

**Auto Insurance in California:
Differentials in Industrywide Pure Premiums and Company
Territory Relativities between Adjacent Zipcodes**

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Abstract

This study examined California adjacent zipcode differentials in auto insurance loss costs and the adjacent zipcode differentials in company premiums. Two major data sets were analyzed respectively. The first data set is the zipcode level, aggregated industrywide loss cost data in the period from 1993 to 2001. The data was collected from all auto insurers operating in the state per Insurance Code Section 11628. The second data set contains territory relativities of each zipcode for seven major auto insurers operating in the state. Territory relativities describe the relationship between the premium charged and territory factors. The proportional relationship between the value of territory relativities and the premium charged dictates that the differentials in territory relativities between adjacent zipcode pairs are equivalent to the premium differentials due to territory factors. The study examined BI (Bodily Injuries) and PD (Property Damages) liability coverages only. Major findings of the study are as follows:

- Significant variations in industrywide pure premium (average loss cost per insured vehicle) occur globally in the state and across adjacent zipcodes. Based on 72 CAARP (California Automobile Assigned Risk Plan) Statistical Territories in the state, the differences in combined BI and PD pure premium between the lowest region and the highest region are about a factor of 4.2 (or differed by 320%). While in 65 percent of the adjacent zipcode pairs the differential in BI and PD pure premium is less than 10 percent, about 4 percent of the pairs have a differential over 30 percent.
- The statewide differential ratio between a company's largest territory relativity and smallest relativity for combined BI and PD coverages varies from less than 3.0 to over 4.5 depending on the company.
- Territory relativities between adjacent zipcode pairs vary markedly across companies. The percentage of adjacent zipcode pairs with small territory differentials (less than 10 percent) ranges from 54 percent to 82 percent, depending on the specific company. The percentage of adjacent zipcode pairs with very large differentials (over 30 percent) in territory relativities ranges from a minimum of under 2 percent to a maximum of nearly 8 percent depending on the company.
- Because little overlap occurs among companies for adjacent zipcode pairs with differentials over 30 percent, the percent of the adjacent zipcode pairs in the state with this large differential for at least one of the seven insurers is much larger (22 percent).
- The largest differential in territory relativities between adjacent zipcode pairs also changes from company to company both in terms of the differential percentage and in terms of the specific zipcode pairs. The largest differential ranges from 58 percent to 124 percent depending on the company and the adjacent zipcode pair.
- Empirical evidence shows that differentials in territory relativities between adjacent zipcode pairs for some companies do not closely follow the patterns of the industrywide pure premium experience. Many possible explanations for this difference exist for any individual company.

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Introduction

The Department issued an Invitation to Prenotice Public Discussion Regarding Automobile Rating Factors on November 6, 2003. Since then the Department has held workshops in Oakland, Los Angeles, San Diego, Chico, and Fresno. At issue is essentially how much impact territory, as a rating factor, should have in determining insureds' premiums. One of the complaints expressed in the workshops by individual consumers and consumer groups is that there are dramatic premium differentials across a particular street or between adjacent zipcodes.

This research will examine the following two questions:

- How do industrywide loss costs differ across adjacent zipcode areas?¹
- How do premiums charged by major insurance companies differ between adjacent zipcode areas simply because of the territory rating factors?

We present results for adjacent zipcode differentials in terms of (1) industrywide loss costs (typically in the form of pure premiums) and (2) premiums (using territory relativities as a proxy) charged by major insurers. Caution must be exercised in comparing the two sets of results. The industrywide loss cost differentials between zipcodes depend on many factors (known or unknown), such as drivers' safety records and other characteristics, conditions of vehicle population, road and traffic conditions, and the prevalence of fraud. The company premium differentials between zipcodes presented in this study are differentials resulting from territory rating factors alone. The study is not intended to use the loss costs to draw definitive conclusions about the company premium differentials. Rather, loss costs are examined to provide a context when company premium differentials are analyzed. The study examined BI (Bodily Injury) and PD (Property Damage) liability coverages only. The results, interpretations, and conclusions of this study are limited to BI and PD coverages.

The rest of the report proceeds in the following way: First, the data sources are briefly listed. Then, statewide loss statistics, loss statistics by CAARP territories, and zipcode claim statistics are presented. Next, credibility adjustments are discussed. This is followed by an analysis of industrywide loss cost differentials between adjacent zipcodes. Finally, the report examines company premium differentials between adjacent zipcodes for seven major insurers. This examination includes a comparison of company relativity differentials with industrywide pure premium differentials. The end of the report provides a number of conclusions and corresponding implications.

Data Sources

The following five types of data are analyzed or used in this research:

¹ Adjacent zipcodes share a common boundary, though the common boundary may be relatively short. Zipcodes where corners touch are considered adjacent zipcodes for the purposes of this research.

- A data set of industrywide loss costs by zipcode for 9 years from 1993 to 2001.² The data set include the number of exposures (insured vehicles), the number of claims, and loss costs in dollar amount for each zipcode of the state. Statistical Analysis Division (SAD) of the Department provided the data.
- Data sets of zipcode-to-band assignments and band relativities of major auto insurance companies. This data is part of the rate filings that all insurance companies operating in the state submit to the Department. At the request of Policy Research Division, seven major insurers provided the data in electronic format.
- A data set of paired adjacent zipcodes. The data was provided by an independent contractor.
- A data set of zipcodes in the state and a data set which defines the mapping between CAARP (California Automobile Assigned Risk Plan) territories and zipcodes. The source of the two data sets is the Rate Regulation Division of the Department.
- A data set of zipcode population sizes and square miles. The source of data is the Department of Finance.

The department maintains a list of zipcodes in California based on information from the US Postal Office for auto rating and data collection purposes. The list includes zipcodes with geographic boundaries and a considerable number of postal box zipcodes for auto rating purposes. The number of zipcodes on the list has changed slightly over the years but remains a little over 1,800. The department's zipcode level loss cost data has been collected, by and large, based on the list. The number of zipcodes in the adjacent zipcode file is considerably smaller. After removing zipcodes designated for state parks, national parks, military bases, and other federal lands (zipcodes starting with zero), 1,647 zipcodes remain in the file. A cross analysis of the loss cost data file and the adjacent zipcode file revealed a little over 200 zipcodes in the loss cost data file were missing in the adjacent zipcode file. For over 90 percent of those zipcodes (primarily postal box zipcodes), we were able to reassign their data to their nearby zipcodes. Most of the remaining 10 percent have less than 25 claims in the entire period from 1993 to 2001 and were removed from the data file. The final loss cost data file contained 1,611 zipcodes.

We also found 36 zipcodes in the adjacent zipcode file but missing from the loss cost data file. Some of these zipcodes are university and college campuses. We decided to keep these zipcodes in the adjacent zip file for the completeness of the map layer. The 1,647 zipcodes generate 4,416 unique pairs of adjacent zipcodes.

We obtained data sets of zipcode-to-bands definition and territory relativities from seven major auto insurance companies operating in the state. The seven major insurers were randomly assigned the following alias names: Hawaii, Kauai, Lanai, Maui, Molokai, Niihau, and Oahu.

² The word "industrywide" used in this report refers to the aggregate data of all companies operating in the state in a specific region (a zipcode or the entire state, for example).

Statewide Loss Statistics

Per Insurance Code Section 11628 (a), Statistical Analysis Division annually collects summary data on the exposure, losses, and number of claims by coverage by zipcode for every private passenger auto insurer operating in the state. This analysis is based on BI and PD coverages.

Loss costs can be decomposed into claim frequency and claim severity. The claim frequency is the number of claims divided by the number of years of exposure. The claim severity is loss costs divided by the number of claims.³ Pure premium, or average loss costs per exposure, is simply the product (or the multiplication) of claim frequency and claim severity. For convenience of elaboration, we will refer to claim frequency, claim severity, and pure premium generally as loss statistics in the rest of the report. The calculated statewide loss statistics are reported in Table 1. For comparison purposes, the table also includes loss statistics presented in the California Private Passenger Auto Frequency and Severity Bands Manual (1996) which used data from 1988 to 1993. Table 1 shows that while all loss statistics for BI decreased considerably between the period covered in the 1996 manual and the study period (1993 – 2001), loss statistics for PD increased between the two periods. The decrease in BI pure premium was more than offset by the increase in PD pure premium, resulting in a decline in the combined BI and PD pure premium.

Table 1. California Auto Insurance BI and PD Loss Statistics

Period	1988 - 1993*	1993 - 2001
Bodily Injuries (BI)		
Claim Frequency	0.0167	0.0148
Claim Severity	\$8,913	\$7,706
Pure Premium	\$149	\$114
Property Damages (PD)		
Claim Frequency	0.0405	0.0407
Claim Severity	\$1,472	\$1,890
Pure Premium	\$60	\$77
BI & PD Pure Premium	\$209	\$191

* California Private Passenger Auto Frequency and Severity Bands Manual, 1996

³ Capped incurred loss from the raw data is used for the calculation. Since the “cap” refers to losses paid under the minimum limits required by state law, capped incurred loss is believed to be a desirable measurement for loss because it removes the influence of different levels of insurance coverage (increased limits) purchased from zipcode to zipcode. For more details on this point, see Lyn Hunstad (1996), “Methodology and Data Used to Develop the California Private Passenger Auto Frequency and Severity Bands Manual.”

Loss Statistics by CAARP Territories

Loss statistics for the study period based on CAARP (California Automobile Assigned Risk Plan) territories are reported in Table 2.⁴ There are 72 CAARP territories; each of them includes a different number of zipcodes. Unlike Claim Frequency Bands and Claim Severity Bands discussed later, each CAARP territory by regulation must be contiguous and no less than 20 square miles. There are significant differences in BI claim frequency among CAARP territories; the highest BI claim frequency is about five fold the lowest BI claim frequency. The difference in BI claim severity between the highest and the lowest is, however, only 30 percent. The variation in PD frequency is much more moderate compared with BI claim frequency. The highest PD claim frequency is about 2.6 fold the lowest PD claim frequency. Mainly driven by the variation in BI claim frequency, there are significant differences in the combined BI and PD pure premium among CAARP territories; the highest combined BI/PD pure premium is about 4.2 fold the lowest combined BI/PD pure premium.

Table 2. Summary BI and PD Loss Statistics Based on CAARP Territories, 1993 - 2001

	California Average	Number of CAARP Territories	Minimum	Maximum	Max/Min
BI Claim Frequency	0.0148	72	0.0070	0.0347	4.99
BI Claim Severity	\$7,706	72	\$6,661	\$8,636	1.30
BI Pure Premium	\$114	72	\$58	\$299	5.14
PD Claim Frequency	0.0407	72	0.0254	0.0651	2.57
PD Claim Severity	\$1,890	72	\$1,592	\$2,171	1.36
PD Pure Premium	\$77	72	\$43	\$135	3.13
BI & PD Pure Premium	\$191	72	\$104	\$434	4.19

Zipcode Claim Statistics

The number of claims, exposures and loss costs varies significantly by individual zipcodes. Table 3 reports the number of zipcodes for six ranges of claim counts. For BI claims, in 62 zipcodes no more than 10 claims were reported in the period 1993 – 2001. About 25 percent of the zipcodes had no more than 100 BI claims. On the other hand, over 26 percent of the zipcodes had 2,164 or more BI claims during the period. In comparison, there have been more PD claims than BI claims; about 52 percent of the zipcodes had 2,164 or more PD claims during the period.

⁴ Reporting the loss statistics based on counties was also considered. However, the number of claims and exposures in some counties during the study period were too small to produce reliable statistics. The county with the lowest number of BI claims is Alpine County, which had only 57 claims in the period from 1993 to 2001. In contrast, the lowest number of BI claims among the 72 CAARP territories was 6,118 during the period.

Table 3. Zipcode Distribution by Numbers of BI and PD Claims in California, 1993-2001

Range of Claim Counts	Bodily Injuries		Property Damages	
	Number of Zipcodes	Percent	Number of Zipcodes	Percent
1 - 10	62	3.8%	11	0.7%
11 - 100	334	20.7%	179	11.1%
101 - 500	282	17.5%	279	17.3%
501 - 1,081	200	12.4%	147	9.1%
1,082 - 2,163	312	19.4%	161	10.0%
2,164 +	421	26.1%	834	51.8%

Credibility Adjustments

If the number of claims for a zipcode is small, the loss statistics calculated for the zipcode may be inaccurate and unreliable. The industry's standard practice in this situation is credibility adjustment. Simply put, the idea of credibility adjustment is the following: rather than relying solely on the observations from a particular zipcode, more reliable estimates may be obtained by combining this data with other information. The other information is referred to as complements, which often are the observations from larger territories such as county or state.⁵ If the number of claims for a zipcode is sufficiently large, loss statistics derived from the observations of the zipcode are said to have full credibility and no adjustment is required. The standards for full credibility used in this analysis are 1,082 claims for claim frequency and claim severity, and 2,164 for pure premium.⁶ Table 3 indicates that about 54.5 percent of the zipcodes need credibility adjustment for BI claim frequency or severity and about 73.9 percent of the zipcodes require credibility adjustment for BI pure premium. Because there have been more PD claims, the number of zipcodes that need credibility adjustment for PD loss statistics is smaller. About 38.2 percent of the zipcodes need credibility adjustment for PD claim frequency or severity and about 48.2 percent of the zipcodes require credibility adjustment for PD pure premium.

For a particular zipcode, the loss statistics of all its adjacent zipcodes (that is, a zipcode ring) are used as primary complements in this analysis. However, not all the zipcode rings meet the standards for full credibility. About 15.5 percent of the zipcode rings require credibility

⁵ Per California Code of Regulations, the use of complements for Relative Claims Frequency and Relative Claims Severity shall follow the procedures described in Section 2632.9(d).

⁶ Among insurance professionals, 1,082 claims is a well accepted standard for full credibility of claim frequency. Using 1,082 claims as a standard for full credibility of the claim severity requires an additional assumption, that is, the coefficient of variation of individual loss costs is 1. We can not verify this assumption in the absence of individual policy data. However, there exists documented evidence to support this assumption. Robert J. Finger (2001) pointed out that "many insured populations seem to have a coefficient of variation of about 1.0" by citing SRI (1979) "Choice of a Regulatory Environment for Automobile Insurance." The standard for full credibility of the pure premium is simply the sum of the standards for frequency and severity. For Finger's article and an introductory course in credibility analysis, see Casualty Actuarial Society (2001), *Casualty Actuarial Science*.

adjustment for BI claim frequency/severity, and about 22.9 percent of the zipcode rings require credibility adjustment for BI pure premium. The corresponding percentages for PD are 6.5 percent and 10.4 percent, respectively. As a result, the following two-stage procedure for credibility adjustment is used for BI and PD loss statistics in this analysis. The first stage is to adjust the zipcode ring statistics that are not fully credible. If the zipcode ring statistics are not credible, the CAARP territory statistics are used as complements to adjust the zipcode ring statistics.⁷ The second stage is to use the adjusted zipcode ring statistics as complements to adjust the zipcode statistics when necessary.⁸

Industrywide Loss Cost Differentials between Adjacent Zipcodes

Based on the adjusted loss statistics, the differentials between adjacent zipcodes can be calculated. Throughout this report, two measurements are used to describe the differentials between two adjacent zipcodes. The first measurement is differential ratio, which is calculated as the ratio of the larger loss statistic to the smaller loss statistic of the two adjacent zipcodes. Differential ratios are always greater or equal to 1.0 and are expressed in decimals. For example, if BI pure premiums are \$80 and \$100 for two adjacent zipcodes, their differential ratio is calculated as 1.25. The second measurement is simply called differential. It is calculated as the differential ratio minus 1 and is expressed in percentage. In the above example, the differential is 25 percent. The differentials between adjacent zipcodes in claim frequency, claim severity, and pure premium for BI and PD are reported in Table 4.⁹

The 1,611 zipcodes in the industrywide loss cost data file generate 4,290 adjacent zipcode pairs. Table 4 demonstrates considerable differentials in claim frequency and pure premium between adjacent zipcodes for both BI and PD loss statistics. Let's look at BI loss statistics first. In 2,328 adjacent zipcode pairs (about 54 percent of the total adjacent zipcode pairs), the differentials in BI claim frequency are within 10 percent; 26 percent of the adjacent zipcode pairs have differentials within 10+ to 20 percent; 11 percent of the pairs have differentials within 20+ to 30 percent; about 8 percent of the adjacent zipcode pairs have differentials in BI claim frequency over 30 percent. In contrast, differentials in BI claim severity between adjacent zipcodes are moderate. Among all the adjacent zipcodes, 95 percent have differentials within 10 percent, and virtually all of the adjacent zipcodes have differentials within 20 percent (except 6 pairs).

Changes in BI pure premium across adjacent zipcode pairs are slightly smaller than the changes in BI claim frequency, but generally follow the pattern of claim frequency. There are 59 percent of the total adjacent zipcode pairs with BI pure premium differentials within 10 percent. About 6 percent of the adjacent zipcode pairs have differentials over 30 percent.

Compared with BI loss statistics, there are more adjacent zipcode pairs which have differentials less than 10 percent for all three PD loss statistics (claim frequency, claim severity, pure premium). However, Table 4 shows that the difference in adjacent zipcode differential patterns for BI and PD loss statistics is relatively small. The difference in BI differentials and PD

⁷ Partial credibility was calculated using the well accepted square root rule.

⁸ Other procedures for credibility adjustments were not investigated because of the time constraint for this analysis.

⁹ Percentages in the table may not add to 100% due to rounding errors.

differentials are less dramatic as revealed in Table 2, which examines the “global” variation in the state. The reason for this is that PD loss statistics are less credibility adjusted because there have been more PD claims.

Table 4. Differentials in BI and PD Claim Frequency/Severity, and Pure Premium between Adjacent Zipcodes in California, 1993 - 2001

Range	Claim Frequency		Claim Severity		Pure Premium	
	# of Zip Pairs	Percent	# of Zip Pairs	Percent	# of Zip Pairs	Percent
Bodily Injuries						
0 to 10%	2,328	54.3%	4,080	95.1%	2,540	59.2%
10+ to 20%	1,127	26.3%	204	4.8%	1,105	25.8%
20+ to 30%	487	11.4%	2	0.0%	381	8.9%
30+ to 40%	184	4.3%	0	0.0%	153	3.6%
40+ to 50%	83	1.9%	3	0.1%	52	1.2%
50%+	81	1.9%	1	0.0%	59	1.4%
Total	4,290	100.0%	4,290	100.0%	4,290	100.0%
Property Damages						
0 to 10%	2,760	64.3%	4,105	95.7%	2,863	66.7%
10+ to 20%	1,054	24.6%	174	4.1%	1,004	23.4%
20+ to 30%	318	7.4%	11	0.3%	290	6.8%
30+ to 40%	102	2.4%	0	0.0%	79	1.8%
40+ to 50%	37	0.9%	0	0.0%	29	0.7%
50%+	19	0.4%	0	0.0%	25	0.6%
Total	4,290	100.0%	4,290	100.0%	4,290	100.0%

* The total number of adjacent zipcode pairs shown in the table is slightly smaller than that generated from the map layer (4,416) because, as discussed earlier, 36 zipcodes in the map layer are missing from the industrywide loss cost data file.

Adjacent zipcode differentials in combined BI and PD pure premium are depicted in Figure 1.¹⁰ The combined BI and PD pure premium is the sum of the credibility adjusted BI pure premium and the credibility adjusted PD pure premium. As shown in Figure 1, in about 65 percent of the adjacent zipcode pairs, or in 2,774 adjacent zipcode pairs, the differentials in combined BI and PD pure premium are within 10 percent; about 4 percent of the adjacent zipcode pairs (or in 169 adjacent zipcode pairs) have differentials in combined BI and PD pure premium over 30 percent.

¹⁰ Claim frequency and claim severity are not combined for BI and PD coverages because of the potential different nature of claims. A BI claim and a PD claim may result from a same accident or may result from different accidents.

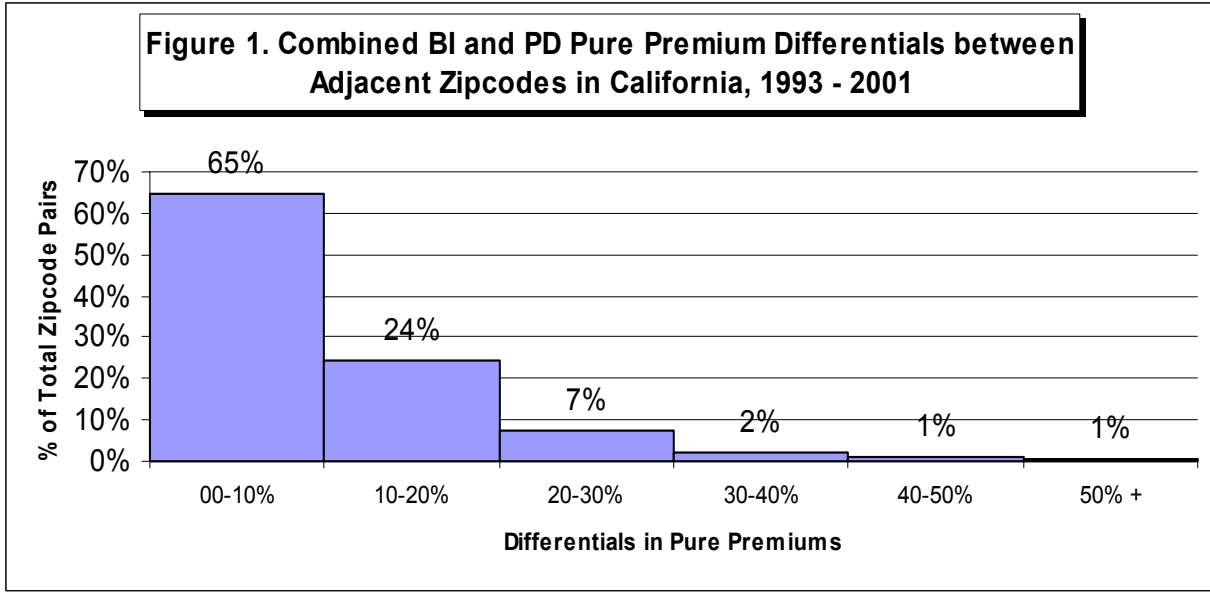


Table 5 reports the statewide average differentials, and the largest differentials between adjacent zipcodes in BI and PD loss statistics and the associated zipcode pairs. Among the seven loss statistics reported in the table, the largest differential in BI pure premium is 99 percent and occurs between zipcode 92055 (Oceanside, San Diego County) and zipcode 92672 (San Clemente, Orange County). The largest differential in PD pure premium is 107 percent and occurs between zipcodes 92055 (Oceanside, San Diego County) and 92028 (Fallbrook, San Diego County). As in the case of PD pure premium, the largest differential in the combined BI and PD pure premium is also between zipcode 92055 and zipcode 92672, with a differential of 102 percent. The average differentials between adjacent zipcodes for BI pure premium, PD pure premium, and the combined BI/PD pure premiums are around 10 percent. It is interesting to note that zipcode 92055 (Oceanside, San Diego County, a marine base) was involved in five of the seven loss statistics where the largest differentials occurs; the zipcode has higher loss costs than its adjacent zipcodes.

Table 5. Average and Largest Differentials (%) in BI & PD Loss Statistics

	Number of Zipcode Pairs	Average Differential	Standard Deviation	Largest Differential	Zipcode Pairs with Largest Differential
BI Claim Frequency	4,290	12.49	12.21	124.52	(92055, 92672)
BI Claim Severity	4,290	3.88	3.40	53.94	(90010, 90057)
BI Pure Premium	4,290	11.02	11.07	99.00	(92055, 92672)
PD Claim Frequency	4,290	9.53	9.08	82.53	(90013, 90023)
PD Claim Severity	4,290	3.53	3.14	28.08	(92055, 92057)
PD Pure Premium	4,290	9.14	9.14	106.92	(92055, 92028)
BI & PD Pure Premium	4,290	9.57	9.68	102.00	(92055, 92028)

Company Premium Differentials between Adjacent Zipcodes: Evidence from Insurer Territory Relativities

In this section, company premium differentials between adjacent zipcodes due to territory factors are examined. The major data sources for the analysis are the data sets of zipcode-to-band assignments and band relativities of seven major auto insurance companies operating in the state. In what follows, we discuss the method first; then we present results for each of the seven major insurers, followed by a summary of the seven companies' results and discussions about the results.

Premiums and Territory Relativities: Procedures to Calculate Premium Differentials

Auto insurance premiums are calculated from the company's rating algorithm, which has two major parts: the base rate and relativities of various rating factors. A base rate for a particular type of coverage is, in general, the same for all policyholders and reflects the company's average level of charges for all its policyholders. Individual policyholders' premiums could be lower or higher than the base rate depending on the relativities of rating factors.¹¹ Every driver (and his/her vehicles) is assigned into one category for each rating factor used. The relativity is simply a number associated with each of those categories, which describe the relationship between a given category rate and the base rate. From the base rate, an individual's premium is then adjusted by applying relativities of all the rating factors used in the rating algorithm.

Among the major insurers, territory factors are applied in such a way that they have multiplicative relationships with the final premium and are generally the penultimate step in premium determination in the rating algorithm. (The last step is to apply the Good Driver Discount). Under current regulations, insurance companies are allowed to use two territory factors: Frequency Band and Severity Band. Based on the base rate and all the rating factors (including territory factors), insurance companies use either a multiplicative algorithm or a mixed algorithm (multiplicative and additive) to calculate an individual's premium.¹² The multiplicative algorithm takes the following form:

$$\text{Premium} = \text{Base Rate} * R_1 * R_2 * \dots * R_i * R_j * \dots * R_n * \text{FB} * \text{SB} * \text{GDD}$$

where R_1, R_2, R_i, R_j, R_n are relativities for rating factor 1, 2, i, j , and n other than Frequency Band, Severity Band, and Good Driver Discount. The relativities of the latter three are represented by FB, SB, and GDD, respectively. The mixed algorithm can be written as follows:

$$\text{Premium} = \text{Base Rate} * (1.0 + R_1 + R_2 + \dots + R_i) * R_j * \dots * R_n * \text{FB} * \text{SB} * \text{GDD}$$

In either case, territory factors have a proportional relationship with the premium. Therefore, if the Frequency Band relativities of two individuals, who have otherwise exactly the same rating characteristics, differ by 10 percent, their final premiums will differ by exactly 10 percent.

¹¹ This is true when balanced relativities are used. Per California Code of Regulations Section 2632.7, balanced relativities are required for sequential analysis and factor weight calculations.

¹² We have not observed a pure additive algorithm used by the major insurers.

The direct proportional relationship between territory relativities and premium charged enables us to examine the effect of territory on premiums between adjacent zipcodes by simply examining the changes in territory relativities across the zipcodes.

Some insurers use an additive expense constant as an additive step in their premium algorithms. Typically, in the presence of an additive expense constant E, the above two premium algorithms would become:

$$\text{Premium} = (\text{Base Rate} * R_1 * R_2 * \dots * R_i * R_j * \dots * R_n * \text{FB} * \text{SB} + E) * \text{GDD}$$

$$\text{Premium} = (\text{Base Rate} * (1.0 + R_1 + R_2 + \dots + R_i) * R_j * \dots * R_n * \text{FB} * \text{SB} + E) * \text{GDD}$$

If an insurer uses an additive expense constant as an additive step in their premium algorithms, the percentage difference in final premiums will be no longer exactly the same as the percentage difference in territory relativities, though the two will change in the same direction. It can be demonstrated that the final premium differentials in the presence of an additive expense constant can be calculated using the following formula:

$$\text{Premium Differential Ratio} = (\text{Territory Relativity Differential Ratio} + F) / (1 + F)$$

Constant F in the equation is the expense constant ratio, the ratio between the expense constant and base rate. Four of the seven companies use an additive expense factor in their rating algorithms. The expense constant ratio ranges from 0.10 to 0.144 among the four companies.

Under current regulations, both Frequency Band and Severity Band are divided into 10 categories (bands). Unlike a CAARP territory, a Frequency Band or a Severity Band is not necessarily geographically contiguous. Table 6 shows one company's territory relativities (Frequency Band and Severity Band) for combined Bodily Injuries (BI) and Property Damages (PD) coverages for illustrative purposes.¹³

If an individual resides in the zipcodes which belong to Frequency Band 1, he would receive a discount of 40 percent based on the Frequency Band rating factor. On the other hand, if an individual resides in the adjacent zipcode which happens to belong to Frequency Band 10 he would receive a surcharge of 50 percent. Based on this company's territory relativities, the differential could be as large as 21 percent even if the two adjacent zipcodes are assigned to two consecutive bands (one in Band 5 and the other in Band 6). The same discussion, in general, applies to Severity Band as well.

We can also think of the overall territory relativities of Frequency Band and Severity Band as the product of the relativities of the two territory rating factors. For example, if the relativity of Frequency Band is 0.6 (customers in the territory receive a discount of 40%) and the relativity of Severity Band is 0.7 (customers in the territory receive a discount of 30%), the overall territory relativity would be 0.42 (customers in the territory receive a total discount of 58%).

¹³ The company (a real company) combines BI and PD coverages for rating purpose. It is interesting to observe that there are significant differentials in the company's Severity Relativities while the industrywide loss costs show only moderate differentials in claim severity among CAARP territories and across adjacent zipcodes.

Table 6. Territory Bands and Relativities from an Example Company

Frequency Band	Frequency Relativities	Severity Band	Severity Relativities
1	0.60	1	0.65
2	0.62	2	0.68
3	0.69	3	0.73
4	0.76	4	0.80
5	0.86	5	0.89
6	1.04	6	1.07
7	1.22	7	1.26
8	1.34	8	1.33
9	1.43	9	1.44
10	1.50	10	1.50

While insurance companies, in general, have territory relativities for Frequency Band and Severity Band by each coverage, three of the seven major insurers included in this study combine BI and PD for rating purposes. If an insurer combines BI and PD for rating purposes, there is only one set of relativities for Frequency Band and one set of relativities for Severity Band. In order to discuss premium differentials on an equal basis with all companies, we combined the BI territory relativities and PD territory relativities for insurers that separate the two coverages. We also corrected the impact caused by the additive expense factor. Specifically, we used the following procedure to calculate premium differentials between adjacent zipcodes:

Step 1: Overall Territory Relativities (OTR)

For companies that combine BI and PD coverages:

$$OTR = FB * SB$$

For companies that separate BI and PD coverages:

$$OTR = (FB_{BI} * SB_{BI} * BASE_{BI} + FB_{PD} * SB_{PD} * BASE_{PD}) / (BASE_{BI} + BASE_{PD})$$

In the above equations, FB and SB are the relativities for Frequency Band and Severity Band, respectively. Subscripts indicate coverages. $BASE_{BI}$ and $BASE_{PD}$ are, respectively, base rates for BI and PD coverages.

Step 2: Initial Differential Ratio (IDR)

$$IDR = \text{Max}(OTR1, OTR2) / \text{Min}(OTR1, OTR2)$$

OTR1 in the equation is the overall territory relativity of a zipcode and OTR2 is the overall territory relativities for its adjacent zipcode. Max is the maximum function and Min is the minimum function.

Step 3: Differential Ratio (corrected, in decimal form)

$$\text{Differential Ratio} = (IDR + F) / (1 + F)$$

F in the equation is the expense constant ratio, the ratio between the additive expense constant and the base rate. For insurance companies that do not use an additive expense constant in their rating algorithms, F is equal to zero.

Step 4: Differential (in percentage form)

$$\text{Differential} = (\text{Differential Ratio} - 1) * 100$$

The premium differentials presented in this report are the *corrected* territory relativity differentials calculated in step 3 and step 4. However, for the convenience of elaboration, “premium differentials” (due to territory factors) and “territory relativity differentials” will be used interchangeably in the rest of this report.

Results for Seven Major Insurance Companies

Table 7 reports some summary statistics for the Overall Territory Relativities for combined BI and PD coverages that are calculated in step 1 above. The Smallest Relativity column indicates the relativities for the companies’ “best territory”, while the Largest Relativity column indicates their relativities for the “worst territory.” Take Company Hawaii as an example. The relativity for its “best territory” is 0.457 (residents in the territory would receive a discount of 54.3 percent based on the territory rating factor), whereas the company’s relativity for its “worst territory” is 2.064 (residents in the territory would receive a surcharge of 106.4 percent).

Table 7. Summary Descriptions of Companies' Territory Combined BI/PD Relativities

Company	Smallest Relativity	Largest Relativity	Largest/Smallest Relativity Ratio
Company Hawaii	0.457	2.064	4.52
Company Kauai	0.554	1.758	3.17
Company Lanai	0.614	1.783	2.91
Company Maui	0.469	2.059	4.39
Company Molokai	0.513	1.783	3.48
Company Niihau	0.527	2.279	4.32
Company Oahu	0.584	1.717	2.94

The column labeled “Largest/Smallest Relativity Ratio” indicates the territory relativity differential ratio between the “worst territory” and the “best territory”. For Company Hawaii, the premiums of its two insureds, who otherwise have the same rating characteristics, would differ by a factor of 4.52 because one resides in the “best territory” and the other one resides in the “worst territory”. As shown in Table 7, Largest/Smallest Relativity Ratio varies from 2.91 Company Lanai to 4.52 of Company Hawaii.

The differentials in territory relativities between adjacent zipcodes for each of the seven companies are presented below. Major results are reported in a figure and a table for each company. The figure presents differentials in overall BI and PD territory relativities between adjacent zipcode pairs. The table reports two zipcode pairs which have the “largest differentials.” The first pair has the largest differential among all the adjacent zipcode pairs statewide. It turns out that for three of the seven companies the largest differentials occur between two adjacent *rural* zipcodes (with a population density of less than 240 persons per square mile). Three other companies’ zipcode pairs with the largest differentials statewide involve an air force base, which appear to be in a generally rural area. The pair with the largest differentials statewide for the one remaining company is between an urban zipcode and a zipcode associated with a university campus. The results are surprising. It appears that the perceived dramatic differentials between adjacent *urban* zipcodes were the primary focus of consumers’ complaints. In order to examine this issue, we identify and report the zipcode pair with the largest differential among urban/suburban zipcodes, which are defined in this study as zipcodes with population density exceeding 3,000 persons per square mile.¹⁴ See Maps 1 to 13 in the Appendix to see how these zipcode pairs fit in their surrounding area.

For these reported zipcodes, the territory relativities are compared with data on industrywide loss costs (the combined BI and PD pure premium) between the adjacent two zipcodes. Industrywide loss costs are potentially affected by many risk factors besides territory. Under current regulations, territory relativities are derived from territorial differences in loss costs (composed of claim frequency and severity) after taking account of safety record, mileage driven, years of license, and other optional rating factors. The difference in territory relativities between two zipcodes should, in general, be smaller than the difference in loss costs because the safety record factor is likely to explain a portion of the difference in loss costs.¹⁵

Industrywide loss cost data rather than company specific loss cost data is used for the following reasons: First, industrywide loss cost data is publicly available while company specific loss cost data is proprietary and confidential. Second, industrywide loss experience may be a better indication of overall risk level of a zipcode in road situation and traffic conditions. If a company happens to have a “preferred” book of business in a zipcode, its loss cost in the zipcode is likely

¹⁴ The standard used in this study is arbitrary, but “robust”, meaning that most of the results will remain the same even with a moderate change of the standard. One may argue that consideration of both population density and population distribution within a zipcode may be a better approach to describe a rural zipcode and an urban/suburban zipcode. The study did not explore this issue further because of time constraints.

¹⁵ Consider only two zipcodes A and B where the BI pure premium (average loss costs) in zipcode A during 1993 - 2001 is 50 percent higher than zipcode B. If the characteristics of all other rating factors are exactly the same for zipcode A and B, the territory relativity differential would be 50 percent between the two zipcodes. (The increased limit factor is the same because capped incurred losses are used in this analysis). However, the difference in BI pure premiums between the two zipcodes is likely to cause a difference in average safety records in the two zipcodes. Based on our earlier discussion, the difference in BI pure premiums is primarily due to the difference in claim frequency. That is, zipcode A would have a higher claim frequency than zipcode B. Since BI claims would generally be reflected in a driver’s safety records, drivers in zipcode A on average would have worse safety records than drivers in zipcode B. A portion of the difference in loss costs between zipcode A and B should be explained by the difference in safety records first. As a result, the differential in territory relativities should be smaller than 50 percent, the total difference in average loss costs, as long as the effect of other rating factors (such as mileage and driving experience) do not completely offset the effect of safety records.

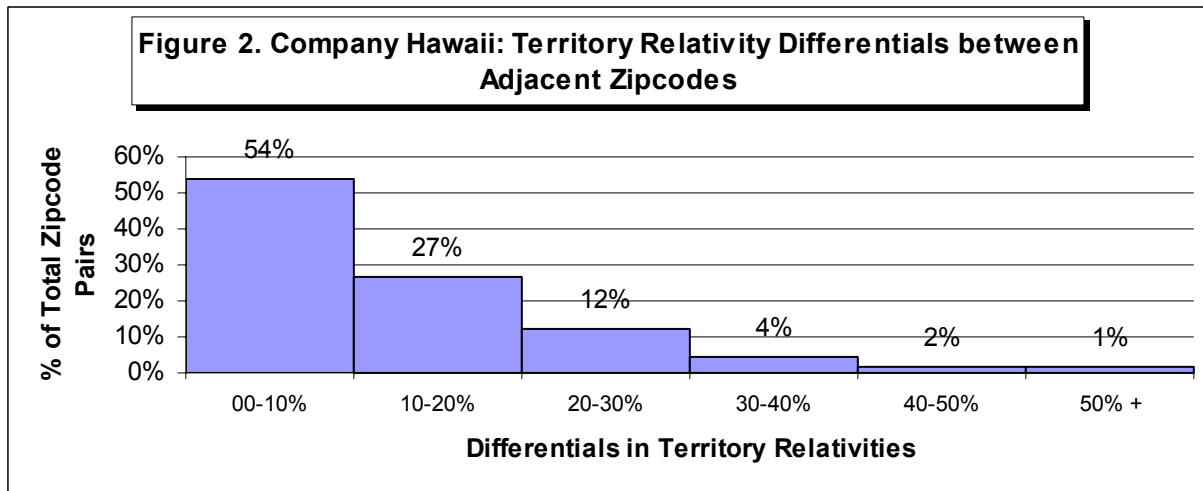
to be lower than the industry average. However, the company's loss cost may not necessarily be a good indication of the risk level for the road and traffic conditions in the zipcode.

While industrywide loss experience in a zipcode might be an indication of overall risk level for the zipcode, a particular company's loss experience may differ from the industrywide loss experience. It is believed that major insurance companies' rates and territory relativities are primarily based on their own loss experience rather than industrywide loss experience. Insurance companies generally use more recent data in their ratemaking process so the rates are more "responsive." In addition, companies may use different credibility adjustment procedures in their ratemaking process.¹⁶ As a result, any discrepancy between the differentials in companies' territory relativities and the differentials in industrywide loss costs should be interpreted with caution. The purpose of the comparison between industrywide loss costs and company territory relativities is not to evaluate companies' rating procedures and the accuracy of their territory relativities. Rather, it is intended to provide background information to provoke critical thinking about the nature of territory rating factors and territory relativities. For example, should a company's territory relativities, which are well supported by the individual company's loss cost data but substantially deviate from the risk level indicated by the industrywide loss costs, be reconciled by incorporating industrywide data in the company's rating making process?

¹⁶ Even though the complement of credibility procedure is described in Section 2632.9(d), the regulation allows for choice in what to use as the complement.

Company Hawaii

Figure 2 displays the distribution of differentials in combined BI and PD territory relativities between adjacent zipcode pairs. It shows that 54 percent of the adjacent zipcode pairs have differentials in territory relativities within 10 percent. The distribution has a relatively long tail. About 7 percent of the adjacent zipcode pairs have territory relativity differentials more than 30 percent.



The largest territory relativity differential statewide is between two rural zipcodes for this company. The ratio of the territory relativities is 2.01. However, as shown in Table 8, industrywide data indicates that the two zipcodes had similar loss experience. Both zipcodes are generally rural, and should have similar territorial characteristics, such as road conditions and traffic density. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.87, which is considerably larger than the differential ratio in industrywide pure premiums, hereinafter referred to as loss costs.

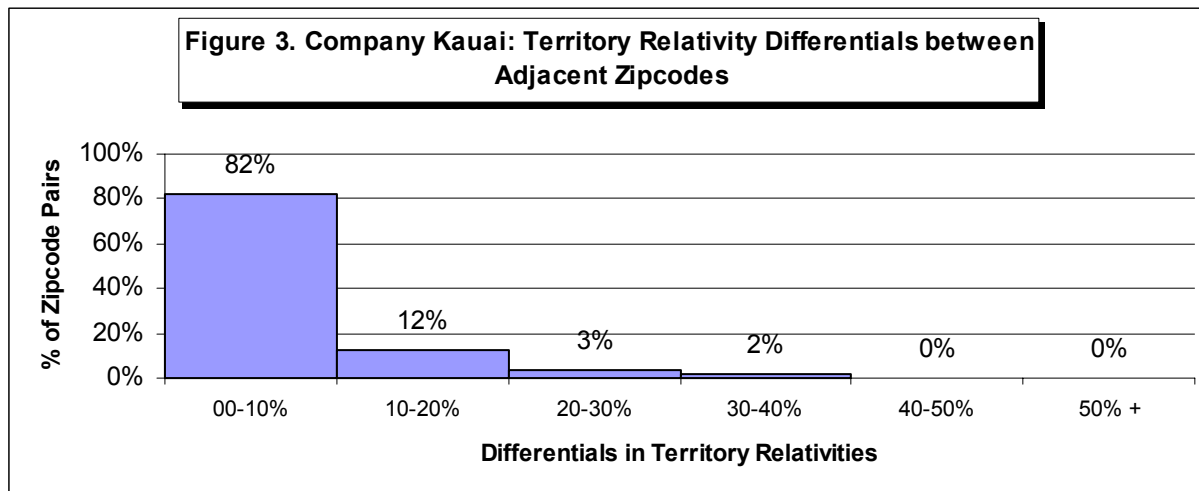
Table 8. Comparison of Co. Hawaii's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
92309	0.9594	1,578	\$114.23	\$104.10
93555	0.4764	191,849	\$93.28	\$97.20
Differential Ratio	2.01		1.22	1.07
Urban/Suburban Area				
94621	1.6220	50,997	\$231.93	\$223.29
94577	0.8697	229,928	\$179.64	\$179.64
Differential Ratio	1.87		1.29	1.24

Note: Adjusted pure premium means credibility adjusted.

Company Kauai

The distribution of differentials in territory relativities between adjacent zipcode pairs for Company Kauai is displayed in Figure 3. In 82 percent of the adjacent zipcode pairs, the differentials in territory relativities are within 10 percent, while about 2 percent of the adjacent zipcodes have territory relativity differentials over 30 percent.



The largest differential statewide in territory relativities for the company is between two rural zipcodes with a differential ratio of 1.58. Industrywide data, as shown in Table 9, indicates the two zipcodes have only moderately different loss experience. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.37, which is considerably smaller than the differential ratio in industrywide loss costs. This zipcode pair has the fifth largest differential in the state in combined BI and PD pure premium.

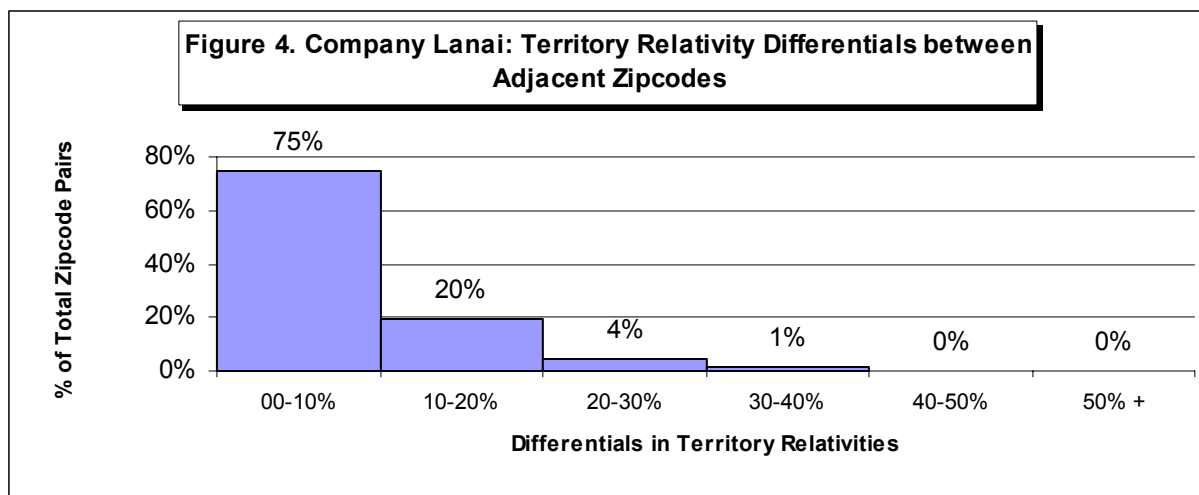
Table 9. Comparison of Co. Kauai's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
93536	0.9522	214,658	\$197.68	\$197.68
93243	0.6016	8,648	\$154.34	\$176.00
Differential Ratio	1.58		1.28	1.12
Urban/Suburban Area				
90027	1.6090	135,878	\$413.31	\$413.31
91506	1.1704	96,191	\$215.50	\$224.50
Differential Ratio	1.37		1.92	1.84

Note: Adjusted pure premium means credibility adjusted.

Company Lanai

The distribution of differentials in territory relativities between adjacent zipcode pairs for Company Lanai is displayed in Figure 4. In 75 percent of the adjacent zipcode pairs the differentials in territory relativities are within 10 percent. About 2 percent of the adjacent zipcodes have territory relativity differentials over 30 percent (percentages in the figure do not add to 2% due to rounding errors).



The largest differential statewide in territory relativities for the company is between a zipcode associated with an air force base and a “semi” urban/suburban zipcode (with a population density of a little over 1,500 persons per square mile). As indicated in Table 10, the differential ratio is 1.64, which is similar to the difference in loss experience. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.47. There is considerable difference in industrywide loss costs between the two adjacent zipcodes. This zipcode pair has the largest differential in the state in PD claim frequency.

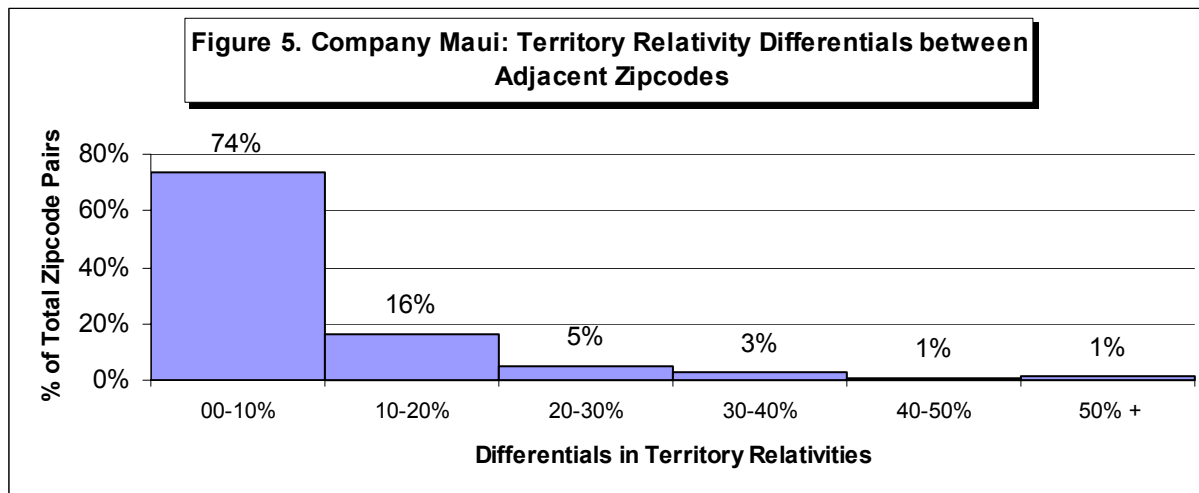
Table 10. Comparison of Co. Lanai's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
93534	1.0820	144,556	\$213.67	\$213.67
93523	0.6614	39,185	\$93.51	\$136.37
Differential Ratio	1.64		2.28	1.57
Urban/Suburban Area				
90013	1.6750	4,664	\$396.27	\$320.08
90023	1.1412	50,469	\$199.94	\$201.16
Differential Ratio	1.47		1.98	1.59

Note: Adjusted pure premium means credibility adjusted.

Company Maui

The distribution of differentials in territory relativities between adjacent zipcode pairs for Company Maui is displayed in Figure 5. In 74 percent of the adjacent zipcode pairs, the differentials in territory relativities are within 10 percent. About 5 percent of the adjacent zipcodes have territory relativity differentials over 30 percent.



The pair of adjacent zipcodes which have the largest differential statewide in territory relativities for the company are between a zipcode associated with an air force base and its adjacent rural zipcode, with a differential ratio of 2.24. Industrywide data, as shown in Table 11, suggests there is a similar but smaller difference in loss experience when credibility adjusted. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.69. The industrywide loss costs of the two adjacent zipcodes are rather similar; the industrywide loss costs in the zipcode that has a higher company relativity is actually slightly smaller than the loss costs in the adjacent zipcode

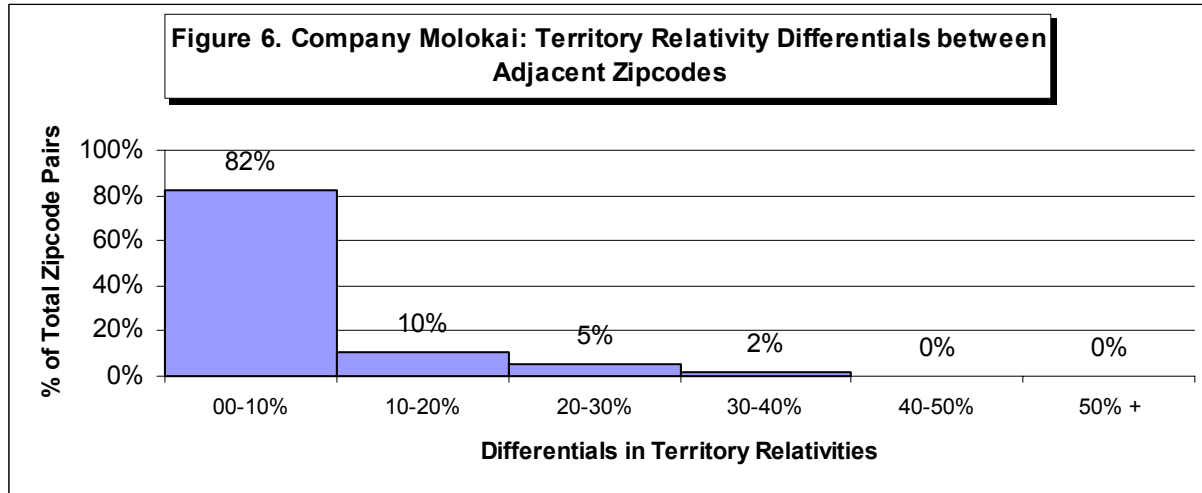
Table 11. Comparison of Co. Maui's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
93535	1.4152	226,563	\$215.97	\$215.97
93523	0.6327	39,185	\$93.51	\$136.37
Differential Ratio	2.24		2.31	1.58
Urban/Suburban Area				
90303	1.9296	51,472	\$221.03	\$225.21
90250	1.1440	253,078	\$234.16	\$234.16
Differential Ratio	1.69		0.94	0.96

Note: Adjusted pure premium means credibility adjusted.

Company Molokai

The distribution of differentials in territory relativities between adjacent zipcode pairs for Company Molokai is displayed in Figure 6. In 82 percent of the adjacent zipcode pairs, the differentials in territory relativities are within 10 percent. Only about 2 percent of the adjacent zipcodes have territory relativity differentials over 30 percent.



The largest differential statewide in territory relativities for the company is between two rural zipcodes with a differential ratio of 1.62. As shown in Table 12, the exposures for both zipcodes are rather small. Although a differential in loss costs exists, the data is far from credible. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.52. The difference in industrywide loss costs between the two adjacent zipcodes is much smaller.

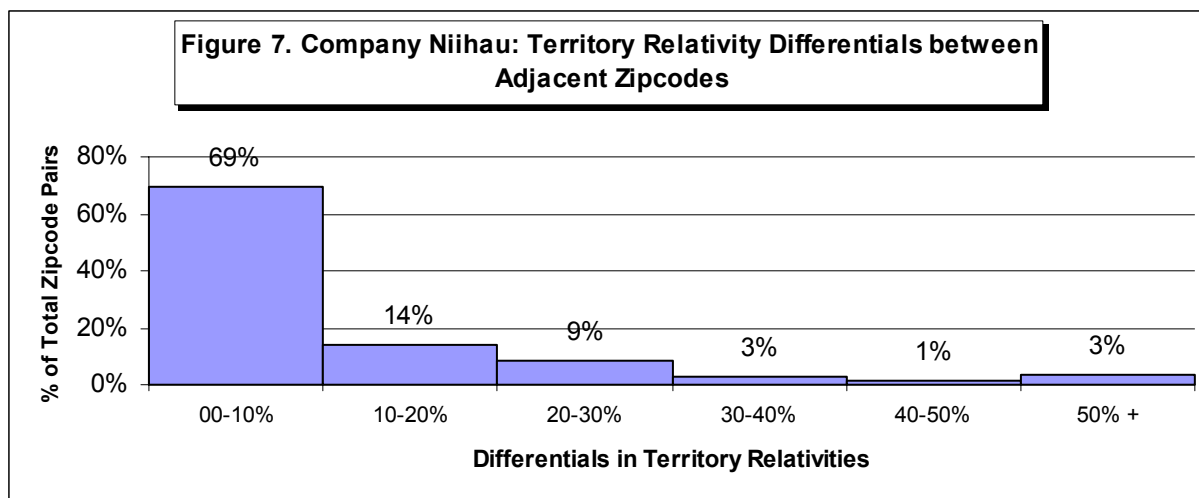
Table 12. Comparison of Co. Molokai's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
92309	0.8642	1,578	\$114.23	\$104.10
92328	0.5350	2,038	\$80.03	\$98.76
Differential Ratio	1.62		1.43	1.05
Urban/Suburban Area				
90001	1.3420	41,522	\$223.56	\$223.82
90255	0.8844	104,867	\$202.74	\$202.44
Differential Ratio	1.52		1.10	1.11

Note: Adjusted pure premium means credibility adjusted.

Company Niihau

The distribution of differentials in territory relativities between adjacent zipcode pairs for Company Niihau is displayed in Figure 7. In 69 percent of the adjacent zipcode pairs, the differentials in territory relativities are within 10 percent. The distribution has a relatively long tail. About 8 percent of the adjacent zipcodes have territory relativity differentials over 30 percent (percentages in the figure do not add to 8% due to rounding errors).



The largest differential statewide in territory relativities for the company is between a zipcode associated with a university campus and an urban zipcode with a differential of 1.71. As shown in Table 13, the average industrywide loss costs of the two zipcodes are almost the same. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.64. Again, the average industrywide loss costs of the two zipcodes are almost the same, although both of them are well above the state average (see Table 1).

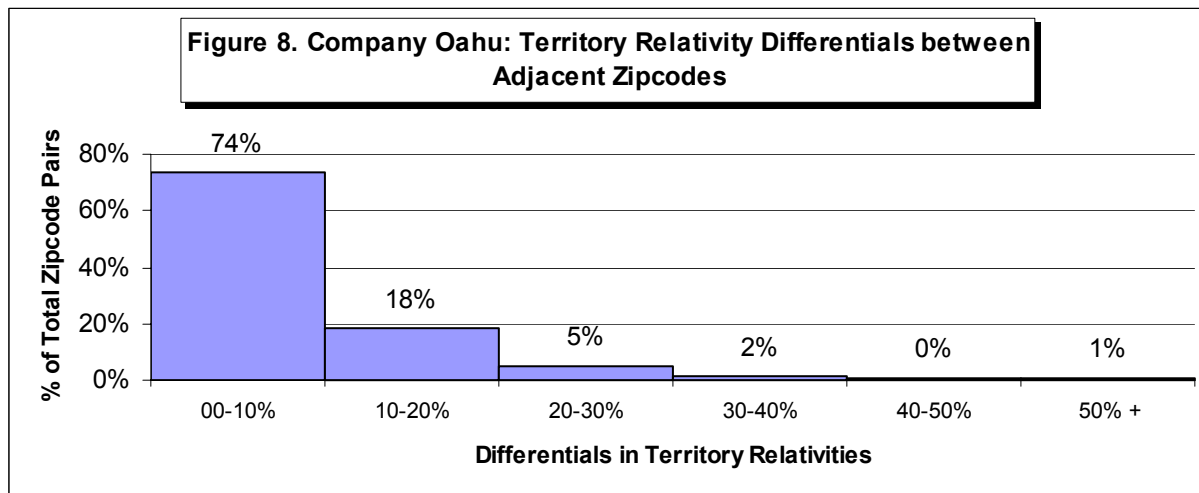
Table 13. Comparison of Co. Niihau's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
95207	1.1680	193,844	\$187.93	\$187.93
95211	0.6849	1,798	\$190.34	\$185.73
Differential Ratio	1.71		0.99	1.01
Urban/Suburban Area				
91343	1.7582	171,599	\$289.53	\$289.53
91344	1.0712	249,093	\$282.52	\$282.52
Differential Ratio	1.64		1.02	1.02

Note: Adjusted pure premium means credibility adjusted.

Company Oahu

The distribution of differentials in territory relativities between adjacent zipcode pairs for Company Oahu is displayed in Figure 8. In 74 percent of the adjacent zipcode pairs, the differentials in territory relativities are within 10 percent. About 3 percent of the adjacent zipcodes have territory relativity differentials over 30 percent.



The largest differential statewide in territory relativities for the company is between a zipcode associated with an air force base and a “semi” urban/suburban zipcode (with a population density of just little over 1,500 persons per square mile); the differential ratio is 2.06. Industrywide data, as shown in Table 14, suggests there is a similar but smaller difference in loss experience if it is credibility adjusted. The largest differential ratio among adjacent urban/suburban zipcode pairs is 1.38. The industrywide loss costs of the two adjacent zipcodes are similar; the industrywide loss cost in the zipcode with higher company relativity is actually slightly smaller than the loss costs in the adjacent zipcode.

Table 14. Comparison of Co. Oahu's Territory Relativities and Industrywide Experience

Zipcode Pair with Largest Relativity Differential	Company Relativities	Industrywide Experience 1993 - 2001		
		Exposures	Unadjusted Pure Premium	Adjusted Pure Premium
Statewide				
93534	1.6416	144,556	\$213.67	\$213.67
93523	0.7969	39,185	\$93.51	\$136.37
Differential Ratio	2.06		2.28	1.57
Urban/Suburban Area				
90304	1.5790	44,994	\$218.22	\$220.59
90045	1.1430	199,130	\$233.14	\$233.14
Differential Ratio	1.38		0.94	0.95

Note: Adjusted pure premium means credibility adjusted.

Company Result Summary and Discussions

The distribution of differentials in territory relativities between adjacent zipcode pairs for each of the seven companies are summarized in Figure 9. For the category of differential less than 10 percent, two companies have at least 80 percent of the adjacent zipcode pairs within the category; three companies have more than 70 percent but less than 80 percent of the pairs within the category. On the other hand, for four out of the seven companies there are less than 3 percent adjacent zipcodes with 30 percent or larger differentials.

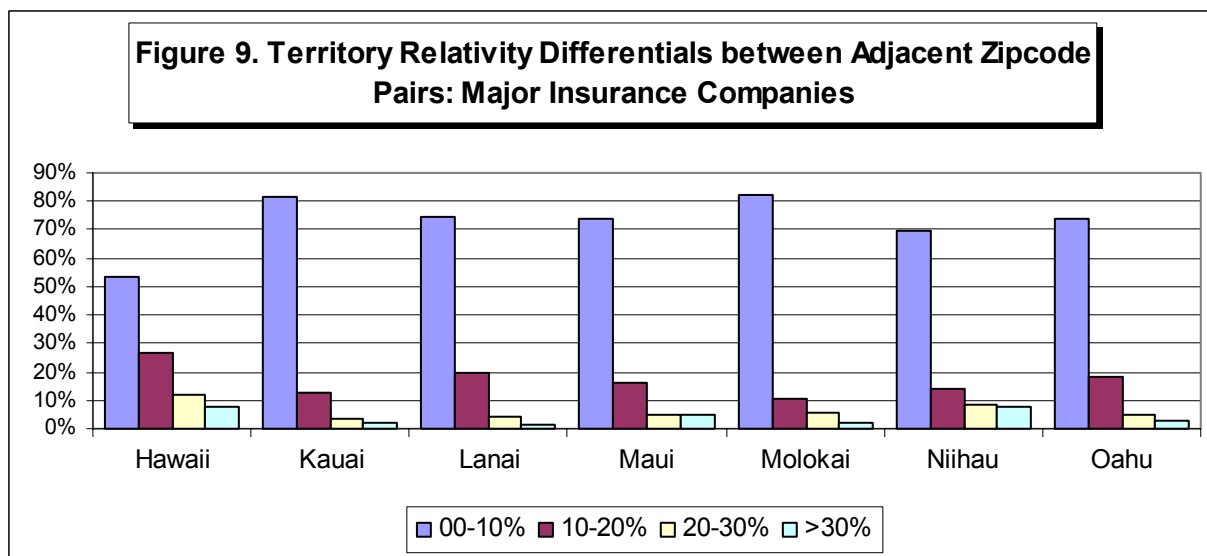


Table 15 reports the adjacent zipcode pairs with the largest differentials statewide for each company and compares how these adjacent zipcode pairs are rated by the other companies. The first column of the table lists the company names and their associated pairs where the largest differentials exist at the respective companies. The second column of the table lists the differentials in credibility adjusted industrywide pure premiums on the seven pairs. Other columns list each company's rated differentials. The third column of the table lists the average of these seven companies' relativity differentials weighted by each company's car exposure months for each zipcode in the relevant zipcode pair. For the largest differential ratios for each company, read the table diagonally (the ratios are in bold and italic). The largest ratios range from 1.58 of Company Kauai to 2.24 of Company Maui. On the other hand, the differential ratios for industrywide loss costs over these adjacent zipcode pairs vary in a much smaller range from 1.01 to 1.58. As noted earlier, many pairs are between two rural zipcodes.

The table can also be read in rows and in columns. The rows of the table compare how a particular adjacent zipcode pair is rated by different companies. Take Company Hawaii's pair as an example. According to Company Hawaii's rating plan, the premium of customers or potential customers in zipcode 92309 is 201 percent as high as customers in its adjacent zipcode 93555 (or 101 percent higher). However, some other companies do not conform to this rating. For this zipcode pair, Company Lanai and Company Molokai's differentials are much smaller. It is interesting to notice that Company Kauai and Company Niihau rates the two zipcodes in an

opposite direction. The table shows that among the seven adjacent zipcode pairs there is not a single pair with unanimous agreement on differentials of their territory relativities among the seven companies. Many of the differentials are not supported by industrywide loss experience and no real intrinsic territorial difference appears to exist between the two zipcodes of these pairs. However, when two adjacent zipcodes show a marked difference in industrywide loss experience, companies tend to conform to each other. For example, the largest differential pairs associated with Company Lanai, Company Maui, and Company Oahu are similarly rated, to a different degree, by a majority of the companies (Company Niihau is always an exception). All the three company's pairs are in the same general location, with 93523 (an air force base) on one side for the three pairs. See Maps 1 to 6 in the Appendix to see how these zipcode pairs fit in their surrounding areas. Note that all these adjacent pairs share only relatively small boundaries.

Table 15. Comparison of Adjacent Zipcode Pairs with Largest Relativity Differentials

Company and Its Adjacent Zipcode Pair with Largest Differential	Industrywide Pure Premium Diff. Ratio*	Company Relativity Differential Ratios							
		Avg**	Hawaii	Kauai	Lanai	Maui	Molokai	Niihau	Oahu
Hawaii (92309, 93555)	1.07	1.48	2.01	0.99	1.15	1.45	1.23	0.84	1.51
Kauai (93536, 93243)	1.12	1.53	1.38	1.58	1.19	1.59	1.41	1.00	1.89
Lanai (93534, 93523)	1.57	1.74	1.27	1.32	1.64	2.05	1.41	0.95	2.06
Maui (93535, 93523)	1.58	1.77	1.36	1.47	1.60	2.24	1.41	0.97	1.97
Molokai (92309, 92328)	1.05	1.49	1.70	1.16	1.14	1.61	1.62	1.00	1.67
Niihau (95207, 95211)	1.01	1.20	0.78	0.97	1.03	0.98	1.00	1.71	1.06
Oahu (93534, 93523)	1.57	1.74	1.27	1.32	1.64	2.05	1.41	0.95	2.06

* Differential in industrywide credibility adjusted BI and PD pure premium.

** The seven company average is weighted by car exposure months for the relevant Zipcodes.

The columns of the table represent a particular company's rating with all the seven pairs of adjacent zipcodes. Taking Company Hawaii as an example, the company rated Company Kauai's pair with differential ratio of 1.38, which is different with, but close to, Company Kauai's differential ratio of 1.58. Company Hawaii's differential ratio with Company Molokai's pair (1.70) is even closer to Company Molokai's differential ratio of 1.62. However, a closer examination shows that different companies rated these adjacent pairs very differently. Out of the other six companies, Company Lanai had similar differential rates with only two companies. Company Niihau's rates are different from all other six companies. For two pairs, Company Niihau put each of them in the same claim frequency and the same severity band (no differential exists); differentials exist for another four, but in an opposite direction (a small discount, instead of a surcharge) compared with ratings of other companies.

Similar to Table 15, Table 16 reports the adjacent zipcode pairs with the largest differentials among the urban/suburban zipcodes for each company and compares how these adjacent zipcode pairs are rated by the other companies. See Maps 7 to 13 in the Appendix to see how these zipcode pairs fit into their surrounding areas. Again note that these pairs share relatively small boundaries. The largest ratios range from 1.37 of Company Kauai to 1.87 of Company Hawaii. Except for the pairs associated with Company Kauai and Lanai, there appears no striking difference in industrywide loss costs over these adjacent zipcode pairs. We can also observe a similar pattern in Table 16 as is observed in Table 15.

Table 16. Comparison of Adjacent Zipcode Pairs with Largest Relativity Differentials (Urban/Suburban Zipcodes)

Company and Its Adjacent Zipcode Pair with Largest Differential	Industrywide Pure Premium Diff. Ratio*	Company Relativity Differential Ratios							
		Avg**	Hawaii	Kauai	Lanai	Maui	Molokai	Niihau	Oahu
Hawaii (94621, 94577)	1.24	1.19	1.87	1.10	1.12	1.30	1.11	1.25	1.13
Kauai (90027, 91506)	1.84	1.34	1.48	1.37	1.16	1.49	1.27	0.99	1.15
Lanai (90013, 90023)	1.59	1.39	1.68	1.10	1.47	1.48	1.29	0.99	1.33
Maui (90303, 90250)	0.96	1.08	0.93	0.93	1.15	1.69	1.00	1.57	1.17
Molokai (90001, 90255)	1.11	1.38	1.43	1.22	1.16	1.48	1.52	1.00	1.32
Niihau (91343, 91344)	1.02	0.97	1.08	0.92	0.95	1.03	0.92	1.64	1.00
Oahu (90304, 90045)	0.95	1.11	1.31	0.97	1.21	0.97	0.88	1.56	1.38

* Differential in industrywide credibility adjusted BI and PD pure premium.

** The seven company average is weighted by car exposure months for the relevant Zipcodes.

Examination of the adjacent zipcode pairs with the largest territory relativity differential ratios shows that companies rated these pairs markedly differently. In order to explore this issue further, we examined the similarity or the dissimilarity of territory relativity differential ratios among the seven companies for a larger group of adjacent zipcode pairs. Specifically, we examined the adjacent zipcode pairs with territory relativity differentials over 30 percent.

In Table 17, an adjacent zipcode pair is “shared” by all the seven companies if all the seven companies have territory relativity differential ratios exceeding 30 percent over the pair. A pair is shared by any six companies if any six of the seven companies have territory relativity differential ratios exceeding 30 percent over the pair, so on and so forth. As shown in the table, the number of zipcode pairs with differentials over 30 percent totals 946, or about 22 percent of the total adjacent zipcode pairs in the state. Among the 946 pairs, there are only 2 pairs where differentials over 30 percent are rated by all the seven companies. On the other hand, nearly 80 percent of the pairs are rated by one of the seven companies (not the same company in each case), without conforming by any other six companies.

Table 17. Adjacent Zipcode Pairs with Differentials > 30% Shared by Companies

Number of Sharing Companies	Adjacent Zipcode Pair Count	Cumulative Count	Cumulative Percentage
All 7 Companies	2	2	0.2%
Any 6 Companies	3	5	0.5%
Any 5 Companies	7	12	1.3%
Any 4 Companies	25	37	3.9%
Any 3 Companies	42	79	8.4%
Any 2 Companies	124	203	21.5%
Only 1 Company without Sharing	743	946	100.0%

Examination of the adjacent zipcode pairs with the largest territory relativities also shows that some of them are not supported by the industrywide loss experience.

Conclusions

The study results lead to some interesting conclusions. First, industrywide pure premiums do not strongly support the company zipcode relativities. On the other hand, they don't necessarily contradict them either. In this study, numerous examples exist of large zipcode relativity differentials for individual companies that are inconsistent with corresponding industrywide pure premium differentials. This is not surprising in light of numerous problems inherent in comparing the company relativities with the industry pure premiums. An industry average implies some companies will fall above the average and some below. Also, some companies may perform better underwriting in some markets or territories. Furthermore, the industrywide data, un-weighted for current relevance, covered nine years while the company data was calculated from a much more limited time period.

Second, the analysis in this study highlights the importance of credibility adjustments in comparisons of territory relativities. It is surprising that for such an important issue, companies are inconsistent with each other in their procedural application of credibility, arising from a lack of a required standardized method. As a consequence, any comparison between companies regarding territory relativities will be problematic, let alone comparisons with any industrywide average.

Third, the choice of individual zipcodes as an appropriate building block in constructing territory bands is questionable because of the problems evidenced in this study. Zipcodes by themselves are rarely credible. This forces grouping them together, but depending on the company, groups are formed differently.

Fourth, the marked differences between companies in their zipcode relativities, and consequently the premiums that they charge their customers, make it critical that customers comparison shop

between companies, and probably on a frequent basis. Otherwise, they may find themselves paying much more than a similar customer in a neighboring zipcode, or more importantly, a similar consumer in the same zipcode but with a different company. The data in the study indicates that even in a high premium zipcode, some companies will charge significantly less than other companies. Furthermore, it is not always the same company offering the lowest rates.

Fifth, the advantage to the consumer in switching companies reinforces the importance in how persistency is applied as a rating factor. Differences in premiums between companies in problem zipcodes cannot be circumvented as easily if the customer has to concern himself with persistency factors. Policymakers wishing to lessen consumer difficulties in lowering premiums need to consider lessening the importance of persistency as a rating factor.

This study offers an important glimpse into the relationship between auto premiums and losses and how they can affect adjacent zipcodes. For the reasons stated above, it can only offer clues and indications about this relationship. It does make a case for a more in depth study that would attempt to draw in more factors that affect this relationship and possibly allow correlation analysis or a multi-variate regression analysis that might sort out the contributing importance of each factor. Another area of interest might be to compare indicated and selected relativities and how they are related to loss, especially in conjunction with market coverage in suspected redline areas. Expanding this line of thought, it might be productive to identify which high premium zipcodes are serviced by only a few companies.

Already this study has generated other interesting research, such as, an analysis of how individual companies allocate their book of business among the available frequency and severity bands. Preliminary work has also been conducted on enclaves where a zipcode is surrounded by zipcodes with dissimilar relativities. Other research has delved into whether frequency and severity relativities tend to cancel each other out.

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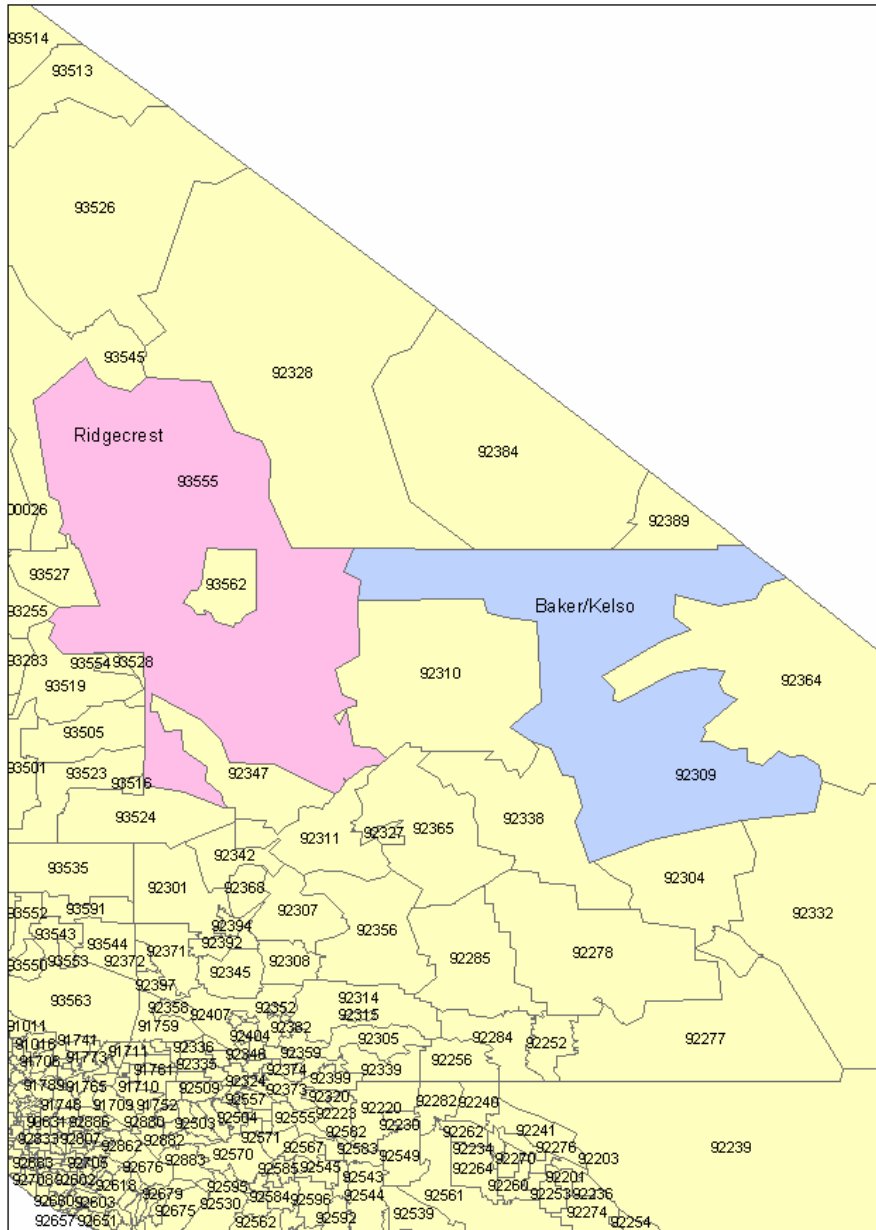
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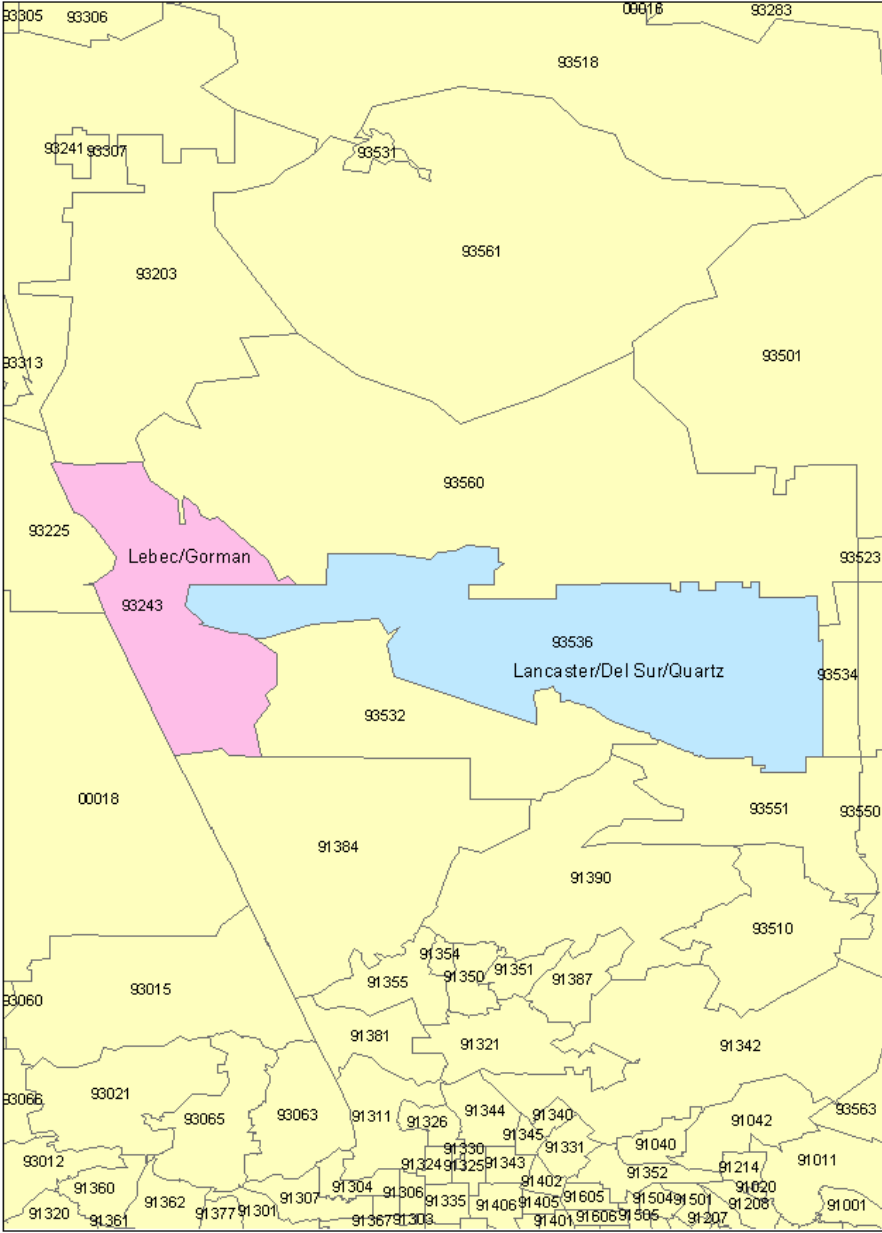
Mahler, Howard C. and Curtis Gary Dean (2001), "Credibility" Casualty Actuarial Society (2001), *Casualty Actuarial Science*.

APPENDIX

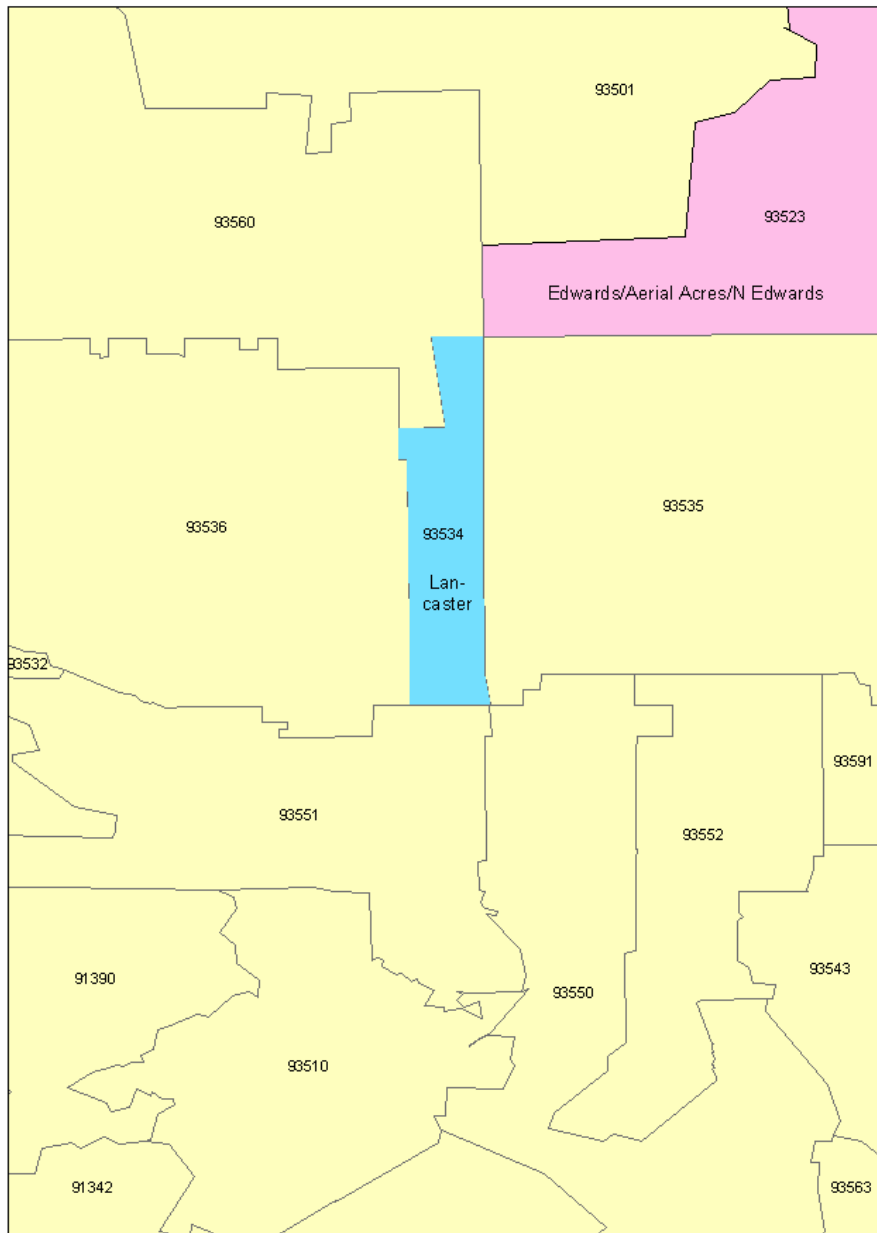
Map 1. Adjacent ZIPcodes (92309, 93555) and Their Surrounding Area



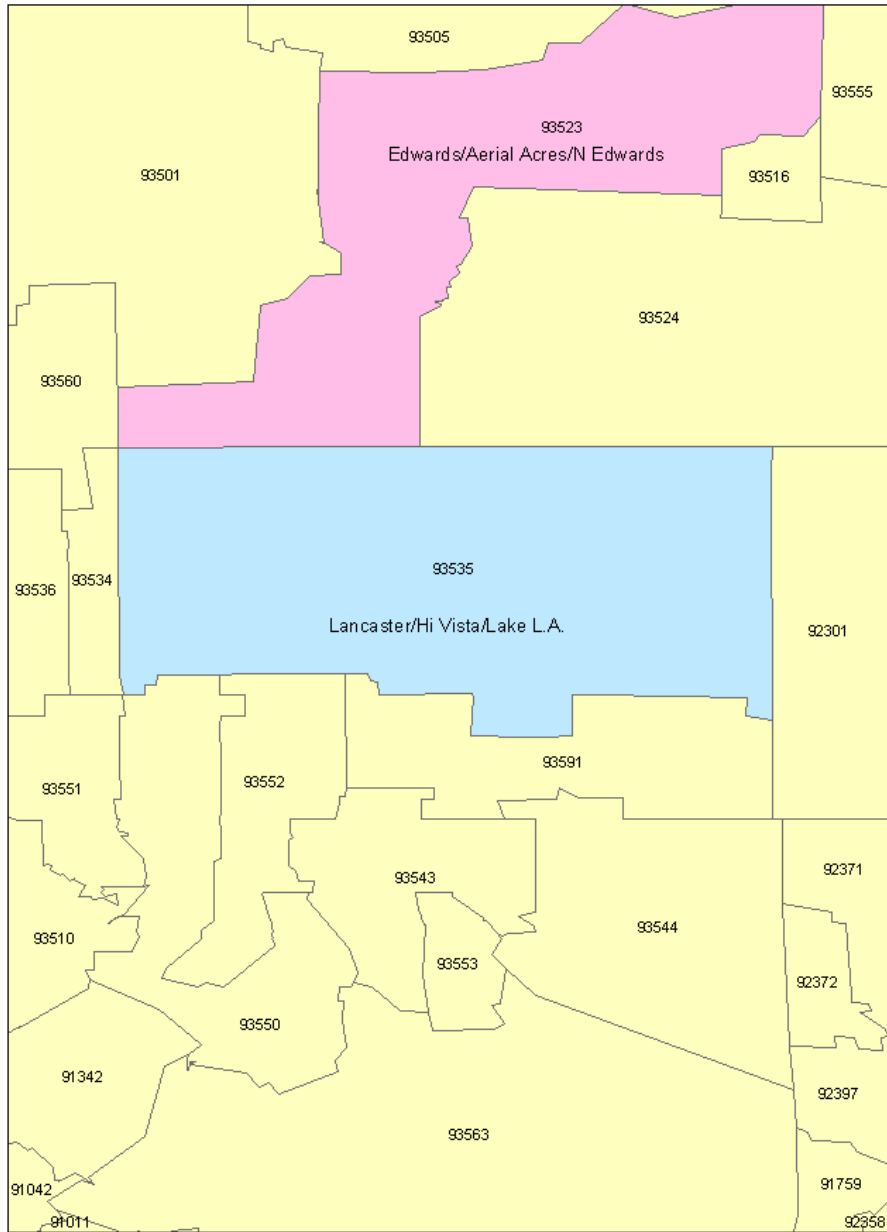
Map 2. Adjacent ZIP codes (93536, 93243) and Their Surrounding Area



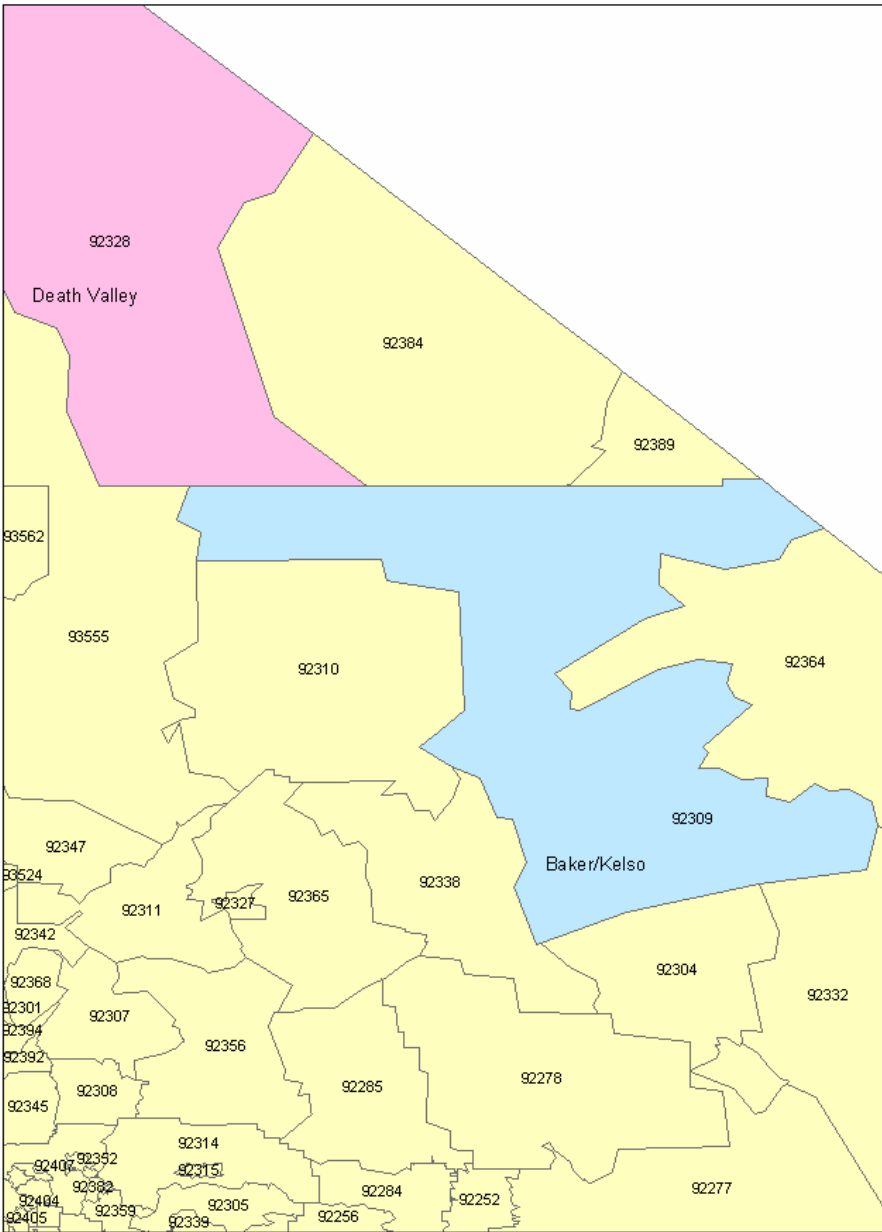
Map 3. Adjacent ZIPcodes (93534, 93523) and Their Surrounding Area



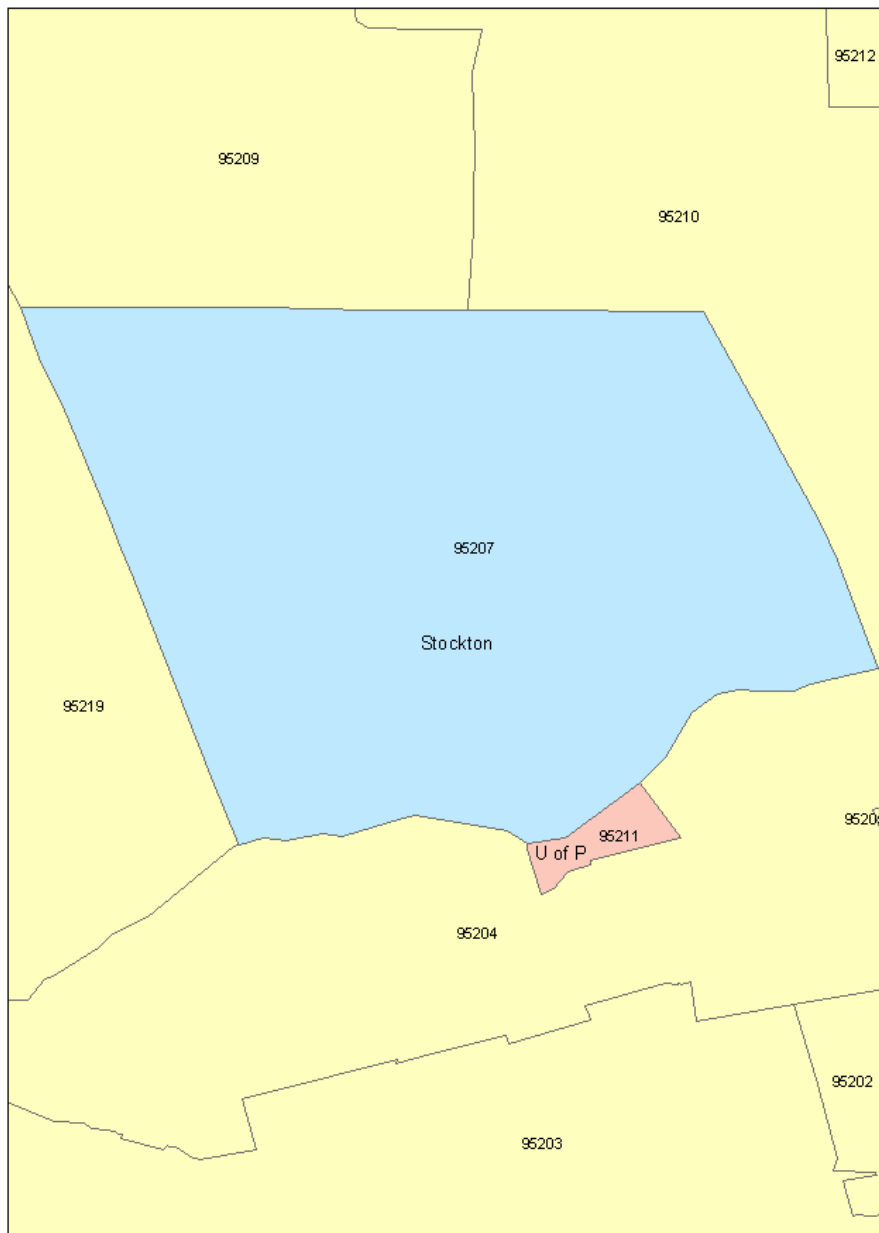
Map 4. Adjacent ZIPcodes (93535, 93523) and Their Surrounding Area



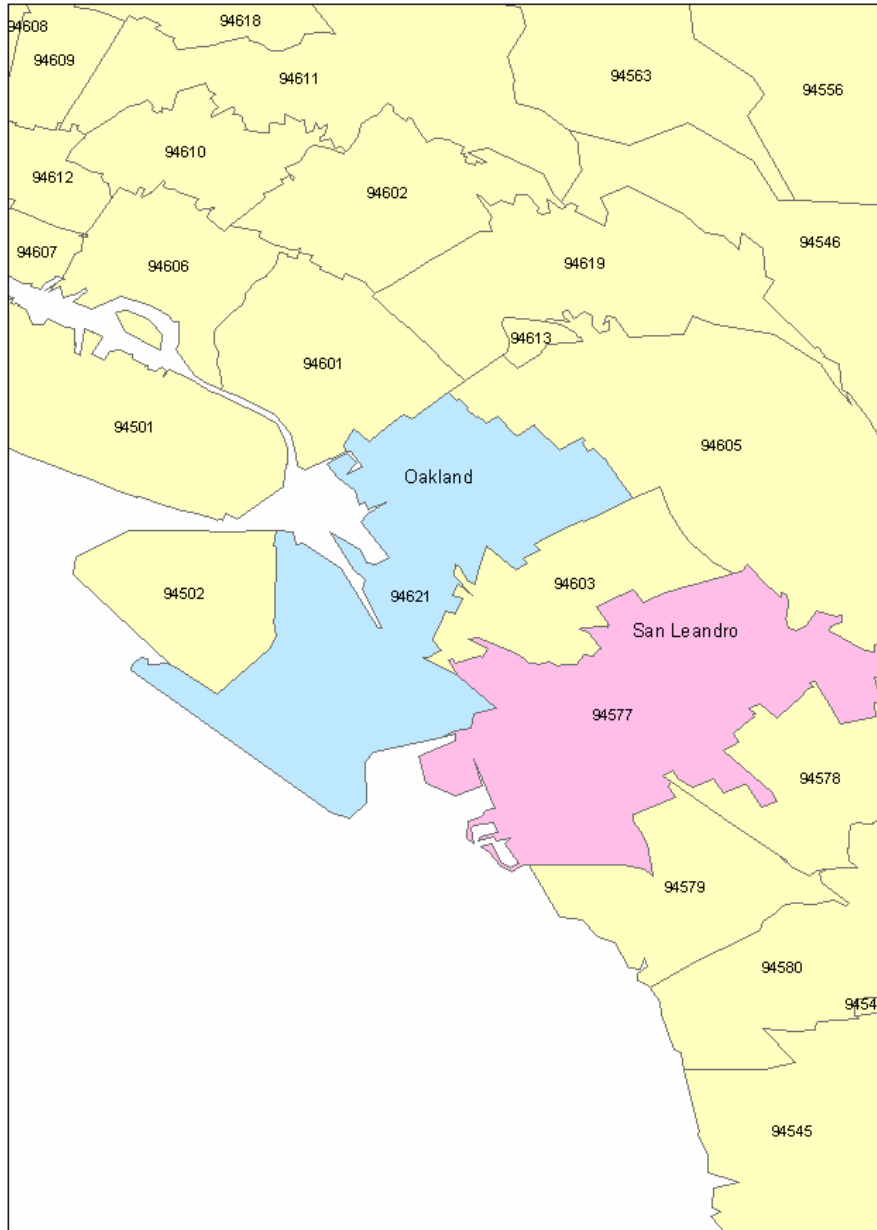
Map 5. Adjacent ZIPcodes (92309, 92328) and Their Surrounding Area



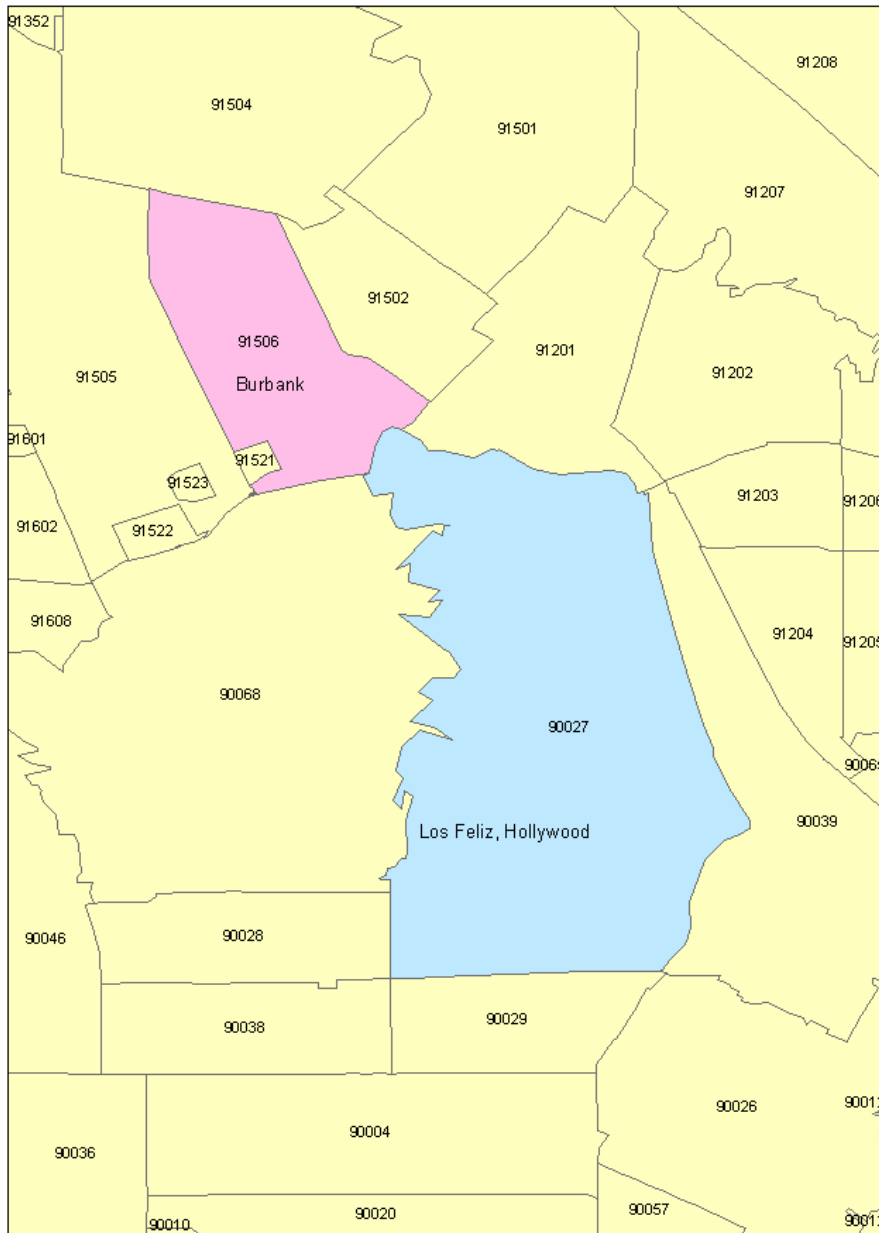
Map 6. Adjacent ZIPcodes (95207, 95211) and Their Surrounding Area



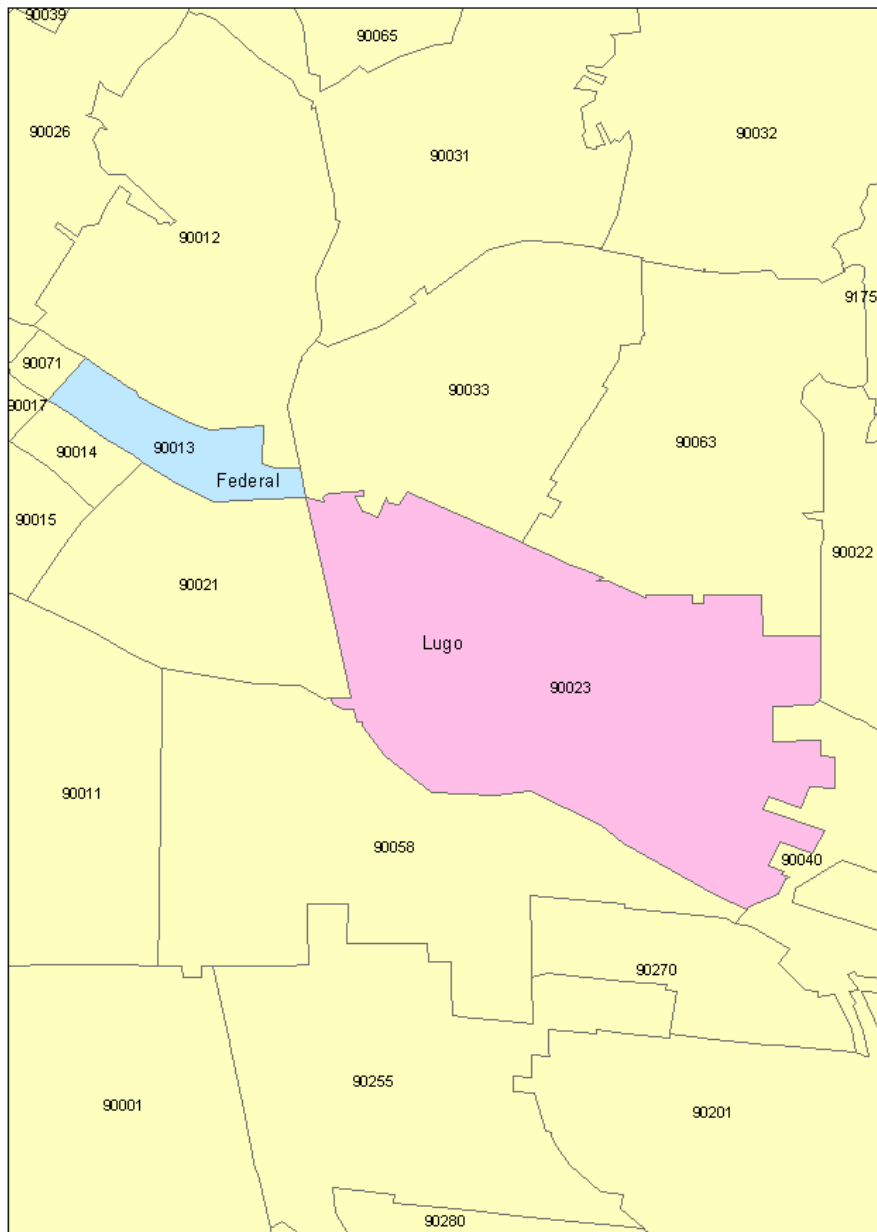
Map 7. Adjacent ZIPcodes (94621, 94577) and Their Surrounding Area



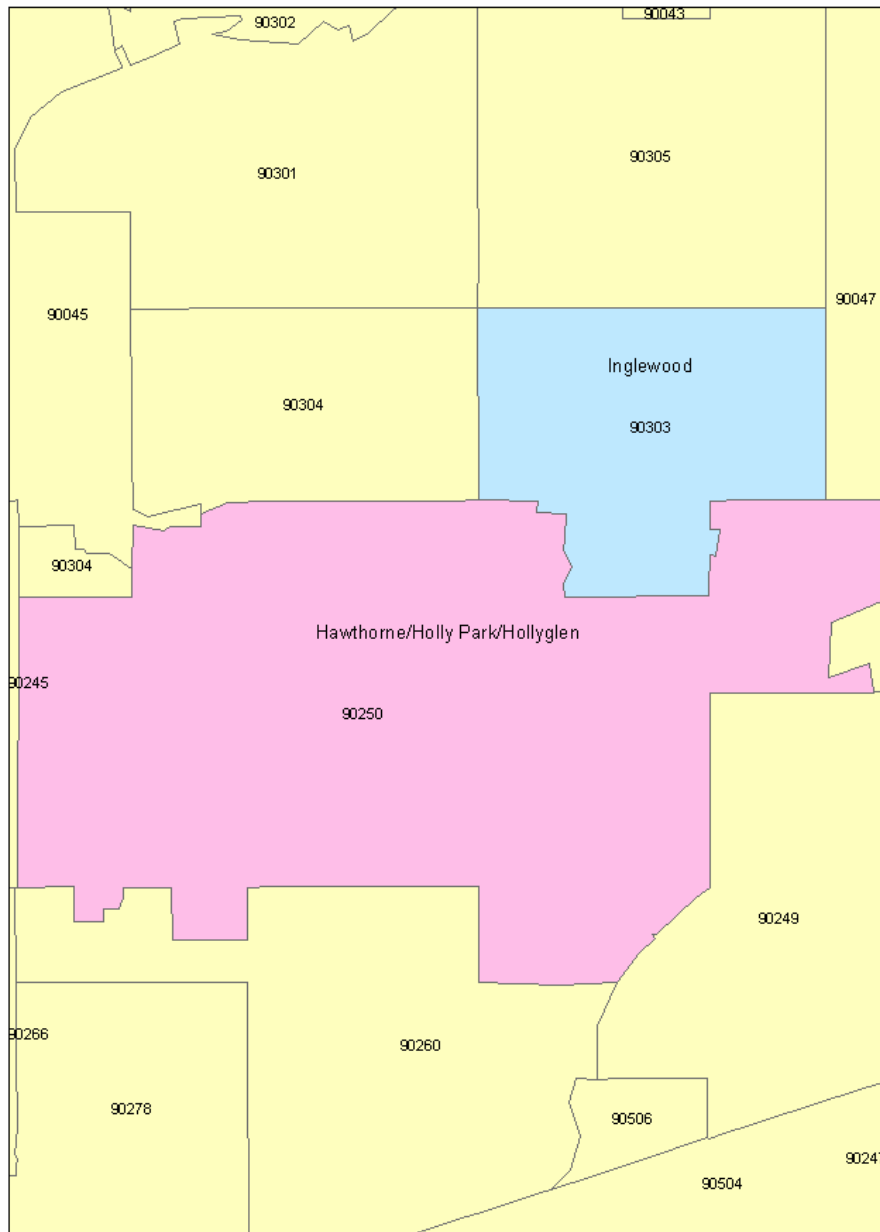
Map 8. Adjacent ZIPcodes (90027, 91506) and Their Surrounding Area



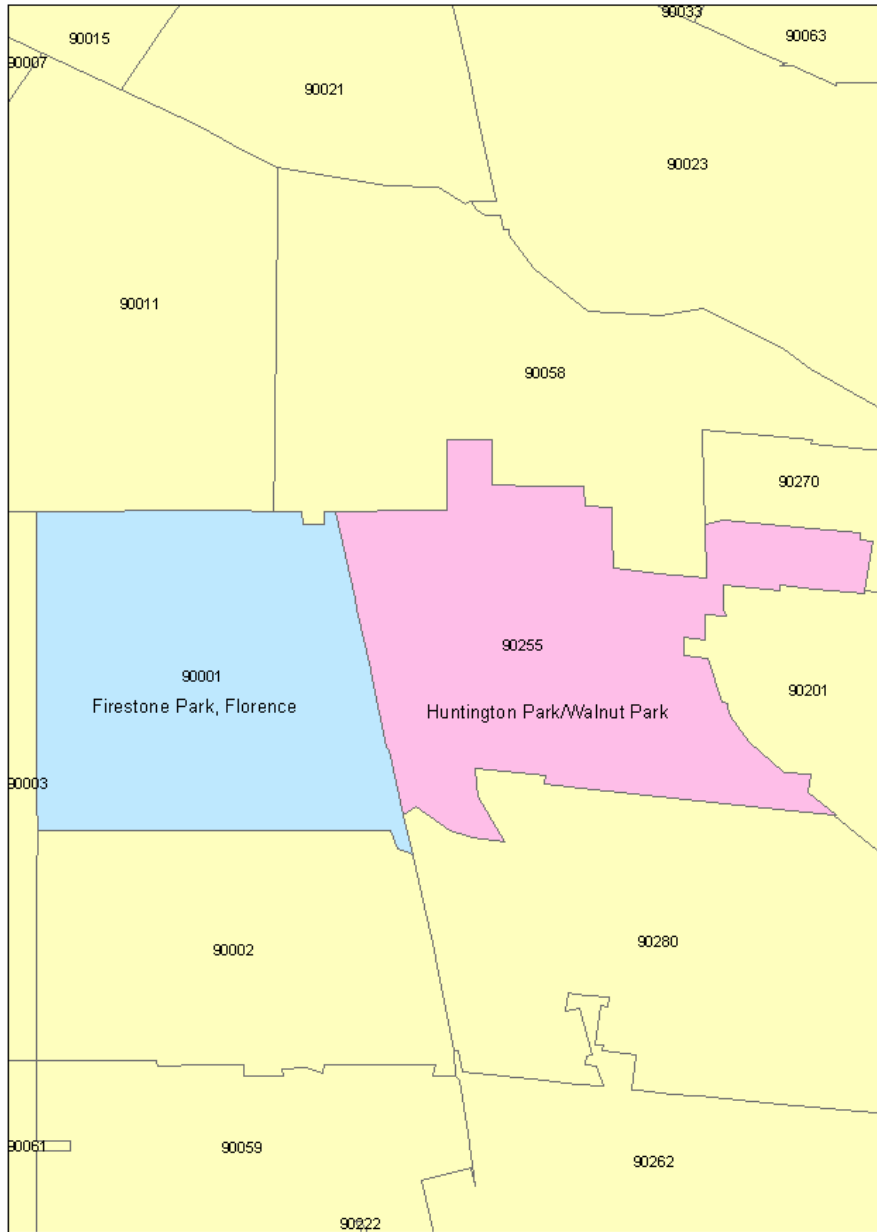
Map 9. Adjacent ZIPcodes (90013, 90023) and Their Surrounding Area



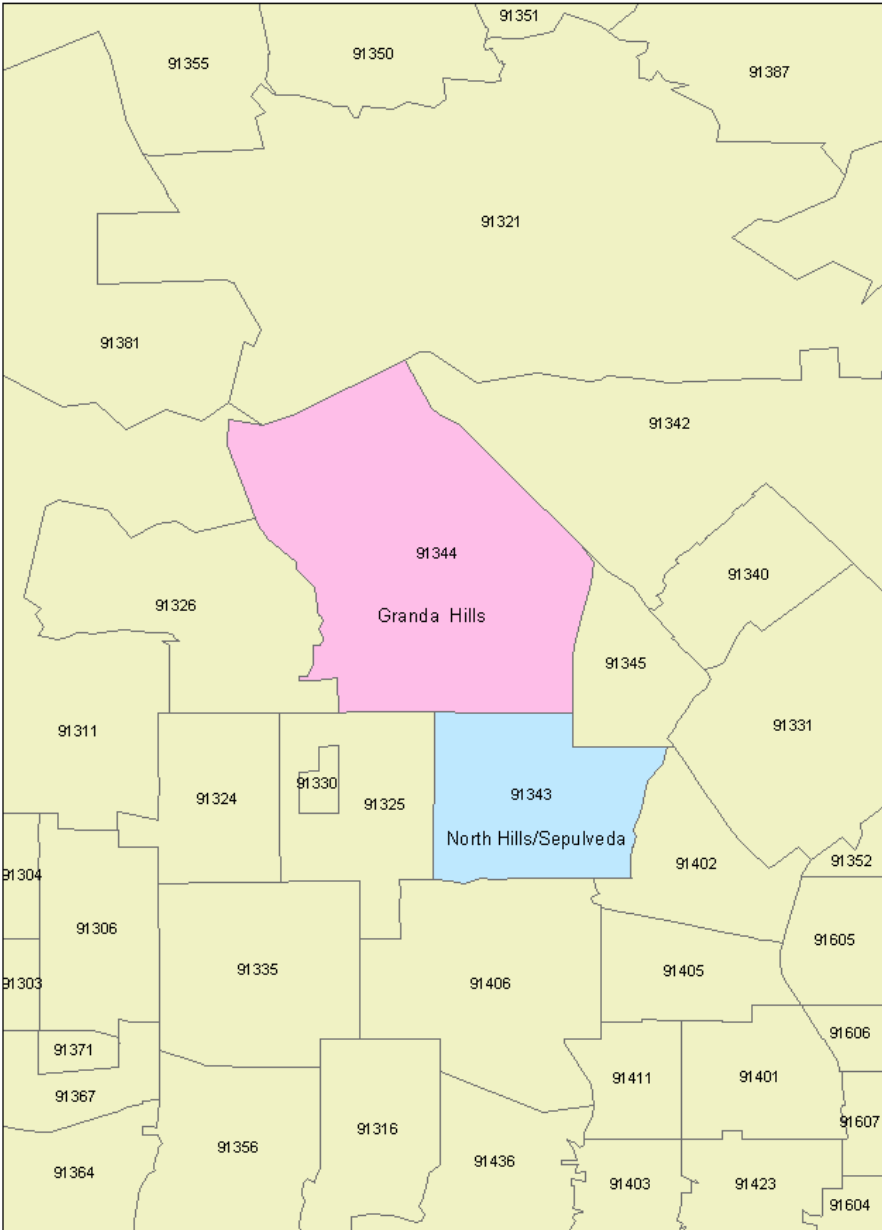
Map 10. Adjacent ZIPcodes (90303, 90250) and Their Surrounding Area



Map 11. Adjacent ZIPcodes (90001, 90255) and Their Surrounding Area



Map 12. Adjacent ZIPcodes (91343, 91344) and Their Surrounding Area



Map 13. Adjacent ZIPcodes (90304, 90045) and Their Surrounding Area

