Back of a Napkin
Actuarial Estimates

Presented by:
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You are a Pool Board Director

You have 15 to 30 minutes to review and approve your actuarial report at the board meeting.

What do you look for?
Are the results reasonable?
Discussion points

• Set the framework for key estimates
• Extract the key estimates
  ▪ Actuarial report
  ▪ Financial statement
• Apply the back of a napkin estimates approach
**Tips**

- Know and understand the key estimates needed for due diligence
- Round values to easy, whole numbers
  - e.g. round $19,375,419 to $20M.
- Don’t sweat the details
Focus on key estimates

1. Outstanding losses
   - Unpaid losses from prior years to be paid out in the future

2. Future (next year’s) contributions
   - Projected losses
   - Expenses

3. Net position (surplus)
   - Solvency measure

4. Variability
How the estimates fit in a financial statement

- Outstanding losses – *Statement of Net Position* (balance sheet)
- Contributions – *Statement of Revenues* (income statement)
- Payouts – *Statement of Cash Flows*
- Net position (aka surplus)
  - Surplus = assets *minus* liabilities - Balance sheet
  - Change in surplus - Income statement
Focus on key estimates

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4. Variability
Two time perspectives

Outstanding losses

Prior FY15 FY16 FY17 FY18

June 30, 2018

Projected contributions

FY19 FY20 FY21 FY22 ...
Outstanding losses

- Unpaid amount as of
  - Fiscal year-end June 30, 2018
  - Accounting date, e.g. quarter end March 31, 2019
- Comprised of:
  - Case reserves – estimated by claim adjuster or staff
  - IBNR – estimated by actuary
- Where do you find it?
  - Balance sheet
  - Actuarial report
Case reserves

- Case reserves are known
  - Set claim-by-claim
  - Provided by staff or TPA at regular intervals: monthly or quarterly
  - Boards generally approve/discuss large claims

- How much IBNR to add to case reserves to obtain total outstanding losses?
IBNR definition

• IBNYR: Claim not yet reported
  ▪ About 5% to 10% of IBNR

• IBNER: Not enough reserved
  ▪ Additional amount above case reserves to estimate ultimate settlement/payout
  ▪ About 90% to 95% of IBNR

• Generally estimated in aggregate
Two approaches to estimate outstanding losses

1. Start with prior year’s estimate
2. Use current year’s case reserves to estimate IBNRs
1st Approach

Start with prior year’s estimate
Two environments

1. Stable, steady-state

2. Large changes:
   › Large exposure changes
     – e.g. added fleet of cars or new buildings
     – +/- membership
   › Large or catastrophic claims emergence
Estimate outstanding losses in a stable environment

• Preliminary estimate:
  ▪ Start with prior year’s o/s losses, e.g. $20M
  ▪ Reflect growth (exposure and loss rate), e.g. 2%
  ▪ Current year’s o/s loss estimate = $20M + (2% x $20M) = $20.4M

• This works in steady state or stable environment

• What is a stable environment?
  ▪ Additional losses incurred in new year = approximately annual loss payments
Estimate outstanding losses with large exposure changes

- Additional o/s losses =
  (exposure increase) x (loss rate) x (unpaid factor)

- Unpaid factor varies by coverage:
  - WC – 50%
  - Liability – 25%
  - Property – 20%

- Example:
  - New member with $100M payroll; WC loss rate = $1.50 per $100 payroll
  - Additional o/s losses = ($100M) x ($1.50/100) x (50%) = $750,000
  - Current year’s o/s loss estimate = $20M + $0.75M = $20.75M
Estimate outstanding losses with large claims emergence

• Start with prior year’s o/s losses, e.g. $20M
• Add case reserves on large claims
• Add IBNR (10% to 20% of case reserves)
• Example:
  ▪ Two large claims reserved at $1M and $3M
  ▪ Increase due to large claims = ($1M + $3M) x 20% = $4.8M
  ▪ Current year’s o/s loss estimate = $20M + $4.8M = $24.8M
2nd Approach

Estimate IBNR
IBNR ratio

- O/S = case reserves + IBNR
- IBNR = IBNR ratio x case reserves
- Ratio varies by coverage
  - Short tail, e.g. PR and APD – lower ratio
  - Medium tail, e.g. auto liability – mid range ratio
  - Long tail, e.g. WC – higher ratio
## IBNR ratio ranges

<table>
<thead>
<tr>
<th>Category</th>
<th>0%</th>
<th>10%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>100%</th>
<th>125%</th>
<th>150%</th>
<th>200%</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75% to 125%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GL</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>40% to 100%</td>
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<td></td>
<td></td>
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<tr>
<td>PR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10% to 25%</td>
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<tr>
<td>AL</td>
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<td></td>
<td></td>
<td></td>
<td>50% to 75%</td>
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<tr>
<td>Excess Li</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>150% to 200%</td>
<td></td>
</tr>
<tr>
<td>Large claims</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10% to 20%</td>
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<tr>
<td>Limited to SIR</td>
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<td></td>
<td></td>
<td>0%</td>
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</tr>
</tbody>
</table>
Estimate outstanding losses using IBNR ratio

- Outstanding losses = case reserves + (IBNR ratio x case reserves)

- Example:
  - WC case reserves = $10M
  - Selected IBNR ratio = 125%
  - IBNR = 125% x $10M = $12.5 M
  - O/S losses = $10M + $12.5 = $22.5M
Payouts

• In a stable, mature program,
  ▪ Fiscal year payout = approximately new year’s incurred losses

• Approximate number of years to pay out liabilities
  = outstanding losses / fiscal year payout
  ▪ Example: $20M/$5M = 4 years

• This metric ranges from 2 to 5 years
  ▪ Varies by coverage: short tail vs long tail
  ▪ If it changes from previous years, then ask why
Investment income and discounting

• If discounting, then outstanding losses decrease by about:

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>1%</th>
<th>2%</th>
<th>3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC</td>
<td>-4%</td>
<td>-8%</td>
<td>-12%</td>
</tr>
<tr>
<td>GL</td>
<td>-1%</td>
<td>-3%</td>
<td>-4%</td>
</tr>
</tbody>
</table>

• Example
  ▪ Undiscounted o/s losses = $20M for GL; 1% discount rate
  ▪ Discounted o/s losses = $20M x (100%-1%= 99%) = $19.8M
  ▪ If discounting, then surplus increases by discount amount = $200,000
Reserve opinion

• Actuaries opine on the reasonability of outstanding losses in totality
• Final selection is management’s “best estimate”
• Board accepts the actuarial report and signs off on the financial estimate – their fiduciary responsibility
Focus on key estimates

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   - Projected losses
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3. Net position (surplus)
   - Solvency measure

4. Variability
Two time perspectives

Outstanding losses

Prior FY15 FY16 FY17 FY18

June 30, 2018

Projected contributions

FY19 FY20 FY21 FY22 ...

25
Contribution components

- Contributions comprised of:
  - Expected ultimate losses
  - Discounted or full value
  - Investment income anticipated
  - Risk margin
  - Claims administration
  - Excess insurance
  - Other program costs

- Contribution rate:
  - Divide contribution by exposure, (e.g. payroll per $100 for WC)
Project next year’s losses

- Start with prior year’s loss rate, e.g. $1.50 per $100 payroll
  - Or you can average last few years’ rates – well, then it is not back of the napkin!
- Trend forward to next year’s loss rate
  - Loss cost trend (excess of exposure growth)
  - Ranges from 1% to 3%
- Exposure growth
  - e.g. payroll (2% to 3%); or
  - +/- membership; or
  - +/- TIV
Project next year’s losses

Example

- Current year’s loss rate = $1.50 per $100 payroll
- Next year’s rate $1.50 x 1.02
  - Assume loss rate trend = 2%
- Current year’s payroll = $100M
  - Assume payroll trend = 3%
- Next year’s losses
  = (Current loss rate x 1.02) x (current exposure x 1.03)
  = ($1.50 per $100 of payroll x 1.02) x ($100M x 1.03)
  = $1.6M
Estimate expenses

- Expenses range from 20% (1/5) to 33% (1/3) of premiums (contributions)
  - Select 25%
  - Assume 75% loss ratio
  - Equivalent to adding 33% (= 25% divided by 75%) of projected losses
- Select high end of range if paying commissions
Estimate contributions
Example

• Estimated losses = $1.6M
• Expenses = 33% of losses
  ▪ 1/3 of $1.6M ≈ $0.5M
• Contributions = losses + expenses
  = $1.6M + $0.5M = $2.1M
Reinsurance costs

- Start with prior year’s and add percentage change
- Changes vary from 0% (flat) to 10%
  - Subject to market cycles
- (Re) Insurance market highly capitalized
- Negotiable – review your long-term large claims experience
Estimate reinsurance costs

1. Find average annual excess losses
2. Add provision for:
   a) Development and trend, and
   b) Reinsurer’s expenses
Estimate reinsurance costs

- Review large claims above a threshold (near the SIR)
- Find average annual losses above threshold for 10 to 15 years
- Adjustments to average annual losses:
  - Add **about 50%** to average annual losses to account for development & trend
  - Add **about 50%** for reinsurer’s expense and risk loading
  - Reinsurance cost = average annual losses
    + 50% x average annual losses
    + 50% x average annual losses
    = 2 x average annual losses
Estimate reinsurance costs

Beware!

• This approach provides the low end of the estimate
• Entity’s experience may not be credible, hence may be combined with reinsurer’s applicable book of business
  ▪ Your entity/pool may not have large claims
Focus on key estimates

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3. Net position (surplus)
   ▪ Solvency measure

4. Variability
Net position

- Key solvency metric
- Regulatory minimum
- Pool governance policy
- Shown on balance sheet as of the current accounting date
Surplus metrics

• Use surplus to estimate financial ratios
  ▪ Claim liabilities/surplus
    › e.g. $20M/20M = 1:1
  ▪ Contributions/surplus
    › e.g. $15M/20M = 0.75:1
  ▪ Surplus/SIR
    › e.g. $20M/1M = 20:1
  ▪ Etc., like RBC,
    › e.g. 600%, Authorized Control Level is at 200%

• Review several metrics and changes over time
• AGRiP has developed a database for such ratios
Surplus accumulation

- Surplus built up gradually over time
  - Release surplus gradually, too!
- Sources of accumulation
  - Favorable underwriting results
    - Losses emerged less than expected
  - Investment income
  - Addition to contributions
- Board policy/regulatory guidelines determine how much (minimum) surplus is needed
Accumulated surplus decomposition

- Review how surplus accumulated
- Today’s surplus position needs to be viewed over a longer time horizon
Surplus at June 30, 2018 = $5M

Surplus first 11 years = $35M

Deficit last 6 years = $30M
Surplus at June 30, 2018 = $10M

- Surplus first 12 years = $10M
- Last 20 years = $0

Claim Period

Millions

-2 -1 0 1 2 3

Focus on key estimates

1. Outstanding losses
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4. Variability
Variability

- Referred to as “confidence levels”
- Statistical measure of variability in loss experience
- Various measures:
  - Standard deviation, Coefficient of Variation (CV), Value at Risk (VaR)
  - Simulation of aggregate losses and ensuing percentiles
  - Produces returns in years
    - e.g. 1 in 10 years (90% confidence level) or 1 in 100 years (99% confidence level), etc.
Variability

- Review 10-year loss rate graph
- If approximately straight line, less variability
- If zig-zagging, more variability
Confidence level factors

Example

- Projected 2019 losses = $10M
- Want 80% confidence level for 2019 funding
- Experience is “medium” variable
- 80% confidence level losses = $10M x 1.25 = $12.5M

<table>
<thead>
<tr>
<th>Variability</th>
<th>Confidence Level</th>
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<tbody>
<tr>
<td></td>
<td>70%</td>
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<tr>
<td>Low</td>
<td>1.05</td>
</tr>
<tr>
<td>Medium</td>
<td>1.10</td>
</tr>
<tr>
<td>High</td>
<td>1.15</td>
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</tbody>
</table>
Case study

- This is for illustration.
- To customize your entity’s factors, use average of last three years
**Case study**

**Estimate outstanding losses**

<table>
<thead>
<tr>
<th></th>
<th>As of 12/31/17</th>
<th>Growth Factor</th>
<th>As of 12/31/18</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approach 1 – Steady State</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Outstanding Losses</td>
<td>$30M</td>
<td>5%</td>
<td>$31.5M</td>
</tr>
</tbody>
</table>

| **Approach 2**                     |                |               |                |
| (B) Case Reserves                |                |               | $20M           |
| (C) IBNR Ratio                  |                |               | 40%            |
| (D) IBNR (B x C)                |                |               | $8M            |
| (E) Outstanding Losses (B + D)  |                |               | $28M           |
## Case study

### Payouts

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Outstanding Losses as of 12/31/18</td>
<td>$32M</td>
</tr>
<tr>
<td>2018 Loss Payments</td>
<td>$10M</td>
</tr>
<tr>
<td>Ratio (~ Years to Pay Liabilities)</td>
<td>3 years</td>
</tr>
</tbody>
</table>
# Case study
## Estimate contributions

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>Trend</th>
<th>2019</th>
</tr>
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<tbody>
<tr>
<td><strong>Losses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Loss Rate per $100 Payroll</td>
<td>$1.60</td>
<td>3%</td>
<td>$1.65</td>
</tr>
<tr>
<td>(B) Payroll</td>
<td>$725M</td>
<td>2%</td>
<td>$740M</td>
</tr>
<tr>
<td>(C) Projected Losses (A x B / 100)</td>
<td>$11.6M</td>
<td></td>
<td>$12.2M</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(D) Expense Ratio</td>
<td>33%</td>
<td></td>
<td>33%</td>
</tr>
<tr>
<td>(E) Projected Expenses (C x D)</td>
<td>$3.9M</td>
<td></td>
<td>$4.1M</td>
</tr>
<tr>
<td><strong>Total Contributions (C + E)</strong></td>
<td>$15.5M</td>
<td></td>
<td>$16.2M</td>
</tr>
</tbody>
</table>
## Case study
### Surplus metrics

<table>
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<tr>
<th></th>
<th>Amount</th>
<th>Ratio to Surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surplus as of 12/31/18</td>
<td>$25M</td>
<td></td>
</tr>
<tr>
<td>O/S Losses as of 12/31/18</td>
<td>32M</td>
<td>1.3</td>
</tr>
<tr>
<td>2018 Contributions</td>
<td>25M</td>
<td>1.0</td>
</tr>
<tr>
<td>SIR</td>
<td>0.5M</td>
<td>50</td>
</tr>
</tbody>
</table>
Caveat

- Factors in this presentation are based on industry data and professional judgment
- Your entity’s results may be different
- This presentation provides an approach for back of the napkin estimates
Questions?

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Thank You!