



Rethink Your WC Reserve Analysis

Using Predictive Modeling

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16 September 2014

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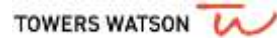
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Agenda

- Predictive Modeling Overview
 - Applications
 - Reserving
 - Claims Triage
- Traditional Reserving Development Methods
 - Key Points
 - Challenges
- Reserving with Predictive Modeling
 - Advantages
- Aggregate Reserving Methods
 - Aggregate Incremental Paid Method
 - Calendar Year Method
- Individual Claim Reserving Methods
 - Incremental Paid Method
 - Claim Closure Rate Method
 - Open Claim Method
 - Frequency/Severity Method

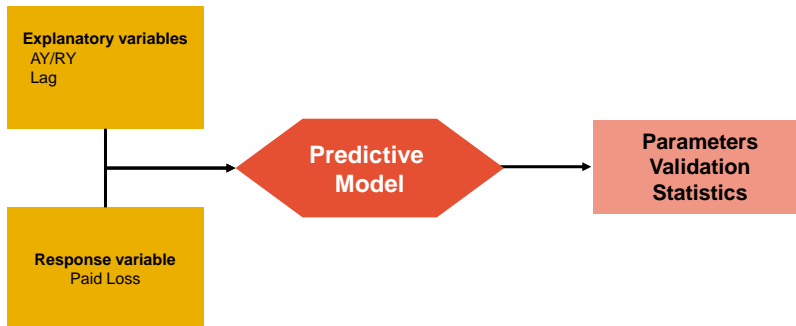


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Predictive Models

Definition: Statistical model to predict a response variable using a series of explanatory variables



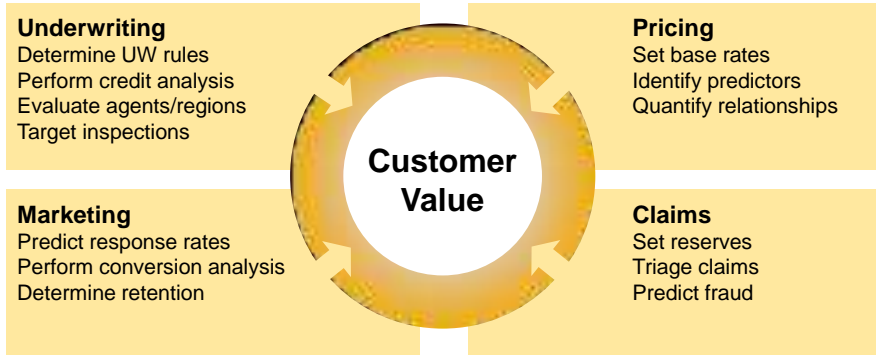
Same techniques apply regardless of what is being modeled

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Predictive Models

Application

Predictive modeling can help integrate all aspects of insurance operations and help identify the value of all customers

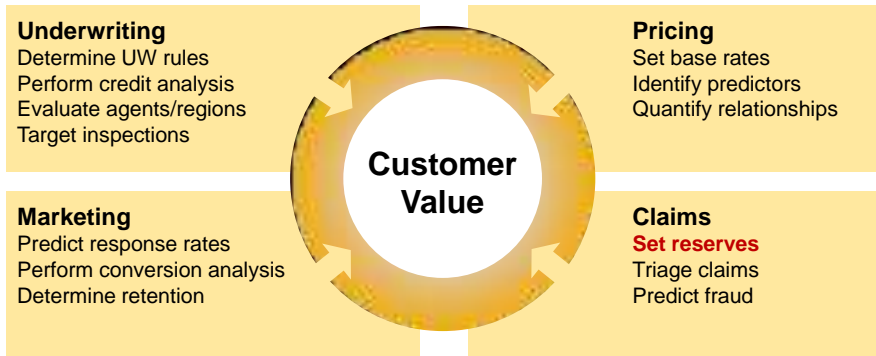


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Predictive Models

Application

Predictive modeling can help integrate all aspects of insurance operations and help identify the value of all customers

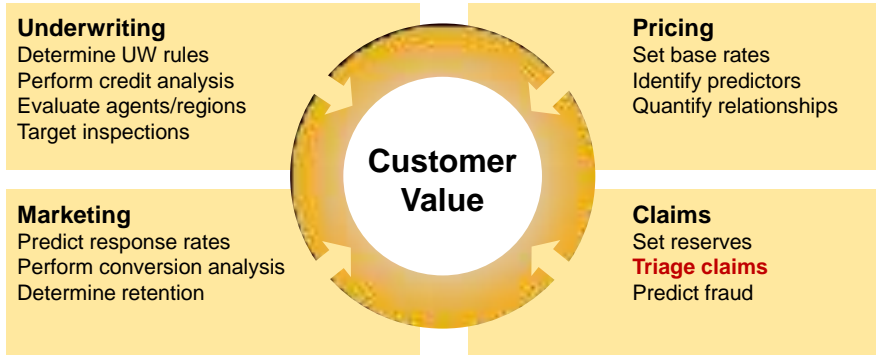


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Predictive Models

Application

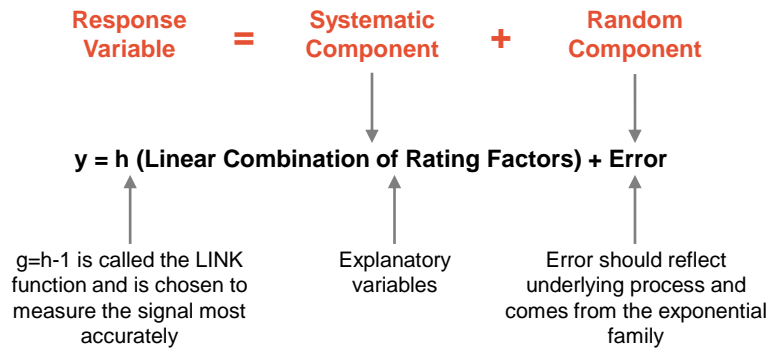
Predictive modeling can help integrate all aspects of insurance operations and help identify the value of all customers



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Generalized Linear Models (GLMs)

GLMs are a flexible and sophisticated predictive modeling technique



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Traditional Development Methods

Traditional methods **aggregate** all claims in each cell within the historical triangle on a **cumulative** basis

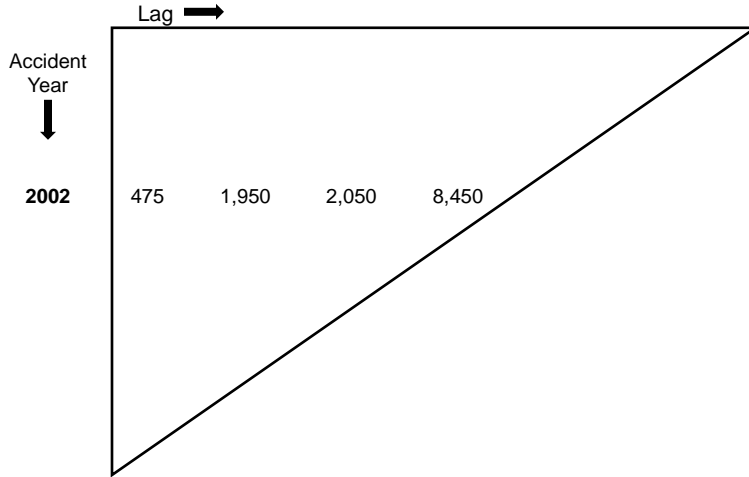
Accident Year 2002

Claim	12	24	36	48
000001	0	1,000	1,000	5,000
000021	50	50	50	50
000060	0	0	0	250
000124	300	500	500	750
000328	125	400	400	400
000443	0	0	100	2,000
2002 Total	475	1,950	2,050	8,450

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Traditional Loss Development Methods

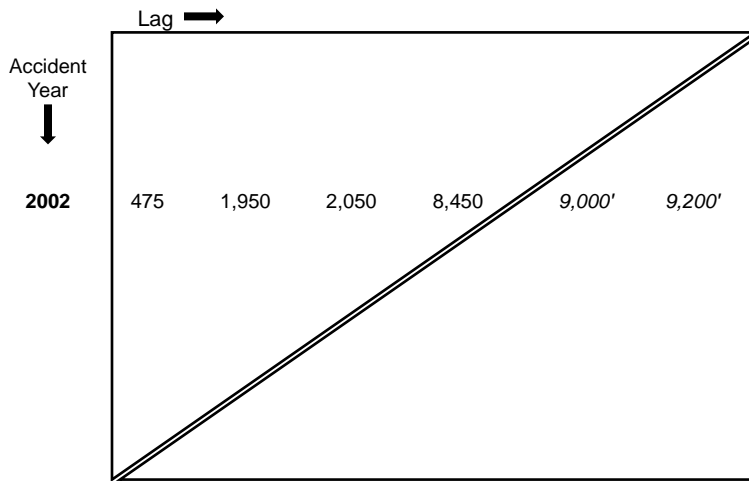
Repeat the process for each year until entire triangle is populated



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Traditional Loss Development Methods

Goal is to square up the triangle using link ratios

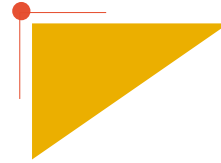


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Traditional Development Methods

Key Points

- Aggregated Data
 - Forfeit almost all information unique to each claim
 - Paid, case, reported, open, closed
- Evaluates across only two dimensions: Year and Lag
- Estimates IBNER and pure IBNR together
- Accuracy hinges on consistency
 - Claim closure rate
 - Case reserve adequacy
 - Inflation
 - Reinsurance
- Traditional development methods work quite well when the historical data is consistent, reasonably credible and contains sufficient history



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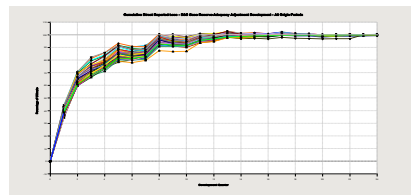
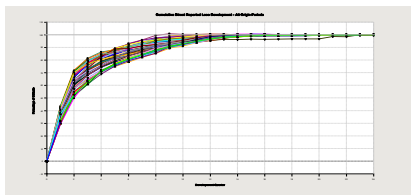
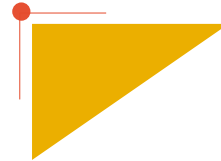
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Traditional Development Methods

Challenges

- Challenge is dealing with inconsistency
 - Can consistency/inconsistency be measured?
 - Few cells within triangle make it challenging to measure
 - Small changes are oftentimes masked by random volatility but can impact indications significantly
 - Especially difficult with low frequency/high severity business
 - When measurable, can historical data be adjusted to be consistent?
 - Traditional adjustment approaches tend to produce patterns that are difficult to interpret



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Predictive Modeling in Reserving



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Predictive Modeling Reserving Methods

- Multiple methodologies exist under a predictive modeling framework
 - Aggregate Data
 - Individual Claim Data
- Advantage: The incorporation of additional variables beyond the traditional two-dimensional model using “year” and “lag” enable us to identify patterns and trends that otherwise would be masked in the data:
 - Can address the inconsistency weakness in traditional methods
 - Provides insights into the drivers of claim cost
 - How much does age affect the cost of WC claims?
 - What is the impact of opioid usage on the cost of claims?
 - How much did reform measures impact claim costs?
 - Enables us to establish consistent and more accurate case reserves

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Aggregate Reserving Methods



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Aggregate Incremental Paid Method

A traditional aggregate loss development method can be **replicated** in a GLM framework

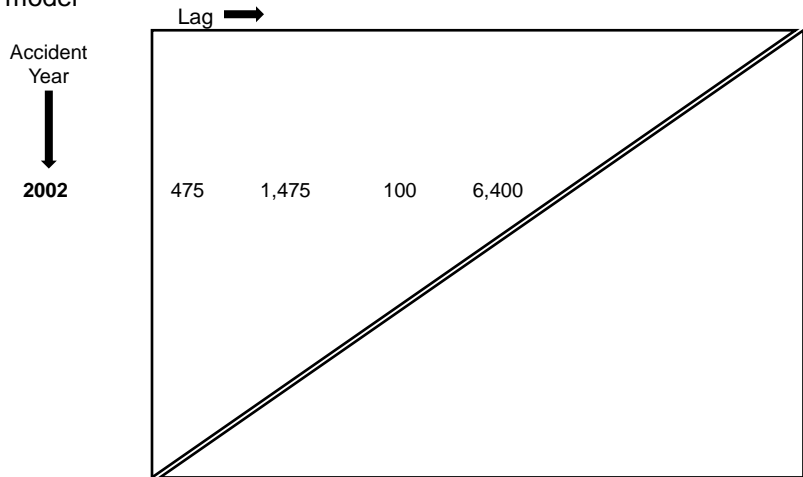
Difference is that GLM triangle is set to an **incremental** basis

Accident Year 2002				
Claim	12	24	36	48
000001	0	1,000	1,000	5,000
000021	50	50	50	50
000060	0	0	0	250
000124	300	500	500	750
000328	125	400	400	400
000443	0	0	100	2,000
2002 Total	475	1,950	2,050	8,450
2002 Incr	475	1,475	100	6,400

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Aggregate Incremental Paid Method

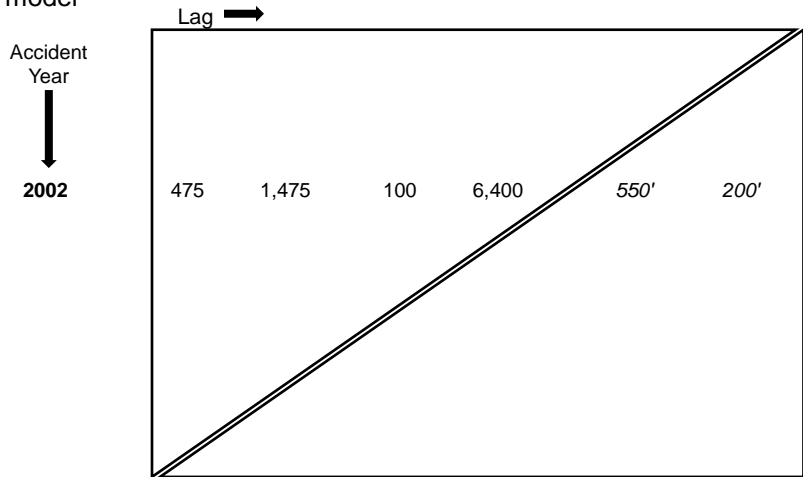
Goal in GLM is the same: square up the triangle using parameters from the model



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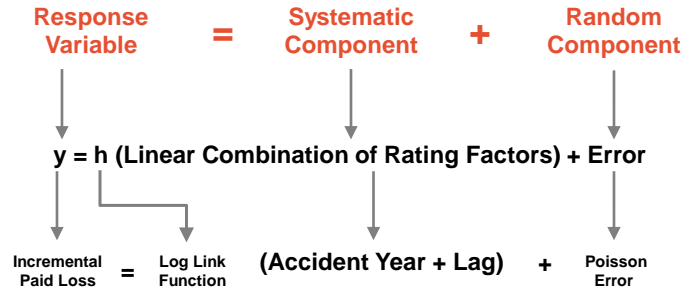
Aggregate Incremental Paid Method

Goal in GLM is the same: square up the triangle using parameters from the model



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Aggregate Incremental Paid Method — GLM Structure



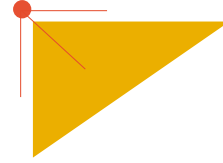
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Aggregate Incremental Paid Method

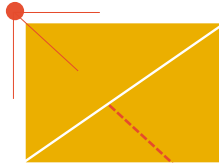
Key Points

- Aggregated Data
 - Forfeit almost all information unique to each claim
 - Paid, case, reported, open, closed
- Evaluates across only two dimensions: Year and Lag
- Estimates IBNER and pure IBNR together
- Accuracy hinges on consistency
 - Claim closure rate
 - Case reserve adequacy
 - Inflation
 - Reinsurance
- Replicates a traditional paid loss development method using volume weighted average link ratios

Calendar Year Method

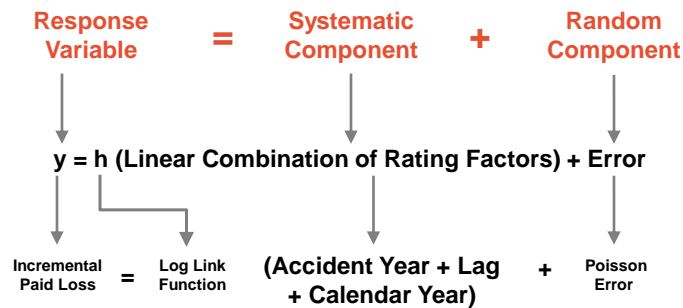


- As the name implies, this method incorporates a third dimension into the modeling process, calendar year
 - Can be applied to aggregate or individual claim data
- Advantage
 - To be able to incorporate changes in inflation/claim cost into the reserve estimation process
- Challenge
 - Squaring up the triangle requires extrapolation of calendar year into the future



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Calendar Year Method — GLM Structure




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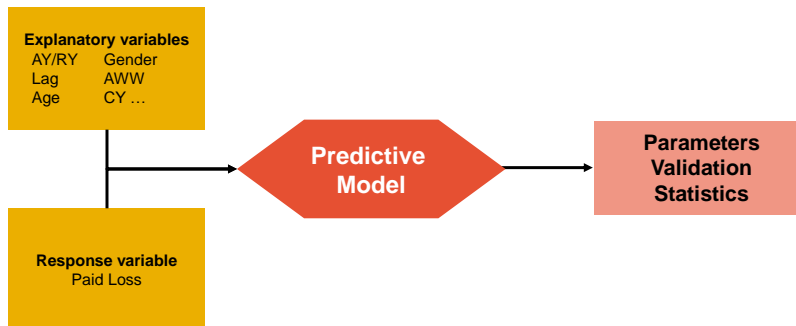
Individual Claim Reserving Methods

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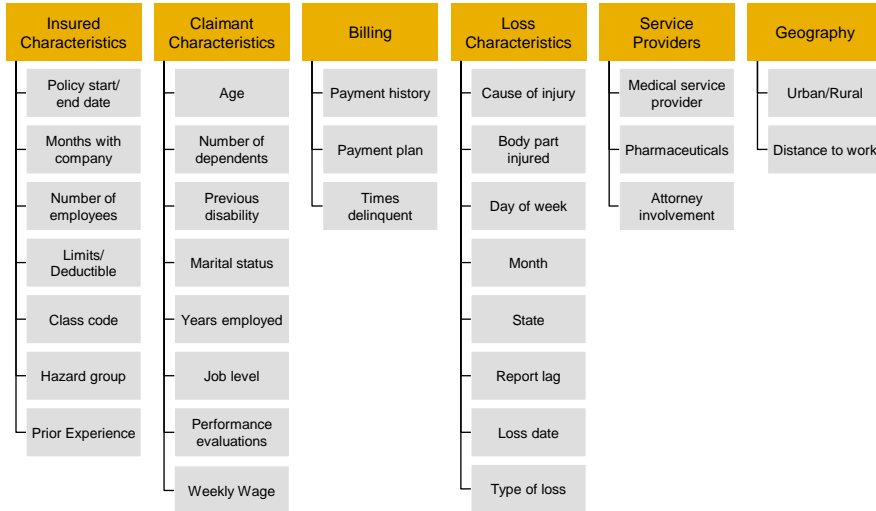
Individual Claim Reserving Methods

- Now that the data is configured by claim instead of in aggregate, we can introduce additional explanatory variables that are unique to each claim:



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Individual Claim Reserving Methods WC Data Utilized



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Incremental Paid Method

While previous examples used aggregated data, GLM's also work with individual claim data

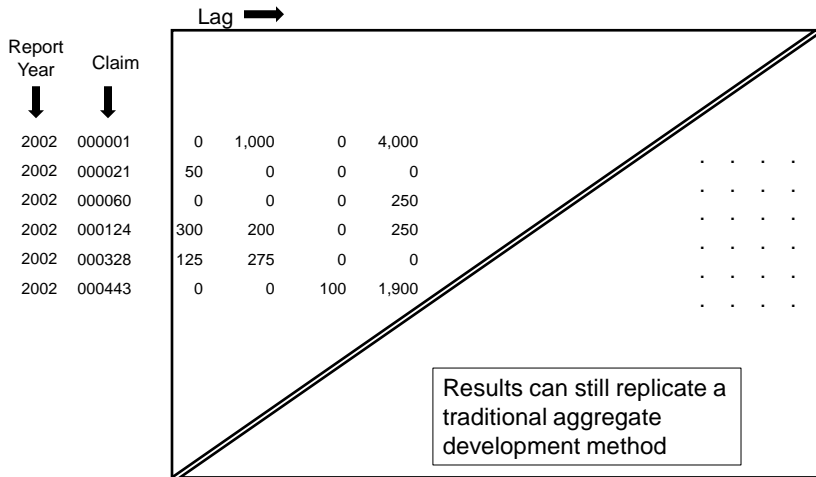
Incremental 2002 Claims

Claim	12	24	36	48
000001	0	1,000	0	4,000
000021	50	0	0	0
000060	0	0	0	250
000124	300	200	0	250
000328	125	275	0	0
000443	0	0	100	1,900
2002 Total	475	1,475	100	6,400

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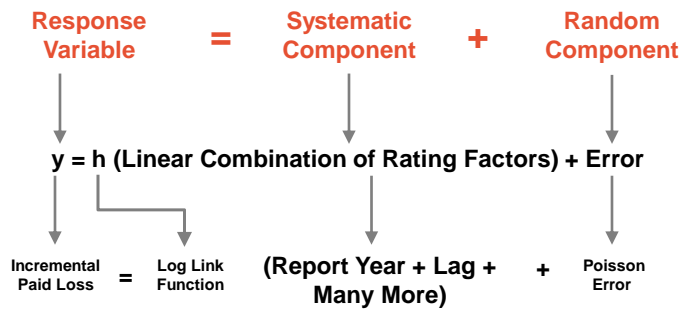
Incremental Paid Method

Goal: square up the triangle with respect to each individual claim



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Incremental Paid Method — GLM Structure



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Incremental Paid Method

Key Points

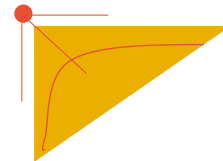
- Aggregate incremental paid method blends the estimation of IBNER and pure IBNR into one single estimate
- Individual Incremental Paid method models individual claim data and as a result focuses solely on forecasting IBNER
 - Pure IBNR must be estimated separately
 - Model to predict the frequency of IBNR claims
 - Model to predict the severity of IBNR claims
- Individual claim characteristics used as explanatory variables must be static or known throughout the forecasted periods
 - Med-only/Lost-time
 - Open/Closed

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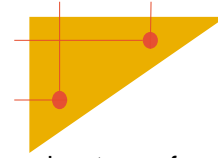
Claim Closure Rate Method



- Models closed claim data and expands on the Calendar Year method by adding a fourth dimension:
 - Year
 - Lag
 - Calendar Year
 - Claim Closure Rate
- Discussed in a paper by Greg Taylor and Grianne McGuire
- Advantages
 - Ideal for high frequency / low severity business where minor changes in claim closure rate affect aggregate methods
 - Estimates total IBNR
- Challenge
 - Method for forecasting future closed claims restricts ability to incorporate unique claim characteristics

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Open Claim Method



- Open Claim method builds a series of models that takes advantage of all information known about the claims, including:
 - Calendar year – builds upon previous method
 - Latest paid/incurred to date
 - Individual claim characteristics
- Models reserves for each open claim
- Advantage
 - Claim information is not limited to being static or known
- Challenge
 - Multiple models need to be built
 - Credibility concerns can occur in the tail

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Frequency / Severity Method

- Aggregate ultimate severity by year estimated through traditional approaches
- Robust severity model is built using all available claim information and latest known information
 - Development is normalized across data
- Ultimate Severity x Severity Model applied to known and IBNR claims individually to produce ultimate
- Advantages
 - Ideal for low frequency / high severity business where aggregate loss development methods are volatile



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