AKUR8
RESERVING

Arius

Generalized Cape Cod Method

The Generalized Cape Cod method

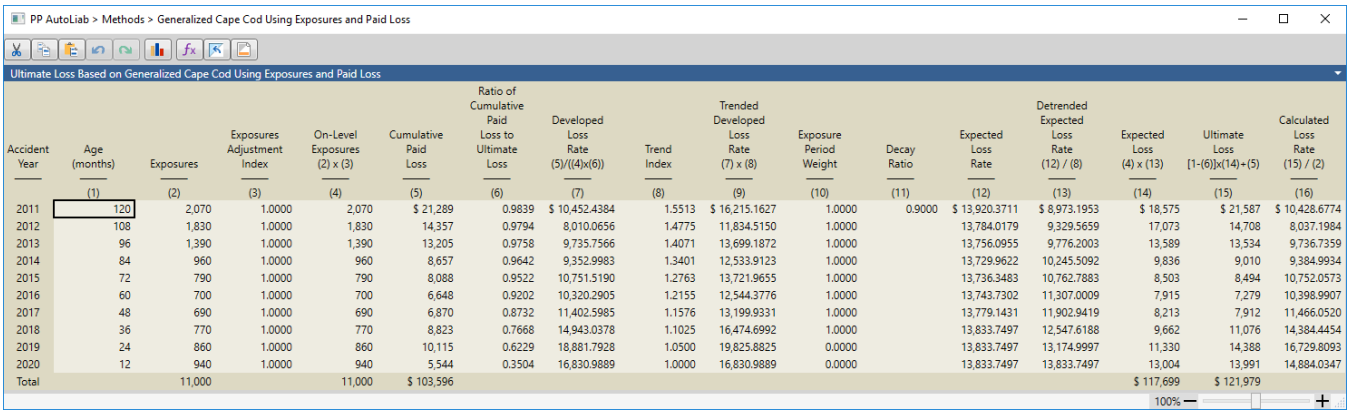
Arius includes several variations of the Cape Cod method to help project ultimate losses, ultimate ALAE, or ultimate Salvage & Subrogation (S&S). The methods vary based on the selection of the exposure base (i.e., exposures, ultimate premiums, ultimate claims, or ultimate loss) and the known cumulative data (i.e., paid loss, incurred loss, paid ALAE, incurred ALAE, or S&S received).

Whenever an appropriate exposure base has been identified, you can rely on a loss reserving method that is a blend between the loss development method and an exposure-based expected loss method. The most common of these blended methods are the Bornhuetter-Ferguson and Cape Cod methods. The two methods are very similar in that an ultimate loss (or ALAE or S&S) is projected based on expected loss rate (or loss ratio, ALAE ratio, or S&S to loss, etc.) estimates. These estimates are then modified to the extent paid losses (or incurred loss, paid ALAE, S&S received, etc.) to date differ from what would have been expected based on the selected development pattern.

The Cape Cod method differs from the Bornhuetter-Ferguson method in the calculation of the expected loss rate estimates. Instead of externally-derived expected loss rate estimates, the Cape Cod method bases its expected loss rate estimates on a weighted average of the trended developed loss rate for all selected exposure periods combined. The weights are based on a three-dimensional weighting scheme:

- they are proportional to exposures for those periods selected to be included in the calculation;
- they are proportional to percentage developed or the ratio to ultimate; and
- they are inversely proportional to the "distance" from the exposure period in question (accomplished through use of a decay ratio).

Because all the variations are similar, the text below is limited to describing the case of the Generalized Cape Cod Using Exposures Premium and Paid Loss.


PP AutoLiab > Methods > Generalized Cape Cod Using Exposures and Paid Loss

Ultimate Loss Based on Generalized Cape Cod Using Exposures and Paid Loss

Accident Year	Age (months)	Exposures	Exposures Adjustment Index	On-Level Exposures (2) x (3)	Cumulative Paid Loss	Ratio of Cumulative Paid Loss to Ultimate Loss	Developed Loss Rate (5)/((4)x(6))	Trend Index	Trended Developed Loss Rate (7) x (8)	Exposure Period Weight	Decay Ratio	Expected Loss Rate	Detrended Expected Loss Rate (12) / (8)	Expected Loss (4) x (13)	Ultimate Loss [1-(6)]x(14)+(5)	Calculated Loss Rate (15) / (2)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
2011	120	2,070	1.0000	2,070	$ 21,289	0.9839	$ 10,452.4384	1.5513	$ 16,215.1627	1.0000	0.9000	$ 13,920.3711	$ 8,973.1953	$ 18,575	$ 21,587	$ 10,428.6774
2012	108	1,830	1.0000	1,830	14,357	0.9794	8,010.0656	1.4775	11,834.5150	1.0000		13,784.0179	9,329.5659	17,073	14,708	8,037.1984
2013	96	1,390	1.0000	1,390	13,205	0.9758	9,735.7566	1.4071	13,699.1872	1.0000		13,756.0955	9,776.2003	13,589	13,534	9,736.7359
2014	84	960	1.0000	960	8,657	0.9642	9,352.9983	1.3401	12,533.9123	1.0000		13,729.9622	10,245.5092	9,836	9,010	9,384.9934
2015	72	790	1.0000	790	8,088	0.9522	10,751.5190	1.2763	13,721.9655	1.0000		13,736.3483	10,762.7883	8,503	8,494	10,752.0573
2016	60	700	1.0000	700	6,648	0.9202	10,320.2905	1.2155	12,544.3776	1.0000		13,743.7302	11,307.0009	7,915	7,279	10,398.9907
2017	48	690	1.0000	690	6,870	0.8732	11,402.5985	1.1576	13,199.9331	1.0000		13,779.1431	11,902.9419	8,213	7,912	11,466.0520
2018	36	770	1.0000	770	8,823	0.7668	14,943.0378	1.1025	16,474.6992	1.0000		13,833.7497	12,547.6188	9,662	11,076	14,384.4454
2019	24	860	1.0000	860	10,115	0.6229	18,881.7928	1.0500	19,825.8825	0.0000		13,833.7497	13,174.9997	11,330	14,388	16,729.8093
2020	12	940	1.0000	940	5,544	0.3504	16,830.9889	1.0000	16,830.9889	0.0000		13,833.7497	13,833.7497	13,004	13,991	14,884.0347
Total		11,000		11,000	$ 103,596									$ 117,699	$ 121,979	

100%

For more detailed information on this method, please refer to *Using Best Practices to Determine a Best Reserve Estimate*, by Paul Struzzieri, FCAS and Paul Hussian, FCAS, available from the Casualty Actuarial Society website.

EXPECTED LOSS RATE

To demonstrate via a formula, the expected loss rate in Column (12) of method #64, entitled **Generalized Cape Cod Using Exposures and Paid Loss**, is calculated as follows:

$$Exp(LR_i) = \frac{\sum_j \frac{TL_j}{(E_j \times RTU_j)} \times (E_j \times EPW_j \times RTU_j) \times D^{|i-j|}}{\sum_j (E_j \times EPW_j \times RTU_j) \times D^{|i-j|}}$$

where

$Exp(LR)$ = expected loss rate estimate for exposure period *i*

TL_j = trended cumulative loss

E_j = on-level exposures for exposure period j

EPW_j = weight given to exposure period j (0 = exclude or 1 = include)

RTU_j = ratio to ultimate for exposure period j (or 1/loss development factor to ultimate)

D = decay ratio ($0 < D \leq 1$)

Aside from exposures, the ratio to ultimate which will be derived from your selected development pattern, and cumulative paid losses to date, the method generally requires four additional inputs:

- Exposure adjustment index,
- Trend index,
- Exposure period weights, and
- Decay ratio.

EXPOSURE (OR PREMIUM) ADJUSTMENT INDEX

Prior to arriving at the trended developed loss rate in Column (9), the exposure measure needs to be adjusted for changes in risk profile via the **Exposure (or Premium) Adjustment Index in Column** (3). The factors to be applied should correspond to an index such as 1.05 or 0.95. As mentioned above, the exposure base used in the Cape Cod methods vary and include ratemaking exposures (e.g., payroll, sales, or car-years), ultimate premiums, and ultimate claims. An ultimate loss is also used when projecting ultimate ALAE and ultimate Salvage & Subrogation.

If ratemaking exposures are used, adjustments need to be made for any change to the risk profile that would affect the expected loss rate. These changes could include:

- number of risks,
- average size of risks,
- policy-limiting factors (limits, deductibles and net retentions),
- class of business (including territory and state),
- underwriting standards (including loss control and risk management initiatives),
- claims adjustment procedures (changes in philosophy, treatment of incidents),
- inflation, and
- external factors (e.g., benefit level changes).

For example, if ratemaking exposures are used as the exposure base, they should first be converted to a base class-equivalent basis to account for any changes in the class mix.

If premiums are used, adjustments need to be made for changes in rate level adequacy. Premiums have certain advantages over exposures when the mix of business by class, territory or limit has changed *as long as these items are priced correctly.* There is also the danger, when using premiums, of being unable to measure changes other than manual rate changes (e.g., changes in the average schedule debit or credit).

All else being equal, the exposure base requiring the fewest adjustments is typically the best choice because additional adjustments can add imprecision to the process. In most situations, this would be ultimate claims or ultimate losses in the case of projecting ultimate ALAE and Salvage & Subrogation.

Alternatively, losses can also be adjusted to reflect the changes in risk profile in the same manner as trend adjustments.

TREND INDEX

Prior to arriving at the **Trended Developed Loss Rate** in Column (9), losses need be adjusted to a common severity and/or frequency level via a **Trend Index** in Column (8). The **Trend Index** to be applied should correspond to an index such as 1.05 or 1.10. For example, an annual 5.0% severity trend over the last 5 years would correspond to an array of indexes such as {1.276, 1.216, 1.158, 1.103, 1.050, 1.000}. This array will then get applied to the **Cumulative Paid Losses** in Column (5).

If ultimate claims are used, losses should be adjusted for severity differences by size of risk, by limits and deductibles, by class/state mix of business, and for changes in underwriting standards and claims adjustment procedures.

If premiums or ratemaking exposures are used, losses should be further adjusted for changes in frequency.

Note that before expected losses can be calculated for each exposure period, the trend adjustments are reversed and the losses are detrended in Column (13) so that each period's losses are at its actual, as opposed to common level.

EXPOSURE PERIOD WEIGHTS

The **Exposure Period Weight** array allows you to exclude certain exposure periods. The weights to be applied should be input as either a 0 (meaning to exclude) or a 1 (meaning to include). It is likely this feature will be applied to periods with zero or few exposures or to the more recent exposure periods where the development method results are not as credible.

DECAY RATIO

The **Decay Ratio** can vary between 0 and 1. At one extreme (where D = 1), all the expected loss rates are set to the same value derived from an overall weighted average based on just the exposures and the ratio to ultimate. This is basically the same as the traditional or standard Cape Cod method. At the other extreme (where D = 0), the expected loss rates will vary for each exposure period and be identical to the loss rates derived from the development method calculated ultimates. Varying the decay ratio between 0 and 1 will determine the amount of "smoothing" to apply to the individual trended developed loss rates. For example, a decay ratio of 0.75 applies a weight of 1.00 to the period in question, a weight of (.75) to the two immediate surrounding periods, a weight of $(.75)^2$ to the next immediate surrounding periods, and so on. In general, as your confidence in the development method

increases, you probably want to apply less weight to the surrounding periods, and therefore smaller decay ratios should be used.

You only need to enter one decay ratio for the entire method. You will enter this into the first row of the Decay Ratio input vector, by selecting the **Decay Ratio** column in the method, right click and select **Source Data**. While only the first entry in the **Decay Ratio** input vector is used in the method calculations, you may want to populate the entire column, so the method will function after structure changes that remove the first row of the vector (ex. removing the oldest exposure period).

Populating entire columns with the same assumption value is easily handled by using the **Defaults** from the **Main** ribbon. See the *Default settings to automate analysis* document for more information.