A GLM-Based Approach to Adjusting for Changes in Case Reserve Adequacy

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Abstract
This paper will address adjusting incurred loss triangles for changes in case reserve adequacy. This proposal is an attempt to improve upon the traditional Berquist-Sherman Method by using a generalized linear model of case reserves as the basis for restating case reserves at earlier evaluations rather than using average case reserves as the basis.

Keywords: Case reserve adequacy; generalized linear modeling; reserving; reserve strengthening

1. INTRODUCTION

This paper describes a method for adjusting incurred loss triangles for changes in case reserve adequacy using a Generalized Linear Model (GLM). In a similar fashion to the Berquist-Sherman method for adjusting case reserves (BSM), this method restates case reserves at prior evaluations based on the case reserves of the most recent evaluation. Instead of simply using the average case reserves of the most recent evaluation of a column to represent current claims handling practice as the BSM does, this method uses a generalized linear model of reserves using all open claims at the most recent evaluation. The individual case reserve by claim at the most recent evaluation is the dependent variable and various characteristics of each claim are the independent variables for the GLM. Independent variables could be any variable that could be associated with a claim such as claimant age, geographic region, pricing variables from the associated policy, etc.

The resulting GLM is understood to be a model of current claims handling practice. Once developed, the GLM is applied to all individual open claims at current and prior evaluations to restate their reserves to what they would be under the current practice. These restated reserves are then aggregated and added to the corresponding paid losses at each evaluation in order to create the restated loss incurred triangle. At this point typical loss development methods can be applied.

1.1 Objective

This method has several advantages over the BSM:

In practice the application of the BSM often results in loss development patterns that are "wavy" with alternating large jumps and drops. This is due to variation in average claim reserves by accident year. In any given column of the triangle, if the most recent point is from an accident year that by chance has types of claims with higher reserves, the whole column will be restated at a high level using this most recent point as the basis. The converse would be true for a column where the most recent point is from an accident year with low reserves. The alternation of columns with high and low restated reserves across the triangle creates the "wavy" effect. It can be difficult to select a smooth loss development pattern under this scenario.

In the proposed method, the reserves for each accident year and evaluation in the triangle are restated using the characteristics of the claims open for that accident year at that evaluation. This is an improvement in accuracy compared to using one accident year with potentially different claim characteristics to restate the reserves of a different accident year. An accident year with types of claims with higher reserves will typically have higher reserves in every column. This leads to consistency across each accident year row of the triangle, eliminating the "wavy" effect.

In the BSM, for each of the points in a given column of the triangle, the average reserves of the most recent accident year in that column is the only source for information to represent the level of case reserves under the current claims handling practice. By applying the GLM, the proposed method uses information from all of the open claims in all columns at the most recent evaluation.

The exercise of developing the GLM for case reserves at the current evaluation increases understanding of the drivers of case reserve levels. If certain characteristics lead to higher case reserve levels, there is potential for the claims department to target claims with those characteristics in order to mitigate losses. The results of the model can also suggest changes to be made to rates.

1.2 Outline

The remainder of the paper proceeds as follows. Section 2 will describe in more detail the steps of the GLM based method. An example of the method using simulated data will be provided in Section 3. Also in Section 3, the BSM will be applied to the same data in order to compare the two methods.

2. STEPS OF THE GLM-BASED METHOD

2.1 Data Collection

Three sets of data need to be created:

Paid Losses

Paid losses will be needed to add to the restated case reserves in order to create the incurred loss triangle. The paid losses can be aggregated as a paid loss triangle. Individual claim detail is not necessary unless partial paid losses for individual claims are used as one of the independent variables.

Earlier Evaluation Points

The data required to restate the triangle once the GLM is created includes the independent variables for every claim that was ever open at an evaluation date included in the loss development triangle. This data set should include a record for each open claim and evaluation date. The independent variables listed in each record should be what they were as of the evaluation date for that record. For each such claim, it would also be helpful to have the historical case reserve to assist in testing the GLM. Time-sensitive variables, such as claimant age at the evaluation date, should be recalculated for each prior evaluation date.

Most Recent Evaluation Point

The data required to create the GLM include the case reserve and any characteristics to be used as independent variables for every claim open as of the most recent evaluation period (latest "diagonal"). As mentioned above, independent variables could be any variables that could be associated with a claim such as claimant age, geographic region, pricing variables from the associated policy, etc. In lines of business with partial payments, paid losses may also be a helpful variable. Care must be taken to choose characteristics that are available for open claims at prior evaluation dates. This data set should include a record for each claim open as of the most recent evaluation period.

2.2 Create the GLM

Use the data set from the most recent evaluation point mentioned in Section 2.1 above to create a GLM using case reserves as the dependent variable and the characteristics selected to be the independent variables. In-depth instruction regarding the creation of GLMs is beyond the scope of this paper. Two excellent resources for those desiring a better understanding of GLMs can be found in the references section. For "hands on" instruction, the CAS Predictive Modeling Limited Attendance Seminar is highly recommended.

2.3 Use the GLM to Restate Historical Case Reserves by Claim

Apply the GLM created in Section 2.2 to the second data set from Section 2.1 to restate the case reserves for all of the claims that were open during any of the evaluation dates in the triangle. If accident year and/or age of claim are used as independent variables, inflation trend may be reflected in the model. In this case, the selection of a separate trend factor and de-trending may not be required.

If the actual case reserves for each open claim at each evaluation are available, compare them to the restated case reserves. Differences should make sense based on conversations with claims management regarding why the case reserve adequacy has changed. Claims with large unexplained differences should be scrutinized in the claims system in order to discover similarities between them that may lead to potential new independent variables for the GLM. If found, they can be used to enhance the GLM and reduce the differences.

It is possible that the new independent variables found cannot be successfully added to the GLM if they cannot pass testing for significance. In this case, the actual historical case reserve may be a better representation of the claim than the restated modeled case reserves and should be substituted as the restated case reserve. This is especially true if discussions with claims management indicate that the causes of change in the level of case reserve adequacy do not apply to these claims.

One situation that may arise is that there are claims that have been settled with payment, yet remain open with a small case reserve for follow-up items such as legal expenses, unpaid medical bills not part of the settlement, etc. The model may generate a large case reserve on these claims based on their characteristics. If settled claims can be identified, an attempt should be made to add a settlement variable to the GLM. If this attempt is unsuccessful, it is best to leave them at the actual case reserve rather than using the modeled reserve.

2.4 Create the Restated Incurred Loss Development Triangle

Sum the restated case reserves from Section 2.3 by accident year and age to create a restated case reserve triangle. Add these to the paid loss triangle from Section 2.1 to create the restated case incurred triangle. This triangle can now be used for typical loss development methods.

3. EXAMPLE OF THE GLM-BASED METHOD

3.1 Overview

The example provided below is intended to illustrate the steps of the GLM based method and is somewhat simple for the sake of brevity. It is not intended to prove the superiority of the proposed method over the BSM, but simply to disclose the new method.

3.2 Creation of Simulated Data

The data for this example was created using the CAS Public Loss Simulator Model (CASPLSM). This model is publicly available software that can be used for the simulation of loss data. More information on this model can be found at http://www.casact.org/research/lsmwp/lossinstruct/index.cfm?fa=main. The data was completely fabricated to represent a generic line of business. The parameters discussed below were not based on any empirical data. The only rationale for the selection of these parameters is to simply provide simulated data that looks as realistic as possible. Data was simulated for accident years 2000 – 2009 with annual evaluations. Each claim had the following characteristics used as independent variables: Injury, Gender, and Claimant Age at time of accident. Injury includes the following levels: Back, Burn, Spinal Cord, and Other. For accident year 2000 the average severities selected for these injury types were:

Back	200
Burn	100
Spinal Cord	500
Other	50

For subsequent accident years, a 5% inflation trend was applied. These severities were adjusted by the following relativities for Gender and Claimant Age:

Male	0.80
Female	1.20
Age Under 16	0.50

Age 16-25	0.75
Age 26-45	1.00
Age 46-65	1.50
Age 66 and Over	2.00

For each accident year there are 40 different combinations of Injury, Gender, and Claimant Age, resulting in 40 different expected severities. These severities were used to create parameters for the CASPLSM in combination with the following coefficients of variation by injury:

Back	2.0
Burn	0.5
Spinal Cord	2.0
Other	1.0

Gamma distributions were used for simulating size of loss in the CASPLSM simulations, which require shape and scale parameters. The shape parameter is calculated as the reciprocal of the square of the coefficient of variation. The scale parameter is the expected severity divided by the shape parameter.

For accident year 2000, mean claim counts were randomly assigned to each of the 40 claim types with an expected total number of claims of 600. This number was selected in consideration of finding a balance between having enough data to create an analysis and keeping the simulated data small enough to be manageable. For subsequent accident years the total number of claims was increased using a 10% growth rate (e.g., 660 for 2001, 726 for 2002). The resulting mean claim counts were used as parameters for the Poisson distributions used for frequency in the CASPLSM simulations.

The CASPLSM includes specification of parameters for setting the level of case reserve adequacy. Two simulations were run for each accident year, one with a lower level of case reserve adequacy and one with a higher level of case reserve adequacy. Output from the CASPLSM includes transaction level detail of when payments were made and case reserves were changed. This output was consolidated by claim and evaluation date (12/31/2000 through 12/31/2009) to create the data used in the example. For evaluations 12/31/2000 through 12/31/2008, the output from the simulations with a lower level of case reserve adequacy were used. For the 12/31/2009 evaluation, the simulations with a higher level of case reserve adequacy were used (thus creating the change in adequacy that is the subject of this paper).

The GLM modeling is done in R. R is a free software environment for statistical computing and graphics that is gaining wide use among actuaries. R was used in order to allow anyone to step through the GLM used in the example. R is readily available for download from http://www.r-project.org. For those unfamiliar with R, a good place to start is the "An Introduction to R" paper in the "Manuals" section of the above website. The Casualty Actuarial Society Open-Source Software Committee maintains a website, http://opensourcesoftware.casact.org, with some useful resources for R. Also, the CAS Predictive Modeling Limited Attendance Seminar provides a "hands-on" opportunity for using R and assumes no previous R experience. See Appendix A for the R code that created the GLM used in this paper.

3.3 Electronic Files Provided

- 2009 Open Claims.csv: Claim detail for all open claims as of 12/31/2009. This is the data set for the most recent evaluation point described in Section 2.1.
- All Open Claims.csv: Claim detail for all open claims as of all evaluations. This is the data set for earlier evaluation points described in Section 2.1 above.
- call_paper_script.R: This is the R script used to create the GLM from "2009 Open Claims.csv" and apply it to the data in "All Open Claims.csv" in order to restate the case reserves.
- Restated Claims.csv: This file has the restated case reserves generated by "call_paper_script.R". This is one column of numbers with an entry for each record in "All Open Claims.csv".
- Exhibits.xls: This Excel workbook uses the raw data and the restated reserves to create the restated case incurred triangle and results for the GLM method. The restated case incurred triangle and results for the BSM are also created in this file. This file has the following tabs:
    - Exhibits: This tab includes the paid loss triangle, reserves and development factors generated by the GLM Method, and the calculations and development factors derived

for the same claim data set using the BSM formatted for printing as (Appendix B).

- WORK: This tab includes the work to support the Exhibits tab.
- All Data Table: This tab includes all paid losses and case reserves by claim for all evaluations. This tab is the source for the paid loss triangle mentioned in Step 2.1.
- All Open and Restated Reserves: This tab includes the data from "All Open Claims.csv" in columns A thru M. Column N has the restated reserves from "Restated Claims.csv".

3.4 Applying the Steps

Step 2.1 has already been completed by the provision of the electronic files mentioned above. Steps 2.2 and 2.3 are completed in R using the commands in the "call_paper_script.R" file. This script uses the files "2009 Open Claims.csv" and "All Open Claims.csv" as inputs and creates the file "Restated Claims.csv." A detailed description of each of the commands in this script is provided in Appendix A. As indicated in Section 2.2, in depth instruction on the creation of GLMs is beyond the scope of this paper. However, it is worth mentioning some important steps in a typical GLM process that were omitted to keep the example simple. These include:

- Initial review of potential independent variables for inclusion in the model. There are often a large number of potential independent variables that must be limited to a manageable number for modeling. An initial step is often performing "one-way" analyses on potential independent variables.
- Creating hold out samples from the data for the purpose of testing the model.
- Testing the independent variables for significance.
- Performing analysis of the residuals and other model diagnostics in order to determine the appropriateness of the model.

Step 2.4 is completed in the Exhibits.xls file. The data from "All Open Claims.csv" is copied into the "All Open and Restated Reserves" tab and the restated reserves from "Restated Claims.csv" are copied into the same tab. The first pivot table in the WORK tab is the paid loss triangle created from the data in the "All Data Table" tab. The second pivot table is the triangle of case reserves restated from the GLM method. These two triangles are added together to create the restated incurred loss triangle.

This triangle is now used to create report to report factors based on weighted averages. The tail factor used was calculated by dividing the actual ultimate losses for accident year 2000 obtained from the simulation process by the case incurred losses for accident year 2000. The resulting report to ultimate factors are applied to actual case incurred losses to calculate ultimate losses by accident year. The paid loss, restated reserve, and restated incurred triangles are shown on Page 1 of Appendix B along with the calculations used to arrive at an estimate of ultimate losses.

3.5 Calculation of the Berquist-Sherman Method

Appendix B Pages 2 and 3 show the calculations for the BSM. On Page 2 the average case reserves are calculated and a trend factor of 1.05 selected. On Page 3 average case reserves are restated by de-trending the average case reserves for the latest diagonal. These average case reserves are then multiplied by the open claims and added to paid losses to create the restated incurred loss triangle. This triangle is now used to create report to report factors based on weighted average. The tail factor is the same as the one used for the GLM method. The resulting report to ultimate factors are applied to case incurred losses to calculate an estimate of ultimate losses by accident year.

4. RESULTS AND DISCUSSION

The results of the proposed GLM method and the BSM can be compared in Appendix B. Rows labeled "Actual Ultimate" and "Actual RTRs" are included in Appendix B and, due to the process used for simulating the data, the ultimate losses are known. The actual RTR factors are weighted averages calculated based on a triangle created by using the simulations with a higher level of case reserve adequacy for all evaluations. The GLM method can be observed to provide ultimate losses and RTRs that are closer to the actual values than the BSM method. This is not necessarily a fair comparison since the independent variables used in the GLM model were also used in the creation of the simulated data.

However, examination of the BSM example illustrates the "wavy" effect described in the introduction. In particular, there is a huge drop in RTR factors at age 5 and a jump at age 6. In comparing accident year 2004 average case reserves for ages 1 to 5 to other accident years, it is clear that 2004 is a "good" year with claims that have relatively lower severity than other years. In the BSM the average case reserve for 2004 at age 6 is the basis for the estimates of the average case reserves for all of the prior years at age 6. This causes the restated losses for these prior years to be understated leading to a drop in the RTR at age 5 and a jump in the RTR at age 6. This shows a weakness in the BSM, as it assumes the same mix of claim characteristics for all accident years.

The "wavy" effect is not observed with the proposed GLM method because it reflects variation of claim characteristics by accident year, assuming predictive claim characteristics can be found and incorporated into the GLM as independent variables.

It should be noted that the use of accident year as an independent variable in the GLM method accounted for the inflation trend in the data. In this case, the selection of a separate trend factor was unnecessary.

5. CONCLUSIONS

The GLM method proposed in this paper offers a new approach to adjusting loss development triangles for a change in case reserve adequacy. In cases where detailed claim and claimant information is available for evaluation points at current and historical periods, this approach may offer a significant improvement over the BSM.

For high frequency, low severity lines of business, the proposed method should work well, since enough data should be available in order to create an accurate GLM. On the other hand, the GLM method may not produce a significant improvement over the BSM, since the weaknesses inherent in the BSM are not as pronounced in these lines. There is less variation in average claim reserves by accident year and the latest accident year in a given column of the triangle is more likely to be representative of prior accident years.

For low frequency, high severity lines of business, it may be more challenging to create an accurate GLM due to the limited amount of data. However, for these lines the GLM method offers the most opportunity for improvement over the BSM due to the increased variation in average claim reserves by accident year.

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Supplementary Material

See section 3.2

Appendix A

Appendix A includes the R script used for this paper.

Appendix B

Appendix B includes the calculations described in Section 3.

6. REFERENCES

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Abbreviations and notations

BSM, Berquist-Sherman method for adjusting case reserves
GLM, generalized linear models
RTR, Report to Report
CAS, Casualty Actuarial Society
CASPLSM, CAS Public Loss Simulator Model

Biography of the Author

Larry Decker is a senior actuarial analyst at Midwest Employers Casualty Company. His duties include modeling and support for reserving. Prior to joining Midwest Employers in 2005 he had over 15 years of personal lines experience in various pricing and reserving roles. He has a bachelor's degree in System Science and Mathematics from Washington University in St. Louis. He is a Fellow of the CAS and a Member of the American Academy of Actuaries.

Appendix A: R Script Used to Create GLM Example

The "statmod" package is required for the Tweedie distribution as it is used for the GLM error distribution in this example. It must be installed in order for the command loading it to work. The command below loads this package.

```
# load the package with the Tweedie distribution. This may have to be installed.
library(statmod)
```

The next command reads the "2009 Open Claims.csv" file into the data frame "Open2009". Note that the path must be changed to the location of this file. Also note that the forward "/" must be used in the path since "\" is a special character in R.

```
#Read in the 2009 open claims data (latest evaluation)
Open2009<-read.csv("c:/callpaper/2009 Open Claims.csv",sep=",")
```

The next two commands set the levels to be used as the base levels for injury and claimant age. This was done in order to set the base levels to be the same as those used to create the simulated data. When "real" data is used the base level is typically set to be the one with the largest number of observations. This step is not necessary to run the model, but if it is omitted R uses the first level in alphabetical order as the base level. This can create erratic results if this level has a low number of observations.

```
#Change the base level for Injury and Clmt.Age
Open2009$Injury<-relevel(Open2009$Injury,"Other")
Open2009$Clmt.Age<-relevel(Open2009$Clmt.Age,"26-45")
```

The next command creates the GLM "OpenGLM" using Reserve as the dependent variable and accident year, gender, claimant age, and injury as the independent variables. The Tweedie distribution is used with variance power equal to 2 and link power equal to zero. This distribution was selected because it seems to work well in a variety of situations. The link power of zero results in a log link, which is often used. The variance power of 2 was selected based on judgment and was subject to less analysis and testing than would usually be done in practice.

```
#Create the GLM
OpenGLM<-glm(Reserve~Accident.Year+Gender+Clmt.Age+Injury,
 data=Open2009, family=tweedie(var.power=2,link.power=0))
```

The next command shows a summarization of the GLM with coefficient estimates and goodness-of-fit statistics. This completes Step 2.2.

```
#Show the results of the GLM
summary(OpenGLM)
```

The output from the summary command is shown below.

```
Call:
glm(formula = Reserve ~ Accident.Year + Gender + Clmt.Age + Injury,
    family = tweedie(var.power = 2, link.power = 0), data = Open2009)

Deviance Residuals:
       Min          1Q      Median          3Q         Max
-3.9339130  -1.6120198  -0.4569802   0.2380754   6.4625565

Coefficients:
                         Estimate    Std. Error   t value   Pr(>|t|)
(Intercept)         -96.914820682  18.142193797  -5.34196 9.5743e-08 ***
Accident.Year         0.050666820   0.009042205   5.60337 2.2070e-08 ***
GenderM              -0.302648091   0.040644581  -7.44621 1.1132e-13 ***
Clmt.Age16-25        -0.313418574   0.066329026  -4.72521 2.3575e-06 ***
Clmt.Age46-65         0.332054992   0.066226809   5.01391 5.5052e-07 ***
Clmt.Age66 and Over   0.585376897   0.065969382   8.87346 < 2.22e-16 ***
Clmt.AgeUnder 16     -0.672501602   0.064194852 -10.47594 < 2.22e-16 ***
InjuryBack            1.453199179   0.061068655  23.79615 < 2.22e-16 ***
InjuryBurn            0.754684943   0.058116036  12.98583 < 2.22e-16 ***
InjurySpinal Cord     2.277638842   0.058428812  38.98143 < 2.22e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Tweedie family taken to be 2.179067388)

    Null deviance: 18844.622  on 5373  degrees of freedom
Residual deviance: 14355.060  on 5364  degrees of freedom
AIC: NA

Number of Fisher Scoring iterations: 17
```

Step 2.3 is completed in the next two steps. In this command "All Open Claims.csv" is read in to the data frame "OpenAll".

```
#Read in the data for all of the open claims at all evaluations
OpenAll<-read.csv("c:/callpaper/All Open Claims.csv",sep=",")
```

In the next command the GLM "OpenGLM" is applied to this data set to obtain the restated reserves in the "OpenRestated" array.

```
#Obtain the restated values for all of the open claims at all evaluations
OpenRestated<-predict(OpenGLM,newdata=OpenAll,type='response')
```

The next command sets the option for how many digits will be written. A few more than the default of 7 was desired.

```
#set the number of digits to be written out
options("digits"=10)
```

The final command writes the restated reserves to the file "Restated Claims.csv".

```
#Write the restated values to a file
write(OpenRestated,"c:/callpaper/Restated Claims.csv",sep=",",ncolumns=1)
```

Appendix B: Ultimate Losses Using GLM Based Method and Berquist-Sherman Method **Page 1**

PAID LOSSES

Age										
Accident Year	1	2	3	4	5	6	7	8	9	10
2000	11,859	24,975	44,312	60,972	73,490	82,477	94,199	98,595	101,078	105,467
2001	13,916	46,989	71,368	86,520	103,005	120,614	134,482	146,104	157,391	
2002	10,726	26,710	47,271	78,252	118,524	135,367	146,345	156,631		
2003	6,386	20,919	46,540	61,770	92,823	111,674	128,699			
2004	14,668	23,949	37,889	85,848	100,959	120,804				
2005	6,117	26,869	58,434	110,236	145,030					
2006	22,453	59,637	95,094							
2007	19,338	60,820	112,036							
2008	28,672	90,411								
2009	54,424									

GLM BASED METHOD

Restated Reserves

Age										
Accident Year	1	2	3	4	5	6	7	8	9	10
2000	204,127	196,620	163,974	131,223	105,900	83,082	67,252	51,749	44,014	30,681
2001	285,696	266,167	218,144	181,627	145,959	119,263	91,578	69,423	51,877	
2002	257,074	250,931	212,368	168,226	123,193	95,581	73,843	57,067		
2003	269,409	250,686	204,074	162,771	126,908	96,332	76,484			
2004	282,101	266,584	225,028	178,128	145,528	115,911				
2005	354,078	333,633	276,596	222,185	176,404					
2006	381,173	357,873	307,448	254,882						
2007	508,896	490,213	410,455							
2008	708,427	653,411								
2009	764,927									

Restated Incurred

Age										
Accident Year	1	2	3	4	5	6	7	8	9	10
2000	215,986	221,595	208,286	192,195	179,390	165,559	161,451	150,344	145,092	136,148
2001	299,612	313,156	289,512	268,147	248,964	239,877	226,060	215,527	209,268	
2002	267,800	277,641	259,639	246,478	241,717	230,948	220,188	213,698		
2003	275,795	271,605	250,614	224,541	219,731	208,006	205,183			
2004	296,769	290,533	262,917	263,976	246,487	236,715				
2005	360,195	360,502	335,030	332,421	321,434					
2006	403,626	417,510	402,542	254,882						
2007	528,234	551,033	522,491							
2008	737,099	743,822								
2009	819,351									

Report to Report Factors

Age									
Accident Year	1	2	3	4	5	6	7	8	9
2000	1.026	0.940	0.923	0.933	0.923	0.975	0.931	0.965	0.938
2001	1.045	0.924	0.926	0.928	0.964	0.942	0.953	0.971	
2002	1.037	0.935	0.949	0.981	0.955	0.953	0.971		
2003	0.985	0.923	0.896	0.979	0.947	0.986			
2004	0.979	0.905	1.004	0.934	0.960				
2005	1.001	0.929	0.992	0.967					
2006	1.034	0.964	0.633						
2007	1.043	0.948							
2008	1.009								

Wtd Avg	1.018	0.936	0.888	0.954	0.951	0.963	0.954	0.969	0.938	**0.958**
Cumulative	0.614	0.603	0.644	0.725	0.760	0.799	0.830	0.870	0.899	**0.958**
Case Incurred	843,192	712,769	535,091	335,810	329,777	208,510	212,847	221,876	217,227	131,181
Ultimate	517,568	429,608	344,502	243,598	250,715	166,613	176,671	193,104	195,199	125,622
Actual Ultimate	574,974	492,017	364,166	278,450	266,085	178,339	180,345	201,849	197,819	125,622
Difference	-57,406	-62,409	-19,664	-34,852	-15,370	-11,726	-3,674	-8,745	-2,620	0
Actual RTR	0.996	0.931	0.927	0.945	0.956	0.957	0.974	0.968	0.978	0.958

Appendix B: Ultimate Losses Using GLM Based Method and Berquist-Sherman Method **Page 2**

BERQUIST-SHERMAN METHOD

Case Reserves

Accident Year \ Age	1	2	3	4	5	6	7	8	9	10
2000	65,093	63,292	51,526	41,860	34,300	29,156	21,467	18,619	15,540	25,714
2001	110,790	103,274	90,761	79,514	67,777	57,927	45,727	39,413	59,836	
2002	104,149	105,569	96,960	78,728	54,134	43,471	37,343	65,245		
2003	110,813	107,534	94,923	84,790	66,479	55,609	84,148			
2004	93,277	95,674	88,720	60,268	52,178	87,706				
2005	147,552	146,874	132,356	102,975	184,747					
2006	146,093	138,584	117,743	225,574						
2007	197,305	200,143	423,055							
2008	265,840	622,358								
2009	788,768									

Open Claim Count

Accident Year \ Age	1	2	3	4	5	6	7	8	9	10
2000	606	569	479	385	310	245	191	148	123	88
2001	656	620	511	416	330	265	209	154	108	
2002	724	706	601	464	350	274	223	172		
2003	753	700	580	466	365	274	211			
2004	740	712	614	494	404	315				
2005	939	895	740	603	462					
2006	939	885	743	607						
2007	1,169	1,116	935							
2008	1,221	1,158								
2009	1,318									

Average Reserves

Accident Year \ Age	1	2	3	4	5	6	7	8	9	10
2000	107	111	108	109	111	119	112	126	126	292
2001	169	167	178	191	205	219	219	256	554	
2002	144	150	161	170	155	159	167	379		
2003	147	154	164	182	182	203	399			
2004	126	134	144	122	129	278				
2005	157	164	179	171	400					
2006	156	157	158	372						
2007	169	179	452							
2008	218	537								
2009	598									
Latest	598	537	452	372	400	278	399	379	554	292
Selected Trend	1.05									

Appendix B: Ultimate Losses Using GLM Based Method and Berquist-Sherman Method **Page 3**

BERQUIST-SHERMAN METHOD (Continued)

Restated Avg. Reserve (Latest Average Reserve Detrended)

Accident Year \ Age	1	2	3	4	5	6	7	8	9	10
2000	386	364	322	277	313	229	345	344	528	292
2001	405	382	338	291	329	241	362	361	554	
2002	425	401	355	306	345	253	380	379		
2003	447	421	372	321	363	265	399			
2004	469	442	391	337	381	278				
2005	492	464	410	354	400					
2006	517	487	431	372						
2007	543	512	452							
2008	570	537								
2009	598									

Restated Incurred

Accident Year \ Age	1	2	3	4	5	6	7	8	9	10
2000	245,637	231,956	198,339	167,736	170,619	138,598	159,999	149,517	165,979	131,181
2001	279,635	283,798	243,900	207,649	211,571	184,352	210,083	201,739	217,227	
2002	318,653	309,850	260,337	220,112	239,427	204,565	231,044	221,876		
2003	342,660	315,689	262,442	211,365	225,211	184,331	212,847			
2004	361,660	338,763	277,875	252,361	254,820	208,510				
2005	468,437	442,384	362,129	323,653	329,777					
2006	507,889	491,053	415,267	225,574						
2007	653,894	632,044	535,091							
2008	724,593	712,769								
2009	843,192									

Report to Report Factors

Accident Year \ Age	1	2	3	4	5	6	7	8	9	
2000	0.944	0.855	0.846	1.017	0.812	1.154	0.934	1.110	0.790	
2001	1.015	0.859	0.851	1.019	0.871	1.140	0.960	1.077		
2002	0.972	0.840	0.845	1.088	0.854	1.129	0.960			
2003	0.921	0.831	0.805	1.066	0.818	1.155				
2004	0.937	0.820	0.908	1.010	0.818					
2005	0.944	0.819	0.894	1.019						
2006	0.967	0.846	0.543							
2007	0.967	0.847								
2008	0.984									
Wtd Avg	0.963	0.839	0.860	1.035	0.835	1.143	0.953	1.091	0.790	**0.958**
Cumulative	0.541	0.562	0.670	0.778	0.752	0.900	0.787	0.826	0.757	**0.958**
Ultimate	456,304	400,580	358,407	276,699	248,009	187,698	167,563	183,202	164,409	125,622
Actual Ultimate	574,974	492,017	364,166	278,450	266,085	178,339	180,345	201,849	197,819	125,622
Difference	-118,670	-91,437	-5,759	-1,751	-18,076	9,359	-12,782	-18,647	-33,410	0
Actual RTR	0.996	0.931	0.927	0.945	0.956	0.957	0.974	0.968	0.978	0.958