ICRFS™

BEST'S SCHEDULE P

A.M BEST®

Insureware
Innovative Statistical Solutions for P&C Insurance

Contents

1. Introducing ICRFS™ Best's Schedule P

You have ELRF™ Best's Schedule P and want more modeling power?

Insureware has created ICRFS™ Best's Schedule P for you.

This premium application from Insureware adds the innovative probabilistic modeling frameworks of ICRFS™ to the functionality of ELRF™ Best's Schedule P.

ICRFS™ Best's Schedule P empowers you to answer questions like:
- Are our company's loss costs similar to our competitors?
- How do our company's trends, risk diversification, and loss ratios rank in the industry?
- Which companies could be targeted for reinsurance or acquisition?
- What correlations should be used to calculate our risk diversification?

Examples of the Extended Link Ratio Family (ELRF) modeling framework and database navigation can be found in Insureware's ELRF™ Best's Schedule P brochure.

ELRF™ Best's Schedule P versus ICRFS™ Best's Schedule P

| Data and modeling frameworks	ELRF™ Best's Schedule P 2015	ICRFS™ Best's Schedule P 2015	Data and modeling frameworks	ELRF™ Best's Schedule P 2015	ICRFS™ Best's Schedule P 2015
Database			**Extended Link Ratio Family (ELRF)**		
Best's Schedule P long-tail liability lines	✓	✓	Mack	✓	✓
Industry Totals	✓	✓	Murphy	✓	✓
Net and Gross data	✓	✓	Trends (down accident years) and intercepts	✓	✓
Critical financial information:			Optimisation	✓	✓
Reserves Held	✓	✓	Bootstrap	✓	✓
%IBNR	✓	✓	Quantiles, V@Rs, and T-V@Rs	✓	✓
Total Loss Ratios	✓	✓	**Probabilistic Trend Family (PTF)**		
Survival Ratios	✓	✓	Full trend identification (including calendar)		✓
Ratios relative to Industry	✓	✓	Volatility quantification		✓
All Schedule P triangles			Modeling wizard		✓
Paid Losses	✓	✓	One year ahead statistics (CDR)		✓
Case Reserve Estimates	✓	✓	Liability stream		✓
Incurred Losses (not including BULK and IBNR)	✓	✓	Risk capital by calendar year		✓
Bulk and IBNR	✓	✓	Risk capital by accident year		✓
Number of Claims Reported	✓	✓	Quantiles, V@Rs, and T-V@Rs		✓
Number of Claims Closed	✓	✓	**Multiple Probabilistic Trend Family (MPTF)**		
Additional Triangles			Full trend identification (including calendar)		✓
Reserves Held	✓	✓	Volatility quantification		✓
Ultimates Held	✓	✓	Correlations		✓
Link Ratio methods			One year ahead statistics (CDR)		✓
Link Ratio Techniques (LRT)	✓	✓	Liability stream		✓
Aggregate Link Ratio Techniques (ALRT)	✓	✓	Risk capital by calendar year		✓
Payment Per Claim Incurred (PPCI)	✓	✓	Risk capital by accident year		✓
Projected Case Estimates (PCE)	✓	✓	Solvency II one-year ahead metrics		✓
Fisher-Lange (FL)	✓	✓	Ultimate year risk horizon metrics		✓

2. ICRFS™ probabilistic trend family modeling frameworks

ICRFS™ Best's Schedule P contains the two modeling frameworks of PTF and MPTF.

The Probabilistic Trend Family (PTF) modeling framework enables analysts to describe the trends in the data in all time directions (development, accident, and calendar) along with the volatility around those trends. The Multiple Probabilistic Trend Family (MPTF) modeling framework extends this further by also including correlations between lines of business – measured from the data.

Forecast scenarios are data driven. Future trends are related to trends found in the past data coupled with business knowledge and future expectations.

- Probabilistic Trend Family (PTF):
  - o Identify trends in the three directions (development, accident, and calendar);
  - o Measure the volatility around the trends;
  - o Use the modeling wizard to quickly generate starting models;
  - o Compare loss costs between companies and much more!
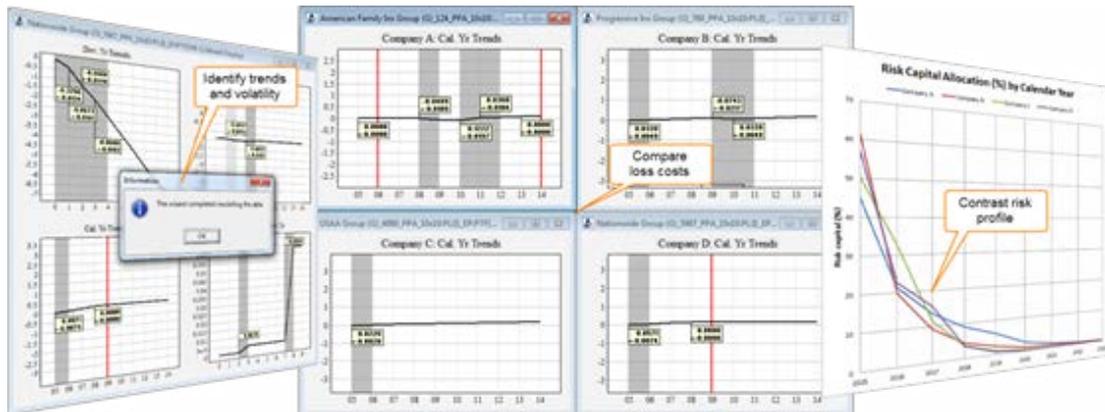
- Multiple Probabilistic Trend Family (MPTF):
  - o Measure correlation between multiple Lines of Business directly from the data;
  - o Determine risk capital allocation and diversification credit for entire companies;
  - o Calculate Solvency II one-year ahead statistics and associated risk for individual Lines of Business or whole companies;
  - o Create company profiles to visually compare performance and much more!
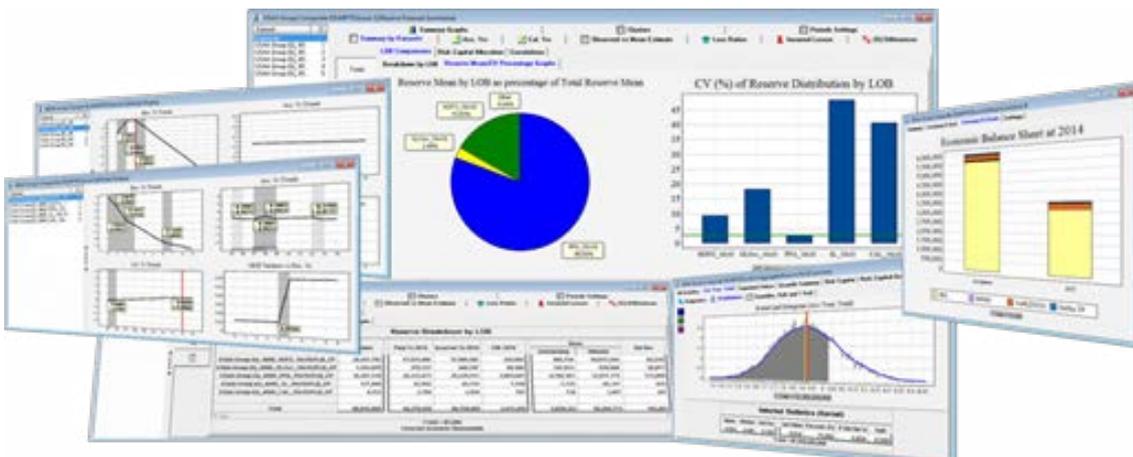
3. A.M. Best Schedule P snapshot (Net)

In this section, metrics are extracted from the Best's Schedule P database to create a snapshot of key performance indicators for the companies based on the Net data.

3.1. AMB Group companies - Net Market share (2015)

To calculate the market share amongst the AMB Group Companies the total Net Earned Premium (NEP) for each company is divided by the total Net Earned Premium written by the AMB Group companies. Note that unaffiliated (non-Group) companies comprise just over 6% of the total Industry's Net Earned Premium.

The largest 16 AMB Group Companies are displayed (in order of Total Net Earned Premium) with the remainder aggregated into 'Other'. The line shows the cumulative market share (left to right).

The first 20% of market share is distributed between three AMB Group companies. The next 20% is distributed between four AMB Group companies. Over half the total Net Earned Premium at the AMB Group level is earned by a mere nine company groups.

## 3.2. Industry Net Premium by Line of Business

The following graphic shows the Net Earned Premium earnt by Line of Business at the industry level.
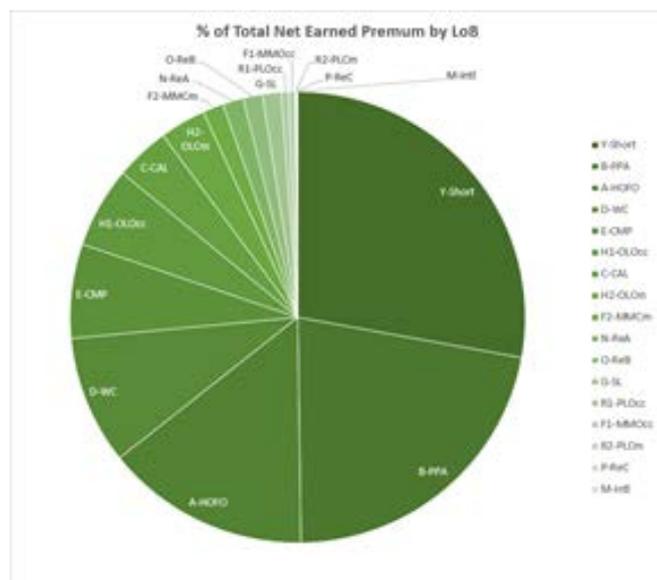
The largest segment is the short tail lines (Y-Short), followed by B (Private Passenger Automobile) and A (Home Owners / Farm Owners). These three lines make up 64% of the Total Net Earned Premium.

The sum of the smallest four lines (F1-MMOcc, R2-PL-CM, P-ReC, and M-Int) NEP is still less than one percent for the total NEP. In dollar terms, the NEP over a ten year period for these three lines is 30.2B − not in itself a small figure, but it pales in comparison to the 1,008B premium in B-PPA over the same period.

3.3. Number of AMB Group companies by Line of Business

The competition of Group companies amongst the Lines of Business in Best's Schedule P is not evenly distributed. Very few groups write the lines M-Intl and P-ReC for instance.

Line	A-HOFO	B-PPA	C-CAL	D-WC	E-CMP	F1-MMOcc	F2-MMCm	G-SL	
% of Total NEP	14.52	21.91	3.89	9.21	6.75	0.49	1.48	1.32	
N Group Companies	213	209	196	163	206	63	67	108	
N Group Companies / % of Total NEP	14.67	9.54	50.35	17.70	30.52	129.44	45.16	81.96	

Line	H1-OLOcc	H2-OLCm	M-Intl	N-ReA	O-ReB	P-ReC	R1-PLOcc	R2-PLCm	Y-Short
% of Total NEP	5.77	3.28	0.03	1.46	1.37	0.05	0.51	0.09	27.86
N Group Companies	248	112	21	89	71	25	108	39	282
N Group Companies / % of Total NEP	42.96	34.17	673.28	60.78	51.66	538.22	213.53	424.00	10.12

The above graphic shows the number of AMB Group companies writing each line along with the percentage of Net Earned Premium (red line) contributing to the total Net Earned Premium. There is a close relationship between the market volume (as measured by Net Earned Premium) and the number of companies competing for that Net Earned Premium. The more companies competing for Net Earned Premium, the harder it is to increase market share.

Another way of looking at this is to consider the Total Percentage of Net Earned Premium versus the number of companies competing for that percentage point.

For the AMB Group Companies, it is likely more profitable to pursue lines with less concentration per total % of EP. The lower numbers indicate less concentration per percentage point. B-PPA is the 'best' line by this metric, despite having the third-largest number of AMB Group companies competing for the premium. The lines M, P, and R2 are the worst to compete for despite having a low number of AMB Group companies writing the lines.

Note this does not consider profitability of the line – only the possible Earned Premium income.

3.4. Insureware calculated metrics by Line of Business

Insureware calculates a number of metrics for each triangle group in the Best's Schedule P database. (A triangle group is set of triangles, exposures, models, and other objects connected with the same Company, Line of Business, or other definable grouping variable).

Insureware

Survival Ratios for each company and by Line of Business

Insureware calculates survival ratios as the total reserves held (IBNR + CRE) divided by the total dollars paid in the last calendar year excluding development period zero.

This represents the number of years the company could survive given the held reserves and losses in every year occurring at the same magnitude of the last calendar year. Development period zero is excluded since the reserves held do not allocate any reserves to development year zero.
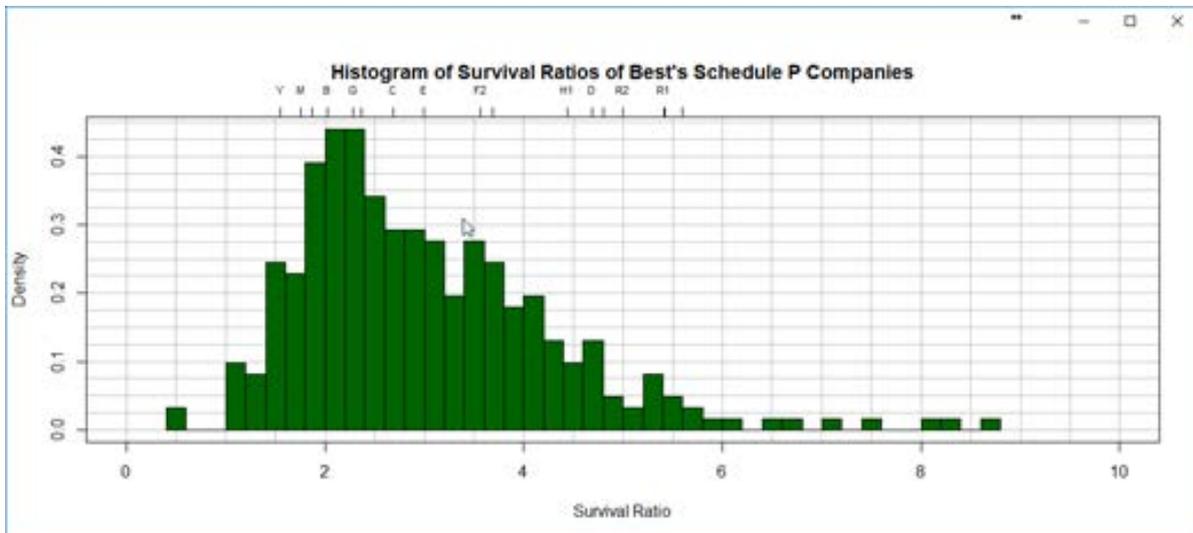
The Survival Ratios for AMB Group companies are displayed above (a few outliers are excluded). The median survival ratio for individual LoBs are marked at the top of the display.

Expected Loss Ratios for each company and by Line of Business

The Expected Loss Ratios for all AMB Group companies are displayed by Line of Business below. The median Expected Loss Ratios for individual LoBs are marked at the top of the display.
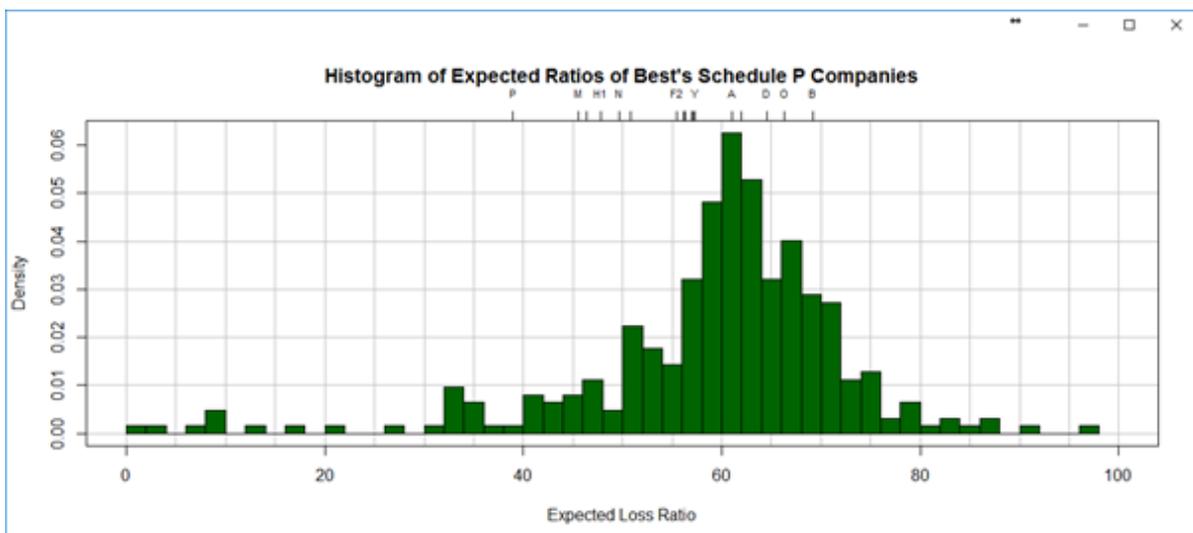
Most of the Group companies have an overall Net Expected Loss Ratio between 44% (10% quantile) and 74% (90th quantile). Reinsurance C (Best's Schedule P prefix 'P') has the lowest median Expected Loss Ratio.

3.5. If the Industry was in 'distress' which Lines of Business would be the main contributors?

If the Industry was in 'distress', which Lines of Business would be the main contributors?

Distress in this instance means that the total losses in the next calendar year are at the 99.5th percentile of the aggregate distribution. The distribution of the aggregate is derived from the forecast scenarios for each LoB and the correlations between LoBs.

To obtain the distribution, since there is no analytical formula, many simulations must be generated from the correlated log-normal distributions for each cell and each line.
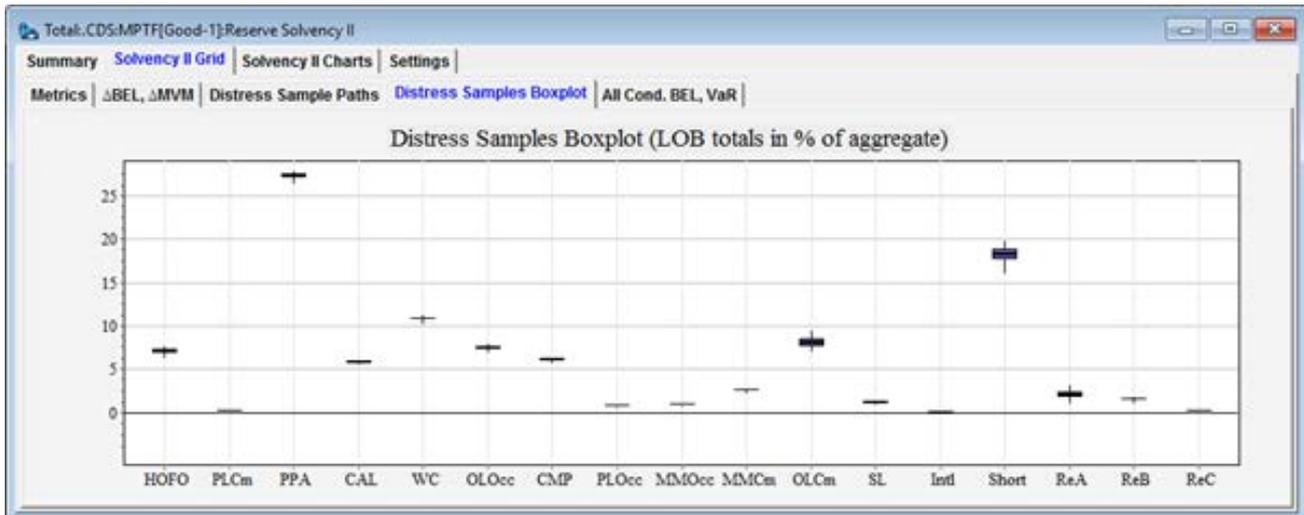
The line most likely to be in distress is B-PPA (understandably given the business volume) followed by the Short-tail lines. A-HOFO takes a much smaller proportion of the distress sample than might be expected, however this is because a large proportion of the losses are paid in development year zero.

4. Are trends in your loss costs similar to your competitors?

In order to answer this question, you first need to identify the trends in each time dimension (development, accident, and calendar) along with the volatility around the trends using the Probabilistic Trend Family (PTF) modeling framework.

Four of the top ten writers of Private Passenger Auto (in terms of held reserves) are:
- Progressive Ins Group;
- USAA Group;
- Nationwide Group; and
- American Family Ins Group

For each of these companies, a PTF model was designed for the Net Paid Losses adjusted by Earned Premium. All changes in trends are relative to the earned premium and thus reflect the loss costs of the business.
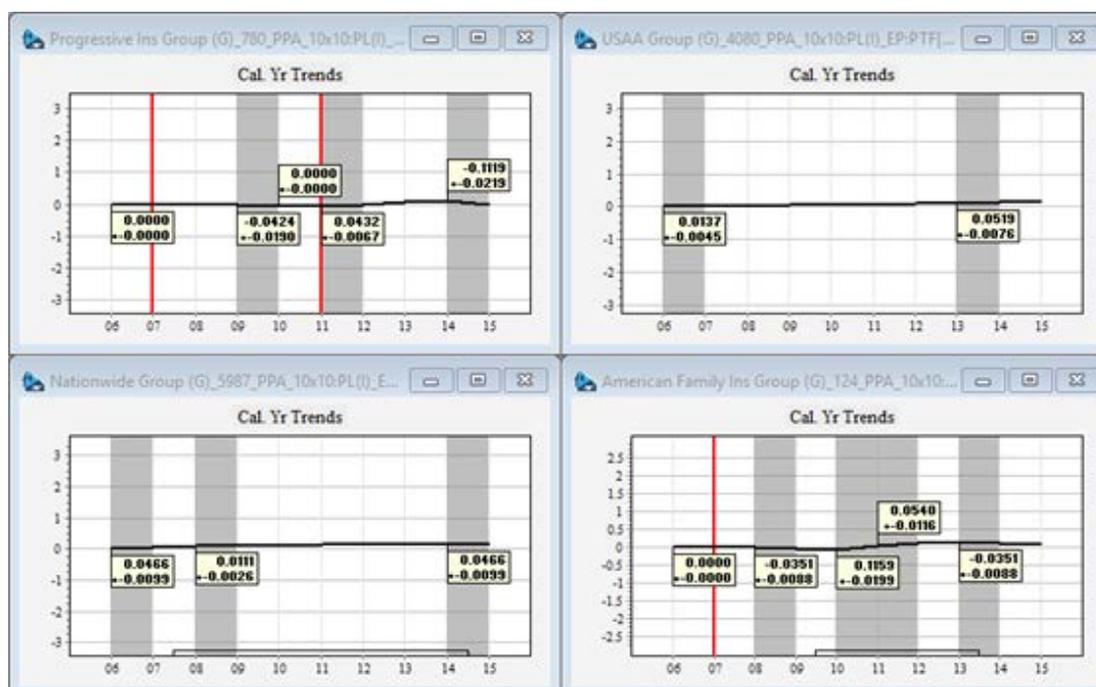
The calendar year trends are unique to each company and represent the net inflation – social and economic – above earned premium changes.

The PTF framework provides the ability to measure these trend changes scientifically. Link ratio methods are unable to quantify any inflation trends and are unable to meaningfully deal with calendar year trend changes as they have no parameters in the calendar year direction.

Further, calendar year trend changes do not coincide or otherwise indicate common drivers.

The most important driver of calendar year trends is social inflation (including changes in claim handling strategy). This inflation can only be measured from the data and is unique to each company.

Do you know the inflation in your Lines of Business?

What net inflation trends are your competitors exposed to?

4.1. Past loss cost trends versus future loss cost trends

After identifying the trends in the three directions in the past, we are positioned for projecting the future reserving (or pricing) periods. Without such decomposition, our understanding of the future losses is limited.

For comparison purposes, we produced forecast scenarios for each of these Private Passenger Auto (PPA) lines to a run-off of 30 development years. The forecast scenarios were designed to approximately match the reserves held by each respective company for the line by modifying the future calendar year trend assumption. The trend was maintained over the 30 year run-off period. For readability, only the first 10 years are shown in the displays below.
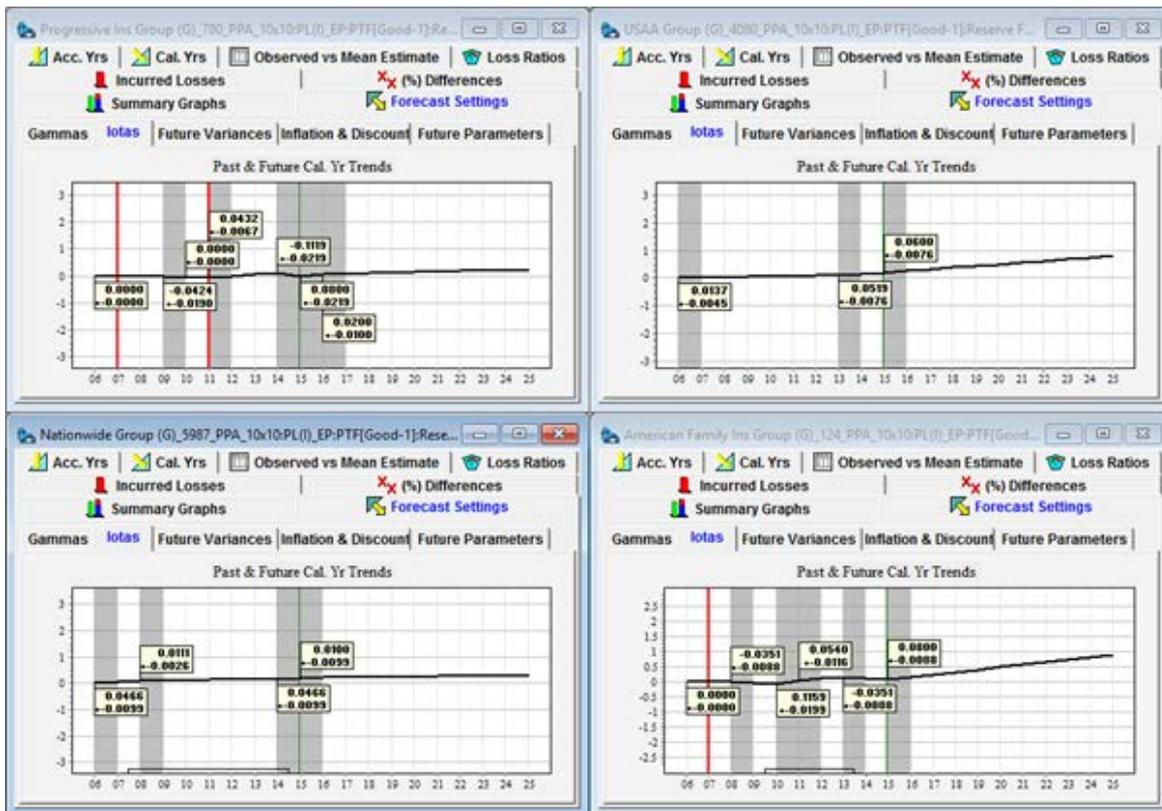
We can immediately see, relative to the identified model:

- American Family Ins Group and USAA Group forecasts are conservative;
- Nationwide's forecast is plausible but possibly optimistic; and
- Progressive Ins Group forecast is optimistic.

Now we compare this information with the respective survival ratios – with Industry survival ratios as a benchmark.

- Progressive Ins Group: 2.00
- USAA Group: 2.22
- Nationwide Group: 1.86
- American Family Ins Group: 2.49
- Industry survival ratio: 2.16

The two companies with the conservative forecasts also have the highest survival ratios – and their survival ratios are above the Industry average.

The other two companies have the same survival ratio – a ratio below the Industry average of 2.16. The respective forecast scenarios however, indicate that relative to the identified model, Nationwide is better positioned.

In this way, not only can trends in loss costs in the past be considered, but necessary loss cost trends in the future to reach Held Reserves can be evaluated for reasonableness and likely profitability.

Note that a full analysis to compare the companies would also consider the diversification between multiple Lines of Business – both the reserve mean and risk capital.

4.2. Future inflation assumptions and asset liability matching

The future net inflation assumptions are also indicative of future reserve allocation and risk capital allocation. Proper allocation of both reserves and risk capital is essential for asset liability matching.
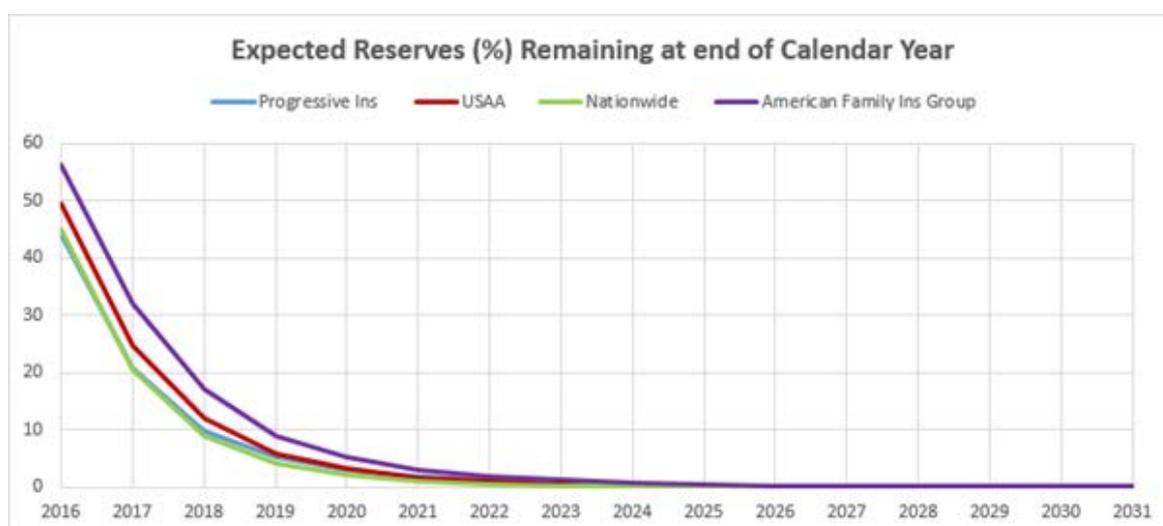
In the graph above we note two important considerations. Firstly, future calendar year trend assumptions are only important for the first five years (after 2021 the percentage allocation of reserves remaining is under 5% (any company).

The company with the highest future inflation assumption, American Family Ins Group, pays more of the reserves later in the development period. Similarly, the company with the lowest future inflation trend assumption, Progressive Ins Group, pays out more money early in the development period.

4.3. Risk capital allocation

Assuming the future forecast scenarios described in the previous section, the total risk capital (risk capital for the entire run-off period) for each company's PPA can be calculated at a desired threshold. For comparison purposes, risk capital was calculated as the difference between the 95th percentile and the reserves held.

Total Risk Capital (Millions) at the 95th Percentile

Risk Capital at the 95th Percentile as a percentage of Reserves Held
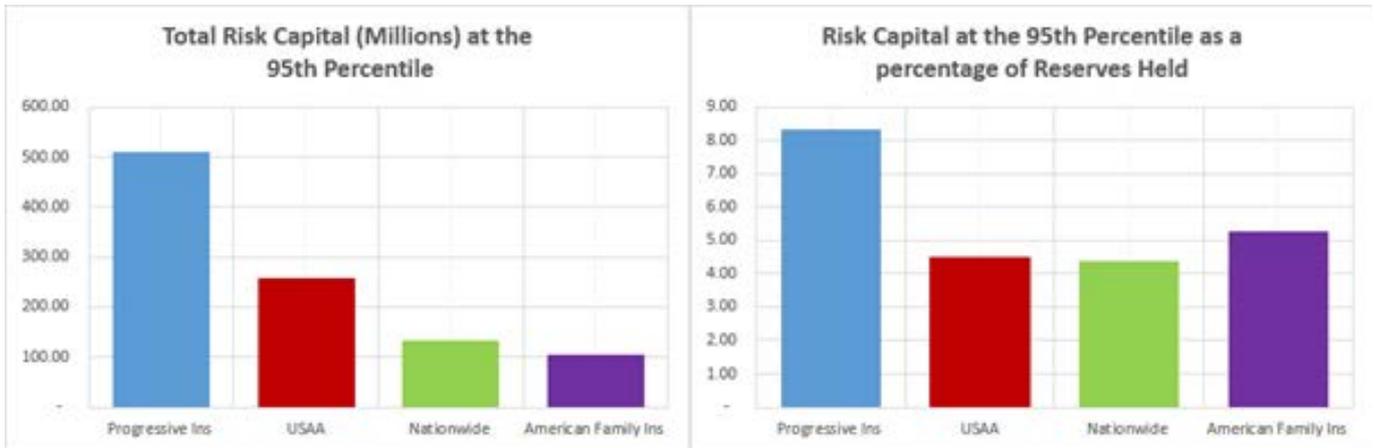
The graph on the right shows that Nationwide is the most efficient in terms of risk capital whereas American Family Ins is the least efficient. Interestingly, Progressive Ins requires over 50% more risk capital than USAA despite having a similar (<10% difference) total Reserves Held.

Due to the inflation assumptions, a similar result to reserve allocation applies for the risk capital allocation. American Family Ins has to hold onto risk capital for longer whereas Progress Ins has the vast majority of the PPA risk capital allocated to the next calendar year.

Expected Reserves (%) Remaining at end of Calendar Year
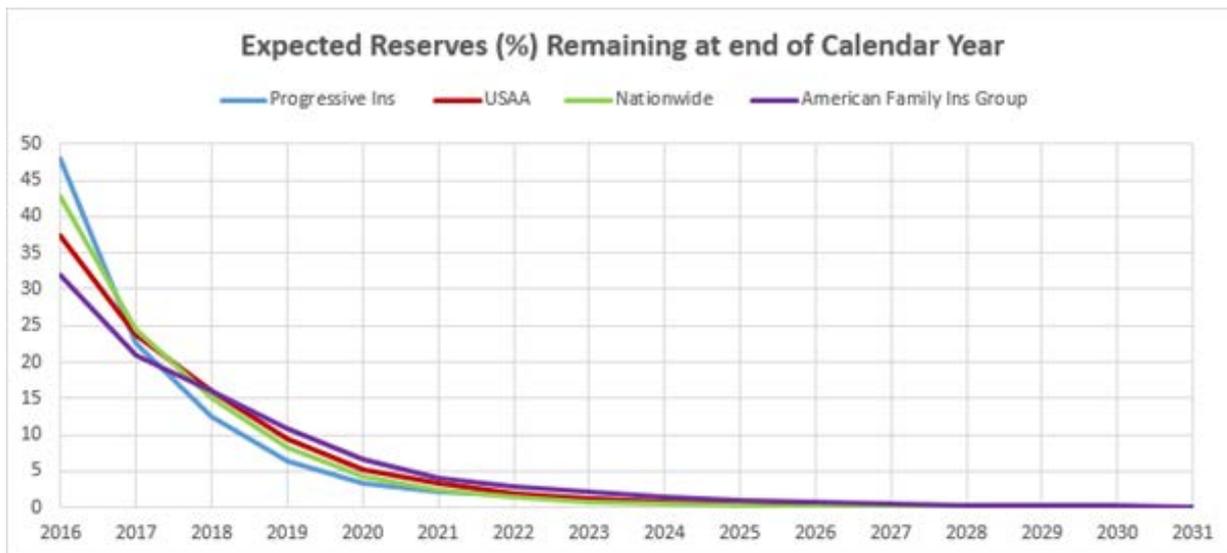
4.4. Cost of risk capital

Using the Solvency II one year ahead metrics we can also compute the total cost of the risk capital. This calculation was applied with a risk free rate of 1% and a spread rate of 6%.

Using these rates, the cost of the holding the capital (Market Value Margin) can be calculated when each year capital is raised and released.

The Solvency Capital Requirement (SCR) is simply the Value at Risk in the next year plus the capital required to rebalance the Economic Balance Sheet should the Value at Risk be exhausted.
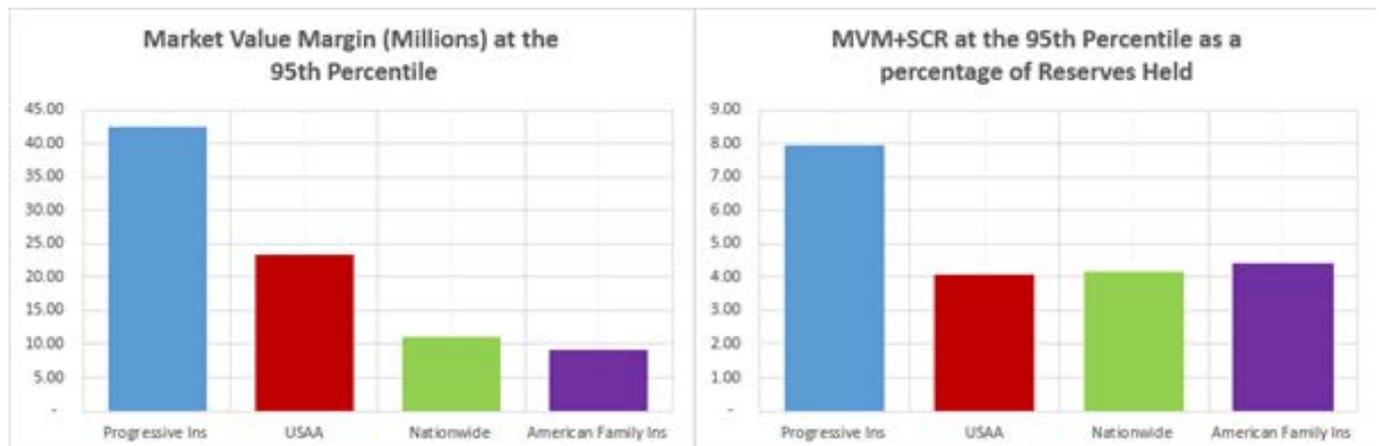
The graphs above show the relative cost of holding the risk capital on a one-year basis. Note, the risk-free rate used in this calculation was 4% and a spread of 6% was applied as the charge for the risk capital.

The allocation of total risk capital (MVM + SCR) as a percentage of the Reserves Held shows a very similar picture to the total risk capital. The main difference is that discounting applies resulting in American Family Ins incurring a lower cost of capital under this formulation as risk capital is required in later calendar years rather than immediately.

5. Industry trends and correlations
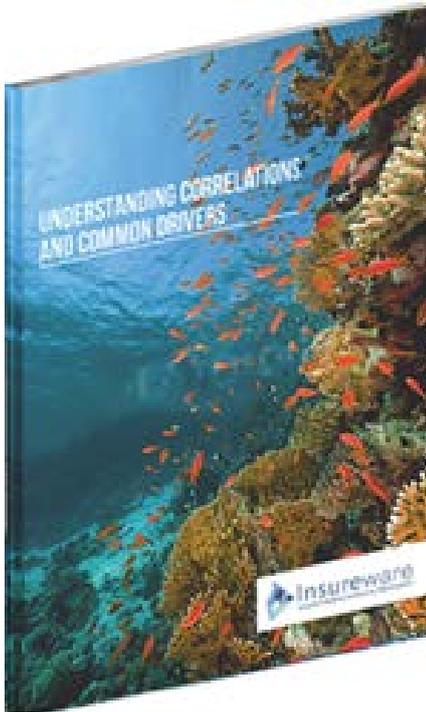
Insureware has produced a booklet on Correlations and common drivers (left) describing the purpose of correlation measures and how they should be calculated.

Key topics are:

- Correlations are model dependent;
- In order to measure correlations, trends in the data must be removed first;
- Common accident year drivers;
- Common calendar year drivers; and
- The impact of all these model attributes on risk capital and pricing.

The correlation that matters, from a risk perspective, is in the volatility component of a forecast.

If a model consists of linear trends plus a random factor then the variability in the observations is

accounted for without the need to introduce a correlation. Common drivers relate the trends in a series – and, should such a link exist, this commonality introduces a stronger relationship that volatility correlation.

The two effects (correlations and common drivers) must be correctly distinguished and adjusted for as management strategies of these risk components differ.

Correlations are in the volatility component of a model

Two lines are (positively) correlated when their results tend to miss their target values in the same way. This is what should concern business planners, because it affects the unpredictable component of the forecasts. What is predictable does not count towards correlation, because its effects are already incorporated into the model and forecast.

A forecast must include a volatility measure, ideally in the form of a loss distribution but at least in the form of a standard deviation.

Common accident year and common calendar year drivers

Common drivers of volatility are a prima facie source of correlation. However, they are not typically found outside closely related losses. For example, Gross versus Net (Net is a subset of Gross so common drivers are expected), layers (layers are subsets of ground up losses), and segments of the same line. In this respect, detection of common drivers is as important as measuring correlations.

To learn more about correlations, accident year drivers, and calendar year drivers, please see the brochure 'Understanding correlations and common drivers' on the Insureware website.

Using Industry correlations

Since correlations are model (and data) dependent it does not make sense to take correlations from the Industry and apply these correlations to an individual company. Although a level of stability is expected, there is no guarantee that the Industry correlations (after trend adjustment) remain stable from year to year.

Industry correlations can, however, be used as a proxy when there is insufficient data at the company level to derive a useful measure of the correlations.

6. A tale of two companies: trends, risk diversification, and loss distributions

In this example we compare two companies, Auto Club Group and Country Financial Property Cas which have similar Held Reserves and Loss Ratios, but with a very different business composition. Net Earned Premium is illustrated for each company by Line of Business below.
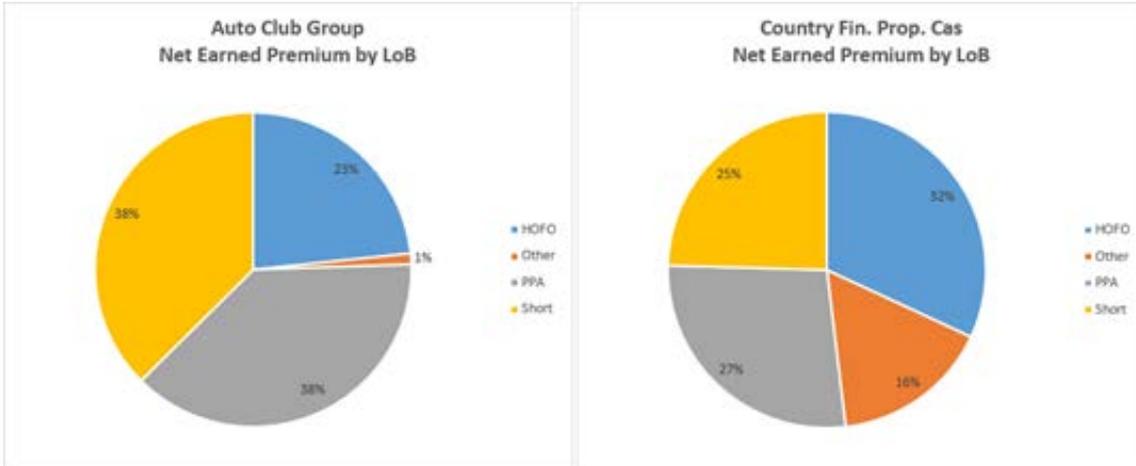
Since PPA, HOFO and the Short Tail Lines make up over 98% of Auto Club's LoBs and over 80% of Country Financial Property Casualty, these are the three LoBs discussed in this section.

6.1. Model displays

Model displays for the three largest individual lines (HOFO, PPA, and Short) are displayed below for Auto Club (top) and Country Fin. Prop. Cas. (bottom) respectively. All lines are adjusted by Earned Premiums as exposure so calendar year trends are trends in loss costs.
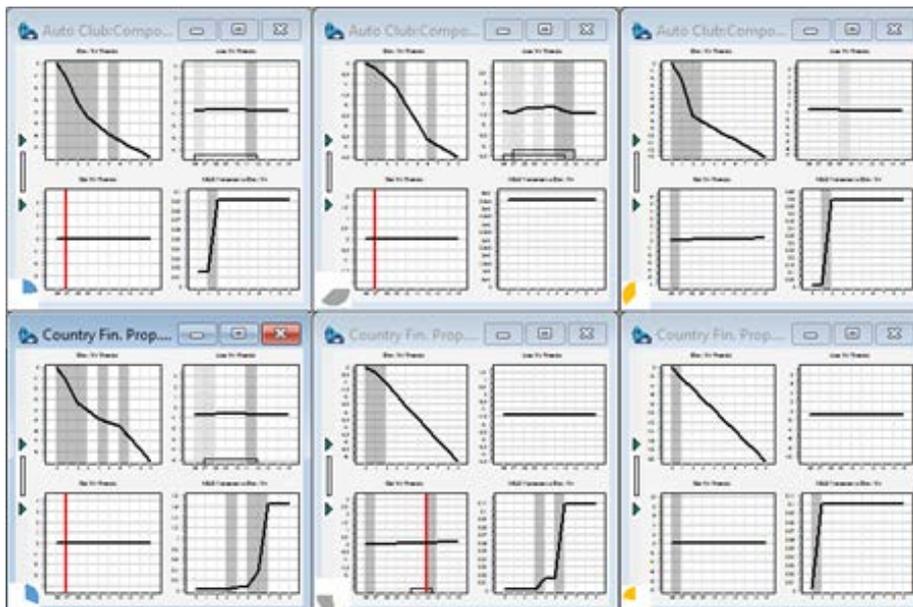
The trends in each LoB for each company are unique. Superficially, some lines are similar – for instance, after adjusting for Earned Premium), there is a single calendar year trend found in the Short Tail Lines (right) for both Auto Club and Country Fin. Prop. Cas. Similarly, the calendar year trend in both HOFO segments is indistinguishable from a zero trend.

6.2. Volatility correlations between lines

The volatility correlations (correlations in the randomness) after adjustment for trends are shown below. As with any time series analysis, correlations must be calculated after detrending the respective series.
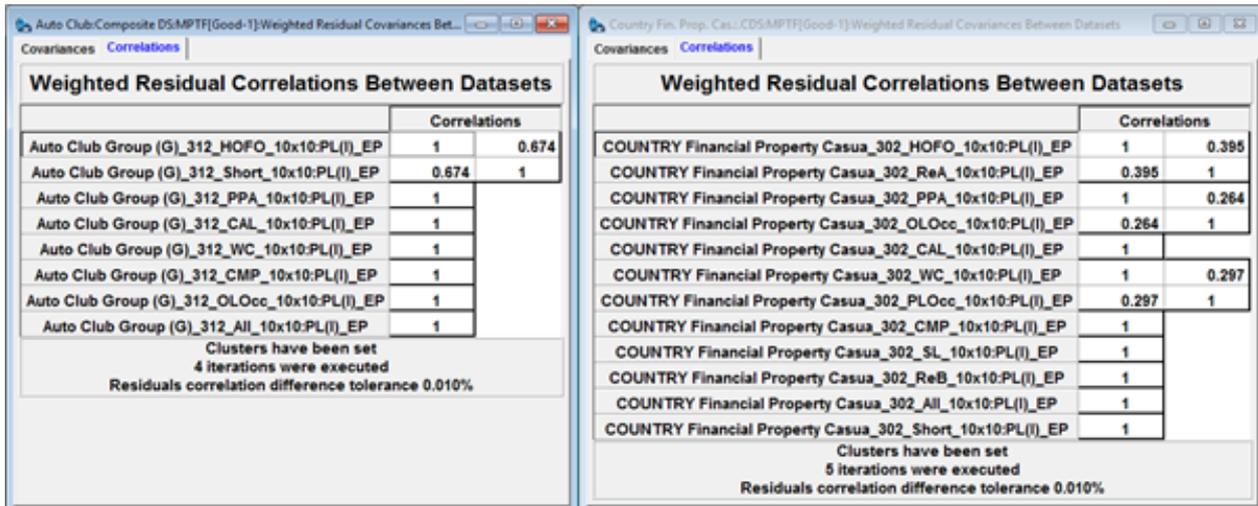

The process correlation matrices for the two companies are entirely distinct. The matrix is simplified by not displaying correlations of zero. Any LoBs containing only zero correlations between other LoBs are collapsed to a single entry of 1.

There are more entries for Country Financial Property Cas since it writes more long tail lines. The only significant volatility correlation for Auto Club is between HOFO and Short. Various statistically significant correlations occur between the LOBs in Country Financial Property Cas.

Volatility correlations are important for calculating diversification credit.

## 6.3. Reserve capital allocation by Line of Business

The company's held reserves are extracted for each line of business and compared in the following pie charts. Almost all Auto Club's reserves held are allocated to two lines (PPA and HOFO). While these two lines also are allocated the majority of the reserves held in Country Fin. Prop. Cas. Around 40% of the reserves is allocated to the remaining lines compared to only 5% of Auto Club.
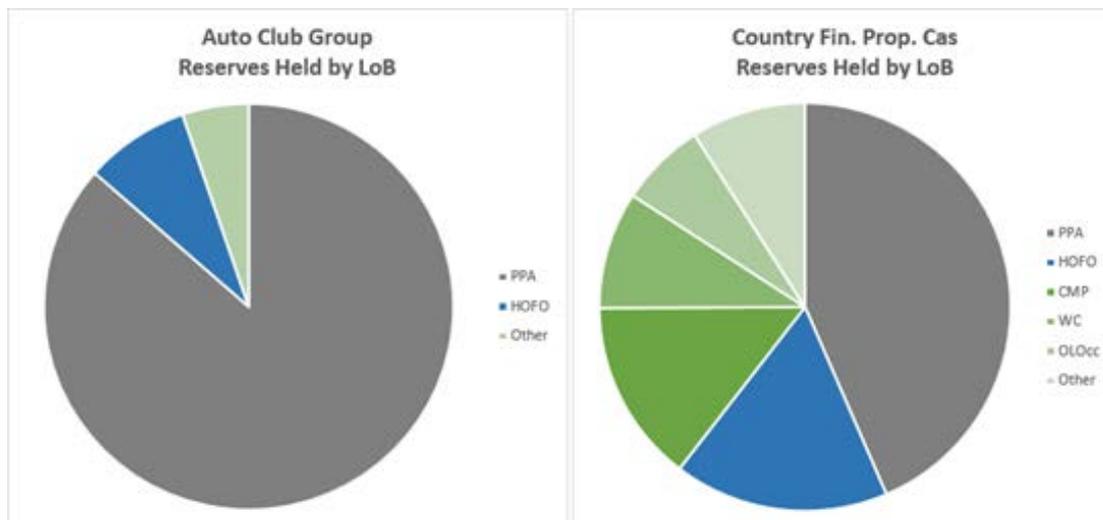
6.4. Risk capital allocation by long tail Line of Business

A forecast scenario was designed for each line to reach the reserves held by the company.

Risk capital can be allocated to each line based on the contribution to the overall volatility. Here, for instance, we use the variance-covariance formula to allocate risk capital to each line. The lines with the largest means are not necessarily the most volatile.
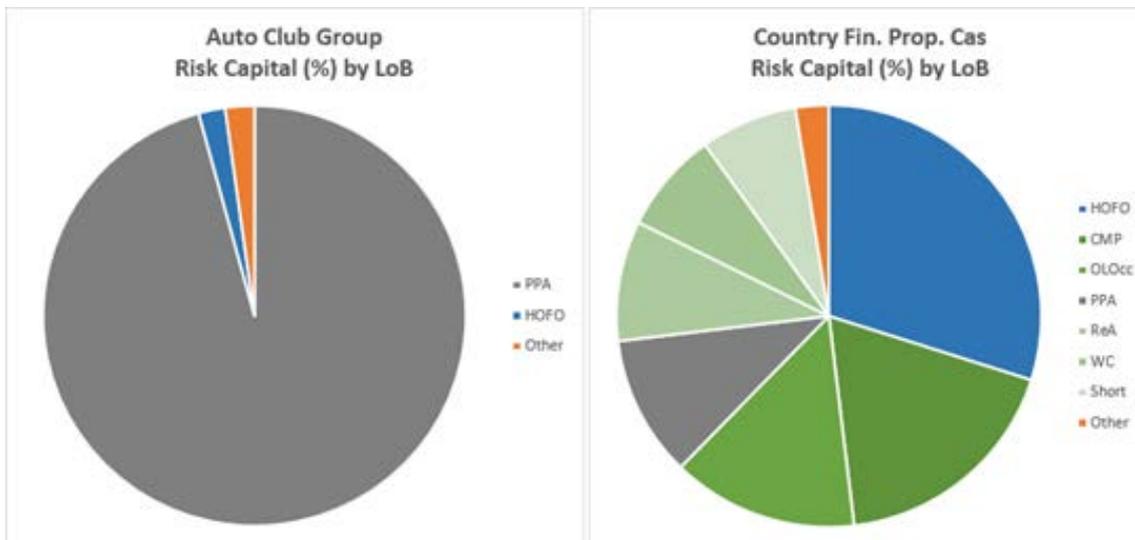
For Auto Club, the capital allocation graph is similar to the Reserve allocation graph – however from a risk diversification credit there is little benefit from writing the other LOBs. Country Financial Property Cas demonstrate that significantly less capital needs to be allocated to PPA despite the high proportion of mean reserves allocated to this line.

6.5. Own Risk and Solvency Assessment (ORSA)

As of 2015, large and medium size U.S. insurance groups (or insurers) must conduct ORSAs. A response to the financial crisis, ORSAs require insurance companies to assess their current and future risk as part of a self-assessment process.

There are two main components to assessing long tail liability risks: model specification error and process variability.

The Probabilistic Trend Family modeling framework minimizes model specification error as the framework facilitates the customization of each model to the trends and volatility structure emerging in the data. There are no assumptions made about trend location, magnitude, or volatility changes. Future assumptions can be directly related to past measurements and, should external knowledge be available, can be transparently modified to accommodate this additional information.

The variability component can be measured, but not controlled.

The Predictive Aggregate Loss Distribution (PALD) module simulates from each log-normal cell projected in the forecast. This provides a complete picture of the volatility of the total loss distribution (and by any sub-period).

The two companies, Auto Club (left) and Country Financial Property Cas (right), have the following loss distributions (based on the forecast scenarios to reach Held Reserves).
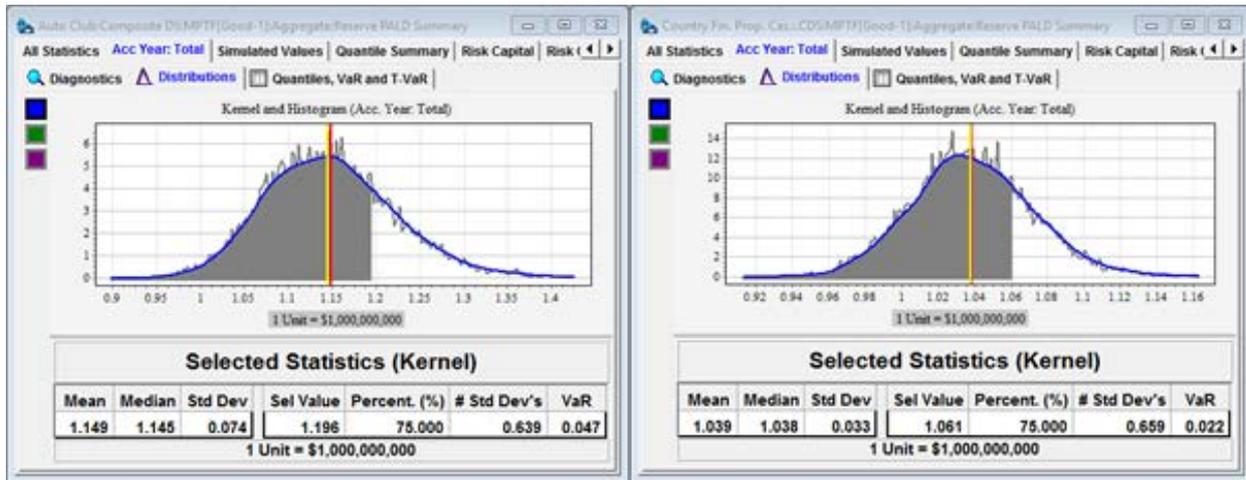
The Value-at-Risk at corresponding percentiles (say 75% as marked) can trivially be computed as part of an insurer's enterprise risk management (ERM) framework. The Value-at-Risk at the 75th percentile is 47M for Auto Club Group and 22M for Country Fin. Prop. Cas respectively.

The calculated risk capital can be allocated to each Line of Business.
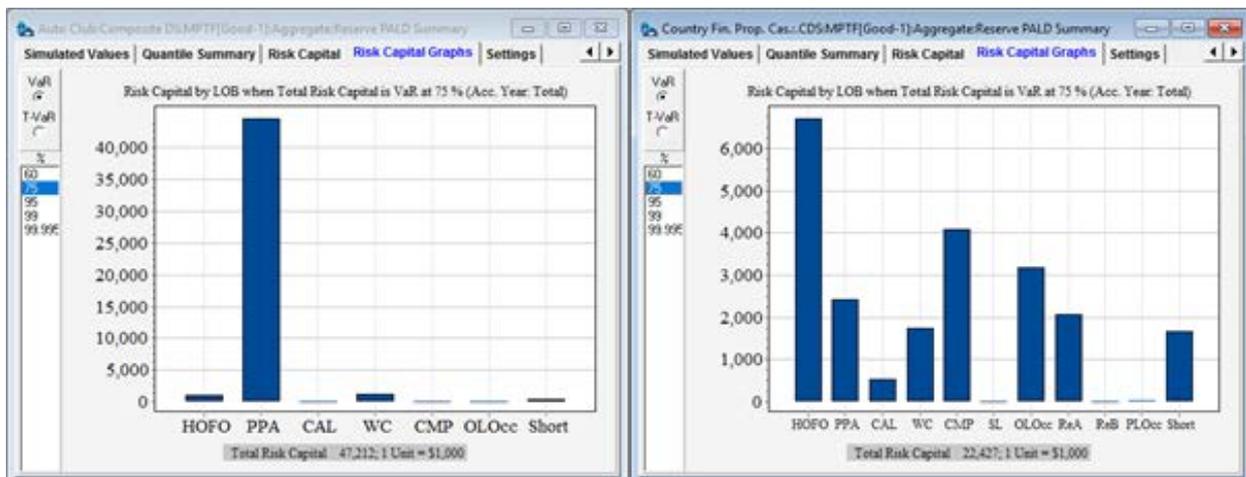
As indicated earlier, Auto Club's risk component is solely driven by PPA – there is almost no risk diversification credit. Country Fin. Prop. Cas. is more diversified and risk capital is distributed across multiple LoBs.

6.6. Solvency II metrics and the Economic Balance Sheet

The Solvency II metrics and accompanying Economic Balance Sheet are included for the two companies by way of example.

For this calculation the risk free rate was set to 1% and the spread to 6%.
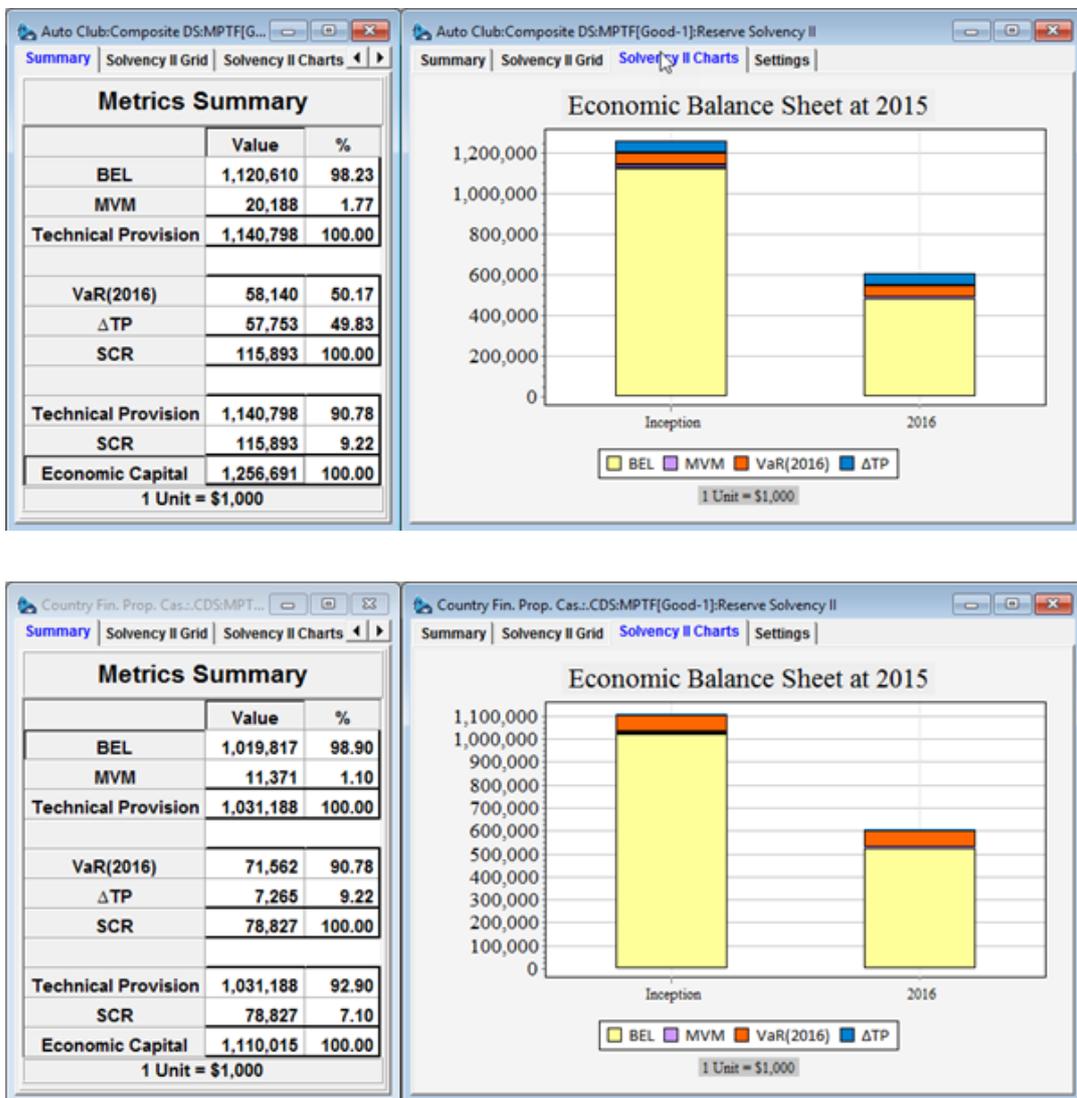
Under these scenarios, Country Financial Property Cas incurs a lower risk capital charge (Market Value Margin + Solvency Capital Requirement).

When considering diversification, risk capital, and asset-liability matching, it is important to consider the whole picture. Measures (trends, correlations, or volatility) should be driven from the data, not imposed by a methodology or from the Industry.

Even for companies with similar total reserves held, premium earned, survival ratios, and other metrics, on closer examination the underlying risks associated with each company are unique to that company. Models, forecast scenarios, and other calculations should be derived from a solution tailored to the company.

The Probabilistic Trend Family modeling frameworks (PTF and MPTF) fit distributions to every cell according to the features identified in the individual Lines of Business. In MPTF, correlations measured from the residuals incorporate correlations in the randomness – the most critical component for measuring risk diversification credit for ORSA and Solvency II calculations.

7. Targeting companies for reinsurance or acquisition

Where they can be calculated, Survival Ratios and %IBNR are provided for each company's Line of

Business at the database level. Companies and Lines can be quickly sorted by these metrics to facilitate quick profiling of potential target companies.

Below is an excerpt of the Best's Schedule P database filtered by B-PPA with triangle groups sorted by Survival Ratio.

ICRFS™ Best's Schedule P extends this further by providing a modeling wizard to aid model identification. The wizard creates initial models which describe the trends and volatility in the data.

Forecast scenarios can be generated from these models and the total reserves can be compared with the reserves held by individual companies. In this way, you can quickly identify which companies require further investigation according to your objectives.

Companies with higher reserves than anticipated are potential targets for reinsurance, acquisition, or investment.

Companies with lower reserves than expected are also of interest – particularly to rating agencies. Of course, this is but one indicator of the health of a company.

The modeling wizard can be run in batch mode in ICRFS Best's Schedule P, however COM access (used to interface to these external charts and assign additional metrics automatically) is only available in the stand alone version ICRFS™ 2016.

Since both the models and forecasts are automatically generated, it is always necessary to analyse the data, models, and forecasts to confirm the results are reasonable.

To find out more about the stand alone version of ICRFS™ 2016 please see the brochures on the

Insureware website or contact Insureware directly at sales@insureware.com.

9. Was Tower Group's collapse predictable as at year end 2011?

The following case study is adapted from an Insureware presentation on Tower Group and how key indicators of upcoming reserve upgrades were discernible many years prior to 2013.

9.1. Tower Group was drastically under-reserved
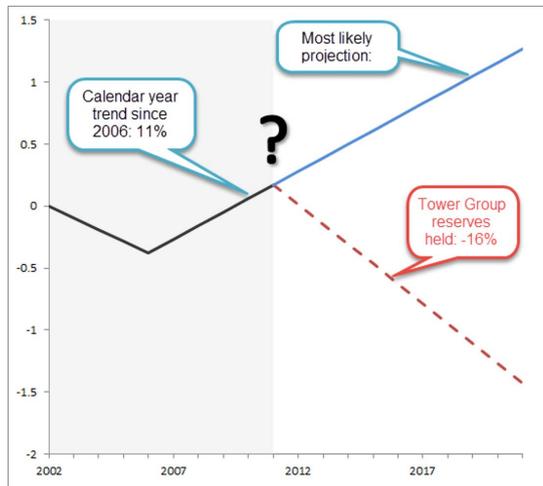
Statistical analysis of Tower Group's year end 2011 Best's Schedule P data reveals alarming reserve health indicators and woeful reserve inadequacy.

In short:

- Inflation (social and economic) of paid losses exceeded earned premium growth by 11% per year for the last five years 2006~2011);
- To reach Tower Group's reserves held and loss ratios, the assumed future calendar year trend must be -16.85% per year for all future calendar years;

- Tower Group's projected calendar year liability stream is far too low (by approximately $1B) as at year end 2011;
- Tower Group's survival ratio (2.41) is well below the industry average (3.51);
    - o   If development year zero is included in the survival ratio, then Tower Group's survival ratio is only 1.33 compared to the Industry's 2.41.
- We demonstrate that the traditional actuarial techniques including Mack (volume weighted average link ratios), applied to Paid and Incurred Losses lack predictive power, do not quantify and measure inflation, and provide completely false indications.
- According to our analyses further significant reserve strengthening (or upgrades) are very likely.

Was too much reliance placed on traditional actuarial techniques for long-tail liability losses which were long past their use-by date? The Mack method, applied to Incurred Losses, yields a mean reserve estimate of $1.059 Billion which is not much higher than reserves held of $922 Million. Did the company maintain stable loss ratios because it was using Bornheutter Ferguson?

There would have been no adverse paid loss experience had the company identified the model that reflected the salient risk characteristics of the business.

The effective forecast assumptions employed by Tower Group were in complete contradiction of past trends (and volatility).

Significant reserve strengthening was entirely predictable.

The ensuing sequence of events was just a matter of time.

- August 2013: Tower Group announced the necessity of reviewing the estimation of its loss reserves and warned of loss reserve hits of $60 million to $110 million.
- October 2013: A.M. Best downgrades Tower Group's rating to B++.
- November 2013: as a result of a comprehensive review, loss reserves were increased by $326.7 million in addition to other restatement adjustments.
- December 2013: Tower Group stock falls further; 10% of its workforce are cut.
- February 2014: adverse loss reserve charges were revised from the range $75 million - $105 million to be recorded as $143 million.

We are concerned reserve upgrades will be required for many years into the future unless the reserving methodology applied to Tower Group's portfolios is seriously revised.

Here's why.

9.2. Net inflation (social and economic) of paid losses exceeded earned premium growth by 11% per year for the last five years (2006~2011)

Let's look at the optimal model identified in the Probabilistic Trend Family (PTF) modeling framework.

The data are normalised by earned premium so any calendar year trends found are already adjusted for premium growth.
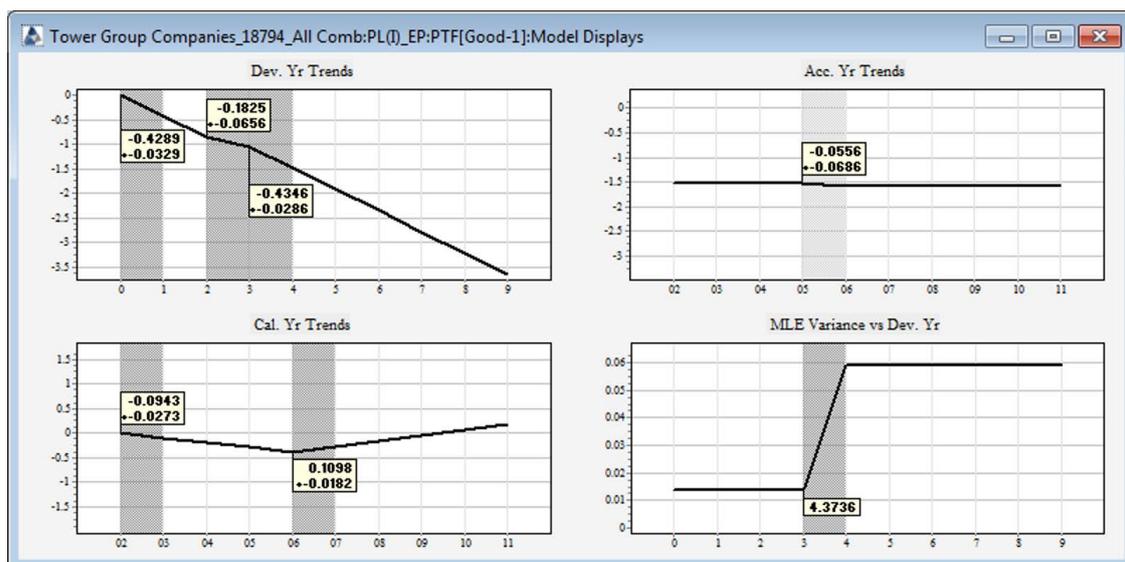

The model for All Lines Combined is displayed above. We observe:

- Development trends demonstrate a strong decay;
- Accident years are stable after adjusting for earned premium;
- Calendar year trends show a 10.98% increase every year since 2006; and
- Volatility increases out in the tail of the development (like one would expect).

It is the third point that is the most critical. As we have already normalised by Earned Premium, this means that paid losses are increasing faster than Earned Premium by nearly 11% every year.

Ouch!

In order to reach the reserves held figure submitted by Tower Group for the data at year end 2011 ($921M), we have to apply the following future calendar year trend assumption (the vertical green line separates the past (left) from the future (right)).
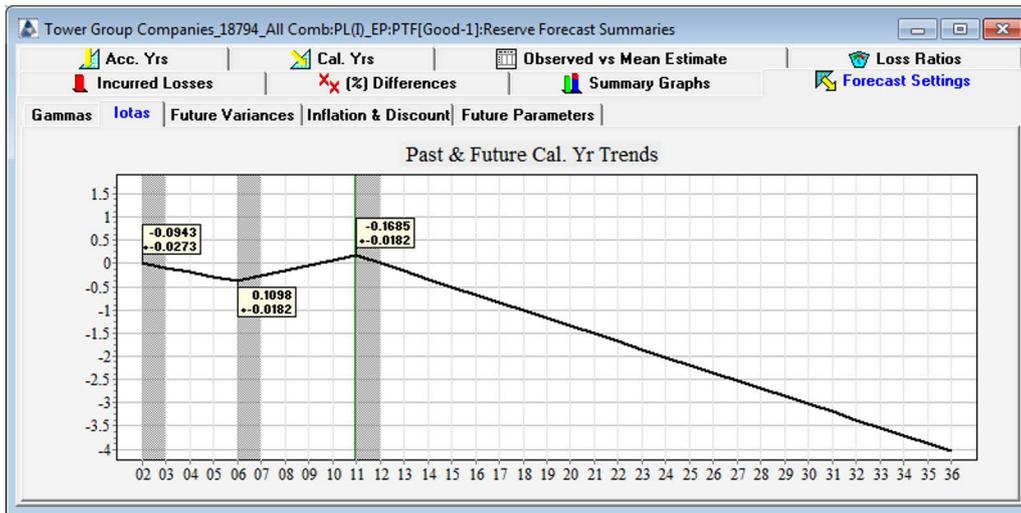
In order to reach Tower Group's 2011 Held Reserves, the future calendar year trend must be negative 16.85% per year from 2011 onward.

Were the 11% ± calendar year trend to continue, the difference between the assumed trend of -16.85% ± and the actual trend of 11% ± is at least 27% - and further diverging every calendar year.

9.3. A negative calendar year trend of -16.85% is required to reach Tower Group's Held Reserves and Loss Ratios

The forecasted liability stream for the -16.85% trend scenario looks something like the table below.

For each observed cell (prior to calendar 2011), we have the pair of **observed** and **model mean** values.

For each future forecast cell (post calendar year 2011) we have the projected distribution **mean** and distribution **standard deviation.**

Aggregate means are also calculated for the future calendar period (bottom rows) and accident year aggregates (rightmost columns) along with their distribution **standard deviations**.

Calendar year summaries of **observed** versus **fitted** are in the column on the left.

In the paid loss data, the losses are increasing across the accident years (blue dashed line) in development years zero and one. However, in the projected data (post 2011) for the development years six and seven (red dashed line), the mean losses are projected to decrease over the same accident years.

Let's compare the projected Tower Group reserve mean with the distributions obtained if the calendar year trend of 10.98% ± 1.82% continues.

Tower Group distributions by calendar year versus Tower Group reserves held
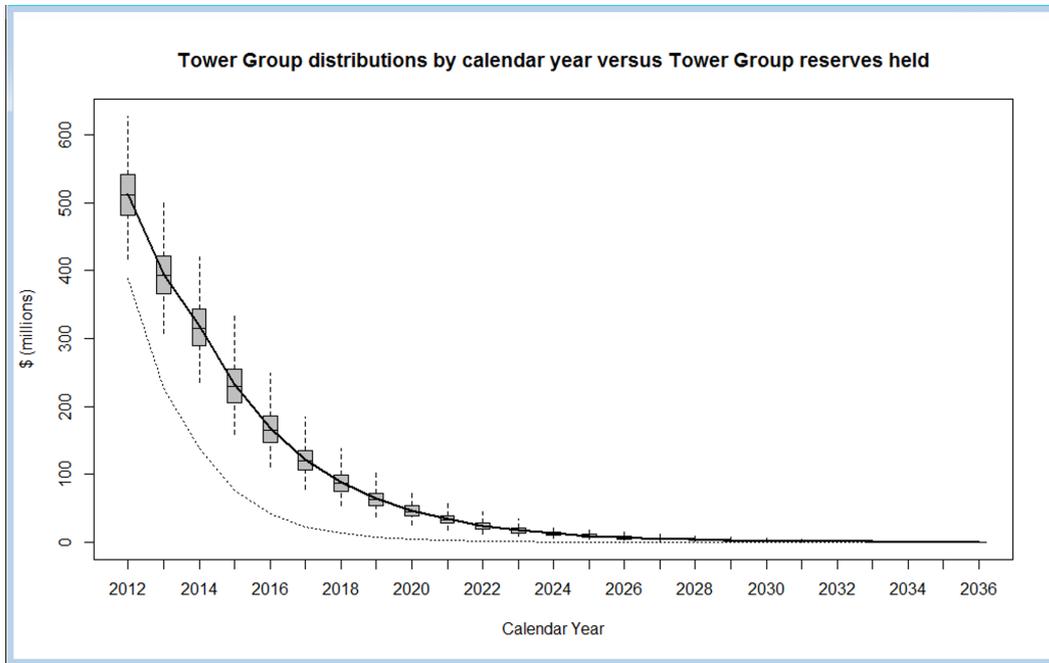
Note the Tower Group mean (dotted line) is well below the forecast distributions assuming the 10.98% ± 1.82% trend continues (boxplots with connected means). The Tower Group reserve mean trend is outside the 1% percentile of this forecast for all calendar years. This is a further indication of the gravity of the Tower Group reserve deficiencies.

Reserve strengthening was inevitable.

Now we compare the resulting cumulative losses by calendar year between the two forecasts.

First 10 calendar years: Tower Group reserves held cumulative losses vs expected cumulative loss

By 2013 the expected cumulative loss is $ 293M
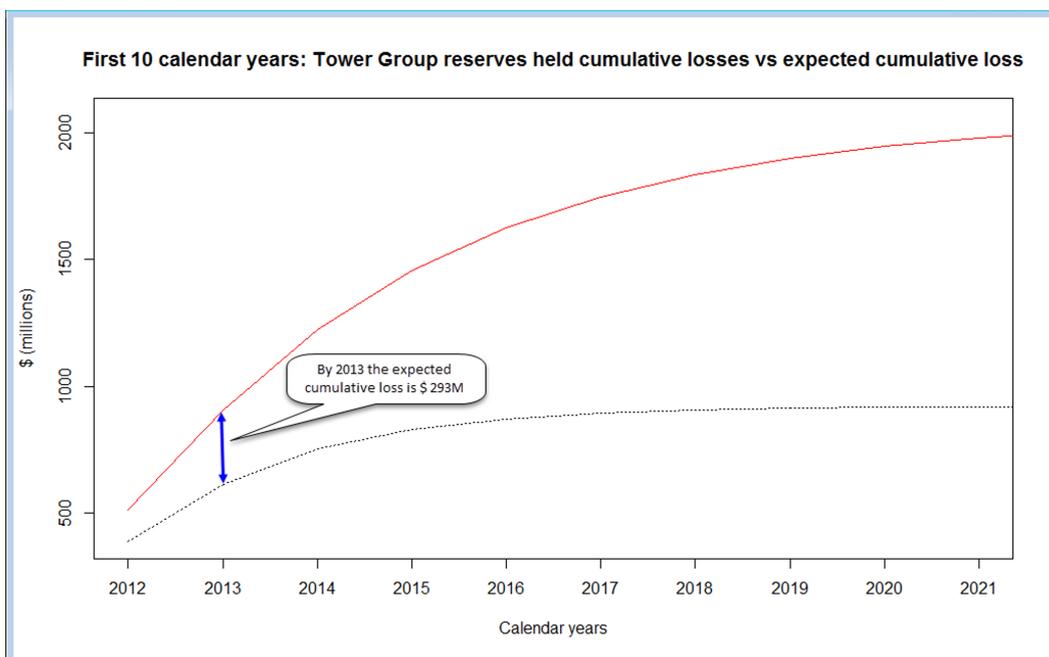
If the paid losses actually followed the 10.98% trend line then we would expect average "adverse development" of $293M by 2013.

This adverse development is not a result of unexpected losses arising from the data, but rather unexpected losses compared to the projected forecast. That is, adverse development arises as a result of poor methodology not truly unusual losses.

Did Tower Group know that in the past there was 10.98% trend? Did they know the future trend required to obtain their ultimates and loss ratios by accident year and total is -16.85%?

We suspect not.

We show that the ultimates held by Tower Group at year end 2011 match closely with the forecast scenario designed to reach Tower Group's reserve held. Tower Group ultimates versus Tower Group scenario - close match!
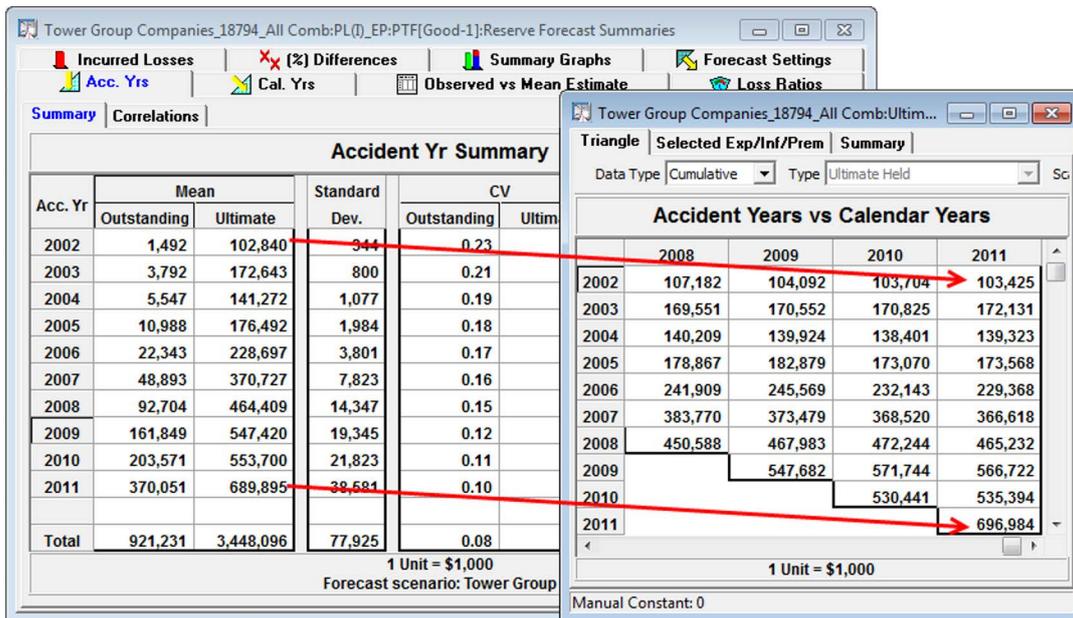
What about the Case Reserve Estimates (CREs)?
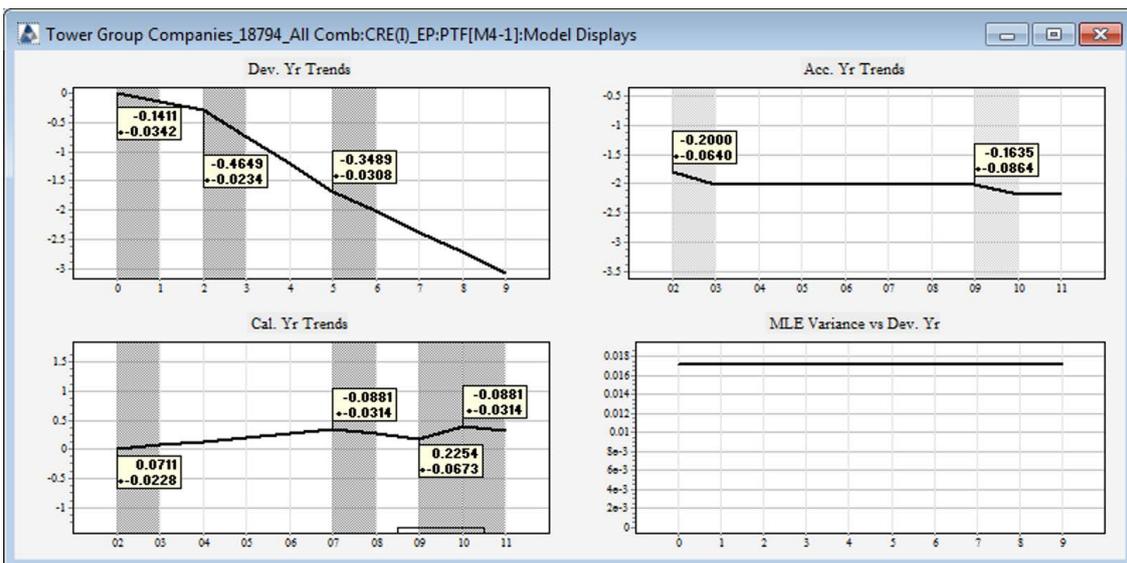
Let's enlarge that lower display.
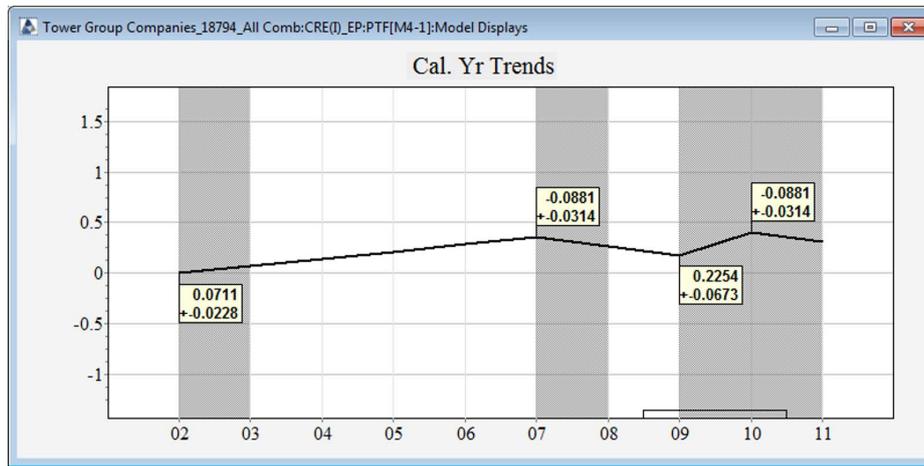
Case Reserve Estimates are increasing over 2002~2007 and decreasing thereafter (calendar year 2009~2010 shows an increase, but is balanced by the decrease in level in the same accident year) by 8.8% per year.

These calendar year trends are in the opposite direction to the losses!!

9.4. Expected Loss Ratios (matching Held Reserves) do not indicate any concern

For the Tower Group reserves held scenario, the loss ratios look good. In fact there is no evidence from the numbers that losses are growing faster than Earned Premium.

Acc. Yr	Premium	Paid To 2011	Mean Outstanding	Mean Ultimate	A Priori	Mean	SD
2002	175,262	101,348	1,492	102,840	59.01	58.678	0.196
2003	289,531	168,851	3,792	172,643	59.45	59.629	0.276
2004	275,146	135,725	5,547	141,272	50.64	51.344	0.391
2005	353,795	165,504	10,988	176,492	49.06	49.886	0.561
2006	493,306	206,354	22,343	228,697	46.50	46.360	0.770
2007	700,159	321,834	48,893	370,727	52.36	52.949	1.117
2008	860,332	371,705	92,704	464,409	54.08	53.980	1.668
2009	982,642	385,571	161,849	547,420	57.67	55.709	1.969
2010	894,285	350,129	203,571	553,700	59.87	61.915	2.440
2011	1,127,743	319,844	370,051	689,895	61.80	61.175	3.421
Total	6,152,201	2,526,865	921,231	3,448,096	****	56.047	1.267

1 Unit = $1,000

The projected reserve losses look plausible compared to the Case Reserve Estimates as the Case

Reserve Estimates are also too low!

Incurred But Not Reported (INBR) is 37.2% of reserves held.

How does this compare to the Industry?

The Industry IBNR is 48.7% for the same proportion of business volume.

Perhaps this is part of the problem.

If the actuarial department was using a method such as Bornheutter-Ferguson to estimate the losses based on Earned Premium, then they would not see the growth in losses since the method calibrates the expected losses to the Earned Premium.

Unfortunately for Tower Group, the loss ratios are more likely to look like this (where the 11% ± trend continues).

Tower Group Companies_18794_All Comb:PL(I)_EP:PTF[Good-1]:Reserve Foreca...

Incurred Losses | **×× (%) Differences** | **Summary Graphs** | **Forecast Settings**
Acc. Yrs | **Cal. Yrs** | **Observed vs Mean Estimate** | **Loss Ratios**

Loss Ratios

Acc. Yr	Premium	Paid To 2011	Mean Outstanding	Mean Ultimate	Loss Ratios (%) A Priori	Loss Ratios (%) Mean	Loss Ratios (%) SD
2002	175,262	101,348	3,229	104,577	59.01	59.669	0.449
2003	289,531	168,851	8,212	177,063	59.45	61.155	0.630
2004	275,146	135,725	12,018	147,743	50.64	53.696	0.883
2005	353,795	165,504	23,809	189,313	49.06	53.509	1.244
2006	493,306	206,354	48,405	254,759	46.50	51.643	1.668
2007	700,159	321,834	105,891	427,725	52.36	61.090	2.337
2008	860,332	371,705	200,684	572,389	54.08	66.531	3.344
2009	982,642	385,571	351,578	737,149	57.67	75.017	4.432
2010	894,285	350,129	461,859	811,988	59.87	90.797	6.041
2011	1,127,743	319,844	852,883	1,172,727	61.80	103.989	8.646
Total	6,152,201	2,526,865	2,068,567	4,595,432	****	74.696	3.424

1 Unit = $1,000

Or summarized graphically:
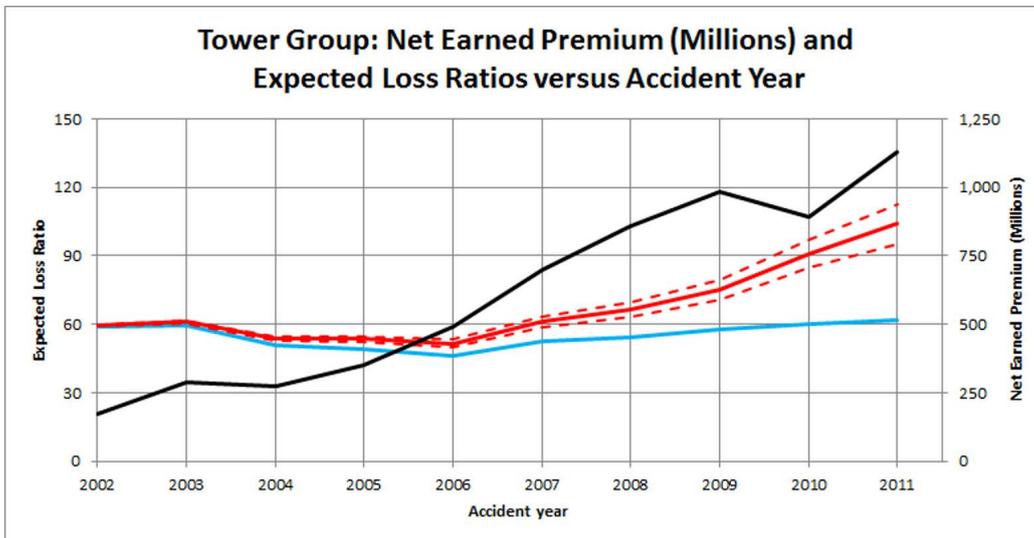
Where the solid black line is the Net Earned Premium (Millions), Red solid line is the Expected Loss Ratio should the 10.98% ± 1.98% trend continue (with the dashed red line being the ELR ± one standard deviation), and the blue solid line is Tower Group's Expected Loss Ratio.

Note the huge increases in loss ratios in accident years 2008~2011 - right where Tower Group had so-called 'adverse development'.

Let's look at the survival ratio.

9.5. The company's survival ratio is substantially lower than the industry average

A powerful metric is the survival ratio: how long the reserves would last if last year's payments were replicated in each subsequent year. That is, total held reserves divided by the total losses in the last calendar year excluding development year zero.

For writers of P&C Insurance, especially long-tail lines like Worker's Compensation, this ratio should be much higher than one.

Tower Group's survival ratio for the whole company is 2.46. For all long-tail lines 2.41. This means that Tower Group could only survive just over two more years of losses, if these were to remain at the level of those observed in 2011.

Perhaps Tower Group writes shorter long-tail lines – let's check against the industry.
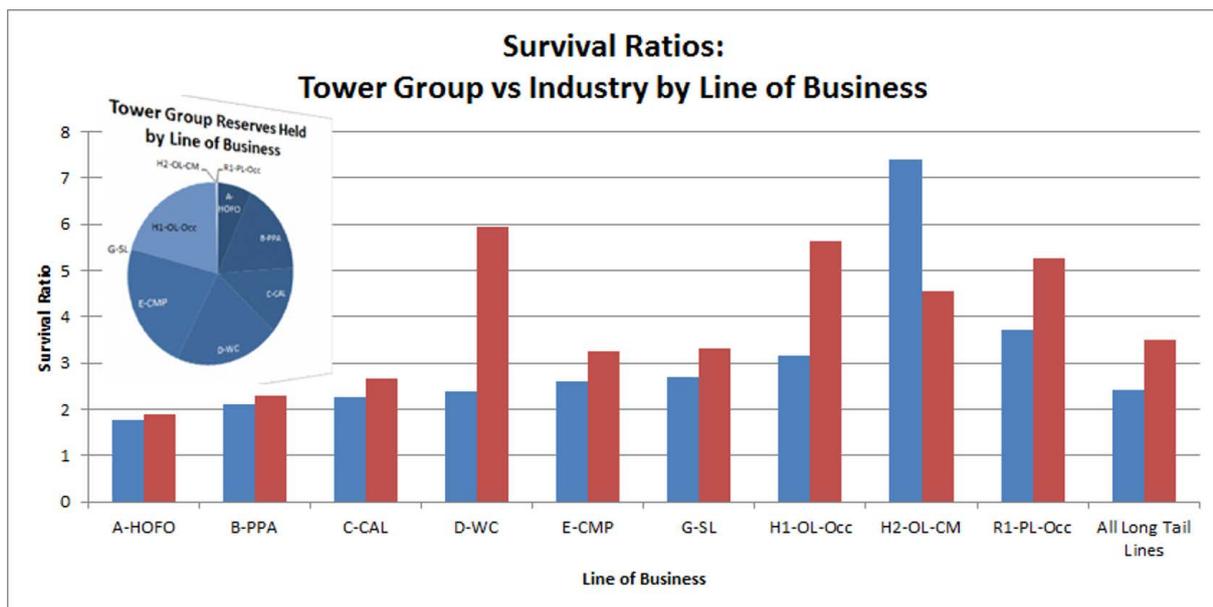
The Industry ratio is 3.51 based on the same allocation of business (using Total Earned Premium as a proxy for LOB volume). This means, on average the industry would be reserving 45% more than Tower Group for the same business volume.

For all lines (except H2-OL-CM), Tower Group's Survival Ratio is much lower than the Industry. The worst offender is D-WC where Tower Group's Survival Ratio of 2.39 is under half the Industry Survival Ratio of 5.93. Similarly, H1-OL-Occ where Tower Group's Survival Ratio is 3.14 compared to the Industry Survival Ratio of 5.62. Both of these lines command a substantial chunk of Tower Group's Reserves Held.

How could anyone justify such a low level of held reserves?

9.6. Link Ratios applied to the Paid Losses have no predictive power and do not capture or quantify the calendar year trends.

Incremental Paid Losses in development period two are not correlated to the previous cumulatives (development period one). Further, incremental incurred losses in development period one are not correlated to the cumulatives in development period zero.
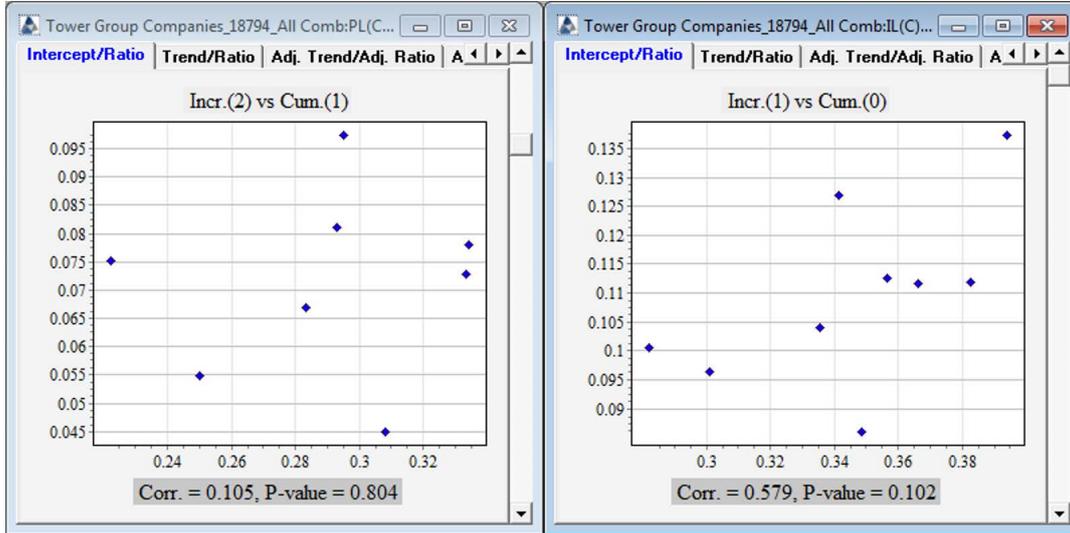
As Tower Group's incremental losses are not correlated to the previous cumulatives, any link ratio method (including Mack) has no predictive power. Choosing link ratios by judgement cannot overcome lack of correlation.

The Mack method (equivalently volume weighted averages) estimates a trend lower than that in the data. So does the arithmetic average link ratio.

Mack is underestimating calendar year trends.
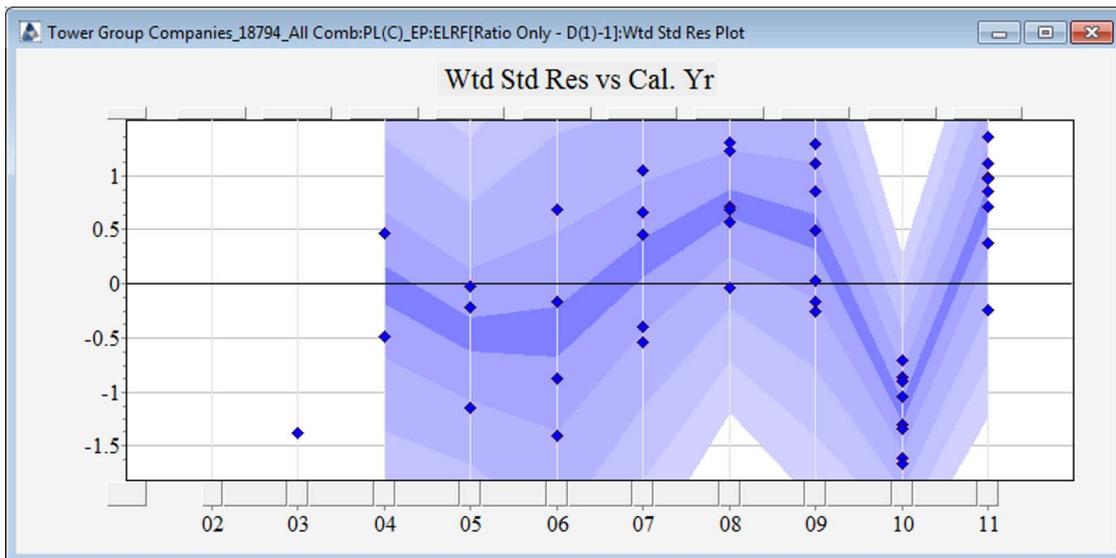
The seesaw pattern in the last calendar years is due to calendar year 2010 being better than expected.

As with the paid losses, the Mack method applied to the Incurred Losses estimates a trend lower than that in the data.
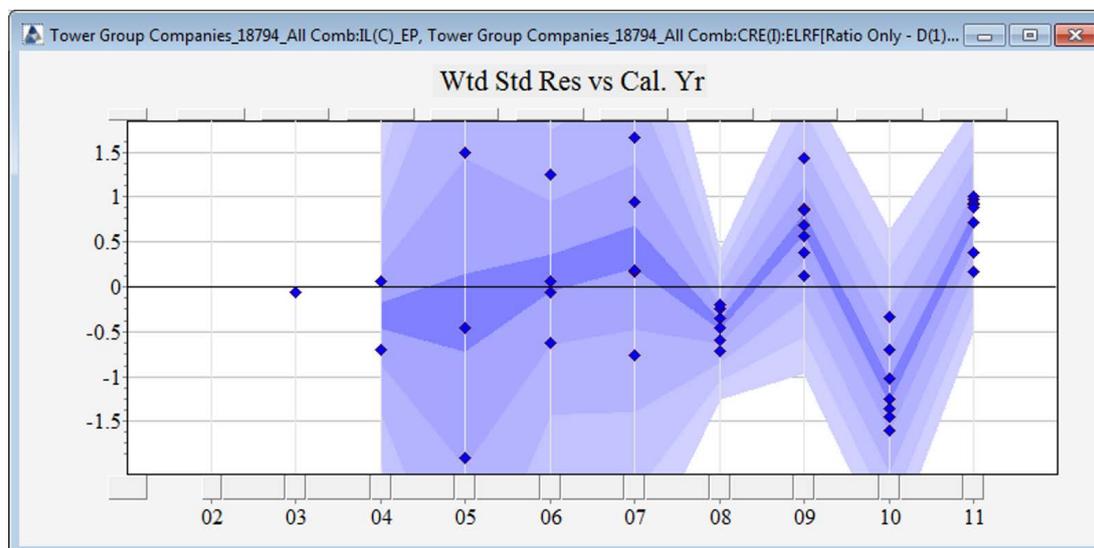
Interestingly the Mack method yields a mean reserve estimate of 1.059 Billion which is not much higher than reserves held of $922 Million.

9.7. Summary

With well established statistical tools available to verify the reasonableness of future forecast assumptions, this result is inexcusable. Earlier intervention and monitoring would not have jeopardized the company.

- Tower Group's projected calendar year liability stream is far too low (by approximately $1B) as at year end 2011;
- Inflation (social and economic) of paid losses exceeded earned premium growth by 11% per year for the last five years (2006~2011);
- To reach Tower Group's reserves held and loss ratios, the assumed future calendar year trend must be -16.85% per year for all future calendar years;
- Tower Group's survival ratio (2.41) is well below the industry average (3.51). No wonder it isn't surviving;
- Standard actuarial techniques have no predictive power for the Tower Group's long-tail Lines of Business, nor do they quantify the calendar year inflationary trends. They therefore give false indications; and
- According to our analyses using the PTF modeling framework, further significant reserve strengthening (or upgrades) are very likely.

This is why Tower Group arrived at the situation it did in 2013.

Whatever methods were used to estimate the total loss reserves were woefully inadequate and put shareholder's funds at risk.

Poor decisions were made by management on what reserves should be allocated and the premiums to charge on new/renewal business.

Just like HIH, Tower Group should serve as a warning to insurance (and reinsurance) companies.

Is your insurance (reinsurance) company using the right reserving methodology?

Are you at risk of adverse development arising from defective loss reserve estimates?

Are you insuring a company that has misrepresented its risk exposure?

info@insureware.com
Suite 6 & 7 40-44 St Kilda Road
St Kilda VIC 3182 Australia
Tel: +61 3 9533 6333 Fax: +61 3 9533 6033

Insureware
Innovative Statistical Solutions for P&C Insurance