Bruin Mutual
Executive Summary
Team 33
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After careful analysis of the provided claim data, we concluded that there were no egregious errors in dates or claim amounts. Claims were always reported before they were resolved, there were few outliers in claim amounts, and no negative values. We then calculated reserves utilizing the paid chain ladder method, reported chain ladder method, expected method, Bornhuetter-Ferguson method, and the Cape Cod method for the personal auto physical damage, personal auto liability, and homeowner's property lines of business in order to determine ultimate losses for each accident year.

Trends in the Data

The data was fairly consistent with a relatively similar number of claims and payments in each year. Overall, personal auto liability claims took the longest to payout with some claims from 2011 still unsettled. Conversely, personal auto physical damage claims were all paid out within 3 years. Throughout all lines of business, 2017 had the highest number of claims and dollars paid out. Additionally, in 2015 in personal auto liability claims, there was a single claim worth over $4 million, and another claim for $1.1 million, which were significantly higher than all other claims. These two claims made up approximately 7.5% of all claims for the entire year.

Analysis of Reserving Methods

Each reserving method is accompanied by various benefits and drawbacks. The chain ladder method is one of the oldest, most widely used, and is appropriate with stable patterns of loss development, but it is only accurate when past patterns are assumed to continue into the future. The expected method can be used even when there is a lack of past data, however it requires a minimum level of loss reserves. The Bornheutter-Fergusen method is exceptional at handling uneven patterns of loss development, especially when data is incurred but not reported. Contrastingly, it is not effective for short-tailed lines of insurance, and will distort results if claim reporting patterns change. The Cape Cod method is reliable because it prevents distortion by unexpected fluctuation at the start of the year, but it requires a high volume of credible reported claims to yield an accurate expected claims estimate.

Ultimate Loss Selections

After calculating the ultimate loss results from accident year 2011 to 2020 for each of the methods, we can compare each method's results to the actual claim data to determine the best reserving method for our situation. Tables 1-3 show the difference from the ultimate loss result from the methods and the actual claim data for each of the three lines of businesses. For each accident year, the best reserving method for that specific year is chosen by first valueing how

close each method's paid data difference is to zero and secondarily how close overall is the reported and paid difference is from zero.

Through this process, we conclude that the paid chain ladder method is the best method overall for each of the lines of the business for a majority of the time period. However, in the homeowners and liability lines of businesses, the expected method served as the best method for 2017 (as well for the total aggregate data shown in Table 4) and the Bornheutter-Fergusen method served as the best method in 2018 of the personal auto physical damage line of business. Nevertheless, the paid chain ladder method held its ground in the total aggregate data in Table 4 where it was the best method in years 2011-2015 and 2018-2020 with the Expected Method as the best method for 2016 and 2017. This follows the pros of the chain ladder method where we have a large volume of claims and generally stable patterns of loss development.

Standardization of a Line of Business

If our team had limited actuarial resources and needed to reduce the amount of time needed to complete the reserve analysis by standardizing the methods used on one line of business, we would standardize using the paid chain ladder method for the personal auto physical damage line of business. Personal auto physical damage's data was very consistent, where each claim was paid out consistently in about three years and had the average claim severity consistent throughout all claims in the line of business. In comparison, due to its large amount of average claim severity and total dollar amount in comparison to the other lines of business, the homeowners line of business should not be standarized so that our team has more control and better specified analysis in a line of business that consumes a majority of the overall loss dollar amount. The liability line of business, on the other hand, should not be standardized since the total dollar amount of loss each year varies significantly with peaks in 2015 of around six million dollars with dips at years such as 2016 of around one million dollars. As shown in Table 3, the paid chain ladder method is the best (or second best) method for the last three years and is spot on with every other method besides Expected for years 2011 to 2017, leading paid chain ladder method as the best method overall for personal auto physical damage.

Excluding Catastrophes

CAT reserving must be done through separate reserving processes since many common loss reserving techniques assume that payment loss patterns can be used to model the future. If included in these models, costly catastrophes would create outliers and disrupt the natural patterns that are being created for commonplace reserve calculations. Thus, unpredictable catastrophes that are not reliant on human behavior must be calculated through separate reserving processes. However, challenges with this distinct reserving process include predicting the likelihood and severity of catastrophic events and facing government regulations that limit reserves for catastrophes. All of these challenges establish a great level of difficulty in producing a proper sum of reserve funds for catastrophic events.

Appendix

Table 1 (Homeowners Ultimate Loss Comparison):

Year	Paid CL Method Reported Data Difference	Paid CL Method Paid Data Difference	Reported CL Method Reported Data Difference	Reported CL Method Paid Data Difference	Expected Method Reported Data Difference	Expected Method Paid Data Difference	BF Method Reported Data Difference	BF Method Paid Data Difference	Cape Cod Method Reported Data Difference	Cape Cod Method Paid Data Difference	Best Method
2011	0	0	0	0	-3,050,708	-3,050,708	0	0	0	0	Any method but Expected
2012	-33,774	0	0	33,774	419,186	452,960	-16,887	16,887	0	33,774	Paid CL
2013	-133,387	17,128	32,994	183,509	1,196,385	1,346,900	-49,028	101,488	34,939	185,454	Paid CL
2014	36,416	179,043	247,386	390,014	1,537,201	1,679,829	152,923	295,550	262,931	405,558	Paid CL
2015	293,315	682,394	813,791	1,202,870	310,711	699,789	547,296	936,375	812,082	1,201,161	Paid CL
2016	1,072,024	1,649,974	1,882,246	2,460,196	2,180,687	2,758,637	1,516,246	2,094,196	1,926,794	2,504,744	Paid CL
2017	2,814,697	4,252,887	4,843,789	6,281,978	1,346,299	2,784,488	3,536,060	4,974,249	4,483,163	5,921,352	Expected
2018	1,599,660	4,848,902	6,122,089	9,371,331	9,664,451	12,913,692	4,881,732	8,130,974	6,877,295	10,126,537	Paid CL
2019	2,990,543	10,189,383	15,615,243	22,814,082	10,884,868	18,083,708	9,760,106	16,958,946	14,105,240	21,304,079	Paid CL
2020	2,595,428	9,827,453	25,497,499	32,729,524	25,192,138	32,424,162	20,935,486	28,167,510	25,650,047	32,882,071	Paid CL

Table 2 (Liability Ultimate Loss Comparison):

Year	Paid CL Method Reported Data Difference	Paid CL Method Paid Data Difference	Reported CL Method Reported Data Difference	Reported CL Method Paid Data Difference	Expected Method Reported Data Difference	Expected Method Paid Data Difference	BF Method Reported Data Difference	BF Method Paid Data Difference	Cape Cod Method Reported Data Difference	Cape Cod Method Paid Data Difference	Best Method
2011	-810	0	0	810	-1,130,649	-1,129,839	-405	405	0	810	Paid CL
2012	-99,032	3	522	99,558	445,138	544,173	-49,210	49,825	870	99,905	Paid CL
2013	-779,101	4,306	47,536	830,943	789,775	1,573,183	-354,548	428,859	91,872	875,279	Paid CL
2014	-276,542	54,543	938,024	1,269,109	-602,503	-271,418	171,113	502,198	887,791	1,218,876	Paid CL
2015	217,575	436,868	2,202,482	2,421,775	-3,366,395	-3,147,102	361,730	581,023	1,065,016	1,284,309	Paid CL
2016	-265,645	276,561	868,064	1,410,270	1,749,988	2,292,194	643,786	1,185,991	1,658,443	2,200,648	Paid CL
2017	718,934	1,141,362	3,387,571	3,809,999	-533,829	-111,401	1,012,652	1,435,079	2,283,762	2,706,189	Expected
2018	-590,953	207,123	3,045,272	3,843,349	1,990,479	2,788,556	1,294,322	2,092,399	3,253,474	4,051,551	Paid CL
2019	-691,289	205,899	6,505,714	7,402,903	2,477,580	3,374,768	2,083,433	2,980,622	4,321,008	5,218,197	Paid CL
2020	-189,722	133,356	27,697,214	28,020,292	3,375,433	3,698,510	3,324,853	3,647,931	5,221,547	5,544,625	Paid CL

Table 3 (Physdam Ultimate Loss Comparison):

Year	Paid CL Method Reported Data Difference	Paid CL Method Paid Data Difference	Reported CL Method Reported Data Difference	Reported CL Method Paid Data Difference	Expected Method Reported Data Difference	Expected Method Paid Data Difference	BF Method Reported Data Difference	BF Method Paid Data Difference	Cape Cod Method Reported Data Difference	Cape Cod Method Paid Data Difference	Best Method
2011	0	0	0	0	-533,947	-533,947	0	0	0	0	Any method but Expected
2012	0	0	0	0	345,288	345,288	0	0	0	0	Any method but Expected
2013	0	0	0	0	-125,293	-125,293	0	0	0	0	Any method but Expected
2014	0	0	0	0	-41,318	-41,318	0	0	0	0	Any method but Expected
2015	0	0	0	0	11,469	11,469	0	0	0	0	Any method but Expected
2016	0	0	0	0	-386,994	-386,994	0	0	0	0	Any method but Expected
2017	0	0	0	0	-18,732	-18,732	0	0	0	0	Any method but Expected
2018	1,509	1,509	1,509	1,509	-539,915	-539,915	1,371	1,371	11,319	11,319	BF Method (by ~100 over Paid CL)
2019	-131,257	58,309	60,136	249,702	320,409	509,975	-32,163	157,403	462,077	651,643	Paid CL
2020	-685,614	452,287	631,864	1,769,765	1,442,786	2,580,687	144,671	1,282,572	5,797,058	6,934,959	Paid CL

Table 4 (Total Ultimate Loss Comparison):

Year	Paid CL Method Reported Data Difference	Paid CL Method Paid Data Difference	Reported CL Method Reported Data Difference	Reported CL Method Paid Data Difference	Expected Method Reported Data Difference	Expected Method Paid Data Difference	BF Method Reported Data Difference	BF Method Paid Data Difference	Cape Cod Method Reported Data Difference	Cape Cod Method Paid Data Difference	Best Method
2011	-810	0	0	810	-7,016,139	-7,015,330	-405	405	0	810	Paid CL
2012	-132,805	5	820	133,630	-1,835,593	-1,702,783	-66,013	66,797	5	132,815	Paid CL
2013	-909,294	24,629	87,219	1,021,141	-1,065,604	-131,681	-412,579	521,343	26,813	960,735	Paid CL
2014	-251,083	222,629	633,693	1,107,405	-2,020,784	-1,547,071	162,763	636,475	231,444	705,156	Paid CL
2015	287,047	895,419	1,548,375	2,156,747	-6,502,211	-5,893,839	706,235	1,314,607	824,858	1,433,230	Paid CL
2016	877,387	1,997,543	2,746,522	3,866,678	340,490	1,460,645	1,714,700	2,834,856	2,154,126	3,274,282	Expected Method
2017	3,133,148	4,993,765	6,416,290	8,276,907	-3,169,365	-1,308,748	3,864,770	5,725,387	4,759,512	6,620,129	Expected Method
2018	1,898,649	5,945,967	8,055,992	12,103,310	1,490,170	5,316,757	9,364,075	7,449,391		11,496,709	Paid CL
2019	3,061,561	11,347,155	17,774,862	26,060,456	9,425,900	17,711,494	9,960,940	18,246,534	14,487,156	22,772,750	Paid CL
2020	3,033,529	11,726,532	27,269,892	35,962,895	25,904,841	34,597,843	21,046,413	29,739,416	26,618,542	35,311,545	Paid CL