2.2 Calendar year 2016 average claim sizes

Figure 4.4 compares calendar year 2016 experience with the forecasts made on the basis of the model adopted for the previous annual review. The left hand vertical scale (claim size) in this figure is logarithmic.

Figure 4.4 **Average claim sizes for positive finalisations in the 12 months to Dec-16**

Figure 4.5 shows the comparison in terms of total finalised claim cost.

Figure 4.5 **Total cost by accident year in the 12 months to Dec-16**

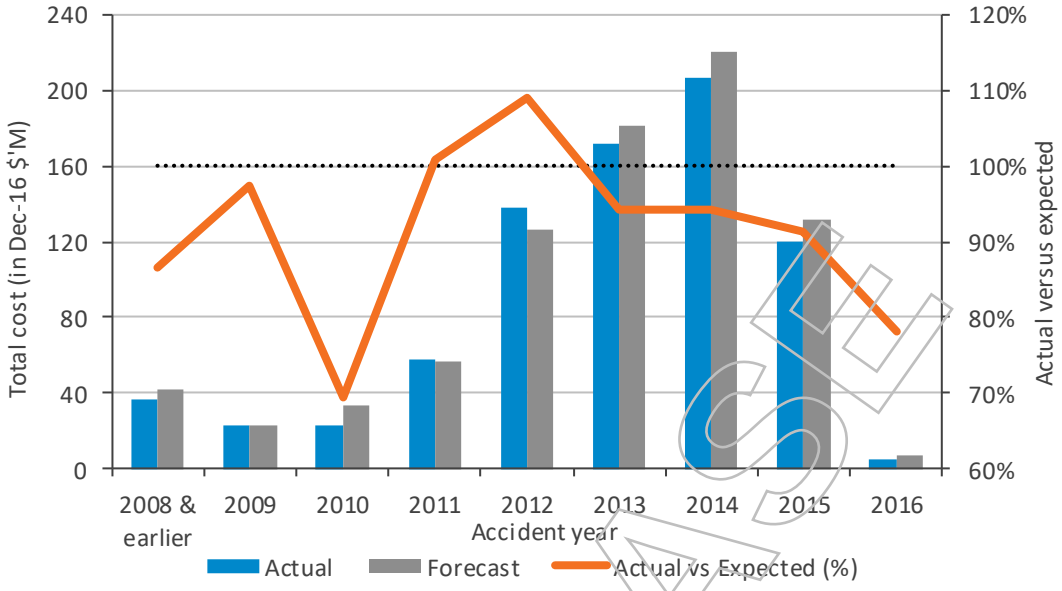


Table 4.3 displays the numerical values of the ratio of actual to forecast claim payments depicted in Figure 4.5. Actual claim payments to claims finalised in the year to date is 5% lower than expected.

Table 4.3 **Ratio of actual to forecast claim payments in the 12 months to Dec-16**

Accident periods	Ratio of actual/forecast claim payments
	%
2008 & earlier	87
2009	97
2010	69
2011	101
2012	109
2013	94
2014	94
2015	91
2016	78
Total	**95**

It is helpful to compare total cost by the major severities. This is shown in Figure 4.6 below.

Figure 4.6 **Total cost by severity in the 12 months to Dec-16**

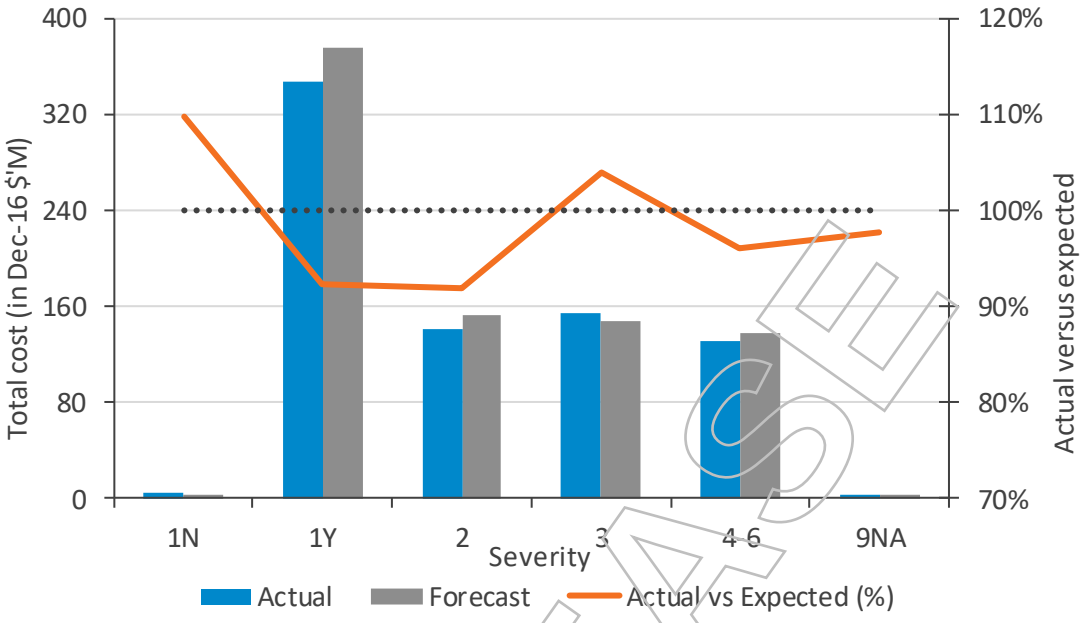


Table 4.4 displays the numerical values of the experience illustrated in Figure 4.6.

Table 4.4 **Ratio of actual/forecast claim payments in the 12 months to Dec-16**

Accident periods	Severity 1N	Severity 1Y	Severity 2	Severity 3	Severity 4-6	Severity 9NA
	%	%	%	%	%	%
2010 & earlier	53	92	77	92	94	23
2011	257	107	92	134	101	110
2012	128	88	97	113	82	81
2013	86	94	97	87	107	93
2014	116	88	93	93	128	136
2015	106	93	63	43	8	182
Total	**110**	**92**	**92**	**104**	**96**	**98**

4.2.3 Case estimate development

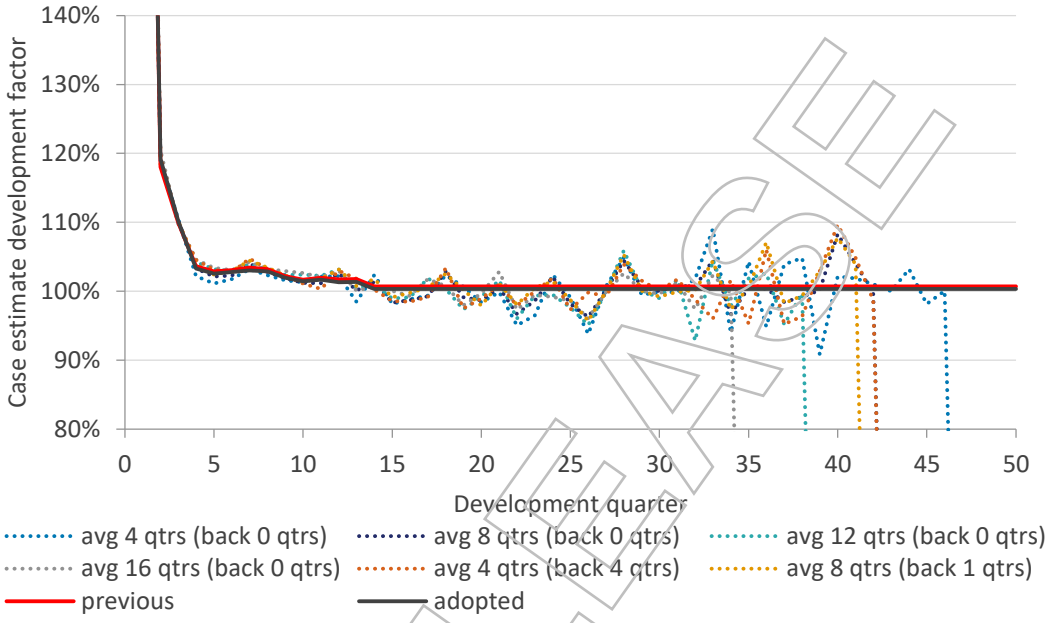
Figure 4.7 illustrates recent changes in the experience of case estimate development ("CED"). The figure plots CED factors, defined for each combination of accident quarter and development quarter. These are defined as follows:

$$\frac{\text{Quarter's closing case estimates + claim payments in the quarter}}{\text{Quarter's opening case estimates}}$$

where all quantities are expressed in constant dollar values.

The numerator of the factor is a hindsight estimate of the denominator, and so the factor represents insurers' change in opinion of the denominator over the quarter. The relevance of case estimates is that they can provide a valuable indication of claim sizes at high operational times.

Figure 4.7 **Case estimate development**



The model CED factor for future development is taken to be the average over the two years ending Dec-16. This leads to a modelled quarterly CED factor of 100.34% in development quarters 14 and later.

We have compared the results of the Projected Case Estimate (PCE) model with our finalised claims model for mature accident years and there is no indication that the finalised claims model is insufficient. The PCE model has not been used in our estimate of risk premium.

4.3 Estimated average claim size

4.3.1 Recalibration of the full severity model

We have updated the full severity model to reflect experience. The full severity model:

- Responds to recent experience at low operational times and low severities
- Adapts more slowly to emerging experience at higher operational times and high severities, reflecting the greater variability in these cohorts.

For example, severity 1N matches recent experience very closely whereas severity 4 and 5 take a longer-term view of average claim size. Severity 1Y responds to recent experience at low operational times, but takes a longer-term view at higher operational times.

Operational time is measured at a severity level. This approach substantially reduces the vulnerability of average claim size estimates to changes in finalisation behaviour. The speed of finalisation of claims of one severity does not affect the average claim size of claims of other severities. This feature, in addition to using a long time window when estimating average claim sizes for higher operational time finalisations, means that average claim size estimates are not likely to be unduly affected by temporary changes in finalisation behaviour.

We demonstrate this philosophy by showing model diagnostics for severities 1Y, 2 and 3. These contribute 81% of the core claims risk premium.

4.3.1 Severity 1Y

Figure 4.8 shows the actual versus projected average claim size by operational time for severity 1Y for the last year. Figure 4.9 shows the actual versus projected average claim size by finalisation year for operational time above 90%. The model follows recent experience closely in low and middle operational times. As the operational time increases, we depart from fitting to recent experience and take a longer-term view. Figure 4.9 shows the fit of this longer-term view at high operational times.

Figure 4.8 **Actual versus projected average claim size for severity 1Y for 2016 finalisation years**

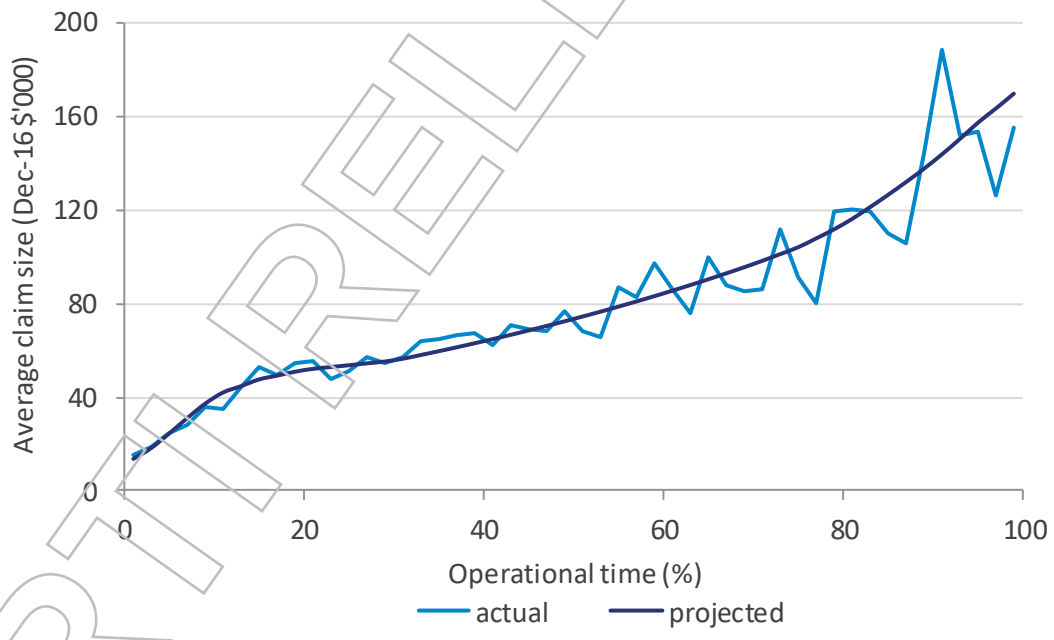


Figure 4.9 **Actual versus projected average claim size for operational times above 90% for severity 1Y**

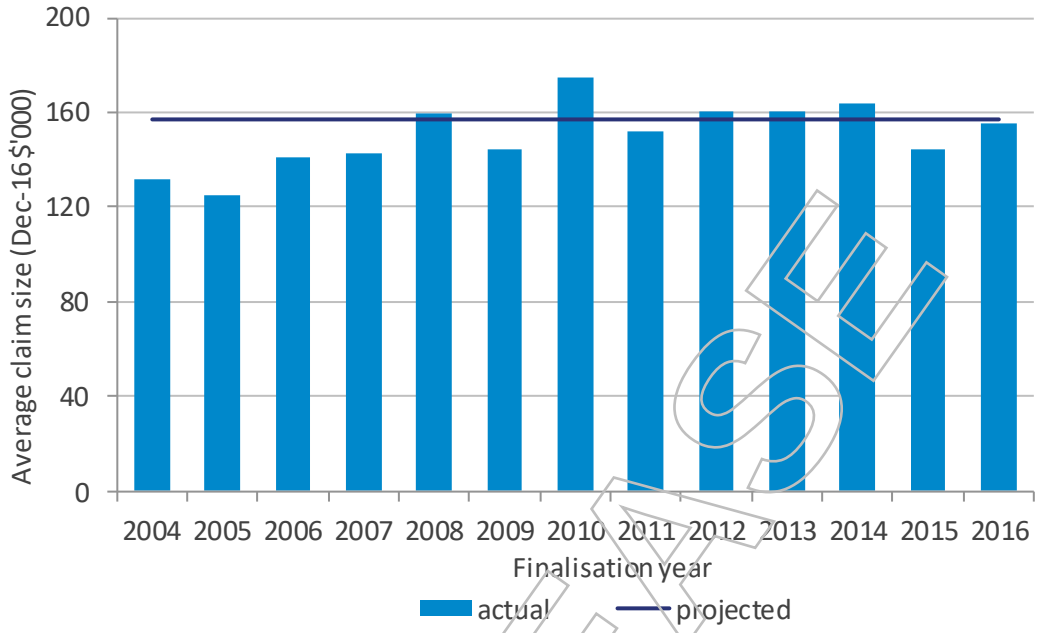
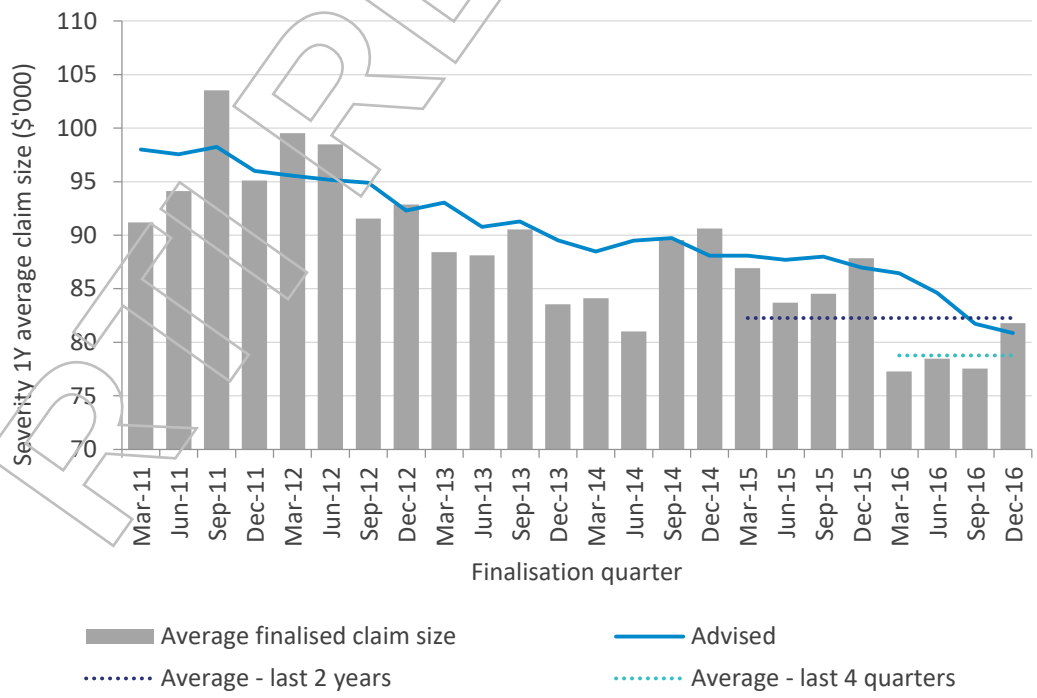


Figure 4.10 shows the severity 1Y average claim size by finalisation period. The actual sizes have been adjusted to account for the operational time profile of finalised claims in each quarter. The advised average claim size is set each quarter based on historically observed average claim size for finalisations up to that date.

Figure 4.10 **Severity 1Y average claim size by finalisation quarter**



There has been a persistent downward trend in severity 1Y average claim size since 2011. The average claim size of finalisations in 2016 is 3% lower than the projected advised average claim size as at 31 December 2016.

4.3.2 Severity 2

Figure 4.11 shows the actual versus projected average claim size by operational time for severity 2 for the last two years. Figure 4.12 shows the actual versus projected average claim size by finalisation year for operational time above 80%. The model follows recent finalisation experience closely for early operational times. As the operational time increases from 50% to 80%, we depart from fitting to recent experience and take a longer-term view. This happens earlier along the operational time curve for severity 2 than we saw in severity 1Y because the claim experience is more volatile. Figure 4.12 shows the fit of this longer-term view.

Figure 4.11 **Actual versus projected average claim size for severity 2 for 2015 and 2016 finalisation years**

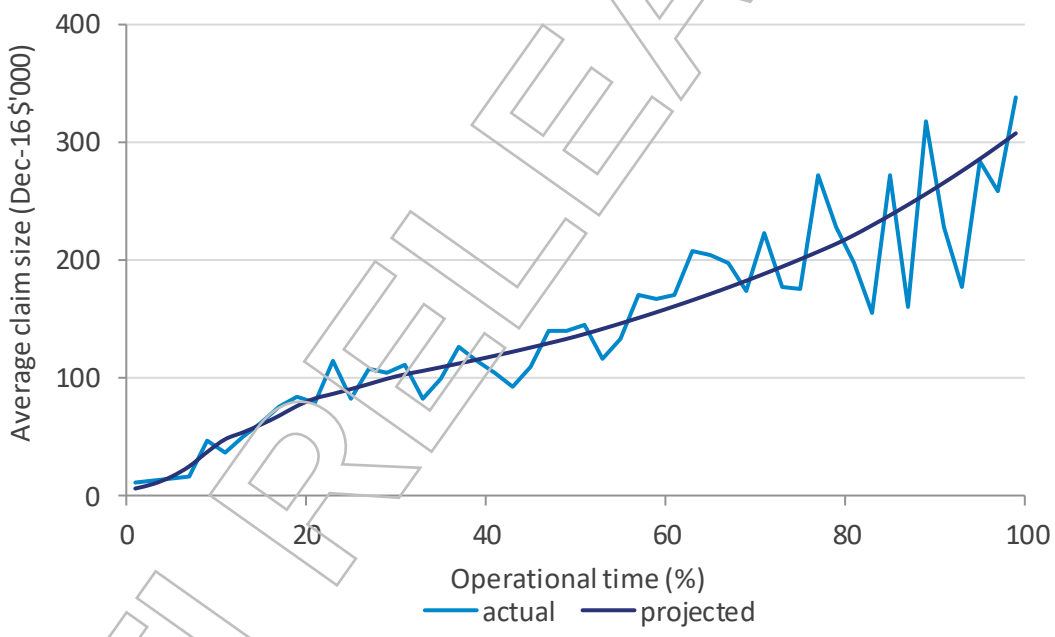
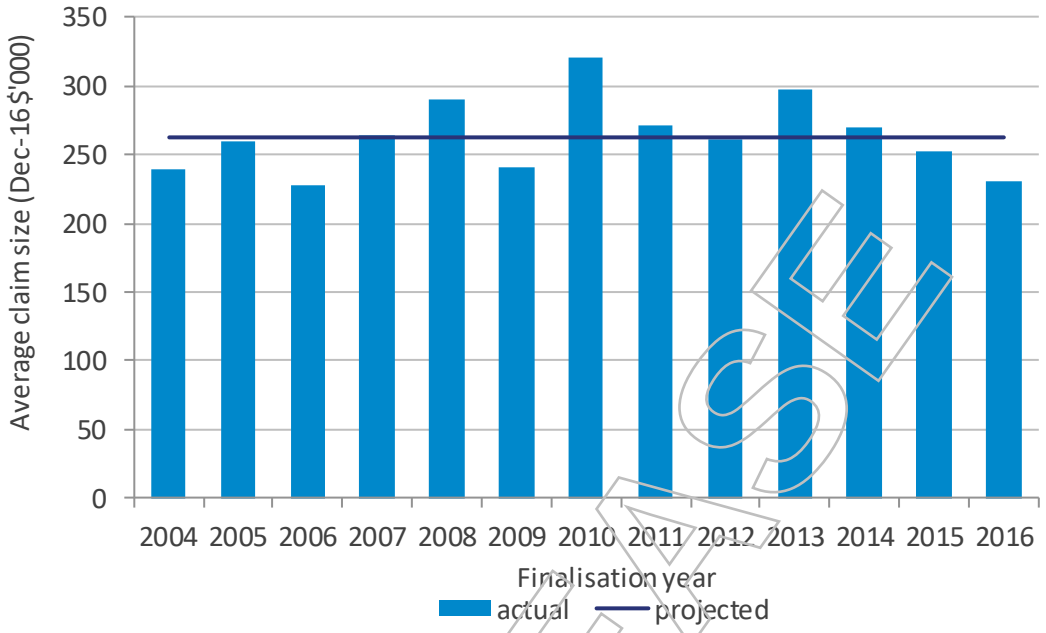


Figure 4.12 **Actual versus projected average claim size for operational times above 80% for severity 2**



4.3.3 Severity 3

Figure 4.13 shows the actual versus projected average claim size by operational time for severity 3 for the last two years. Figure 4.14 shows the actual versus projected average claim size by finalisation year for operational time above 30%. The model fits adequately at early operational times. As the operational time increases from 0% to 30%, we depart from fitting to recent experience and take a longer-term view. This happens earlier along the operational time curve for severity 3 than we saw in severities 1Y and 2 because the claim experience is more volatile. Figure 4.14 shows the fit of this longer-term view.

Figure 4.13 **Actual versus projected average claim size for severity 3 for 2015 and 2016 finalisation years**

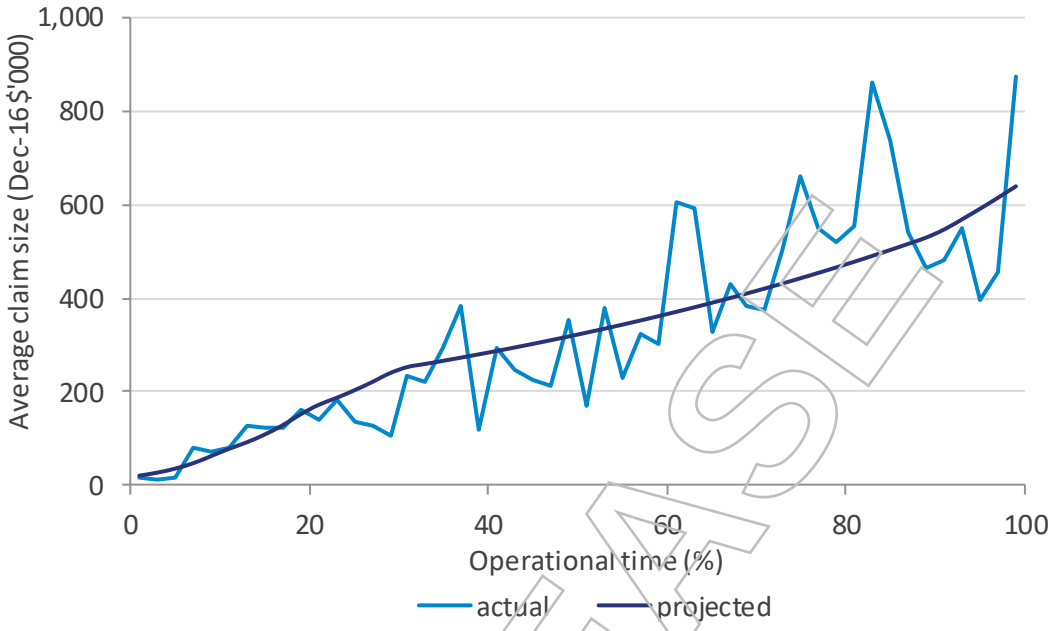
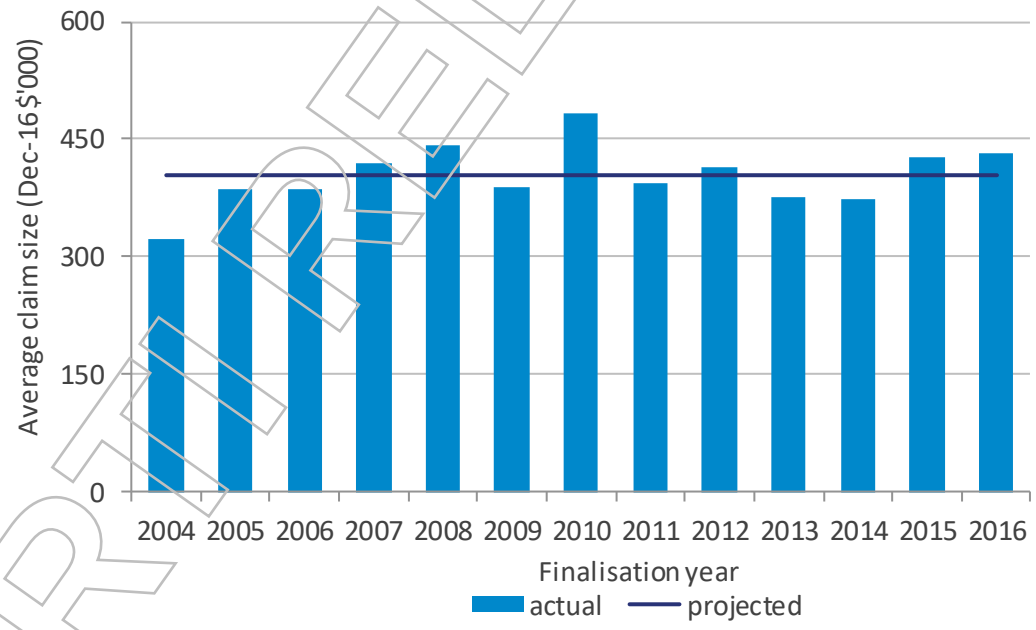


Figure 4.14 **Actual versus projected average claim size for operational times above 30% for severity 3**



4.4 Forecast gross non-ITC average claim size for core claims

Table 4.5 displays for the underwriting quarter beginning 1 July 2017:

- The inflation adjusted estimated claim sizes from the previous quarterly review

- The projected average claim sizes using the model as described in Section 4.3.

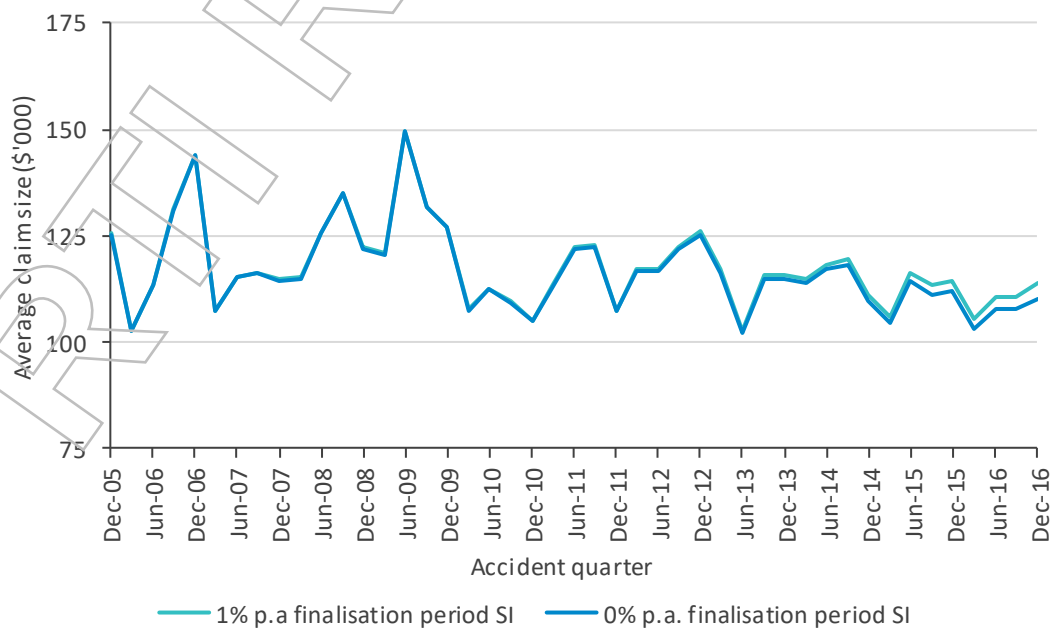
Table 4.5 **Estimated average claim size in Dec-16 dollars, excludes WC & IS and CLAA and tax loadings**

Severity	Previous review	Current review	Change
	$	$	%
1N	5,454	5,941	+8.9
1Y	81,736	80,866	-1.1
2	145,517	144,404	-0.8
3	317,227	317,458	+0.1
4	839,803	853,420	+1.6
5	1,720,430	1,706,184	-0.8
6	202,992	203,751	+0.4
9NA	14,633	16,591	+13.4
All	**113,875**	**111,588**	**-2.0**

There has been an increase in severity 1N and 9NA claims. We continue to revise severity 1Y and 2 downwards in light of favourable claims experience. The 2.0% reduction in overall average claim size is caused mostly by the weaker severity profile described in Section 3.3.

Figure 4.15 plots the estimated average core claim size by accident quarter in 31 December 2016 dollars. We show the average claim size under the 0% p.a. and 1% p.a. finalisation period superimposed inflation scenarios for accident periods up to 31 December 2016.

Figure 4.15 **Average claim size in Dec-16 dollars**



4.5 Average claim size for WC and IS claims

Simple aggregate payments per claim finalised models were separately fitted to the WC and IS claims experience leading to average claim sizes of:

- $10,667 for WC
- $47,451 for IS claims.

5 RISK PREMIUM

The risk premium is composed of:

- The cost of normal claims (Sections 2.5, 3.3 and 4.4)
- The cost of WC and IS claims (Sections 2.6 and 4.5)
- Loadings for:
  - CLAA
  - 2012 tax cuts.

Each of these is discussed below.

5.1 Risk Premium for core claims

Combining our claim frequency and claim size projections for core claims gives an uninflated, undiscounted, gross, non-ITC risk premium estimate for the underwriting quarter beginning 1 July 2017, excluding any allowance for future superimposed inflation, CLAA, 2012 tax changes or WC and IS claims of $191.93.

Table 5.1 shows the changes between this estimate and the corresponding estimate from the previous quarterly review.

Table 5.1 **Changes in risk premium from the previous quarterly review**

Severity	Risk premium as at Sep-16[1] ($'s)		Change in risk premium due to experience ($'s)			Risk premium as at Dec-16 ($'s)
	Sep-16 AWE	Dec-16 AWE	Overall frequency	Severity profile	Claim size	
1N	0.97	0.96	0.03	-0.03	0.09	1.05
1Y	86.18	85.01	3.07	0.63	-0.94	87.76
2	36.08	35.59	1.29	-0.33	-0.28	36.27
3	32.82	32.37	1.17	-1.92	0.02	31.65
4	14.37	14.17	0.51	-0.38	0.23	14.54
5	17.22	16.99	0.61	-0.92	-0.14	16.54
6	3.18	3.13	0.11	-0.22	0.01	3.03
9NA	0.82	0.81	0.03	0.12	0.13	1.08
All severities	**191.64**	**189.03**	**6.83**	**-3.05**	**-0.88**	**191.93**

Notes: 1. Risk premium for September based on baseline frequency of 0.166%

5.2 Risk premium for WC and IS claims

The risk premium for WC claims is calculated as $1.21, based on:

- A claim frequency of 0.0113%
- An average claim size of $10,667.

The risk premium for IS claims is calculated as $2.09, based on:

- A claim frequency of 0.0044%
- An average claim size of $47,451.

5.3 Loadings

5.3.1 CLAA

We recommend that the Civil Liability and Other Legislation Amendment Act 2010 (CLAA) loading is removed as the claims experience is expected to have incorporated the impact of the change.

5.3.2 2012 tax cuts

We recommend that the loading for the tax cuts over several years to 2012 is removed as the claims experience is expected to have incorporated the impact of the change.

5.4 Total risk premium

Combining the results from Sections 5.1 to 5.3 leads to the following components of risk premium for the underwriting quarter beginning 1 July 2017 (based on a baseline claim frequency of 0.172%):

Table 5.2 **Components of risk premium**

	($)
Risk premium for core claims	191.93
WC claims	1.21
IS claims	2.09
Tax cut loading	0.00
CLAA loading	0.00
Total	**195.23**

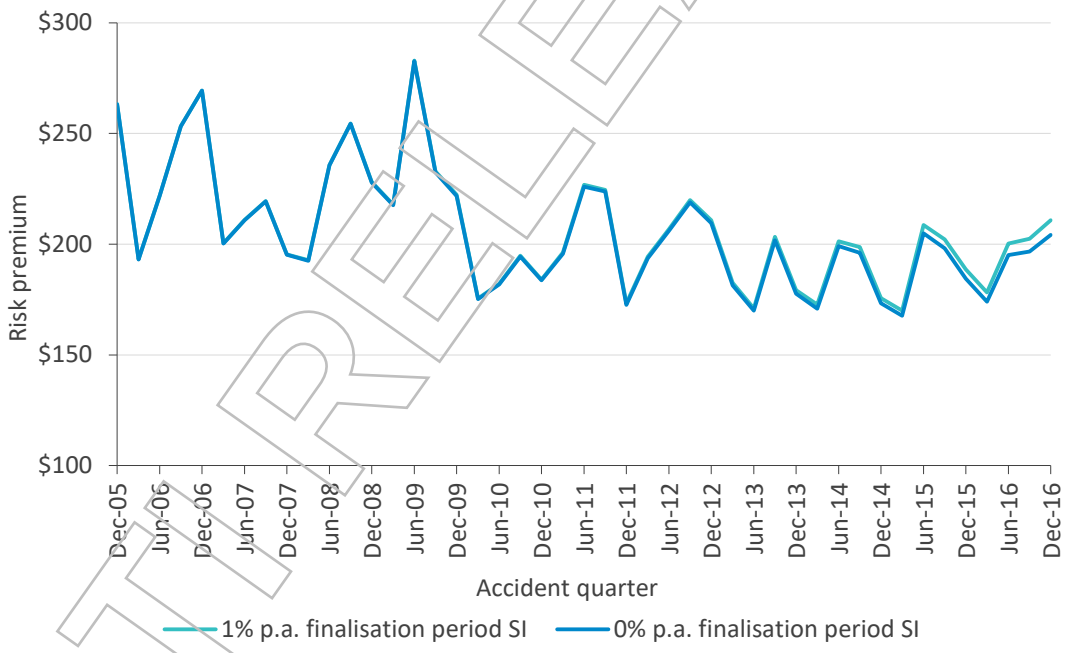
Table 5.3 presents the quarterly reconciliation of all components of risk premium.

Table 5.3 **Quarterly reconciliation of risk premium**

	($)
Risk premium at 30 September 2016	**197.79**
Changes due to	
AWE	-2.65
Core claim frequency	+6.83
Severity profile	-3.05
Claim size	-0.88
WC and IS	-0.16
Loadings	-2.66
Total	***-2.57***
Risk premium at 31 December 2016	**195.23**

Figure 5.1 displays the estimated risk premiums for each accident quarter. We show the risk premium under the 0% p.a. and 1% p.a. superimposed inflation scenarios.

Figure 5.1 **Risk premiums in 31 December 2016 dollars updated for Dec-16 experience**



5.5 Sensitivity

Table 5.4 illustrates the sensitivity of the risk premium estimate. Specifically, we examine the effect on risk premium of adopting:

- A core frequency of:
  - 0.176%, which is the projected core claim frequency for 2016
  - 0.185%, which is the projected core claim frequency for 2016Q4 after seasonal adjustments

- A core average claim size of:
  - $110k, which incorporates the 2016 finalisation year reduction in severity 1Y claims size in full
  - $104k, which is the average claims cost if the downward trend in severity 1Y average claim size is projected to the average finalisation date of the 2017Q3 underwriting quarter.

We highlight the diagonal to emphasise the potential offsetting quality of these sensitivities. These sensitivities are not intended to exhaustively cover the sources of uncertainty which impact on these possible outcomes.

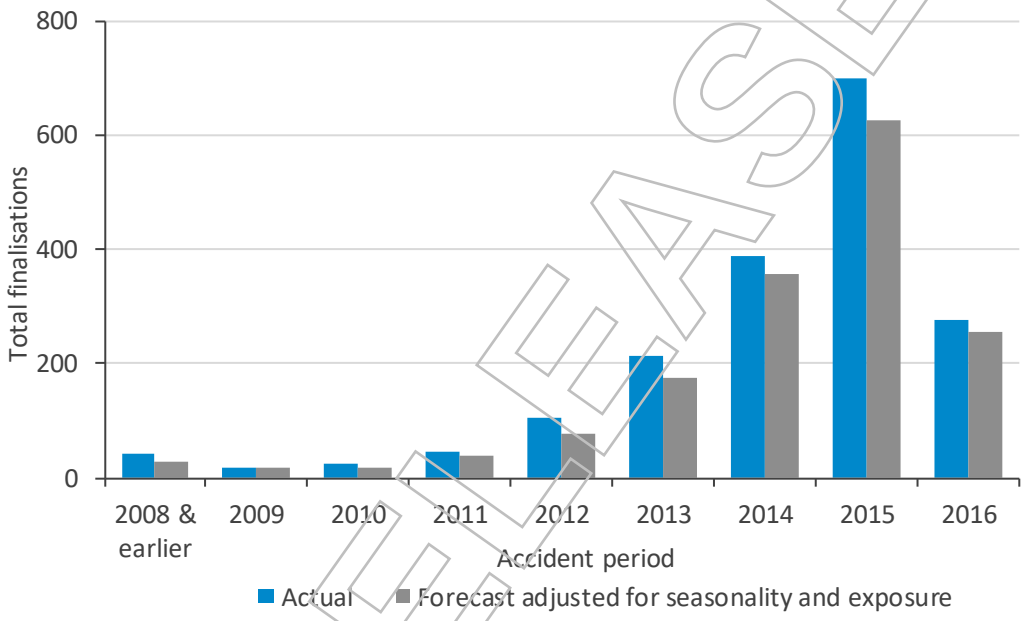
Table 5.4 **Sensitivity to important assumptions**

		Average claim size		
		Advised Dec-16 ($112k)	Average of last 4 quarters ($110k)	Continued downward trend in severity 1Y ($104k)
Core frequency	Baseline (0.172%)	$0	-$2	-$13
	2016 average (0.176%)	+$5	+$2	-$9
	2016Q4 estimate (0.185%)	+$14	+$12	$0

6 PAYMENT PATTERN

Figure 6.1 shows the number of positive claim finalisations compared to expected numbers based on the model from the previous annual review. Overall, finalisation experience in 2016 has been significantly higher than previous years, with actual numbers being 12% above expected.

Figure 6.1 **Actual versus expected finalisations in calendar year 2016**



The term "payment pattern" is used to describe the distribution of an underwriting quarter's claim costs over development periods. It is determined mainly by reference to the models of finalisation rates and finalisation sizes. Table 6.1 sets out the payment pattern that follows from the models of the present report, and compares it with that used by MAIC in calculating Floor and Ceiling premium rates over the past four quarters. The payment pattern is a little shorter than previous assumptions, in partial recognition of the increase in finalisation rates observed over the year as well as the weaker severity profile. Note that the payment pattern is in current dollar values, and excludes both future wage and superimposed inflation.

Table 6.1 **Payment pattern**

Development year (from underwriting)	Previous review	Current review
	%	%
1	0.9	1.1
2	12.7	14.3
3	27.8	29.7
4	24.2	24.1
5	13.8	13.5
6	7.8	6.8
7	4.3	3.3
8	2.6	2.1
9	1.8	1.5
10	1.3	1.1
11	0.9	0.8
12 & later	1.9	1.7
Total	**100.0**	**100.0**
Mean term	**3.85**	**3.67**

7 ECONOMIC ASSUMPTIONS

7.1 Past inflation

Our model of average claim size relies upon quarterly indexing of historical claim payments up to the date of review. We index historical claim payments using the Australian Bureau of Statistics ("ABS") publication of Average Weekly Earnings ("AWE"), index 6302.0, QLD seasonally adjusted, all employees total earnings series and the Deloitte Access Economics forecasted Queensland AWE rates.

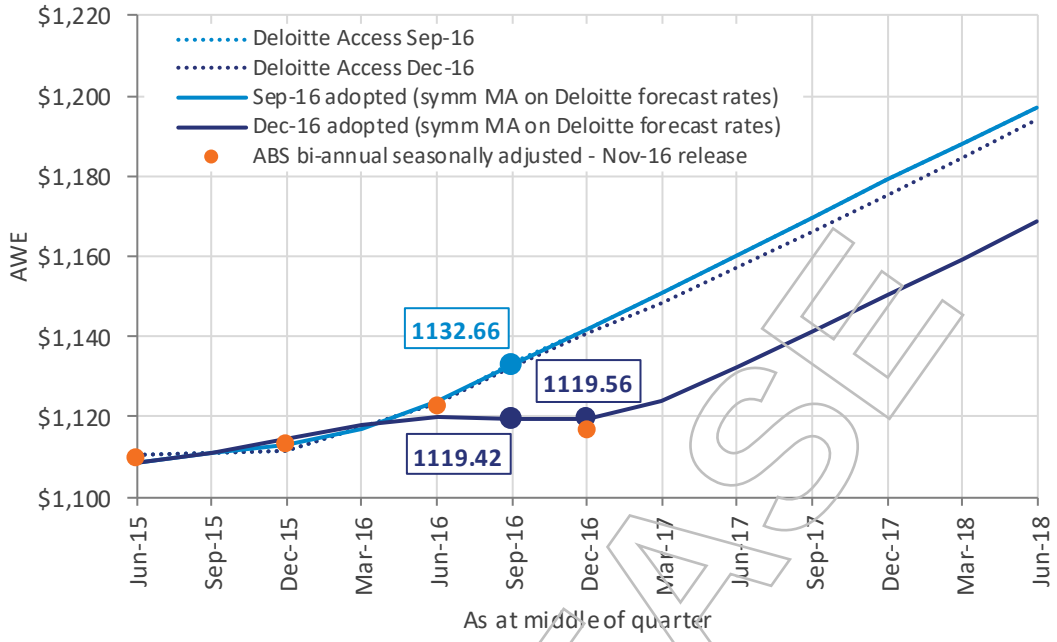
In 2012, the ABS changed the frequency of their publication of past AWE from a quarterly series to a half yearly series. As a result, the ABS does not publish an AWE series for the September and March quarters. The latest available series published by the ABS is the November 2016 series, published in February 2017.

We have elected to combine the published ABS seasonally adjusted series together with the latest available forecasted rates from Deloitte Access Economics to produce an augmented ABS seasonally adjusted series up to December 2016. We then apply the ABS trending methodology to estimate the eventual values of the ABS trended series.

Figure 7.1 shows the comparison between:

- The November 2016 ABS seasonally adjusted series (orange markers)
- The September 2016 Deloitte Access Economics series (dotted light blue line)
- The December 2016 Deloitte Access Economics series (dotted dark blue line)
- Our adopted forecasts at September 2016 (solid light blue line)
- Our adopted forecasts at December 2016 (solid dark blue line).

Figure 7.1 **Queensland AWE estimates for 31 December 2016 quarter**



As shown in Figure 7.1:

- Our previous adopted AWE estimate for the middle of the September 2016 quarter was $1,132.66
- Our current adopted AWE estimate for the middle of the December 2016 quarter is $1,119.56, representing a decrease of 1.2% over the quarter.

Historical claim payments are inflated to the date of review:

- Our previous adopted AWE estimate for 30 September 2016 was $1,137.18
- Our current adopted AWE estimate for 31 December 2016 is $1,121.72, representing a decrease of 1.4% over the quarter.

7.2 Future inflation

Forecasts of future inflation and bond yields have changed since the previous quarterly review. Both have been estimated period by period into the future. The inflation projections are for QLD AWE inflation and sourced from Deloitte Access Economics. The bond yields are derived from market yields as at 7 March 2017. References to the previous quarterly review in the tables below refer to the rates based on yields as at 6 December 2016.

Table 7.1 shows the economic assumptions by future year.

Table 7.1 **Future economic assumptions by year**

Future Year	Wage inflation (% p.a.)		Investment return (% p.a.)	
	Previous quarterly review	Current review	Previous quarterly review	Current review
Up to underwriting quarter	3.3	2.7		
1	3.2	3.3	1.8	1.8
2	3.2	3.6	2.1	2.2
3	3.2	3.6	2.4	2.5
4	3.4	3.6	2.7	2.8
5	3.5	3.4	3.0	3.0
6	3.4	3.1	3.3	3.3
7	3.1	2.7	3.5	3.4
8	3.1	2.7	3.7	3.6
9	3.1	2.7	3.9	3.8
10	3.1	2.7	4.0	3.9
11	3.1	2.7	4.1	4.0
12	3.1	2.7	4.3	4.1

The inflation rates have been reduced to a constant "flat" rate over all future years equivalent in its effect to the estimated variable rates. Similarly, a constant flat rate of discount has been estimated.

Table 7.2 shows the flat rates and the resulting "gap".

Table 7.2 **Economic gap**

Parameter	Estimate (% p.a.)	
	Previous quarterly review	Current review
Wage inflation	3.23	3.31
Investment return	2.42	2.44
Gap	**-0.80**	**-0.87**

Table 7.3 shows the adopted payment pattern, as well as the derived inflation factors based on both the variable rates shown in Table 7.1 and the flat rates shown in Table 7.2. The adopted payment pattern was outlined in Section 6. The inflation factors include 1% p.a. superimposed inflation and allow for inflation from 31 December 2016 to the middle of each development year. The inflated payment pattern shows the variable inflation rate is equivalent to a flat rate of 3.31%.

Table 7.3 **Payment pattern and inflation factors**

Development year	Payment pattern (%)	Inflation factor (%)		Inflated payment pattern (%)	
		Variable rate	Flat rate	Variable rate	Flat rate
1	1.1	105	105	1.2	1.2
2	14.3	109	109	15.6	15.7
3	29.7	114	114	33.9	33.9
4	24.1	120	119	28.8	28.7
5	13.5	125	124	16.9	16.8
6	6.8	130	130	8.9	8.8
7	3.3	135	135	4.5	4.5
8	2.1	140	141	2.9	3.0
9	1.5	145	147	2.2	2.2
10	1.1	151	154	1.7	1.7
11	0.8	156	161	1.3	1.3
12 & later	1.7	162	167	2.8	2.8
Total inflation adjustment				**120.5**	**120.5**

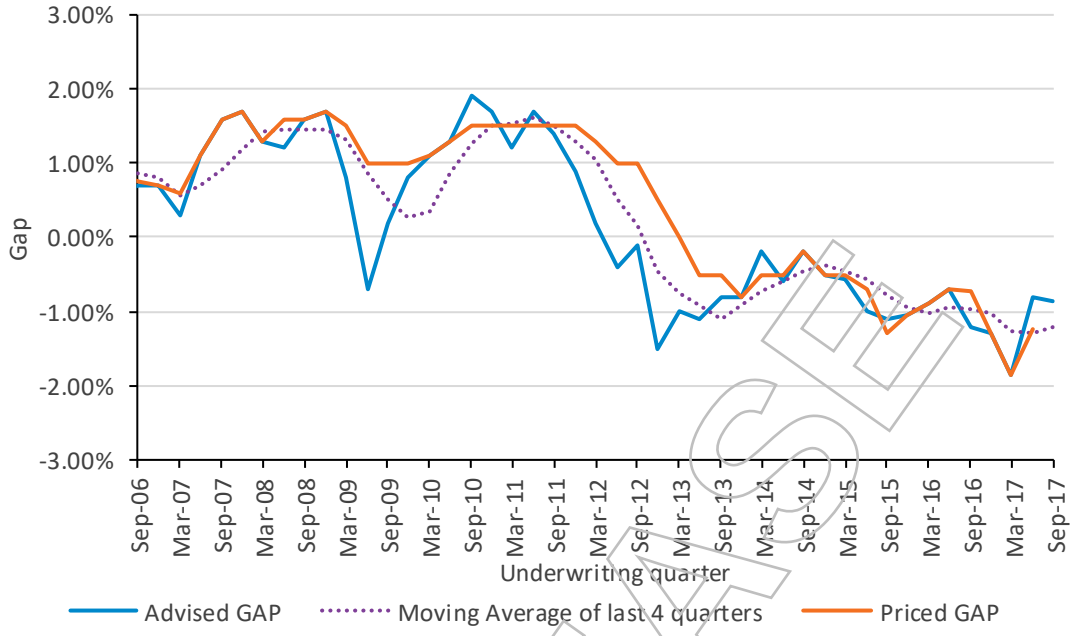
Table 7.4 shows the same analysis with inflation and discounting. The inflated and discounted payment pattern shows the variable rates are equivalent to a gap of -0.87% p.a..

Table 7.4 **Payment pattern and inflation and discount factors**

Development year	Payment pattern (%)	Inflation and discount factor (%)		Inflated and discounted payment pattern (%)	
		Variable rate	Flat rate	Variable rate	Flat rate
1	1.1	104	104	1.1	1.1
2	14.3	106	106	15.2	15.1
3	29.7	108	108	32.2	31.9
4	24.1	110	110	26.6	26.4
5	13.5	112	112	15.1	15.1
6	6.8	113	114	7.7	7.7
7	3.3	114	116	3.8	3.8
8	2.1	114	118	2.4	2.5
9	1.5	114	120	1.7	1.8
10	1.1	114	122	1.3	1.3
11	0.8	114	125	0.9	1.0
12 & later	1.7	113	127	1.9	2.2
Total inflation and discount adjustment				**110.0**	**110.0**

Figure 7.2 shows a history of the estimated gap since September 2006. The four quarter moving average estimate of the gap is -1.21%.

Figure 7.2 **History of the Economic Gap**



8 SUPERIMPOSED INFLATION

Observed changes in average claim size since the introduction of the CLA reflect two effects, namely:

- The decrease in claim frequency for low severity claims, causing a shift in the proportions by severity towards higher severity claims and hence an increase in average claim size
- The remaining changes, which represent superimposed inflation.

In estimating superimposed inflation, we have removed the first component by estimating average claim size for each post-CLA accident quarter as if the claim proportions from 2002Q4 remained constant thereafter. We have estimated the second component, superimposed inflation, over seven time periods:

1. The period from September 1996 to December 2002 (introduction of the CLA)
2. The one-quarter period from December 2002 to March 2003
3. The period from March 2003 to December 2016 (the most recent quarter)
4. The period from March 2003 to December 2011
5. The period from December 2011 to December 2016 (the last five years)
6. The entire period from September 1996 to December 2016
7. The 4 quarter moving average for the entire period (from June 1997 to December 2016).

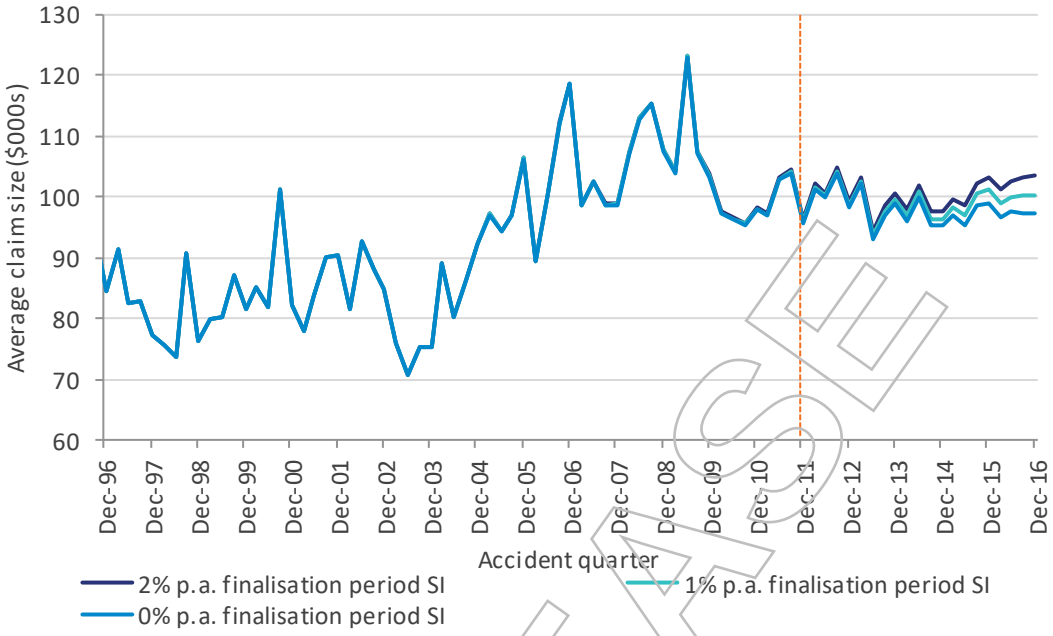
Our estimates are for superimposed inflation in the claim size across accident periods. The estimates depend on any finalisation period superimposed inflation which occurs between now and when the claims for each past accident period are all finalised. Our estimates of accident period superimposed inflation therefore depend on assumptions for future finalisation period superimposed inflation. Current recent finalisation period superimposed inflation is zero. Our estimates are as follows:

Table 8.1 **Accident year superimposed inflation**

Period (accident quarter)	Superimposed inflation Assuming future finalisation period SI of:		
	0% p.a.	1% p.a.	2% p.a.
Sep-96-Dec-02	-1.7%	-1.7%	-1.7%
Dec-02-Mar-03	-10.3%	-10.3%	-10.3%
Mar-03-Dec-16	1.8%	2.0%	2.3%
Mar-03-Dec-11	2.7%	2.7%	2.7%
Dec-11-Dec-16	0.3%	0.9%	1.4%
Sep-96-Dec-16	**0.1%**	**0.3%**	**0.4%**
Jun-97-Dec-16 (4-qtr moving average)	**0.5%**	**0.7%**	**0.8%**

The figure below displays the average claim sizes which underlie Table 8.1.

Figure 8.1 **Claim size in current values: 0% p.a., 1% p.a. and 2% p.a. future SI[1,2]**



1. Post Dec-02 quarters adjusted to Dec-02 severity mix
2. Including WC & IS.

9 VEHICLE CLASS RELATIVITIES

Registered vehicles are assigned to vehicle classes for CTP premium purposes. The premium rate payable in respect of a vehicle class is related to the premium payable under Class 1 (cars and station wagons) through the relativity for that class. The scope of the analysis was limited to existing vehicle classes only, and consideration of possible cross-subsidy within classes (geographic or other) was regarded as beyond scope.

The MAIC database has been used to produce separate estimates of claim frequency and average claim size relativities. GLM methodology has been used in each case. The GLM leading to the average claim size model is based on the incurred cost for individual claims in respect of accident periods 1 July 1996 up to 30 June 2015 while the claim frequency GLM is based on claim notifications in respect of accident periods 1 July 1996 up to 30 June 2016.

No assessment was made of the representativeness of that database with respect to catastrophic claims. Hence the relativities below include no specific allowance for catastrophe potential beyond that reflected in the data.

The modelling of claim frequency sought any trends, relative to Scheme average frequency, over time. Statistically significant trends were detected in respect of:

- Class 2 (motorised homes) – a decreasing trend which has flattened at 2001
- Class 3 (taxis) – an increasing trend which has flattened at 2006
- Class 4 (hire vehicles) – a decreasing trend which has flattened at 2009
- Class 6 (trucks, utes and vans) – an increasing trend which has flattened at 2006
- Class 7 (heavy trucks) – an increasing trend which has stepped down at 2010
- Class 8 (Buses: charitable, community service, driver tuition, not otherwise for business or commercial use) – an upwards step at 2005
- Class 10A (Buses: not class 8, 9 or 10B but used within 350 km of base) - an increasing trend since 2005 which has flattened at 2009
- Class 10B (Translink service contract other than school or restricted school service) - a downwards step since 2010
- Class 12 (driver only motor cycles) – a decreasing trend which flattened at 2001
- Class 13 (passenger carrying motor cycles) – a decreasing trend which flattened at 2015
- Class 15 (self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles) – an upwards step at 2005
- Class 16 (ambulances) – an increasing trend which has flattened at 2008
- Class 19 (motor vehicles conditionally registered) – a step downwards at 2009
- Class 21 (self-propelled machinery) – a step downwards at 2009.

We adopt a twelve year average for determining average claim size relativities for all classes.

The average claim size relativity also includes a NIISQ adjustment by class to reflect the change in claim size after the introduction NIISQ. The NIISQ adjustments are sourced from our report "Advice on NIIS levies – update of Scenario C" dated 25 May 2016 by Richard Brookes and Ashley Evans. The impact of introduction of the NIISQ on claim size is

incorporated through an adjustment factor that is applied to the estimated average claim size relativity.

Since the GLMs for frequency and size relativities are stochastic, they generate confidence intervals in each case. These confidence intervals were combined to produce a confidence interval for the risk premium relativity in respect of each vehicle class. These are set out in Table 9.1, where existing relativities adopted by MAIC are also displayed.

Table 9.1 **Risk premium relativities**

	Vehicle class	Risk premium relativity (%)		
		Post-NIISQ central estimate	90% confidence interval	Existing
		%	%	%
1	Cars and station wagons	100	-	100
2	Motorised homes	34	19-53	100
3	Taxis	1899	1641-2173	1800
4	Hire vehicles	185	160-212	180
5	Vintage, veteran, historic or street rod motor vehicles	4	1-7	12
6	Trucks, utilities and vans 4.5t GVM or less	115	110-121	115
7	Trucks, utilities and vans more than 4.5t GVM	405	373-439	420
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use	227	148-321	160
9	Buses: school, therapy, rehabilitation, remedial or special education	162	103-213	140
10A	Buses: not class 8, 9 or 10B but used within 350 km of base	780	571-1016	630
10B	Buses: Translink service contract other than school or restricted school service	1351	1124-1595	1700
11	Buses: not class 8, 9, 10A or 10B	577	469-695	520
12	Motorcycles: for driver only	21	13-31	20
13	Motorcycles: with pillion passenger/sidecar	48	39-59	50
14	Tractors	9	4-16	15
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles	154	99-219	100
16	Ambulances	287	131-493	200
17	Primary production vehicles	46	33-60	45
19	Motor vehicles conditionally registered - limited access	28	16-44	35
20	Motor vehicles conditionally registered - zoned access	3	1-7	15
21	Self-propelled machinery other than a vehicle of class 14, 15, 19 or 20	25	7-50	30
23	Dealer's plate issued	25	10-46	100
24	Supplementary trailer insurance including Federal/Interstate	8	1-19	20

10 REDUCTION IN RISK PREMIUM WITH THE INTRODUCTION OF THE NIISQ

We have estimated the reduction in CTP premium which will result from the introduction of the NIISQ. This estimate was presented to MAIC in the letter "Estimate of the reduction in CTP premium with the introduction of the NIIS" by Richard Brookes and Ashley Evans on 15 June 2016 ("the reduction letter").

We have updated the economic assumptions used in the reduction letter to be consistent with the advised economic assumptions presented in Section 7, and included superimposed inflation at 1% p.a.. If MAIC adopts economic assumptions different to those advised, we advise that the reduction in CTP premium moves accordingly.

Table 16.1 shows the reduction in risk premium with the introduction of the NIISQ. We provide the inflated and discounted version because these costs have a different discounted mean term to the risk premium.

Table 16.1 Reduction in risk premium (excl. GST) with the introduction of the NIISQ

Item	Risk premium (excl. GST)
Reduction in risk premium (Dec-15 values)	$13.84
Inflation/discounting factor (incl. SI)[1]	113%
Reduction in risk premium (inflated/discounted)	$15.71

1. Includes inflation from 31 December 2015 to the underwriting date.

17 March 2016

Neil Singleton
Insurance Commissioner
Office of the Insurance Commissioner
33 Charlotte Street
Brisbane QLD 4000

Dear Neil,

Vehicle class relativities 2016/17

1 Introduction

Vehicles insured under the *Queensland Motor Accident Insurance Act 1994*, as amended, are categorised into **vehicle classes** of similar vehicle types. Each vehicle class is assigned a **relativity**, which determines a premium charged by an insurer for that vehicle class.

Our report dated 17 March 2016 on "Queensland CTP Insurer Briefing: Review of the components of risk premium for the underwriting period 1 July to 30 September 2016" ("the Insurer Report"), authored by Richard Brookes and Ash Evans, gave estimates of vehicle class relativities to apply to the year commencing 1 July 2016. These are found in Table 9.1 of that report.

These vehicle class relativities are more strictly referred to as **risk premium relativities**. Each of them is the product of a **claim frequency relativity** and an **average claim size relativity**. The claim frequency relativity relates to claim frequency of the relevant vehicle class to the Class 1 claim frequency and the average claim size relativity is defined similarly.

You have requested that we provide the claim frequency and average claim size relativities, by vehicle class, corresponding to the risk premium relativities appearing in the Insurer Report. These are given in Section 3.

2 Models and methodology

2.1 Claim frequency relativities

We model the claim frequency relativity of each class by a Generalised Linear Model ("GLM"). This model recognises:

- A different relativity for each vehicle class

- For some vehicle classes, claim frequency relativities which display trends over accident years.

The model was calibrated against raw claim frequencies, by vehicle class, over the accident years ended 30 June 1996 to 30 June 2015. The raw claim frequency for each accident year was calculated as number of claims notified to 31 December 2015 divided by the number of vehicle-years of exposure in the accident year.

2.2 Average claim size relativities

These are modelled by means of a GLM of the average claim size which recognises a different relativity for each vehicle class. The dispersion of individual claim sizes is such that no trend over time in relativities was apparent except for class 4. Further detail of this trend is given in the Insurer Report.

The model was calibrated against the raw average claims sizes over the accident years ended 30 June 1996 to 30 June 2014. The raw average claim size of an accident year was measured as the amount of claims incurred to 31 December 2015 for that accident year divided by the number of claims notified to 31 December 2015. The amount of claims incurred consisted of case estimates at 31 December 2015 plus claim payments to that date expressed in 31 December 2015 dollars.

3 Claim frequency, average claim size and risk premium relativities

Table 3.1 displays claim frequency, average claim size, and risk premium relativities for all vehicle classes as they are estimated to apply to the underwriting year commencing 1 July 2016. Where claim frequency relativity is estimated to be subject to a trend over accident years up to 2014/15, that trend has not been extrapolated beyond 2014/15, i.e. the estimated relativity for accident year 2014/15 has been assumed to apply to underwriting year 2016/17.

Table 3.1 **Relativities**

	Vehicle class	Estimated relativity		
		Claim frequency	Average claim size	Risk premium
		%	%	%
1	Cars and station wagons	100	100	100
2	Motorised homes	37	130	48
3	Taxis	2224	90	2002
4	Hire vehicles	163	105	171
5	Vintage, veteran, historic or street rod motor vehicles	7	97	6
6	Trucks, utilities and vans 4.5t GVM or less	98	115	113
7	Trucks, utilities and vans more than 4.5t GVM	314	132	415
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use	146	158	231
9	Buses: school, therapy, rehabilitation, remedial or special education	158	97	154
10A	Buses: not class 8, 9 or 10B but used within 350 km of base	671	109	729
10B	Buses: operating under an integrated mass transit service contract, other than buses used only for a school service or a restricted school service	2734	57	1545
11	Buses: not class 8, 9, 10A or 10B	476	108	517
12	Motorcycles: for driver only	11	210	23
13	Motorcycles: with pillion passenger/sidecar	27	183	50
14	Tractors	7	100	7
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles	85	165	141
16	Ambulances	254	107	273
17	Primary production vehicles	27	201	54
19	Motor vehicles conditionally registered - limited access	11	319	34
20	Motor vehicles conditionally registered - zoned access	7	56	4
21	Self-propelled machinery not class 14, 15, 19 or 20	11	241	26
23	Dealer's plate issued	23	72	17
24	Supplementary trailer insurance including Federal/Interstate	12	55	6

The final column of the table is equal to the product of the preceding two columns. However, the reader may not be able to reproduce the calculations precisely due to rounding errors.

Yours sincerely,

Contrary to public interest

Richard Brookes

Contrary to public interest

Ashley Evans

Fellows of the Institute of Actuaries of Australia

21 March 2017

Neil Singleton
Insurance Commissioner
Office of the Insurance Commissioner
By email: Neil.Singleton@treasury.qld.gov.au

Dear Neil,

Vehicle class relativities 2017/18

1 Introduction

Vehicles insured under the *Queensland Motor Accident Insurance Act 1994*, as amended, are categorised into **vehicle classes** of similar vehicle types. Each vehicle class is assigned a **relativity**, which determines a premium charged by an insurer for that vehicle class.

Our report "Queensland CTP Insurer Briefing: Review of the components of risk premium for the underwriting period 1 July to 30 September 2017" dated 17 March 2017 by Richard Brookes and Ashley Evans ("the Insurer Report") gave estimates of vehicle class relativities to apply to the year commencing 1 July 2017. These are found in Table 9.1 of that report.

These vehicle class relativities are more strictly referred to as **risk premium relativities**. Each of them is the product of a **claim frequency relativity** and an **average claim size relativity**. The claim frequency relativity relates to claim frequency of the relevant vehicle class to the Class 1 claim frequency and the average claim size relativity is defined similarly.

The average claim size relativity also includes a NIISQ adjustment by class to reflect the change in claim size after the introduction NIISQ. The NIISQ adjustments are sourced from our report "Advice on NIIS levies – update of Scenario C" dated 25 May 2016 by Richard Brookes and Ashley Evans.

You have requested that we provide the claim frequency and average claim size relativities, by vehicle class, corresponding to the risk premium relativities appearing in the Insurer Report. These are given in Section 3.

2 Models and methodology

Claim frequency relativities

We model the claim frequency relativity of each class by a Generalised Linear Model ("GLM"). This model recognises:

- A different relativity for each vehicle class
- For some vehicle classes, claim frequency relativities which display trends over accident years.

The model was calibrated against raw claim frequencies, by vehicle class, over the accident years ended 30 June 1996 to 30 June 2016. The raw claim frequency for each accident year was calculated as the number of claims notified to 31 December 2016 divided by the number of vehicle-years of exposure in the accident year.

Average claim size relativities

These are modelled by means of a GLM of the average claim size which recognises a different relativity for each vehicle class. The dispersion of individual claim sizes is such that there is no trend over time. A 12 year average was adopted for all classes.

The model was calibrated against the raw average claims sizes over the accident years ended 30 June 1996 to 30 June 2015. The raw average claim size of an accident year was measured as the amount of claims incurred to 31 December 2016 for that accident year divided by the number of claims notified to 31 December 2016. The amount of claims incurred consisted of case estimates at 31 December 2016 plus claim payments to that date expressed in 31 December 2016 dollars.

The impact of introduction of the NIISQ on claim size is incorporated through an adjustment factor that is applied to the estimated average claim size relativity.

3 Claim frequency, average claim size and risk premium relativities

Table 1 displays claim frequency, pre-NIISQ average claim size, post-NIISQ average claim size, and risk premium relativities for all vehicle classes as they are estimated to apply to the underwriting year commencing 1 July 2017. Where claim frequency relativity is estimated to be subject to a trend over accident years up to 2015/16, that trend has not been extrapolated beyond 2015/16, i.e. the estimated relativity for accident year 2015/16 has been assumed to apply to underwriting year 2017/18.

Yours sincerely,

Contrary to public interest

Richard Brookes

Fellow of the Institute of Actuaries of Australia

Contrary to public interest

Ashley Evans

Fellow of the Institute of Actuaries of Australia

Table 1 Estimated relativities by vehicle class

Vehicle class		Claim frequency relativity	Average claim size relativity			Risk premium
			Pre-NIISQ	NIISQ adjustment	Posts-NIISQ	
		%	%	%	%	%
1	Cars and station wagons	100	100	100	100	100
2	Motorised homes	35	90	109	99	34
3	Taxis	2166	84	104	88	1899
4	Hire vehicles	164	109	104	113	185
5	Vintage, veteran, historic or street rod motor vehicles	6	54	109	59	4
6	Trucks, utilities and vans 4.5t GVM or less	97	118	101	119	115
7	Trucks, utilities and vans more than 4.5t GVM	310	129	102	131	405
8	Buses: charitable, community service, driver tuition, not otherwise for business or commercial use	145	162	96	156	227
9	Buses: school, therapy, rehabilitation, remedial or special education	160	92	109	101	162
10A	Buses: not class 8, 9 or 10B but used within 350 km of base	641	113	108	122	780
10B	Buses: operating under an integrated mass transit service contract, other than buses used only for a school service or a restricted school service	2084	61	106	65	1351
11	Buses: not class 8, 9, 10A or 10B	477	120	101	121	577
12	Motorcycles: for driver only	12	254	69	175	21
13	Motorcycles: with pillion passenger/sidecar	26	200	94	188	48
14	Tractors	7	112	109	122	9
15	Self-propelled machinery or equipment, fire engines, bush fire brigade and other emergency vehicles	84	203	90	183	154
16	Ambulances	274	96	109	105	287
17	Primary production vehicles	27	215	79	170	46
19	Motor vehicles conditionally registered - limited access	13	341	65	222	28
20	Motor vehicles conditionally registered - zoned access	6	47	109	51	3
21	Self-propelled machinery not class 14, 15, 19 or 20	11	205	109	224	25
23	Dealer's plate issued	23	99	109	108	25
24	Supplementary trailer insurance including Federal/Interstate	10	69	109	76	8

The final column of the table is equal to the product of the first and fourth columns. However, the reader may not be able to reproduce the calculations precisely due to rounding error.