The 2008 California Private Passenger Auto Frequency and Severity Bands Manual
Second Edition
(Updated With Data Through 2011)

Rate Regulation Branch
California Department of Insurance

December 21, 2015

Abstract

Pursuant to Title 10 of the California Code of Regulations, section §2632.9, the California Department of Insurance publishes data on private passenger automobile insurance relative claims frequency rates and relative claims severity rates. These data are published so that insurers may, if necessary, have credible data upon which to base their private passenger automobile insurance class plans pursuant to Title 10 of the California Code of Regulations, section §2632.5. This publication is commonly referred to as the Bands Manual.

The 2008 Bands Manual was updated in 2015 with data through 2011. This paper provides an overview of the methods and data employed in this revision.

Auto insurance loss data were obtained from the California Department of Insurance Statistical Analysis Division. Private passenger claims frequency and severity were calculated by zip code, for each coverage type, using 2007-2011 data for all coverages. When data were insufficient to produce credible results in a particular zip code, the data was augmented by employing the band assignments from the previous edition of the 2008 California Private Passenger Auto Frequency and Severity Bands Manual. The resulting relative claims frequency and severity data were calculated by coverage and by zip code and published as the 2008 Frequency and Severity Bands Manual, Second Edition (Updated With Data Through 2011).

Acknowledgements

Introduction

California requires private passenger automobile insurance rates to be approved by the Insurance Commissioner before they may be employed by insurers (CA Insurance Code, section §1861.05 et seq.) The California Department of Insurance (CDI) has adopted regulations implementing this law (Title 10, Cal. Code Regulations, sections §2632.1 to §2632.9). These regulations require that the statistical significance of all non-geographic explanatory variables be calculated before any territory-related characteristics are modeled. Only two geographic variables are permitted, claim frequency and claim severity. Each of these variables is limited to no more than twenty rating bands. Each frequency band must be formed by grouping zip codes with comparable claim frequencies. Each severity band must be formed by grouping zip codes with comparable claim severities.

Many insurers operating in California lack their own company-specific data which are adequate to develop credible matrices for claim frequency and claim severity. On May 15, 2008, CDI published claim frequency and claim severity matrices which these insurers are permitted to use in developing their rates, pursuant to Title 10, California Code Regulations, section §2632.9. These matrices are commonly referred to as the Bands Manual. With the passage of time, the first edition of the 2008 Bands Manual has become obsolete, due both to changes in the governing law and to changes in loss statistics. In 2015, the CDI updated the Bands Manual. The purpose of this document is to explain the methodology used to develop the second edition of the 2008 Bands Manual.

Data Used

Data used in both editions of the 2008 Bands Manual was supplied by the CDI Statistical Analysis Division (SAD). The SAD annually tabulates all automobile private passenger exposures, losses, and claims for each private passenger auto coverage and for each insurer in the state writing this insurance. SAD data are compiled for the seven primary coverages. These coverages are:

1. Bodily Injury Liability (BI);

2. Property Damage Liability (PD);
3. Medical Payments (MP);
4. Uninsured Motorist Bodily Injury (UMBI);
5. Uninsured Motorist Property Damage (UMPD);
6. Collision (CL); and
7. Comprehensive (CM).

The SAD data provide total exposure years, ultimate capped incurred losses, and total claim counts, by calendar year, for each zip code. The second edition of the 2008 Bands Manual uses data from 2007 to 2011 for both liability insurance (coverages 1-5) and physical damage (coverages 6-7).

In all cases, frequency is defined as total claims divided by total exposure years. For liability coverages, severity is defined as capped losses divided by total claims. (The definition of severity is dictated by CA Vehicle Code Section §16451, which mandates the capped amount as part of the Financial Responsibility law.) Severity for physical damage is defined as paid losses divided by total claims.

Not every zip code in the state provided sufficient data to be fully credible. In order to improve the credibility of the data in these zip codes, the previous Band Manual's frequency and severity band configuration was used to compile and aggregate the new frequency and severity data. The new compilations were then used to calculate a complement for the zip codes that were not fully credible.

Methodological Changes from the First Edition of the 2008 Bands Manual

With three notable exceptions, the methodology for generating the second edition of the 2008 Bands Manual data followed the methodology employed by Wooten for the first edition of the 2008 Bands Manual. The methodology used in 2008 is covered in detail in Attachment A. This section of the report contains a brief comparison of the methods used in 2008 and 2015.

The second edition of the 2008 Bands Manual follows the methodology used in the first edition of the 2008 Bands Manual for determining the credibility standard with certain modifications. The second edition of the 2008 Bands Manual assumes that the claim count has a Binomial distribution, and establishes the credibility standard for zip code frequency rates (1.e., the number of exposure years required for a zip code's data to be fully credible) by solving the formula for n, the number of vehicle years:

$$n = (y^2/k^2)(\sigma^2_f/\mu_f)$$

Where the variables are defined as follows:

y = 95% of probability of normal distribution = 1.96
k = the probability that observation X is within $\pm k$ of the mean = 10%
σ^2_f = Variance of Claim Count (Binomial Distribution)
μ_f = Mean of Claim Count (Binomial Distribution)

For the calculation of number of claims for full credibility for severity, the second edition of the 2008 Bands Manual gathered a sample of zip codes with one claim count and used those statistics to generate the statewide severity (mean) and the standard deviation for each coverage. Because the data were not available for all losses on an individual claim basis, it was impossible to calculate the standard deviation for all of the losses. Using the collected sample of zip codes with one claim count, the calculated variance was estimated for the five years (2007 to 2011). This estimation as done assuming $p = 95\%$, $k = 0.1$ and the loss distribution with means μ_s and variance $\sigma_s{}^2$. The severity, i.e. the mean of the distribution, is estimated by $(X_1 + X_2 + \ldots + X_N)/N$. The variance of the observed severity is $Var(\sum X_i/N) = (1/N^2)\sum Var(X_i) = \sigma_s{}^2/N$. According to the Central Limit Theorem, the distribution of severity $(X_1 + X_2 + \ldots + X_N)/N$ can be approximated by a normal distribution for large N. The formula is as follows:

$$n = (y^2/k^2)(\sigma_s/\mu_s)^2$$

In the first edition of the 2008 Bands Manual, the Uninsured Motorist coverages (UMBI and UMPD) are combined into one coverage under Uninsured Motorist. The second edition of the 2008 Bands Manual separates the UM coverage into Uninsured Motorist Bodily Injury and Uninsured Motorist Property Damage, and calculates the frequency and severity bands for each coverage. Also, for the first edition, only four years of data were available for the Comprehensive and Collision coverages, but for the second edition of the 2008 Bands Manual, the same five years of data (2007 to 2011) were used for all coverages.

In the previous Bands Manual, the California Automobile Assigned Risk Plan's territorial configuration was used to establish the partial credibility complements for the zip codes which were not fully credible. The 2007-2011 industry zip code data were aggregated using the previous Band Manual configuration. The newly-calculated frequency and severity statistics were used as the complements in the second edition.

Tables One and Two below display the full credibility standards for frequency and severity. The full credibility standard for frequency is calculated using the number of vehicle years of

exposures, and the full credibility standard for severity is calculated using the number of claim counts.

Table One
Claim Frequency Standards

Coverage	Statewide Frequency	Number of Vehicle Years of Exposures for Full Credibility
Bodily Injury	0.00920	41,372
Property Damage	0.03822	9,668
Medical Payments	0.00958	39,718
Uninsured Motorist Bodily Injury	0.00186	206,130
Uninsured Motorist Property Damage	0.00376	101,806
Collision	0.06405	5,613
Comprehensive	0.03781	9,776

Table Two
Claim Severity Standards

Coverage	Statewide Severity	Standard Deviation	Number of Claims for Full Credibility
Bodily Injury	$8,697	$8,173	420
Property Damage	$2,412	$1,624	214
Medical Payments	$850	$572	165
Uninsured Motorist Bodily Injury	$9,578	$9,998	407
Uninsured Motorist Property Damage	$1,782	$1,231	185
Collision	$3,288	$4,583	661
Comprehensive	$1,509	$3,658	1,487

Tables Three and Four show data on the credibility distribution among zip codes in California by type of coverage for claim frequency and claim severity. The table divides the data into those zip codes with full credibility and those without full credibility. The table also displays two percentages for those zip codes that are fully credible and those that are not. One shows the percentage based on the number of zip codes, and the other shows the percentage based on the years of exposure.

For the major coverages of BI, PD, Collision, and Comprehensive, at least 92.8% of the earned exposure resided in zip codes which contained frequency data which was fully credible. Similarly, for those same major coverages, at least 86.0% of the earned exposure resided in zip codes which contained severity data which was fully credible.

Table Three
Frequency Credibility Levels

Coverage Type	Credibility	# of Zip Codes	Zip Code Percentage	Exposure Years	Exposure Percentage
Bodily Injury (BI)	Fully Credible	938	51.6%	109,660,146	92.8%
	Not Fully Credible	881	48.4%	8,555,562	7.2%
Property Damage (PD)	Fully Credible	1,235	67.9%	116,404,635	98.5%
	Not Fully Credible	584	32.1%	1,813,550	1.5%
Medical Payments (MP)	Fully Credible	610	33.5%	41,878,229	75.7%
	Not Fully Credible	1,209	66.5%	13,478,416	24.3%
UMBI	Fully Credible	21	1.2%	4,735,795	4.8%
	Not Fully Credible	1,798	98.8%	93,786,576	95.2%
UMPD	Fully Credible	0	0.0%	0	0.0%
	Not Fully Credible	1,818	100.0%	22,063,116	100.0%
Collision (CL)	Fully Credible	1,248	67.4%	82,730,653	98.8%
	Not Fully Credible	604	32.6%	1,032,062	1.2%
Comprehensive (CM)	Fully Credible	1,166	62.9%	84,977,671	98.0%
	Not Fully Credible	687	37.1%	1,737,077	2.0%

Table Four
Severity Credibility Levels

Coverage Type	Credibility	# of Zip Codes	Zip Code Percentage	Exposure Years	Exposure Percentage
Bodily Injury (BI)	Fully Credible	842	46.3%	998,933	91.9%
	Not Fully Credible	977	53.7%	88,614	8.1%
Property Damage (PD)	Fully Credible	1,279	70.3%	4,481,462	99.2%
	Not Fully Credible	540	29.7%	36,311	0.8%
Medical Payments (MP)	Fully Credible	930	51.1%	495,332	93.4%
	Not Fully Credible	889	48.9%	34,942	6.6%
UMBI	Fully Credible	46	2.5%	22,546	12.3%
	Not Fully Credible	1,773	97.5%	160,720	87.7%
UMPD	Fully Credible	66	3.6%	15,724	19.0%
	Not Fully Credible	1,752	96.4%	67,209	81.0%
Collision (CL)	Fully Credible	1,112	60.0%	5,251,505	97.9%
	Not Fully Credible	740	40.0%	113,687	2.1%
Comprehensive (CM)	Fully Credible	781	42.1%	2,820,049	86.0%
	Not Fully Credible	1,072	57.9%	458,669	14.0%

Attachment A

Methodology Summary for the First Edition of the 2008 Band Manual

The major steps to creating the first edition of the 2008 Frequency and Severity Bands Manual can be summarized as follows:

1. The Bands Manual specifies claim frequency and claim severity relativities for twenty zip code bands for each rating factor (overall, four hundred different possible combinations of claim frequency and claim severity) for six major coverages: Bodily Injury, Property Damage, Medical Payments, Uninsured Motorist, Comprehensive, and Collision.

2. The primary data source is the Section §11628 data collected by Statistical Analysis Division, which contains zip code level industry wide data on exposures and losses for the auto insurance coverages noted above.

3. Some insurers write combined single limits, where bodily injury and property damage are combined into a single product with the same coverage limits for both types of coverage. For purposes of the manual, the following exposure and loss data is combined: (a) bodily injury and combined single limits and (b) uninsured motorist bodily injury, uninsured motorist property damage and combined single limits uninsured motorist is also combined.

4. For claim severity, the liability data (BI, PD, MP, and UM) is based on incurred capped losses, that is, losses paid assuming that all insureds in the zip code have policies with coverage limits equal to the prescribed legal minimums ($15,000 / $30,000 per person / per accident bodily injury and $5,000 property damage). The most important reason for using the incurred capped loss data is that total incurred losses in a zip code will be influenced by differences in average coverage limits from one zip code to another. Insureds in some zip codes will have preferences for more coverage than required by state law. The Prop 103 rating factor weight requirements do not include coverage limits as a rating factor. The claim severity relativities estimated in the manual should thus control for the influence of differences in average coverage limits among different zip codes, otherwise, that would affect the rating factor weight for claim severity. The simplest way to do this is to use the capped loss data. A secondary reason for using incurred capped losses is that it does not include allocated loss adjustment expenses.

Insurers' practices for allocated loss expenses vary from one company to another and therefore should not be included in the loss data for this analysis.

5. While the 1996 Bands Manual's justification for adjusting the paid loss data for Comprehensive and Collision coverages was conceptually sound, empirical evidence did not confirm the hypothesis that paid losses are positively correlated with average vehicle values. After studying the correlation results of the 1999 Auto Historical Loss data, the paid loss data for Comprehensive and Collision coverages was employed without any adjustments.

6. Different standards of credibility are applied to the claim frequency and claim severity data at the zip code level. For frequency, a zip codes' data is fully credible when there are sufficient exposures that there is a 95% probability that the zip code's estimated frequency rate is as accurate as the average difference of the band frequency rates over the twenty bands from a preliminary assignment of zip codes to rating bands. For severity, a zip code is fully credible as determined by the greater of the standard of 1,082 claims or the number of exposure years for full credibility for claim frequency (exposure years are converted to number of claims), adjusted by the standard deviation of the unadjusted statewide average claim severity.

7. Zip codes that were determined not to be fully credible had their claim frequency and claim severity adjusted using CAARP territory data for claim frequency and claim severity as the credibility complement. All CAARP territories are fully credible. Algebraically, a credibility adjusted frequency or severity rate is equal to (credibility level * zip code rate) + (1 – credibility level * CAARP rate). The CAARP territory of which that zip code is a member serves as the complement. The credibility level is calculated using the square root formula, specifically, the square root of (number of years of exposure or claims/credibility standard in exposure years of claims).

8. Based on the credibility adjusted claim frequency and claim severity data, a frequency distribution of exposures and claim frequency and exposures and claim severity were developed. These frequency distributions were divided into approximately ten bands with an equal number of exposures in each band. The claim frequency and claim severity for each band was calculated by summing the exposures and either number of claims or total losses and calculating the claim frequency and claim severity for that band.

Attachment B

Statewide Data from the First and Second Editions of the 2008 Bands Manual

	1999-2003 Exposure Years	1999-2003 # of Claims	1999-2003 Total Losses	1999-2003 Statewide Frequency	1999-2003 Statewide Severity
Bodily Injury (BI)	97,750,723	1,377,245	$9,699,419,232	0.01409	$7,043
Property Damage (PD)	97,977,379	4,254,485	$8,711,126,708	0.04342	$2,048
Medical Payments (MP)	53,106,394	614,738	$626,275,053	0.01158	$1,019
Uninsured Motorist (UM)	105,676,447	342,927	$2,059,579,338	0.00325	$6,006
Collision (CL)	57,202,335	4,406,285	$14,631,510,520	0.07703	$3,321
Comprehensive (CM)	59,203,947	2,835,326	$4,735,830,136	0.04789	$1,670
Total	470,917,225	13,831,006	$40,463,740,987		$2,926

	2007-2011 Exposure Years	2007-2011 # of Claims	2007-2011 Total Losses	2007-2011 Statewide Frequency	2007-2011 Statewide Severity
Bodily Injury (BI)	118,215,708	1,087,547	$9,458,591,717	0.00920	$8,697
Property Damage (PD)	118,218,185	4,517,773	$10,896,635,437	0.03822	$2,412
Medical Payments (MP)	55,356,645	530,274	$450,571,184	0.00958	$850
UMBI	98,522,371	183,266	$1,755,262,278	0.00186	$9,578
UMPD	22,063,116	82,933	$147,787,631	0.00376	$1,782
Collision (CL)	83,762,715	5,365,192	$17,640,976,700	0.06405	$3,288
Comprehensive (CM)	86,714,748	3,278,718	$4,946,621,991	0.03781	$1,509
Total	582,853,488	15,045,703	$45,296,446,938		$3,011