

**The 2008 California Private Passenger Auto Frequency and Severity Bands
Manual**

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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 rate 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 Bands Manual was revised in 2008. This paper provides an overview of the methods and data employed in that 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 1999-2003 data for liability coverages and 2000-2003 data for physical damage coverage. When data were insufficient to produce credible results in a particular zip code, the data was augmented by employing data for the California Automobile Assigned Risk Program territory which contained that zip code. 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.

Acknowledgements

All data analysis and computation was done by Donald Wooten, Ph.D., of the California Department of Insurance Policy Research Division. Donald received assistance from Luciano Gobbo, Statistical Analysis Division, Joan Koyama, Rate Specialist Unit, and Eric Johnson of the Rate Regulation Branch. Much of the methodology for the 2008 Bands Manual was originally published by Lyn Hunstad, of the Policy Research Division, in the preparation of the 1996 Bands Manual.

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 Regs., 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 claims severity. Each of these variables is limited to no more than twenty rating bands. Each band must be formed by grouping zip codes with comparable risk.

Many insurers operating in California lack their own company-specific data which are adequate to develop credible matrices for claims frequency and claims severity. Consequently, on April 22, 1996, CDI published claims frequency and claims severity matrices which these insurers are permitted to use in developing their rates, pursuant to Title 10, Cal. Code Regs., section 2632.9. These matrices are commonly referred to as the Bands Manual. With the passage of time, the 1996 Bands Manual has become obsolete, due both to changes in the governing law and to changes in loss statistics. In 2008 CDI updated the Bands Manual. The purpose of this document is to explain the methodology used to develop the 2008 Bands Manual.

Data Used

Data used in 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 six primary coverages. These coverages are:

1. Bodily Injury (BI), including Combined Single Limits (CSL);
2. Property Damage (PD);
3. Medical Payments (MP);
4. Uninsured Motorist (UM), for both BI and PD, and including CSL;
5. Collision (CL); and
6. Comprehensive (CM).

The SAD data provide total exposure years, total losses, capped losses, and total claims, by calendar year, for each zip code.¹ The 2008 Bands Manual uses data from 1999 to 2003 for liability insurance (coverages 1-4). It uses data from 2000 to 2003 for physical damage (coverages 5-6). In 2000 SAD changed both the format and the variable definitions for physical damage coverages, making the 1999 data for these coverages incompatible with the 2000 to 2003 data.

¹ The data as provided is on a per accident basis, not a per claimant basis. Statistical Analysis receives data from some insurers that is per claimant and others per accident. The data is all standardized to per accident.

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, a file was prepared that mapped all zip codes used for auto rating purposes in California into the 72 territories employed by the California Automobile Assigned Risk Program (CAARP). The loss data by CAARP territories was used throughout the analysis as a complement of credibility when the zip code data alone was not fully credible. Since CAARP territories are geographically contiguous and do not divide zip codes, this analysis complements and does not conflict with analysis by zip code.

Methodological Changes from the 1996 Bands Manual

With two notable exceptions, the methodology for generating the 2008 Bands Manual data followed the methodology employed by Hunstad for the 1996 Bands Manual. This report contains a brief summary of the methods as Attachment A; Hunstad's 1996 paper is available on the CDI website.

In the 1996 Bands Manual, the credibility standard for zip code frequency rates – the number of exposure years required for a zip code's data to be fully credible - is determined by solving the following formula for n, the number of vehicle years:

$$n = (p * q * 2.0^2) / (\text{minimum band difference})^2$$

where the variables are defined as follows:

p = the statewide frequency rate

q = 1 - p

minimum band difference = the smallest difference between the band frequency rates across all ten bands based on a preliminary assignment of zip codes to bands.²

Initial analysis showed that the credibility standard estimated from this formula was not robust with respect to the number of rating bands employed. The regulatory change from 10 rating bands to 20 rating bands effectively reduced the minimum bands difference by about half. Other factors equal, this would increase the number of vehicle years for full credibility about four times compared to the frequency standards employed in the 1996 Bands Manual.³ The 1996 Manual

² This formula is the operational version of the statistical test referred to in Attachment A, step 6.

³ The statewide frequency rates are either lower or nearly unchanged from the 1996 Bands Manual data. The most notable decreases are for Medical Payments, Uninsured Motorist and Comprehensive, whose frequency rates are respectively about two thirds, one third and two thirds the frequency rates in the 1996 data. Bodily Injury is lower

was reviewed by several insurers; improvements suggested as a result of this review did not include comments on the method used to determine the frequency credibility standards or the required vehicle year credibility standards for zip code frequency rates. If the minimum bands difference were to be used in the 2008 Bands Manual, the credibility standard for BI and PD would have exceeded 160,000 vehicle years. Although the data used in this revision to the Bands Manual generally had 10 to 20 percent more vehicle years than the 1996 Bands Manual, the end result would be credibility adjustments to a significantly larger number of zip codes than was the case in 1996.

In place of the minimum bands difference, the frequency credibility standards employed in the 2008 Bands Manual are based on the average difference of the band frequency rates over the twenty bands from a preliminary assignment of zip codes to rating bands. This substitution alters the statistical test such that for the average difference in the band frequency rates, a given zip code has a 95 percent probability of being as accurate as the average difference in band rates.

Tables One and Two show the resulting credibility standards for claims frequency and claims severity.

Table One
Claims Frequency Standards

<u>Coverage</u>	<u>Statewide Frequency</u>	<u>Number of Vehicle Years of Exposures for Full Credibility</u>
Bodily Injury	0.01409	27,991
Property Damage	0.04344	8,812
Medical Payments	0.01158	34,155
Uninsured Motorist	0.003245	122,867
Collision	0.07703	4,793
Comprehensive	0.04789	7,952

by about 15 percent. Attachment B shows the statewide 1996 and 2008 data by coverage.

Table Two
Claims Severity Standards

<u>Coverage</u>	<u>Statewide Severity</u>	<u>Standard Deviation</u>	<u>Number of Claims for Full Credibility</u>
Bodily Injury	\$7,043	\$1,593	415
Property Damage	\$2,048	\$258	389
Medical Payments	\$1,019	\$229	415
Uninsured Motorist	\$6,006	\$3,244	515
Collision	\$3,321	\$2,742	621
Comprehensive	\$1,670	\$3,922	2,480

Table Three shows data on the credibility distribution among zip codes in California by type of coverage for claims frequency and claim severity. The table divides the data into those zip codes with a credibility level of 50 percent or lower and zip codes with a credibility level of greater than 50 percent. In addition, the percentage of zip codes that are fully credible is reported. Even with industry-wide data at the zip code level, it is clear that a large number of zip codes have a credibility level of 50 percent or less due to a low number of exposures or few claims. This result is not surprising given that California still has a large portion of the state that is rural and sparsely populated, for example, Alpine or Modoc County. Of the zip codes with a credibility level greater than 50 percent, most of those zip codes are fully credible with no adjustment to the claim frequency or claim severity rate. For the remaining zip codes in this group, their credibility adjusted rates are mostly a function of that zip code's data; the CAARP territory complement is not given a lot of weight.

The last three columns show the exposures or claims for the same grouping of California zip codes. This data again shows that while a significant number of zip codes have credibility levels equal to 50 percent or less, for many coverages, nearly all of the exposures or claims occur in zip codes where the zip code data is highly credible. Thus, for the 2008 Bands Manual, in those regions of the state that are heavily populated, the frequency and severity experience in that zip code is the most important determinant of that zip code's frequency or severity rate.

**Table Three
Frequency Credibility Levels**

Coverage Type	# of Zip Codes	Zip Code Percentage	Fully Credible	Exposure Years	Exposure Percentage	Fully Credible
			Zip Codes			Exposures
Bodily Injury	594	32.3%		1,322,457	1.4%	
	1,247	67.7%	51.7%	96,428,236	98.6%	93.9%
Medical Payments	748	40.7%		1,789,904	3.4%	
	1,091	59.3%	43.4%	51,316,478	96.6%	79.7%
Property Damage	362	19.7%		347,729	0.4%	
	1,479	80.3%	65.3%	97,629,621	99.6%	98.3%
Uninsured Motorist	898	48.8%		7,019,593	6.6%	
	943	51.2%	16.6%	98,656,843	93.4%	49.9%
Collision	379	20.6%		182,440	0.3%	
	1,465	79.4%	63.9%	57,019,895	99.7%	98.4%
Comprehensive	461	25.0%		334,736	0.6%	
	1,381	75.0%	59.9%	58,869,186	99.4%	97.5%

Severity Credibility Levels

Coverage Type	# of Zip Codes	Zip Code Percentage	Fully Credible	# of Claims	Claims Percentage	Fully Credible
			Zip Codes			Claims
Bodily Injury	684	37.2%		19,128	1.4%	
	1,157	62.8%	48.5%	1,358,116	98.6%	94.2%
Medical Payments	789	42.9%		20,261	3.3%	
	1,050	57.1%	32.1%	594,476	96.7%	78.3%
Property Damage	428	23.2%		16,136	0.4%	
	1,413	76.8%	62.2%	4,238,349	99.6%	98.3%
Uninsured Motorist	1,019	55.4%		26,235	7.7%	
	822	44.6%	9.9%	316,692	92.3%	37.7%
Collision	520	28.2%		28,031	3.3%	
	1,324	71.8%	57.7%	4,378,254	96.7%	97.4%
Comprehensive	819	44.5%		138,900	4.9%	
	1,023	55.5%	22.6%	2,696,424	95.1%	65.2%

The second methodological difference between the 1996 and 2008 Bands Manual is in the treatment of the paid loss data for Collision and Comprehensive. In the 1996 Bands Manual, considerable effort was expended to adjust the paid loss data for differences in vehicle value, vehicle model year and deductible across zip codes. These adjustments were conceptually similar to the use of capped loss data for the liability coverages: differences in paid losses are thought to vary systematically across zip codes. For example, zip codes in Marin County are expected to have higher paid losses because of higher vehicle values (newer and more expensive

autos) and lower deductibles.

While conceptually sound, empirical evidence did not confirm the hypothesis that paid losses are positively correlated with average vehicle values. The average vehicle value data came from the 1999 Auto Historical Loss data call that included the largest auto insurers in the state. This data included 1998 vehicle values for individual policy holders. A weighted average vehicle value was estimated at the zip code level using individual insurer market shares statewide. This data was correlated with the Collision and Comprehensive paid loss data for the approximately 1,840 zip codes used in the 2008 Bands Manual. For Collision, the estimated correlation coefficient was -0.024 and for Comprehensive, the estimated correlation coefficient was 0.086. Neither correlation coefficient was statistically significant and the coefficient for Collision is the wrong sign. Given these results, the paid loss data was employed without any adjustments.

Attachment A

Methodology Summary for 1996 Frequency and Severity Bands Manual

The major steps to creating the 1996 Frequency and Severity Bands Manual can be summarized as follows:

1. The Bands Manual specifies claim frequency and claim severity relativities for ten zip code bands for each rating factor (overall, one 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 (\$30,000 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. The Collision and Comprehensive loss data, as reported in the Section 11628 data, are also influenced by differences in average coverage limits from one zip code to another. Thus, it is as important for these coverages as it is for Bodily Injury, etc., that the influence of different coverage limits be controlled for in so far as that is possible. Data on average vehicle values, vehicle model year and deductible at the zip code level are used as a proxy for differences in coverage limits. Zip code level indices for vehicle value, vehicle model year and deductible are constructed and used to adjust the zip code level loss data for Collision and Comprehensive.

6. Different standards of credibility are applied to the claim frequency and claim severity data at the zip code level. For frequency, a zip code's 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 minimum difference between the closest two 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 $(\text{credibility level} * \text{zip code rate}) + (1 - \text{credibility level} * \text{CAARP rate})$. 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 or 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 1996 and 2008 Bands Manual

	1988-93 Exposure Years	1988-93 # of Claims	1988-93 Total Losses**	1988-93 Statewide Frequency	1988-93 Statewide Severity	1999-2003 Exposure Years	1999-2003 # of Claims	1999-2003 Total Losses**	1999-2003 Statewide Frequency	1999-2003 Statewide Severity
Bodily Injury (BI)	77,213,587	1,292,338	\$11,518,166,461	0.01674	\$8,913	97,750,723	1,377,245	\$9,699,419,232	0.01409	\$7,043
Property Damage (PD)	77,213,933	3,128,683	\$4,604,162,222	0.04052	\$1,472	97,977,379	4,254,485	\$8,711,126,708	0.04342	\$2,048
Medical Payments (MP)	60,055,405	907,942	\$1,028,765,803	0.01512	\$1,133	53,106,394	614,738	\$626,275,053	0.01158	\$1,019
Uninsured Motorist (UM)	70,417,114	689,784	\$3,268,446,926	0.00980	\$4,738	105,676,447	342,927	\$2,059,579,338	0.00325	\$6,006
Collision (CL)*	57,498,671	4,845,166	\$6,840,162,863	0.08427	\$1,412	57,202,335	4,406,285	\$14,631,510,520	0.07703	\$3,321
Comprehensive(CM)*	61,573,395	4,170,179	\$2,133,424,318	0.06773	\$512	59,203,947	2,835,326	\$4,735,830,136	0.04789	\$1,670
Total:	403,972,105	15,034,092	\$29,393,128,593		\$1,955	470,917,225	13,831,006	\$40,463,740,987		\$2,926
Annualized	67,328,684	2,505,682	\$4,898,854,766		\$1,955	100,003,759	3,128,282	\$9,061,115,230		\$2,897

* 2000-2003 Data

**Capped losses for Liability Coverages, paid losses for Physical Damage