The Effect of Changing Exposure Levels on Calendar Year Loss Trends

Chris Styrsky, FCAS, MAAA

Abstract

This purpose of this paper is to illustrate the impact that changing exposure levels have on calendar year loss trends by creating a situation where the calendar year loss trends are inaccurate. The results show that the calendar year loss trends can be distorted significantly by exposure level changes, with the potential to affect rate levels if not accounted for.

However, the effect of changing exposure could be accounted for. The proposed method of data organization will allow the impact of changing exposure levels to be negated, allowing actuaries to set more precise rates.

Due to the significant impact that changing exposure levels can have on the calendar year loss trends, it would be beneficial to organize the data in a similar fashion to what is proposed in this paper. This would reduce the chance of increasing market share at an inadequate rate or decreasing market share with an excessive rate.

Keywords. Calendar year, loss trends, data organization, exposure level change.

1 INTRODUCTION

When pricing a product in a competitive market, a delicate balance is struck between acquiring market share and the rate of return. Missteps in setting a proper price can lead to either an overpriced product that few will purchase or an inadequate rate that many will purchase but will not result in a sufficient profit.

The insurance industry's difficulty is compounded by the fact that insurance companies do not know what the actual cost of the product is until some time after it is sold. This makes the ability to accurately forecast the price of insurance contracts of the utmost importance.

According to the Statement of Principles for Ratemaking, an actuary should consider data organization and trends when determining a rate. The choice of data organization often used in trend analysis is calendar year. This is done because of the responsiveness of calendar year data and that calendar year data is readily available. The calendar year loss trends are used as guidance for the actuary to project historical data to reflect loss cost differences over time. Without carefully considering what is driving the underlying data, however, a trend may be selected that will have one of two effects. Either the product will be so under-priced that the company's bottom line will be hurt, or that product will be so over-priced that it will be uncompetitive.

Unfortunately, calendar year data does have limitations. One of the underlying assumptions when using calendar year loss trends is that the book of business is relatively stable in size. This is often not a reasonable assumption, and, as a result, the calendar year loss trend will be a distorted reflection of reality.

The goal of this paper is to show how and why calendar year loss trends are distorted by changes in exposure levels and to propose an alternative method that eliminates the need to assume constant exposure level.

2 ANALYSIS USING CALENDAR YEAR LOSS TRENDS

One disadvantage of using calendar year data is the influence from multiple accident years within a single calendar year. This is particularly evident when calendar year data is used to calculate loss trends.

The following formulas are typically used to calculate calendar year paid frequency, severity, and pure premium for trending:

CY_X Paid Frequency = $(C_{0,12,X} + C_{12,24,X} + \ldots) / E_X$

CY_X Paid Severity = $(L_{0,12,X} + L_{12,24,X} + \ldots) / (C_{0,12,X} + C_{12,24,X} + \ldots)$

CY_X Paid Pure Premium = $(L_{0,12,X} + L_{12,24,X} + \ldots) / E_X$

Where:

- CY_X = Calendar year X
- $C_{T,T+12,X}$ = # of claims paid during CY_X that were paid between T and T + 12 months after the claim occurred
- $L_{T,T+12,X}$ = \$'s of paid losses during CY_X that were paid between T and T + 12 months after the claim occurred
- $S_{T,T+12,X}$ = The average paid severity of claims paid during CY_X between T and T + 12 months after the claim occurred
- E_X = Earned Exposures from calendar year X.

Graphically, the diagonal in Table 1 below represents the accident year X+1 paid claims. Accident year X+1 potentially contributes claims to calendar years X+1, X+2, X+3, and X+4.

TABLE 1

	Claim Payment Period			
Calendar Year	0-12	12-24	24-36	36-48
X	$C_{0,12,X}$	$C_{12,24,X}$	$C_{24,36,X}$	$C_{36,48,X}$
X+1	$C_{0,12,X+1}$	$C_{12,24,X+1}$	$C_{24,36,X+1}$	$C_{36,48,X+1}$
X+2	$C_{0,12,X+2}$	$C_{12,24,X+2}$	$C_{24,36,X+2}$	$C_{36,48,X+2}$
X+3	$C_{0,12,X+3}$	$C_{12,24,X+3}$	$C_{24,36,X+3}$	$C_{36,48,X+3}$
X+4	$C_{0,12,X+4}$	$C_{12,24,X+4}$	$C_{24,36,X+4}$	$C_{36,48,X+4}$

Let's take a look at a few examples to see how calendar year data is dependent on exposure level. We will use the following assumptions for each example:

- All policies are written on January 1st and are 12 month policies
- The ultimate claim frequency for every risk in existence is 0.20
- 50% of the ultimate claims are paid within 12 months of the date the policy was written, 30% between 12 and 24 months, and 20% between 24 and 36 months (no claims paid past 36 months)
- The claim payment pattern does not change over time
- During calendar year X+2, claims that were paid within 12 months of the date the policy was written were settled for \$100, \$200 for claims between 12 to 24 months, and \$400 for claims between 24 to 36 months
- Annual inflation is 5% for all claims

2.1 No Exposure Level Change

The following chart contains the exposure for this example.

TABLE 2	
Calendar Year	Earned Exposures
X	100,000
X+1	100,000
X+2	100,000
X+3	100,000
X+4	100,000
X+5	100,000
X+6	100,000

Based on the exposure level:

TABLE 3					
	Calendar Year Paid Claims				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	4,000[1]				
X+1	6,000	4,000			
X+2	10,000	6,000	4,000		
X+3		10,000	6,000	4,000	
X+4			10,000	6,000	4,000
X+5				10,000	6,000
X+6					10,000
All AY (total CY)	20,000[2]	20,000	20,000	20,000	20,000
CY Pd Freq	0.2	0.2	0.2	0.2	0.2
Change vs. Prior Year		0.0%	0.0%	0.0%	0.0%

[1] 4,000 = 0.04 * 100,000

[2] 0.20 = 20,000 / 100,000

In this example, the calendar year paid frequency is 0.2 for each year, resulting in a 0% trend.

The calendar year paid severity is:

TABLE 4					
	Calendar Year Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$1,600,000[1]				
X+1	$1,200,000	$1,680,000[2]			
X+2	$1,000,000	$1,260,000	$1,764,000		
X+3		$1,050,000	$1,323,000	$1,852,200	
X+4			$1,102,500	$1,389,150	$1,944,810
X+5				$1,157,625	$1,458,608
X+6					$1,215,506
All AY (total CY)	$3,800,000	$3,990,000	$4,189,500	$4,398,975	$4,618,924
CY Pd Severity	$190.00[3]	$199.50	$209.48	$219.95	$230.95
Change vs. Prior Year		5.0%	5.0%	5.0%	5.0%

[1] $1,600,000 = 4000 * 400

[2] $1,680,000 = 4000 * 400 * 1.05

[3] $190.00 = 3,800,000 / 20,000

The resulting calendar year paid severity trend is 5%, which matches the inflation rate.

The calendar year paid pure premium is:

TABLE 5					
	Calendar Year				
	Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$1,600,000[1]				
X+1	$1,200,000	$1,680,000[2]			
X+2	$1,000,000	$1,260,000	$1,764,000		
X+3		$1,050,000	$1,323,000	$1,852,200	
X+4			$1,102,500	$1,389,150	$1,944,810
X+5				$1,157,625	$1,458,608
X+6					$1,215,506
All AY (total CY)	$3,800,000	$3,990,000	$4,189,500	$4,398,975	$4,618,924
CY Pd Pure Premium	$38.00[3]	$39.90	$41.90	$43.99	$46.19
Change vs. Prior Year		5.0%	5.0%	5.0%	5.0%

[1] $1,600,000 = 4000 * 400

[2] $1,680,000 = 4000 * 400 * 1.05

[3] $38.00 = 3,800,000 / 100,000

In this example, the calendar year pure premium trend is 5%, which equals (1 + pd freq trend) * (1 + pd sev trend) – 1.

2.2 Increasing Exposure Level

The following chart contains the exposure for this example.

TABLE 6	
Calendar Year	Earned Exposures
X	100,000
X+1	100,000
X+2	100,000
X+3	104,200
X+4	111,275
X+5	122,700
X+6	139,500

Based on this exposure level:

TABLE 7					
	Calendar Year				
	Paid Claims				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	4,000				
X+1	6,000	4,000			
X+2	10,000	6,000	4,000		
X+3		10,420	6,252	4,168	
X+4			11,128	6,677	4,451
X+5				12,270	7,362
X+6					13,950
All AY (total CY)	20,000	20,420	21,380	23,115	25,763
CY Pd Freq	0.2	0.1960	0.1921	0.1884	0.1847
Change vs. Prior Year		-2.0%	-2.0%	-2.0%	-2.0%

The result is important to note. One of the assumptions is that every exposure has an ultimate frequency of 0.2 (i.e. the paid frequency trend should be 0%), but based on using calendar year data a –2.0% paid frequency trend is measured.

The artificial trend is a mismatch between the numerator and the denominator of the formula used to calculate the calendar year paid frequency. The formula for CY_X Paid Frequency is $(C_{0,12,X} + C_{12,24,X} + \ldots) / E_x$. The numerator contains multiple accident years produced from different exposure levels (years X-1, X-2, …) while the denominator is the most recent calendar year exposures (year X). Since the numerator contains some claims that were produced by a different set of exposures, the possibility of a mismatch is possible unless the exposure levels in years X-1, X-2, … just happened to stay constant.

Therefore, the following observations can be made:

- The "true" paid frequency trend will not be captured with calendar year data unless the change in exposure level is the same from year to year
- If there is a constant non-zero change in exposure level the absolute paid frequency will not be accurate even though the trend is.

The calendar year paid severity is:

TABLE 8					
	Calendar Year				
	Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$1,600,000				
X+1	$1,200,000	$1,680,000			
X+2	$1,000,000	$1,260,000	$1,764,000		
X+3		$1,094,100	$1,378,566	$1,929,992	
X+4			$1,226,807	$1,545,777	$2,164,087
X+5				$1,420,406	$1,789,711
X+6					$1,695,637
All AY (total CY)	$3,800,000	$4,034,100	$4,369,373	$4,896,175	$5,649,436
CY Pd Severity	$190.00	$197.56	$204.37	$211.82	$219.28
Change vs. Prior Year		4.0%	3.5%	3.6%	3.5%

The resulting calendar year paid severity trend is approximately 3.5%, well below the inflation rate of 5%.

The reason that the calendar year paid severity trend is different than the inflation rate is not that intuitive. The change in exposure level changes the distribution of each calendar year's claims by accident year. With increasing exposure level, the latest calendar year contains a higher percentage of paid claims from recent accident years (and those claims typically have a smaller severity). For example, in calendar year X+2 50% of the claims were from claims settled within 12 months of policy inception, 30% from 12-24 months, and 20% from 24-36. In calendar year X+3 the distribution was 51%, 29.4%, and 19.6%.

The calendar year paid pure premium is:

TABLE 9

	Calendar Year Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$1,600,000				
X+1	$1,200,000	$1,680,000			
X+2	$1,000,000	$1,260,000	$1,764,000		
X+3		$1,094,100	$1,378,566	$1,929,992	
X+4			$1,226,807	$1,545,777	$2,164,087
X+5				$1,420,406	$1,789,711
X+6					$1,695,637
All AY (total CY)	$3,800,000	$4,034,100	$4,369,373	$4,896,175	$5,649,436
CY Pd Pure Premium	$38.00	$38.71	$39.27	$39.90	$40.50
Change vs. Prior Year		1.9%	1.4%	1.6%	1.5%

The calendar year paid pure premium trend is between 1.4% and 2%, well below the "true" pure premium trend of 5%.

What would happen if an actuary did not account for the increasing exposure level distorting the trends in this example? If the actuary selects trends in line with what is produced by the calendar year data, then the selections will be too low. When trends are understated, then the indication will not be at an adequate level. If the company is not able to get to the appropriate rate level, the margins will be lower than needed and the price will be very competitive (if not too competitive). As a result, this might lead to a growth spurt with low margins.

2.3 Decreasing Exposure Level

The following chart contains the exposure for this example.

TABLE 10	
Calendar Year	Earned Exposures
X	100,000
X+1	100,000
X+2	100,000
X+3	90,900
X+4	78,500
X+5	63,475
X+6	48,575

Based on this exposure level:

TABLE 11					
	Calendar Year Paid Claims				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	4,000				
X+1	6,000	4,000			
X+2	10,000	6,000	4,000		
X+3		9,090	5,454	3,636	
X+4			7,850	4,710	3,140
X+5				6,348	3,809
X+6					4,858
All AY (total CY)	20,000	19,090	17,304	14,694	11,806
CY Pd Freq	0.2	0.2100	0.2204	0.2315	0.2430
Change vs. Prior Year		5.0%	5.0%	5.0%	5.0%

Similar to the increasing exposure level example, the use of calendar year data creates an artificial paid frequency trend. In this example, the paid frequency trend should be 0%, but the mismatch of paid claims and exposures has created a 5.0% trend.

The calendar year paid severity is:

TABLE 12					
	Calendar Year Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$1,600,000				
X+1	$1,200,000	$1,680,000			
X+2	$1,000,000	$1,260,000	$1,764,000		
X+3		$954,450	$1,202,607	$1,683,650	
X+4			$865,463	$1,090,483	$1,526,676
X+5				$734,802	$925,851
X+6					$590,432
All AY (total CY)	$3,800,000	$3,894,450	$3,832,070	$3,508,935	$3,042,959
CY Pd Severity	$190.00	$204.00	$221.46	$238.81	$257.75
Change vs. Prior Year		7.4%	8.6%	7.8%	7.9%

In this example, the paid severity trend is about 8%, above the actual 5%.

The calendar year paid pure premium is:

TABLE 13					
	Calendar Year				
	Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$1,600,000				
X+1	$1,200,000	$1,680,000			
X+2	$1,000,000	$1,260,000	$1,764,000		
X+3		$954,450	$1,202,607	$1,683,650	
X+4			$865,463	$1,090,483	$1,526,676
X+5				$734,802	$925,851
X+6					$590,432
All AY (total CY)	$3,800,000	$3,894,450	$3,832,070	$3,508,935	$3,042,959
CY Pd Pure Premium	$38.00	$42.84	$48.82	$55.28	$62.64
Change vs. Prior Year		12.7%	13.9%	13.2%	13.3%

Since the use of calendar year data overestimated the paid frequency trend and the paid severity trend, it is not surprising that the paid pure premium trend is overestimated. Additionally, when both trends are misestimated in the same direction the issue is magnified.

What would happen if an actuary did not account for the decreasing exposure level distorting the trends in this example? If the actuary selected trends in line with what is produced by the calendar year data, then the selections would be too high. If the trends are overstated, then the rate level indication will be higher than one produced from accurate trend projections. This may result in a price that is not competitive in the marketplace leading to a greater loss of business.

3 ADJUSTMENT TO CALENDAR YEAR DATA

Currently, actuaries have a few alternatives available to them.

The actuary can use reported claims instead of paid claims. The delay from the accident date to report date is shorter than the delay from accident date to close date. Since this time is shorter, the mismatch between claims and exposures is not as significant. However, there are a few drawbacks with using reported claims instead of paid claims. Using reported claims has the following disadvantages:

- Reported claims can be distorted by seasonality of reporting patterns. There could be spikes during different times of the year for things like claims office holiday schedules or a rush to file before the end of the year.
- Just because a claim is reported does not mean that it will ever be paid. For example, during periods of fraudulent activities there will be a significant increase in reported claims, but if these claims are found to be fraudulent, they will not translate into a paid claim.
- If there is an internal change in claim opening practice, the resulting numbers could distort the results.
- Using reported claims does nothing to address the problem with paid severity or paid pure premium.

Another alternative is to use accident year data instead of calendar year data. Accident year data will not have the problem of mismatching risk and exposures, nor will it have the same problem addressed above with the use of reported claims. The issue that accident year claim count data does have is that recent years are immature, so the data needs to be developed to ultimate. Loss development is a stochastic process, so there is inherent variability. As a result, there are multiple methods of loss development that could be appropriate to use. Since there is no established loss development method to be used in all situations, there is some subjectivity to using accident year data for loss trends.

The proposed solution is to attempt to match the risk with the appropriate exposure. The issue with calendar year data is that the paid claims in any calendar year may have come from older accident years, yet they are matched to the most recent calendar year exposures.

In the increasing exposure level example above, the number of paid claims in year X+6 was 25,763 and was matched to the 139,500 exposures. The reason that the paid frequency did not match the actual frequency is that the claims from accident year X+4 and X+5 had lower exposure level. Intuitively, it would make more sense to match these paid claims to the exposures that produced these claims. Using the notion from earlier in the article, the proposed formula is:

Adjusted Paid Frequency (APF) = $C_{0,12,X} / E_X + C_{12,24,X} / E_{X-1} + C_{24,36,X} / E_{X-2} + \ldots$

This formula can be thought of as adding the incremental frequencies. The incremental paid frequency in the first year ($C_{0,12,X}$ / E_X) is added to incremental paid frequency in the second year ($C_{12,24,X}$ / E_{X-1}), etc. The formula should end when all further $C_{T,T+12,X}$ are equal to 0.

The formula for pure premium is very similar to the one for adjusted paid frequency, replacing paid claims with paid losses:

Adjusted Paid Pure Premium (APPP) = $L_{0,12,X} / E_X + L_{12,24,X} / E_{X-1} + L_{24,36,X} / E_{X-2} + \ldots$

Since paid severity has to equal paid pure premium divided by paid frequency, the formula for adjusted paid severity (APS) is:

Adjusted Paid Severity = $(L_{0,12,X} / E_X + L_{12,24,X} / E_{X-1} + L_{24,36,X} / E_{X-2} + \ldots)/(APF)$
$= (L_{0,12,X} / E_X)/APF + (L_{12,24,X} / E_{X-1})/APF + \ldots$
$= ((L_{0,12,X} / C_{0,12,X}) * (C_{0,12,X} / E_X))/APF + ((L_{12,24,X} / C_{12,24,X}) * (C_{12,24,X} / E_{X-1}))/APF + \ldots$
$= (S_{0,12,X} * (C_{0,12,X} / E_X))/APF + (S_{12,24,X} * (C_{12,24,X} / E_{X-1}))/APF + \ldots$

The adjusted paid severity can be thought of as a weighted average of each 12-month accident year severity where the weight is the percentage that each 12-month segment contributes to the overall paid frequency.

3.1 Increasing Exposure Level using the Adjusted Formulas

The adjusted paid frequency is:

TABLE 14					
	Adjusted Paid Claim Frequency				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	4,000 / 100,000 = .04				
X+1	6,000 / 100,000 = .06	4,000 / 100,000 = .04			
X+2	10,000 / 100,000 = .10	6,000 / 100,000 = .06	0.04		
X+3		10,420 / 104,200 = .10	0.06	0.04	
X+4			0.10	0.06	0.04
X+5				0.10	0.06
X+6					0.10
Adjusted Paid Freq	.04 + .06 + .10 = .20	0.20	0.20	0.20	0.20
Change vs. Prior Year		0.0%	0.0%	0.0%	0.0%

When the adjusted paid frequency method is used, the paid frequency trend is 0% that matches what is assumed in the example.

The adjusted paid severity is:

TABLE 15					
	Paid Severities				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$400[1]				
X+1	$200	$420[2]			
X+2	$100	$210	$441.00		
X+3		$105	$220.50	$463.05	
X+4			$110.25	$231.53	$486.20
X+5				$115.76	$243.10
X+6					$121.55
Adj Pd Severity	$190.00[3]	$199.50	$209.48	$219.95	$230.95
Change vs. Prior Year		5.0%	5.0%	5.0%	5.0%

[1] $400 = $1,600,000 / 20,000

[2] $420 = $1,680,000 /20,000

[3] $190.00 = $400 * .04 / .20 + $200 * .06 / .20 + $100 * .10 / .20

The use of adjusted paid severity formulas accounts for the mismatch of risk and exposures and accurately measures a 5% paid severity trend.

The adjusted paid pure premium is:

TABLE 16					
	Paid Losses				
Accident Year	X+2	X+3	X+4	X+5	X+6
X	$16.00[1]				
X+1	$12.00	$16.80[2]			
X+2	$10.00	$12.60	$17.64		
X+3		$10.50	$13.23	$18.52	
X+4			$11.03	$13.89	$19.45
X+5				$11.58	$14.59
X+6					$12.16
Adj Pd Pure Premium	$38.00[3]	$39.90	$41.90	$43.99	$46.19
Change vs. Prior Year		5.0%	5.0%	5.0%	5.0%

[1] $16.00 = $1,600,000 /100,000

[2] $16.80 = $1,680,000 /100,000

[3] $38.00 = $16.00 + $12.00 + $10.00

The adjusted paid pure premium formula measures the assumed 5% trend.

The adjusted formulas work under constant, increasing, or decreasing exposure level.

These formulas seem to work on a theoretical basis, but what about when actual data is used?

3.2 Actual Example

The data used in this example is hypothetical data from a personal lines insurance company.

The exposure level in this particular state was decreasing significantly:

TABLE 17	
Earned Exposures	
Calendar Year ending December 31	
Calendar Year	Earned Exposures
1998	60,249
1999	59,655
2000	53,760
2001	39,698
2002	21,525

In this example, the calendar year paid frequency is:

TABLE 18
Calendar Year Paid Frequency Trend
Bodily Injury Coverage

Date	actual data	6 pt. curve of best fit
9/01	3.97	4.107
12/01	4.61	4.575
3/02	5.23	5.096
6/02	5.79	5.677
9/02	6.44	6.325
12/02	6.78	7.046

REGRESSION	6 pt.
Avg Annual Trend =	54.02%

This is a significantly high paid frequency trend and should trigger some alarms. When the adjusted paid frequency formulas are used, the paid frequency is:

TABLE 19
Adjusted Paid Frequency Trend
Bodily Injury Coverage

Date	Actual Data	6 pt. curve of best fit
9/01	3.23	3.471
12/01	3.54	3.513
3/02	3.80	3.556
6/02	3.80	3.600
9/02	3.72	3.643
12/02	3.41	3.688

REGRESSION	6 pt.
Avg Annual Trend =	4.96%

The 5% trend is more reasonable than the 50+% trend that the calendar year data produced.

The calendar year paid severity is:

TABLE 20
Calendar Year Paid Severity Trend
Bodily Injury Coverage

Date	Actual Data	6 pt. curve of best fit
9/01	10,691	10,967
12/01	11,788	11,435
3/02	11,707	11,923
6/02	12,680	12,431
9/02	13,228	12,962
12/02	13,155	13,515

REGRESSION	6 pt.
Avg Annual Trend =	18.19%

In comparison, the adjusted paid severity trend is:

TABLE 21
Adjusted Paid Severity Trend
Bodily Injury Coverage

Date	Actual Data	6 pt. curve of best fit
9/01	10,228	10,597
12/01	11,194	10,782
3/02	10,800	10,971
6/02	11,436	11,163
9/02	11,654	11,358
12/02	11,144	11,557

REGRESSION	6 pt.
Avg Annual Trend =	7.18%

The 7% severity trend produced by the adjusted paid severity formula is closer to the inflation rate rather than the calendar year paid severity trend.

The calendar year paid pure premium trend is:

TABLE 22
Calendar Year Paid Pure Premium Trend
Bodily Injury Coverage

Date	actual data	6 pt. Curve of best fit
9/01	424	450
12/01	544	523
3/02	612	608
6/02	734	706
9/02	852	820
12/02	892	952

REGRESSION	6 pt.
Avg Annual Trend =	82.04%

The adjusted paid pure premium is:

TABLE 23
Adjusted Paid Pure Premium Trend
Bodily Injury Coverage

Date	actual data	6 pt. curve of best fit
9/01	330	368
12/01	397	379
3/02	410	390
6/02	434	402
9/02	434	414
12/02	380	426

REGRESSION	6 pt.
Avg Annual Trend =	12.51%

It is unlikely that the unadjusted calendar year paid pure premium trend can be thought of as being accurate, especially since it is known that the exposures are decreasing significantly.

4 CONCLUSION

This paper presents a theoretical solution that can be applied to real world issues. The method presented is not without drawbacks.

The premise of the method is to match risk to the exposure that produced the risk. Unfortunately, it is not practical to match every paid claim to the appropriate exposure, especially for long tail lines of business. In the hypothetical example in Section IV, most of the claims were paid within 8 years. Since most of the claims were paid within 8 years, all other paid claims from the 7th prior accident year or older were grouped together and matched to the 7th prior year's earned exposures. The 7th prior year's earned exposures were used since the exposure level then should be more reflective of the exposure level that produced the claims than the figures from the most recent year. In the example, since almost all claims are paid within 7 years, this is not a major drawback. It is outside the scope of this article to determine the optimal number of years to match the risk with exposure, because all years is not always a practical solution, but more than one is an improvement over current practices.

Another drawback of the proposed method is that it requires an extensive amount of data. For example, to calculate a 6-point annual calendar year paid frequency trend, an actuary needs 6 data points for 6 years of earned exposures and 6 data points for 6 years of calendar year paid claims. Under the proposed method, the actuary would need 13 data points for earned exposures and 48 data points for the 6 calendar year paid claims, with each year broken out by the most recent 8 accident years. Another weakness of this method is the method that data needs to be organized. The proposed method segments data into groups that are traditionally not used.

The other drawback of this method is the erratic results this method will produce when used for new lines of business. When companies enter lines of business, their exposure level will be low. Since this method matches claims/losses to exposures, there is a possibility that this method may produce results that are irrational. Although the adjusted formulas provide a more accurate result, credibility must be considered for small or volatile lines of business as with other methods of trending. Again, it is outside the scope of this article to determine the appropriate credibility standard for the results that this method will produce.

On the other hand, this method has multiple advantages. There is no need to assume a constant exposure level since risks are matched to the appropriate exposure. Also, there is no need to select development factors because calendar year data is still used. Finally, there is no need to make an assumption relating reported claims to paid claims.

The adjusted paid frequency, adjusted paid severity, and adjusted paid pure premium formulas are better alternatives to current practices since they eliminate the need to make major assumptions about the data and they provide a better match of risk and exposure.

Acknowledgments

I would like to thank Charles Parsons, Floyd Yager, Kathy Reither, members of the Committee on Ratemaking, and numerous others for their valuable assistance in reviewing earlier drafts.

Biography of Author

Chris Styrsky is an assistant actuary at Allstate Insurance Company in Northbrook, IL. His primary responsibility is personal lines pricing. He has a degree in Actuarial Science for the University of Illinois, Champaign-Urbana. He is a Fellow of the CAS and a Member of the American Academy of Actuaries.