The United States Postal Service's New Role: Territorial Ratemaking

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Abstract

For many years actuaries have recognized the importance of location as a major determinant of risk. Recently, new methodologies have been developed to better utilize geographic information systems (GIS) for territorial ratemaking. These new models generally require data assigned to a unit of geography (e.g., zip code, county, or latitude/longitude). Each unit of geography has specific advantages and disadvantages associated with it. A recent CAS survey verified zip codes are the most prevalent geographic unit used in the industry today. Unfortunately, zip codes possess a very undesirable characteristic: they are not static. This paper explores some of the issues that arise when creating, maintaining, and analyzing territorial boundaries and relativities based on zip codes.

I want to thank Robert Kane, Jason Martin, Chris Norman, and Joe Sterling. It was this small group that helped to identify the problems and to develop the solutions outlined in this paper.

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INTRODUCTION

For many years actuaries have recognized the importance of location as a major determinant of risk. In fact, according to a 1982 AIRAC study, territorial ratemaking dates back to the beginning of the twentieth century.[1] At first, the territories were selected based on limited data and a lot of judgement. Today data is more plentiful and many models have and are being developed to better analyze the data using the latest geographic information systems (GIS) technology.

In 1996 the CAS Ratemaking Call Paper Program produced two papers on territorial ratemaking: "Geographic Rating of Individual Risk Transfer Costs without Territorial Boundaries" by Randall Brubaker and "Using a Geographic Information System to Identify Territory Boundaries" by Debra Werland and Steven Christopherson. These papers helped bring territorial boundary ratemaking into the new GIS era.

Both of these models require data assigned to a unit of geography. Brubaker's model requires the most refined level of detail, latitude and longitude. His model uses the data to assign appropriate geographically-based rates to predetermined grid points. Interpolation of grid points is then used to determine the appropriate rate for a given location.[2] The Werland/Christopherson model assigns loss experience to zip codes. Due to credibility concerns, each of the zip code's loss experience is augmented with the data from nearby zips as necessary. Similar zip codes are then clustered to create territories.[3]

The aforementioned models utilize two of the units of geography being used today for territorial ratemaking. Reviews of rate filings and discussions with GIS specialists reveal a more comprehensive list of geographic units to which data can be assigned. The following choices are used individually or in combination: counties, cities/townships, zip codes (five- or nine-digit), census tracts, latitude/longitude, and areas bounded by visible markers such as streets, rivers, railroads, etc. Each of these units of areas has advantages and disadvantages. This paper will focus on the disadvantages of choosing a unit that changes over time. Specifically, the paper will focus on zip code changes as zip codes are commonly used and change more frequently than the other units. However, the comments apply to any unit susceptible to change.

GEOGRAPHIC RISK UNIT CONSIDERATIONS

There are a variety of considerations when deciding which geographic risk unit to use for territorial ratemaking:

- The unit must be small enough to be homogeneous with respect to geographic risk.
- It should be large enough to produce credible results.

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[1] Geographical Differences in Automobile Insurance, AIRAC, October, 1982.
[2] Brubaker, Randall E., "Geographic Rating of Individual Risk Transfer Without Territorial Boundaries," Casualty Actuarial Forum, Winter 1996.
[3] Christopherson, Stephen and Werland, Debra L., "Using a Geographic Information System to Identify Territory Boundaries," Casualty Actuarial Forum, Winter 1996.

- The collected premium and loss data should be easily assigned to the chosen unit.
- All competitive and/or external data should be easily mapped to it.
- It should be easy for the insured and company personnel to understand.
- The unit must be politically acceptable.
- The unit should be verifiable.
- It should not change over time.

While the paper will focus on the last criterion, Appendix A contains a short discussion about each one.

As Randall Brubaker pointed out in "Geo-coding Descriptions and Uses" latitude and longitude is the ideal as these geographical measurements are fixed (i.e., they only change if the tectonic plates shift and this is a relatively minor issue).[4] At this time, most companies do not carry that level of detail. While software is available that establishes the latitude and longitude given a street address, many actuaries may not have access to street addresses or the companies may not be able to expand their databases to carry the latitude and longitude.

The Winter 1997 Casualty Actuarial Society Forum included the results of the "1996 CAS Geo-coding Survey". Thirty-one percent of the respondents reported using geo-coded data for the definition of rating territories. When surveyed which type of geo-coded data was used for this purpose, zip code data was the most popular response. Unfortunately, as three of the respondents pointed out, zip codes can create problems because of their propensity to change.[5]

The actuary should keep in mind zip codes were created to be a label to aid in mail delivery. As zip codes were not intended to be used for data aggregation, there are issues that need to be resolved before using them for risk analysis. For example, some locations unrelated to risk can have a zip code (e.g., post office boxes), zip codes are not always easily mapped polygons, and zip codes can and do change. As mentioned previously, this paper will concentrate on the last problem. Zip codes are continually being added, deleted, and modified. And, these changes can take many forms; for example, an added zip code may include area from one existing zip code or may be formed from multiple existing zip codes. According to Joe Sterling, a GIS specialist at USAA, "any type of zip code change imaginable has probably already happened."

Unless the reader has worked extensively with location-based rating, the importance of these changes may not be obvious. There are two ways changes in the unit of area create problems: the rating of policies and data aggregation/future analysis. Remember, while the focus is on zip codes, the issues discussed apply to any geographic unit that is susceptible to change.

SETTING THE STAGE

The following is a very simplified example designed to illustrate the problems caused by zip code changes when the company defines territories using zips. This example will be used throughout the paper:

- A fictitious company defines rating territories solely by zip codes.

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[4] Brubaker, Randall E., " Geo-coding Descriptions and Uses," 1997 Call Paper Program on Data Management/Data Quality, Casualty Actuarial Society.

[5] "1996 CAS Geo-coding Survey," Casualty Actuarial Forum, Winter 1997.

- The company has the following boundaries in place as of 1/1/94 (Appendix B, Figure 1):
  Territory 1 is comprised of zip codes A and B.
  Territory 2 is comprised of zip codes C and D.
  Territory 3 is comprised of the remaining zip codes.
- Rates are set equivalent to the true pure premium. The following chart lists the premiums and exposures:

Territory	Zip Code	Exposures	Pure Premium	Premium
1	A	1,800	$ 550	$ 550
	B	2,000	$ 550	$ 550
2	C	750	$ 495	$ 495
	D	1,450	$ 495	$ 495
3	Remainder	30,000	$ 440	$ 440

- All policies are annual and written on 1/1 of 94, 95, 96, 97, and 98.
- All losses are incurred (and the ultimate is known) on 7/1 of 94, 95, 96, 97, and 98.
- Zip code C is expanded to encompass part of zip code B on 4/1/95 (Appendix B, Figure 2).

POLICY RATING & INADVERTENT RATE CHANGES

The Issue

Turning to the example, the policy rating issue associated with zip code changes arises on the third renewal (1/1/96). In between the second (1/1/95) and third renewal (1/1/96), part of zip code B changed to zip code C. Consequently, on the third renewal, insureds in that portion of zip code C that used to be in zip code B (marked with an X in Figure 2) receive a 10% decrease ($550 to $495) courtesy of the U.S. Postal Service. Fortunately, from a customer service standpoint, the premium went down. Unfortunately, unless zip code changes are formally monitored, the premium decrease could have occurred unbeknownst to the actuary (if a computer systematically assigns rates given a zip code).

The example shown arises when one zip code is expanded to include at least part of another zip code assigned to a different territory. As mentioned earlier, there are other types of zip code changes and those changes result in different problems.

Instead of the example, assume population shifts necessitated the creation of a new zip code. Consequently, the post office created zip code E. The new zip code was completely carved out of old zip code B (Appendix B, Figure 3). There are two potential outcomes depending on the true definition of Territory 3. If Territory 3 is truly stated as a default option and receives "all remaining zip codes", then this new zip code (which was never contemplated) falls under the Territory 3 definition. Consequently, exposures in that portion of zip code B which became zip code E receive a rate decrease of 20% ($550 to $440). On the other hand, if Territory 3 actually includes a specific list of all the remaining zip codes, there will not be a filed rate for the new zip code. The definitions must be modified to include the newly added zip code. Obviously, the new zip code should be assigned to the same territory as the zip code from which it was created (B), so that there is no premium impact. While this may appear to be an easy fix, keeping up with the changes and updating the manual can be an administrative problem.

Next, assume new zip code E was created from parts of B and C (Appendix B, Figure 4). Again, if Territory 3 is generically stated as "all remaining zip codes", then zip code E will be mapped to Territory 3 and the risks previously in B and C will see decreases of 20% ($550 to $440) and 11% ($495 to $440), respectively. However, if Territory 3 is defined by a specific list of all the remaining zip codes, then a filed rate will be unavailable. The definitions must be modified to include a reference to E. Unfortunately, zip code E includes areas previously in two different territories. Consequently, the company has one of three options. First, E can be assigned to Territory 1 and Y's rate will increase 11% from $495 to $550.[6] Second, E can be assigned to Territory 2 and X's rate will decrease from 10% from $550 to $495.[7] Finally, the company can establish a new territory and charge an average rate; consequently, both X and Y will see moderate changes in premium (X a decrease and Y an increase).[8]

Finally, assume a zip code was deleted. The fact the definitions still include a reference to a non-existent zip code appears to be a minor issue for rating. The major issue depends on how the zip codes were modified to cover the area previously in that zip code. This area could have been covered by the expansion of existing zip codes or the creation of new zip codes (or a combination of both). Each of these options represents a variation of one of the prior examples.

Solution

The main point of the discussion is that a company must monitor zip code changes. If the company fails to do so, in the best case, the changes will be modifications within an existing territory and there will be no policy rating implications. In the worst case, existing zips are expanded to include pieces of another territory or new zip codes are created including pieces of multiple territories. These situations could result in "hidden" rate changes explained previously.

If the company wishes to monitor zip code changes, updates are available from the U.S. Postal Service. The U.S. Postal Service produces the Postal Bulletin biweekly and the Zip Alert quarterly. Each of these documents outlines all of the upcoming zip code changes. The company could regularly review one of these publications to make informed decisions before the zip code change becomes effective. Unfortunately, the description of the change is not always clear and will require further investigation. For example, one entry in the July 1998 Zip Alert reads "Establish a new ZIP CODE for a delivery area. Use Shawnee OK 74804 as the last line of address for a portion of the deliveries previously in ZIP CODE 74801."[9] While it is clear that 74804 has been added, it will require more investigation to determine exactly which piece of 74801 74804 replaced. Additionally, there are rare instances when the changes are not published until after the change has occurred. At this time this monitoring is a manual process unless the company uses a data vendor to monitor the changes for them.

Current GIS technology provides a more efficient option for handling this dilemma. A company can "lock" the boundary definitions as of a particular point in time. Returning to our example, the wording

[6] Y was in the portion of zip code C that is now part of newly added zip code E.

[7] X was in the portion of zip code B that is now part of newly added zip code E.

[8] If deciding between a specific or generic definition of Territory 3, the specific definition appears to be the better choice (although, the ideal solution will be proposed in the next section). The con associated with this option is that there is not a filed rate for all new zip codes; however, the definitions can be amended. If the "generic definition" option is chosen, the actuary has maximized the probability of premium dislocation as all zip codes added outside Territory 3 create premium changes.

[9] ZIP Alert, United States Postal Service, Volume 8, No. 1, July 1998.

can be amended to read:

Territory 1 is comprised of the area within zip codes A and B as of January 1994.
Territory 2 is comprised of the area within zip codes C and D as of January 1994.
Territory 3 is comprised of the remainder of the state.

This note ties the boundary definitions to the zip codes as they appeared in 1994 and not to the current zip code definitions. In essence, this "locks-in" the boundaries until the company --not the U.S. Postal Service-- opts to change them.

When using this option, a company cannot rely solely on a table of zip codes for an agent or a computer to scan. Instead the company should utilize GIS software to digitize the boundaries (based on the zip code lines in place on the selected date). Basically, digitization amounts to translating the boundaries into a set of mapped polygons defined by latitude and longitude points. Then at policy inception or renewal, given the street address, the GIS technology can assign the correct latitude/longitude point and plot the house within the correct polygon (regardless of what the current zip code boundaries are). Thus, the area's predetermined rate will be charged. This approach has been filed and approved in several states.[10]

INTERNAL DATA COLLECTION AND FUTURE REVIEWS

The Issue

Zip code changes not only impact the rating of policies, but they can also impact data collection and, consequently, future analysis. It is not hard to imagine that if a company collects and summarizes data based on territories and/or zip codes, a zip code change will cause some data aggregation issues. And, subsequently, will cause distortions in any reviews based on that data.

Returning to the example in which zip code C expands to include a portion of B (Appendix B, Figure 2), Charts 1 and 2 (in Appendix C) show summarized premium and loss data, respectively. In an effort to make it easier to follow the charts, zip code B is notationally split into B and B' and zip code C is notationally split into C and C'. The apostrophe represents that area that is switching. In other words, on 4/1/95 a portion of zip code B, connoted B', becomes part of zip code C, connoted C' (so the B' and C' represent the same geographical area before and after 4/1/95, respectively).

The distortion occurs in 1995. At the beginning of the year, zip code B exists in its entirety (Appendix B, Figure 1) and the premium is coded accordingly. On 4/1/95 zip code C is expanded to include a portion of B (Appendix B, Figure 2). This occurs before the loss in the middle of the year is coded. Thus, 1995 data is distorted as the $550 of premium is coded in zip code B (in Territory 1), but the loss in zip code C (in Territory 1)[11].

It is easy to see how this overstates the profitability of zip code B at the expense of zip code C. This distortion is exacerbated by the extra $55 ($550-$495) of unfunded loss zip code C must absorb in 1996, 1997, and 1998 as the higher risk ($550) is now being included within the lower risk area at the cheaper rate of $495. This latter phenomenon adversely impacts the profitability of Territory 2.

[10] Adoption of this solution does compromise the understandability of the definitions. In other words, discrepancies between filed and actual zip codes can cause confusion for insureds, agents/policy service personnel, and regulators; although, it does seem like a worthwhile trade-off.

[11] This assumes the claims adjuster simply corrects the address (i.e., updates the zip code), but does not change the territory. Appendix D illustrates the case in which the adjuster changes both the zip code and the territory.

Impact on Territorial Relativity Reviews

If data is summarized on the territorial level, the data will only be impacted if the zip code changes alter the boundaries (as in our example). Zip code changes are most prevalent in areas where the population is shifting. Intuitively, one would expect these shifts to be in or around the cities where the territories are the smallest thus making it more likely the zip code change will alter a territory.

There is some good news. Because the territory was not updated on the loss database when the loss data was collected, there is no impact on the territory (Territory 1) that lost part of its exposures.[12] However, as mentioned previously, Territory 2 will be impacted by the inclusion of the unfunded $55 of loss by the higher risk insured being included at the lower rate level of Territory 2. Fortunately, as in our example, the effected portion of the zip will usually be a small piece of both the original and new territories; consequently, any distortion will probably be minor. In our example (Appendix C, Chart 3) the 250 exposures that switch represent 25% of new Territory 2. Assuming that distribution of exposures, the indicated relativities for Territory 2 were only slightly overstated (.91 versus .90). In fact, those differences are so minor they would likely be eliminated if the raw indicated relativities were credibility-weighted with the current relativities or some other form of supplemental data.

Impact on Territorial Boundary Reviews

On the other hand, if zip codes change (whether it is the addition, deletion, or modification of zip codes), data summarized at the zip code level will be impacted more significantly than the data summarized at the territory level. Of course, this statement assumes that the territories are, in general, made up of multiple zip codes.

Many of the boundary review procedures utilized today assign a measure of risk to a small geographic unit (usually involving zip codes). An obvious measure of risk to assign to the zip code is the indicated relativity. In our example (Appendix C, Chart 4), the indicated relativity for B was understated by 3% (.97 versus 1.00) and the indicated relativity for C was overstated by 8% (.97 versus .90). If the piece of B that moved to C represented more (or less) exposures than 12.5% of B or 25% of C, then the impact would have been larger (or smaller).

One important note, relativities calculated at the zip code level often lack the necessary credibility to warrant full weight. Consequently, the individual zip code relativities will often be weighted with the relativities of contiguous zips. Thus, the understatement of B would be somewhat offset by the overstatement of C in the credibility-weighting procedure. Furthermore, after the zip code's credibility-weighted indicated relativity is determined, zip codes are often clustered with like zips to determine a territory. To the extent the over- or understatement is small, the clustering could likely make the issue moot.

Solution

Does the solution proposed to fix the "rating problem" also fix this problem? The answer is yes and no. By locking in the boundaries as of a specific point in time, the actuary ensures the territorial boundaries will be fixed and all exposures will remain within the originally assigned territory regardless of any zip code changes. As zip code changes will not affect data summarized at the territorial level, this does solve the territorial relativity analysis problem!

[12] Of course, this simplified example assumes the same loss frequency and severity each year. If the years prior to the loss of exposures were significantly better (or worse) than the years after the loss, then a distortion could occur in Territory 1 also.

But no, it does not solve the issue of future boundary analysis. For the future boundary analysis, the actuary will need the data aggregated at the current zip code level to create appropriate boundaries using the most current zip codes.[13] Fortunately, there is a good solution for fixing the data for boundary analysis, too. If each of the historical records has fields populated with the street address or the correct latitude and longitude, then the actuary can use GIS software to map the historical records into the most current zip codes. Once this conversion is completed, the review can be resumed.

It is necessary to consider the situation in which the actuary does not have access to that level of detail. Fortunately--as we discovered in the prior section--the impact of changes in zip codes is probably minor; however, as stated in ASP No. 23 Data Quality, "The actuary may be aware that the data are incomplete, inaccurate, or not as appropriate as desired. In such cases, the actuary should consider whether the use of such imperfect data may produce material biases in the results of the study..."[14] To quantify the magnitude of the problem, the actuary must undergo a two-step approach. First, the actuary must identify the zip code additions, deletions, and modifications. Second, the actuary should determine whether the zip code changes would have a material impact on the analysis.

The U.S. Postal Service's Postal Bulletins and Zip Alerts represent the most accurate and complete list of changes. As mentioned earlier, the actuary can review the bulletins for the time period corresponding to the experience period to determine all of the zip code changes (with the exception of a few recent changes that may not yet be listed). This is an extremely labor-intensive process.

Without going to the U.S. Postal Service's publications, there is another much less desirable technique to identify the zip code changes that impacted a significant number of insureds. The actuary could obtain a list of current zip codes and produce a list of zip codes with the associated exposures for each of the individual years in the experience period. To identify added zip codes, the actuary should find current zip codes that do not show up in the earlier years of the experience period. To identify deleted zip codes, the actuary should find zip codes from the earlier years that do not show up in the current list of zip codes. To identify modified zip codes, the actuary should look for any zip codes that had unexplained material increases or decreases in exposures during the experience period. Looking at our example, zip code B had an unexplained 12.5% exposure decline (2,000 to 1,750) from 1995 to 1996. Further investigation uncovers the neighboring zip, C, increased by 250 exposures (33%) from 750 to 1000. By investigating the data in this manner, the actuary can not only hypothesize what type of change occurred, but can also probably determine when the change happened.[15]

Once all of the changes have been identified, the actuary should estimate the number of exposures impacted. If the number of exposures is material, then an adjustment should be attempted. The actuary should set an appropriate exposure cutoff based on a predetermined tolerance level. Scenario testing similar to the example included in this paper can help identify the different impact of zip code changes given varying levels of exposures. Additionally, the actuary should consider any further adjustments that will be made (e.g., credibility-weighting or clustering) that may further mitigate the distortion. Once the cutoff is established, the actuary can manually re-assign the old zip codes for all

[13] If the actuary wants to aggregate data into the original zip codes then the "locking-in" of boundaries technique could be used at the zip code level; however, it seems impractical to create new boundaries based on old zip codes.
[14] Actuarial Standard of Practice No. 23 Data Quality, Actuarial Standards Board, July 1993.
[15] Be forewarned this method will only uncover zip code changes that impact a significant number of insureds and really requires a stable growth environment. Unfortunately, zip codes changes seem to be most prevalent in areas where the population is not stable.

codes changes effecting more exposures than the cutoff. Once the zips are re-assigned, the review can resume.

EXTERNAL DATA

The Issue

The actuary will frequently use external data to supplement internal company loss data. Competitors' boundaries and relativities, traffic density statistics, and theft rates are examples of supplemental data currently being reviewed by actuaries when making location-based rating decisions. To be valuable for the purpose of location-based rating, this data must be assigned to some unit of geography. Most of the data used today is already summarized at the zip code, county, or census tract level.

Of course, this data is susceptible to changing definitions, too. For example, assume the actuary has Department of Transportation (DOT) data that summarizes the vehicles/square mile at the zip code level and wants to use a traffic density regression model to predict the frequency of a given zip code. If a zip code was newly created, it may not even be in the DOT data. If the actuary uses the unadjusted DOT data, the regression formula will produce a very low frequency, as the zip code will appear to have no exposures.

Similarly, competitive data can be impacted by changes in the units of geography. Referring back to the "policy rating" example, all companies are impacted by zip code changes. Assume the actuary is reviewing competitors' filed zip code-based boundaries similar to those listed earlier in the paper. If the boundaries are not recent and the U.S. Postal Service has changed zip codes in that area, the actuary may have difficulty determining where exactly the competitors' boundaries are. If zip code C is expanded to include part of zip code B (Appendix B, Figure 2), the actuary must decide if the new part of C is being charged Territory 1 or Territory 2 rates. Similarly, if zip code E is created from parts of zip codes B and C (Appendix B, Figure 4), the actuary must decide if zip code E has the rates applicable to Territory 1, 2, of 3.

In most cases this data is simply being used as supplemental data to aid in judgment decisions, and these unit changes will not have a material impact. If, however, the data is being used in formulae on a unit by unit basis, it may be more problematic (especially if the data does not have data from newly added zip codes).

The Solution

Competitive data is probably the most problematic as the actuary may not even be able to determine the applicable version of the geographic unit underlying the data. In other words, the actuary may not know (unless it is noted in the filing) whether a competitor is using the zip codes applicable in 1994 or 1995. Of course, the actuary can make an educated guess based on the date of the filing and can further narrow the choices by examining the boundary definitions for newly added zips (starting with the most recently added zip codes).

In today's world, the actuary can assume that external, non-insurance data is aggregated into the geographic units applicable to that time period. Thus, if the actuary is examining DOT traffic density data for 1994-1998, then the 1994 data is probably using zip codes applicable in 1994, the 1995 data is probably using the zip codes applicable in 1995, and so on.

If the zip code changes are minor and the data is not being directly plugged into a formula, the actuary can probably live with the unadjusted data. For example, the actuary should map the competitors' rates assuming the current zip codes. Barring a note on the competitors' manual pages to the contrary, this assumption should be correct.

If the actuary is using this data formulaically and there are significant zip code changes, he/she may want to try to cleanse the data. Presently, this appears to require a labor-intensive manual mapping. One other alternative is to combine the zip code data. The actuary can assign each zip code a value equivalent to the weighted-average of the values from that zip code and all of the contiguous zip codes. By including all of the contiguous zips, the actuary minimizes the impact of small changes in zip code boundaries. Turning to the example pictured in Figures 1 and 2 of Appendix B, all of zip code B and zip code C (as well as all other contiguous zip codes) will be included in the weighted-average. Therefore, it will not matter where the external data source maps that part of B that is switched to zip code C. Of course, this does diffuse the impact of a particular zip code's own information. The actuary must evaluate which course of action, if any, is best given the particular situation.

SUMMARY

As more and more companies acquire GIS technology and/or move away from traditional territorially-based rating, the issues associated with zip code (or any other geographic unit) changes will no longer be an issue. However, today many companies do not have the technology and are currently defining rating territories based on zip codes. Unfortunately, zip codes can and do change leading to problems for a company. If a company wants to continue to use zip codes, the actuary can choose two paths to handle these issues. He/she can laboriously track all zip code changes, regularly update the manual, and manually map all the data to perform future actuarial analysis. Alternatively, the company can acquire current GIS technology, capture the street address or latitude and longitude on each record, and "lock-in" all boundaries as of a date in time to systematically eliminate the adverse impact of the changes.

APPENDIX A

When attempting to perform boundary analysis, the actuary probably wants to assign a measure of risk to a small geographic unit. Similar small units can then be clustered to determine appropriate territories. The following is a comprehensive list of geographic units to which data can be assigned, these choices are used individually or in combination: counties, cities/townships, zip codes (five- or nine-digit), census tracts, latitude/longitude, and areas bounded by visible markers such as streets, rivers, railroads, etc. As mentioned in the paper, there are a variety of considerations when deciding which geographic risk unit to use:

- The building block must be small enough to be homogeneous with respect to geographic risk.
- The unit should be large enough to produce credible results.
- The collected company loss and premium data should be easily assigned to the chosen unit.
- All competitive and/or external data should be easily mapped to the geographical unit.
- It should be easy for the insured and company personnel to understand.
- The unit must be politically acceptable.
- The unit should be verifiable.
- The geographic unit should not change over time.

The building block must be refined enough to offer a homogenous group of risks with respect to geographic risk. A simple examination of counties around major cities indicate that county-level detail is probably not refined enough. Oftentimes these counties include both urban and suburban risks. Similarly, city-level detail is probably too heterogeneous for the major cities. Five-digit zip codes are probably the largest building blocks that will be acceptable to the actuary in most instances. The greatest common denominator of counties and zip codes, nine-digit zip codes, and census tracts are better choices. Of course, the use of latitude and longitude will allow the actuary to establish the risk unit as small as one location, thus ensuring homogeneity. The actuary can use statistical techniques (e.g., variance analysis) and/or judgement to decide which other units produce homogenous groups.

The building block should also be large enough to produce credible results. Clearly, this criterion represents a trade-off with the preceding criterion. To get around this issue, many actuaries have been using relatively small risk units and bolstering the credibility by using the data from contiguous risk units. The Brubaker[16] and Werland/Christopherson[17] methodologies both employ this type of approach.

The actuary must consider what data is available. If the insurer's databases are built such that the actuary's data is aggregated at the county level (and no further refinement is available), then the actuary may want to consider counties as an appropriate building block. Likewise, if the data is aggregated by zip codes, then zip code may be the most appropriate. If individual records with street addresses are available, then this becomes a non-issue as software is available that could map the data to any of the building blocks. Not surprisingly, the "1996 CAS Geo-coded Survey" indicates zip codes are the most common.[18]

If the actuary is going to use external, supplemental data, he/she must consider how to integrate the company experience with the external data. The two need not use the exact same geographic unit; however, one should be easily mapped to the other. For example, assume the company loss and

[16] Brubaker, Randall E., "Geographic Rating of Individual Risk Transfer Without Territorial Boundaries," Casualty Actuarial Forum, Winter 1996.
[17] Christopherson, Stephen and Werland, Debra L., "Using a Geographic Information System to Identify Territory Boundaries," Casualty Actuarial Forum, Winter 1996.
[18] "1996 CAS Geo-coding Survey," Casualty Actuarial Forum, Winter 1997.

premium experience is reported in zip code/county blocks and the external data is only available at the county level. The actuary can assign the value derived from the external data to each and every zip code/county block that makes up the county. A quick review of available data indicates that most external data is available at the five-digit zip code or county level. Thus, the greatest common denominator of counties and zip codes works well from this standpoint. Of course, latitude and longitude would allow the actuary to map any external data to the internal data.

As always, the unit must be politically acceptable. To date none of the aforementioned units appear to be unacceptable to regulators. Based on their widespread use, zip codes and counties are probably the most acceptable units. Zip codes are not only accepted in many states, but their use has even been mandated in at least two locations, California and Nebraska, for personal automobile insurance. However, early in 1998 the Washington Office of Insurance Commissioner drafted a regulation prohibiting insurers from raising rates solely because the U.S. Postal Service changes the insured's zip code.[19] Note the draft regulation did not prohibit insurers from using zip codes, it simply prohibited any increases due to zip code changes. After an initial inquiry, the Washington OIC decided not to pursue the regulation further, but we could witness similar rules in other locations.

It is always nice to utilize rating variables that are easily verifiable and easy for the insured to understand. Today's GIS software makes any of these units easily verifiable given the correct street address. Clearly, most insureds can recite the city, county, and/or zip code in which they live. On the other hand, most people are not conversant with the geographic units of latitude/longitude and census tract.

Finally, the units should not change over time. Political boundaries like zip codes and cities appear to be the worst from this standpoint. While counties are also political boundaries, they appear to be less susceptible to change than zips or cities. Census tracts change every ten years. For all practical purposes, latitude and longitude is impervious to change; consequently, it appears to be the superior choice from this standpoint.

[19] WAC 284-24-110 Effect of changes to zip code boundaries.

APPENDIX B

Figure 1: Boundaries as of 1/1/94

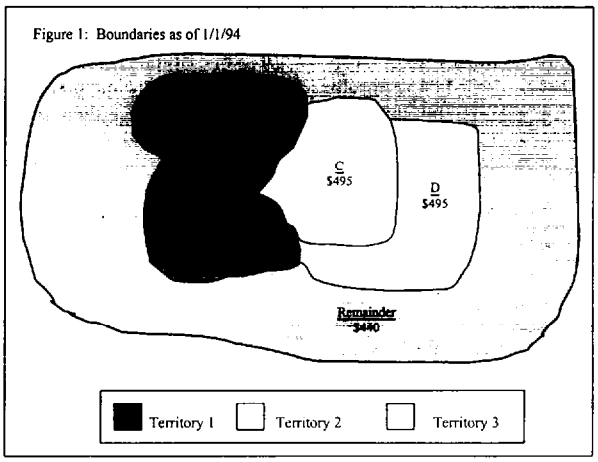
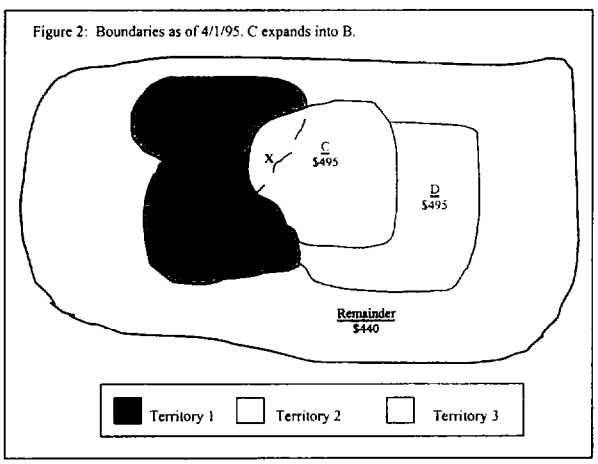
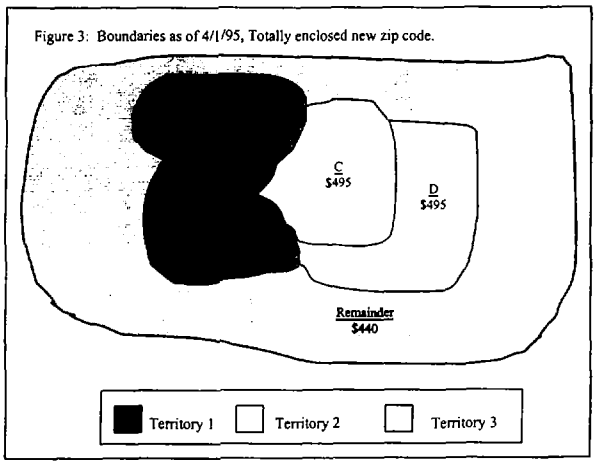
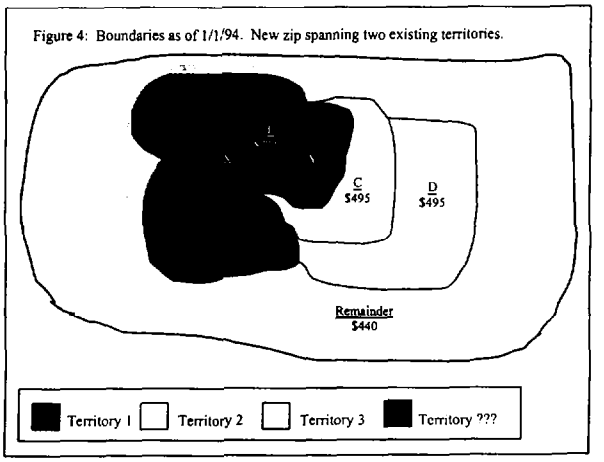


Figure 2: Boundaries as of 4/1/95. C expands into B.



APPENDIX B (Continued)





APPENDIX C

Chart 1
SUMMARIZATION OF PREMIUM

Date	Zip Code	Territory	Written Exposures	Written Premium	
1/1/94	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	Charged: $550
	B'	1	250	$ 137,500	
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/95	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	Charged: $550
	B'	1	250	$ 137,500	
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/96	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	Charged: $495
	C'	2	250	$ 123,750	
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/97	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	Charged: $495
	C'	2	250	$ 123,750	
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/98	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	Charged: $495
	C'	2	250	$ 123,750	
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
Total (By Zip Code)	A		9,000	$ 4,950,000	
	B		9,250	$ 5,087,500	
	C		4,500	$ 2,227,500	
	D		7,250	$ 3,588,750	
	Remainder		150,000	$66,000,000	
Total (By Territory)		1	18,250	$10,037,500	
		2	11,750	$ 5,816,250	
		3	150,000	$66,000,000	

Zip & Territory updated at 1st renewal after zip code change.

APPENDIX C (Continued)

Chart 2
SUMMARIZATION OF LOSSES

Date	Zip Code	Territory	Incurred Claims	Incurred Loss	
7/1/94	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	B'	1	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/95	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	1	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/96	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/97	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/98	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
Total (By Zip Code)	A		900	$ 4,950,000	
	B		900	$ 4,950,000	
	C		438	$ 2,406,250	
	D		653	$ 3,588,750	
	Remainder		12,000	$66,000,000	
Total (By Territory)		1	1,825	$10,037,500	
		2	1,065	$ 5,857,500	
		3	12,000	$66,000,000	

Zip updated at 1st loss date after zip code change.

Territory updated at 1st renewal after zip code change.

APPENDIX C (Continued)

Chart 3
TERRITORIAL ANALYSIS

Territory	Exposures	Premium	Incurred Loss	Loss Ratio	Current Relativity	Proposed Relativity	Over/(Under) Stated
1	18,250	$10,037,500	$10,037,500	1.00	1.00	1.00	0%
2	11,750	$ 5,816,250	$ 5,857,500	1.01	0.90	0.91	1%
3	150,000	$66,000,000	$66,000,000	1.00	0.80	0.80	0%
Total	180,000	$81,853,750	$81,895,000	1.00	0.83		

Chart 4
ZIP CODE ANALYSIS

Zip Code	Exposures	Premium	Incurred Loss	Loss Ratio	Current Relativity	Proposed Relativity	Over/(Under) Stated
A	9,000	$ 4,950,000	$ 4,950,000	1.00	1.00	1.00	0%
B	9,250	$ 5,087,500	$ 4,950,000	0.97	1.00	0.97	(3)%
C	4,500	$ 2,227,500	$ 2,406,250	1.08	0.90	0.97	8%
D	7,250	$ 3,588,750	$ 3,588,750	1.00	0.90	0.90	0%
Remainder	150,000	$66,000,000	$66,000,000	1.00	0.80	0.80	0%
Total	180,000	$81,853,750	$81,895,000	1.00	0.83		

APPENDIX D

Appendix C displayed the situation in which the address (i.e., zip code) was updated on the loss database at the time of the loss, but not the territory. Instead, assume that the territorial number is also changed on the loss database at the time of the loss, but the premium database is unaffected until the next renewal. This does not have any additional impact on the zip code analysis, but leads to a greater distortion in the territorial relativity analysis as the 1995 premium for the portion of zip code B that is switching is coded in Territory 1 and the loss is coded in Territory 2.

Chart 1
SUMMARIZATION OF PREMIUM

Date	Zip Code	Territory	Written Exposures	Written Premium	
1/1/94	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	
	B'	1	250	$ 137,500	Charged: $550
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/95	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	
	B'	1	250	$ 137,500	Charged: $550
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/96	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	
	C'	2	250	$ 123,750	Charged: $495
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/97	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	
	C'	2	250	$ 123,750	Charged: $495
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
1/1/98	A	1	1,800	$ 990,000	
	B	1	1,750	$ 962,500	
	C'	2	250	$ 123,750	Charged: $495
	C	2	750	$ 371,250	
	D	2	1,450	$ 717,750	
	Remainder	3	30,000	$13,200,000	
Total (By Zip Code)	A		9,000	$ 4,950,000	
	B		9,250	$ 5,087,500	
	C		4,500	$ 2,227,500	
	D		7,250	$ 3,588,750	
	Remainder		150,000	$66,000,000	
Total (By Territory)		1	18,250	$10,037,500	
		2	11,750	$ 5,816,250	
		3	150,000	$66,000,000	

Zip & Territory updated at 1st renewal after zip code change.

APPENDIX D (Continued)

Chart 2
SUMMARIZATION OF LOSSES

Date	Zip Code	Territory	Incurred Claims	Incurred Loss	
7/1/94	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	B'	1	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/95	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/96	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/97	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
7/1/98	A	1	180	$ 990,000	
	B	1	175	$ 962,500	
	C'	2	25	$ 137,500	Loss: $550
	C	2	68	$ 371,250	
	D	2	131	$ 717,750	
	Remainder	3	2,400	$13,200,000	
Total (By Zip Code)	A		900	$ 4,950,000	
	B		900	$ 4,950,000	
	C		438	$ 2,406,250	
	D		653	$ 3,588,750	
	Remainder		12,000	$66,000,000	
Total (By Territory)		1	1,800	$ 9,900,000	
		2	1,090	$ 5,995,000	
		3	12,000	$66,000,000	

Zip & Territory updated at 1st loss date after zip code change.

APPENDIX D (Continued)

Chart 3
TERRITORIAL RELATIVITY ANALYSIS

Territory	Exposures	Premium	Incurred Loss	Loss Ratio	Current Relativity	Proposed Relativity	Over/(Under) Stated
1	18,250	$10,037,500	$ 9,900,000	0.99	1.00	0.99	(1)%
2	11,750	$ 5,816,250	$ 5,995,000	1.03	0.90	0.93	3%
3	150,000	$66,000,000	$66,000,000	1.00	0.80	0.80	0%
Total	180,000	$81,853,750	$81,895,000	1.00	0.83		

Chart 4
ZIP COPE ANALYSIS

Zip. Code	Exposures	Premium	Incurred Loss	Loss Ratio	Current Relativity	Proposed Relativity	Over/(Under) Stated
A	9,000	$ 4,950,000	$ 4,950,000	1.00	1.00	1.00	0%
B	9,250	$ 5,087,500	$ 4,950,000	0.97	1.00	0.97	(3)%
C	4,500	$ 2,227,500	$ 2,406,250	1.08	0.90	0.97	8%
D	7,250	$ 3,588,750	$ 3,588,750	1.00	0.90	0.90	0%
Remainder	150,000	$66,000,000	$66,000,000	1.00	0.80	0.80	0%
Total	180,000	$81,853,750	$81,895,000	1.00	0.83		