Discussion Points

• Actuarial report uses
• Risk definition
• Financial statement perspective
  ▪ Unpaid amounts
  ▪ Funding
• TCoR
• Variance measures
• Summary
2 Main Uses of Actuarial Report

- Estimate liabilities
- Project funding level
Other Uses of Actuarial Reports

- Loss Portfolio Transfer analysis
- Retention analysis
- Deductible credits
- Cost Allocation
- Experience Modifications
- Equity Analysis
- Non-P&C – OPEB (GASB 45), pensions, life
Self-Insurance is an Insurance Mechanism

• Insurance Characteristics
  ▪ Pay generally fixed premium up front for a promise to pay claims later
  ▪ Claims will not be known for a while and are subject to variation
Risk Defined

- Deviation or variability around an expected outcome
Financial Statement Perspective
Balance Sheet,  
Financial Position at a Given Point in Time 

**As of June 30, 2015**

<table>
<thead>
<tr>
<th>LIABILITIES AND NET ASSETS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Liability for open and incurred but not reported (IBNR) claims</td>
<td>$117.0</td>
</tr>
<tr>
<td>ULAE</td>
<td>9.0</td>
</tr>
<tr>
<td>Other</td>
<td>1.0</td>
</tr>
<tr>
<td>Total liability</td>
<td>127.0</td>
</tr>
<tr>
<td><strong>Net assets (Surplus)</strong></td>
<td><strong>78.0</strong></td>
</tr>
<tr>
<td><strong>Total Liabilities and net assets</strong></td>
<td><strong>$205.0</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASSETS ($ Millions)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and investments</td>
<td>$204.8</td>
</tr>
<tr>
<td>Receivables</td>
<td>0.2</td>
</tr>
<tr>
<td>Prepaids</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td><strong>$205.0</strong></td>
</tr>
</tbody>
</table>
Valuation Basis

- **Statutory accounting**
  - Focuses on solvency, balance sheet emphasis
- **GAAP**
  - Investors and stakeholders focus on earnings, income statement emphasis
- **International Financial Reporting Standards (IFRS)**
  - Market- consistent principles
- **Other approaches**
Estimated Ultimate Losses

Accident Year: 2005 to 2017

- Paid
- Case Reserves
- IBNR

Millions of Dollars
Estimated Ultimate Losses = Case Reserves + IBNR
Central Estimate

- Range of reasonable estimates
  - Actuaries select “central estimate”
  - Management records “best estimate”
  - Auditors opine on overall representation of financial transactions
Liabilities – *Who Owns It*

- Recorded by management
  - Management establishes “best estimate”
- Board/State “owns” the financial statement
- Auditors rely on actuary’s estimate of unpaid claims
- Auditor’s opinion – financial statements fairly represent financial position
Discounting

• Based on
  - Payout pattern
  - Discount rate
Paid Development Method
Payment Pattern

<table>
<thead>
<tr>
<th>Paid</th>
<th>Development</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental Paid</td>
<td>Cumulative Paid</td>
<td></td>
</tr>
</tbody>
</table>

MONTHS OF DEVELOPMENT

- 0: 18%
- 12: 26%
- 24: 44%
- 36: 60%
- 48: 71%
- 60: 79%
- 72: 86%
- 84: 89%
- 96: 92%
- 108: 94%
- 120: 95%
- 132: 96%
- Tail: 97%
Discounting Risks

- Quicker or larger settlements diminish investment income
- Effective discount rate used may not be realized
- If entity does not have sufficient funds set aside for the liabilities (i.e. in deficit position) then not all liabilities may be discounted
Impact of Discounting on Liabilities

- Discounting reduces liabilities recorded on financial statement
- Increases “net assets” (net position, equity)
- Higher discount rate – lower liabilities
  Lower discount rate – higher liabilities
Funding
Funding Basis

• Accrual
  ▪ Based on projected losses to be incurred in year

• Pay-as-you-go
  ▪ Based on estimated payouts in year
Ultimate Losses at Current Cost-Level

Accident Year

- Paid
- Case Reserves
- IBNR
- Adjustment to 2014-Level
- Projected

Millions

- $0
- $1
- $2
- $3
- $4
- $5
- $6
- $7

Years:
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
Flow of Annual Funding As Claims Mature – adding to deficit or surplus

Funding Amount

<table>
<thead>
<tr>
<th>Age of Claim Period (Years)</th>
<th>Expense Reserves</th>
<th>Expenses Paid</th>
<th>Case Reserves</th>
<th>IBNR</th>
<th>Paid Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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</tbody>
</table>
Funding Amount

- Expected losses
  - Loss rate x exposure
- Inv income offset
  - Discounted loss rate
- Risk Margin
  - Confidence level
- Overhead expenses
- Reinsurance premium
- Surplus addition or withdrawal
Total Cost of Risk: TCoR

- **Traditional definition**
  - Retained loses + overhead expenses + Reinsurance
  - As % of a base, say per $1,000 of revenue

- **RIMS Survey TCoR**
  - 4% per $1,000 of revenue in 2014

- **Evolving definition of TCOR**
  - Includes costs for operation risks, cyber risks, etc.
Liquidity and Solvency Defined

• Liquidity: Ability to pay in cash short term liabilities, usually one year
• Solvency: Ability to pay all liabilities in the long run
Liquidity

- Is “cash” > claim payments + operating expenses
- GASB requirement to split liabilities into:
  - “Current liability” – amount of current outstanding liability expected to be paid out in the upcoming year
  - “Long-term liability” – amount of current outstanding liability expected to be paid beyond the next year
Risk Margin
Risks to be Measured

- Reserve Risk
- Pricing Risk
- Asset Risk
  - Fixed income, interest rate, equities
- Credit Risk
  - Including reinsurance
- Operational Risk
- Catastrophe
  - e.g. floods, earthquake
Risk Categories

- Investment risk
- Credit risk
  - Reinsurance recoverable
  - Other credit risks
- Underwriting risk
  - Premium (pricing) risk
  - Loss reserve risk
- Operating risk
- Catastrophe risk

Operating and catastrophe: n/a
Distribution of Losses Below $100,000
2005/06 through 2014/15

Claim Period

- Jul-05
- Jul-06
- Jul-07
- Jun-08
- Jun-09
- Jun-10
- Jun-11
- Jun-12
- Jun-13
- Jun-14
- Jun-15

$100,000
$75,000
$50,000
$25,000
$0
Distribution of Losses Above $100,000
2005/06 through 2014/15

Claim Period

$100,000
$200,000
$300,000
$400,000
$500,000
$600,000
$700,000
$800,000
$900,000
$1,000,000
$1,100,000
$1,200,000
$1,300,000
$1,400,000
$1,500,000
$1,600,000
$1,700,000
$1,800,000
$1,900,000
$2,000,000
$2,100,000
$2,200,000
$2,300,000
$2,400,000
$2,500,000

Histogram of Claims

About 43,200 claims > $0 from 1995/96 to 2014/15

- 708 claims > $100,000 & incurred = $155M out of $433M
Sources of Variability

- **Process Risk**
  - Associated with projection of future contingencies that are inherently variable

- **Parameter, Model Risk**
  - Associated with selection of parameters of the model (e.g., selecting the wrong LDF)
  - Misidentifying a process model (e.g., Poisson for frequency)

Surplus provides primary protection against adverse deviation
Variability

• Losses are inherently variable
  ▪ Assets less variable

• Varies by coverage
  ▪ Excess liability – very variable
  ▪ WC – indemnity less variable than medical
  ▪ Auto liability – generally more stable

• Higher SIRs have greater variability
Surplus is Key Measure

- Assets minus Liabilities = Surplus
- Surplus a.k.a.:
  - Net assets
  - Pool equity
  - Retained earnings
  - Policyholders’ surplus
  - Fund balance
  - Net position
Capital Requirements

- Insurance company failures in the 1980s
  - U.S. Congress investigates
  - NAIC strengthens state solvency standards
- States set minimum capital requirements
  - CA required surplus of $2.6 million as of Nov 1991
- Concept not new
  - Introduced long ago in Wisconsin
  - Requirements applied to banks
- Financial tests evolving, e.g. Solvency II
Spectrum of Financial Ratios

Backward looking

IRIS

RBC

Scenario-Based Approach

Probabilistic Models

Forward looking

Simple

Complex
Focus on 4 Key Ratios

- Premiums–to–Surplus
- Reserves–to–Surplus
- Liabilities-to-Liquid Assets
- Surplus-to-SIR
Ratio 1: Net Premium-to-Surplus

Private Carriers

Graph showing the ratio of Premium to Surplus.
Ratio 2: Loss Reserves-to-Surplus
Ratio 3: Liabilities-to-Liquid Assets

Liabilities: $16
Liquid Assets: $14
Liabilities-to-Liquid Assets: 93%

Private Carriers: 2009, 80%; 2010, 80%; 2011, 80%; 2012, 80%; 2013, 80%; 2014, 80%
Ratio 4: Surplus-to-SIR

Surplus = $10 million

<table>
<thead>
<tr>
<th>SIR</th>
<th>Surplus-to-SIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>$250,000</td>
<td>40</td>
</tr>
<tr>
<td>$500,000</td>
<td>20</td>
</tr>
<tr>
<td>$750,000</td>
<td>13</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>10</td>
</tr>
</tbody>
</table>
Review Ratios... Over Longer Time Horizon...
Not in Isolation but Interdependently
Other Tests

• RBC: Risk-Based Capital
  ▪ Complex; some parameters do not apply to self-insured entities
  ▪ Establishes amount of required capital
  ▪ Compares required capital to insurer’s surplus

• Other tests exist, but overall concept is same
  ▪ Best’s Capital Adequacy Ratio (BCAR)
  ▪ S & P Capital Adequacy Ratio (CAR)
  ▪ PRISM by Fitch ratings
RBC: Risk-Based Capital

\[ \text{RBC} \% = \frac{\text{Your Surplus}}{\text{Risk-based Capital (calculated)}} \]
Broad Risks: Divided into 7 Elements of RBC

- $R_0$: Off-balance sheet (affiliates, contingent liabilities)
- $R_1$: Fixed-income securities (bonds)
- $R_2$: Equity securities (stocks)
- $R_3$: Credit (e.g. excess reinsurance)
- $R_4$: Loss and LAE reserves
- $R_5$: Net written premium (contributions)
- $R_6$: Catastrophe risk Your surplus
Balance Sheet

Assets

- Real Estate
- Receivables
- Cash
- Stocks
- Bonds

Liabilities

- Case Reserves
- IBNR
  - Other ULAE

Surplus

$Millions
Risk Charges

- Calculates **material** risks, *not all risks*
- Total balance sheet approach
- Factor-based
- Factors *implied* calibration to about 95% confidence level with 1% Expected Policyholder Deficit (EPD)
Canadian Solvency, Factor-Based and Scenario-Based

- Minimum Capital Test (MCT)
- Dynamic Capital Testing Adequacy (DCAT)
Canadian Minimum Capital Test (MCT)

- **MCT** = insurer’s available capital
  capital required

- Minimum required = 100%
- OSFI supervisory target = 150%
- Entities must establish internal target > 150%
Canadian Required Capital – Factor-Based

- Balance sheet assets
  - 0% for government bonds to 15% for equities
- UEPR (8%)
- Unpaid claims
  - E.g. 5% for short-tail lines, 10% for Auto Liability, 15% for others
- Premium deficiency (8%)
- Catastrophic reserve
- Unregistered reinsurance (10%)
- Etc.
Canadian DCAT – Scenario-Based

• Process of projecting and analyzing the trends of capital adequacy under a variety of future scenarios
  ▪ Establish a Base Scenario
    › Consistent with business plan
  ▪ Must test at least 3 most risky scenarios
• Purpose:
  ▪ Assist Board of Directors and senior management in planning and risk management
  ▪ Identify plausible threats, lessen likelihood of threats and migratory actions if they occur
• Need to consider “ripple” effects and associated management actions
DCAT Risk Categories Tested

- Claim frequency and severity
- Policy liabilities
- Inflation
- Premium – varies from expected base scenario
- Reinsurance risk
- Investment risk
- Government and political
  - e.g. rate freeze or rollback, tort reform, privatization of line
- Off-balance sheet risk
  - e.g. contingent liabilities
Monte Carlo Simulation

<table>
<thead>
<tr>
<th>Number of claims (frequency)</th>
<th>Average claim size (severity)</th>
</tr>
</thead>
</table>

Use claim stratification information to simulate claims process.

- Select number of claims
- For each claim, select size

Select number of claims

<table>
<thead>
<tr>
<th>$1,000</th>
<th>$2,000</th>
<th>$3,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4,000</td>
<td>$5,000</td>
<td>$6,000</td>
</tr>
</tbody>
</table>
# Monte Carlo Simulation

## Example – Ranked Simulated Claims

<table>
<thead>
<tr>
<th>Trial Number</th>
<th>Aggregate Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$8,401,712</td>
</tr>
<tr>
<td>2</td>
<td>1,497,651</td>
</tr>
<tr>
<td>3</td>
<td>3,516,291</td>
</tr>
<tr>
<td>4</td>
<td>1,797,246</td>
</tr>
<tr>
<td>5</td>
<td>2,870,778</td>
</tr>
<tr>
<td>6</td>
<td>4,187,925</td>
</tr>
<tr>
<td>7</td>
<td>1,029,627</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>9,999</td>
<td>1,954,018</td>
</tr>
<tr>
<td>10,000</td>
<td>2,509,543</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>Aggregate Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1,020,320</td>
</tr>
<tr>
<td>2</td>
<td>1,024,065</td>
</tr>
<tr>
<td>3</td>
<td>1,029,627</td>
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<tr>
<td>5,000</td>
<td>4,025,944</td>
</tr>
<tr>
<td>7,000</td>
<td>5,353,140</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>9,000</td>
<td>8,849,910</td>
</tr>
<tr>
<td>10,000</td>
<td>155,734,676</td>
</tr>
</tbody>
</table>

Average: $4,293,260

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Confidence Level Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>70%</td>
<td>1.25</td>
</tr>
<tr>
<td>90%</td>
<td>2.06</td>
</tr>
</tbody>
</table>

\[
\frac{\$5.35M}{\$4.3M} = \text{Factor for 70% percentile}
\]

\[
\frac{\$8.8M}{\$4.3M} = \text{Factor for 90% percentile}
\]
Monte Carlo Simulation
Example – Confidence Level

- 70% confidence level
- 99.5% 1 in 200 year
- Expected level

Aggregate Losses ($Million)

% of Trials

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

- 1.6
- 1.9
- 2.2
- 2.5
- 2.8
- 3.2
- 3.7
- 4.3
- 5.4
- 6.0
- 7.3
- 8.8
- 12.2
- 19.4
- Over
Solvency II Quantification

- SCR is calibrated to achieve 99.5% probability of survival (value-at-risk) over one year time period.
VaR and TVaR

- Value-at-Risk (VaR)
  - Threshold value that losses to a certain confidence level, say 99.5% of cases would not be exceeded
- Tail Value-at-Risk (TVaR)
  - Takes the average of all the values in the tail above VaR threshold for a specific time period
1 in a 100 Year event...

- 169,396 games played
- 215 no-hitters
- 19 perfect games
1 in a 100 Year event...

Frequency first 80 years | 0.00012%
Frequency next 20 years | 0.00066%
New level of oversight and governance leads to enterprise-wide assessment of risks

Factors in both quantitative and qualitative analysis

Scenario and stress testing of both historical experience and potential worst case scenarios
Seven Questions

- Does the data have integrity?
- Are the liabilities reasonable?
- Is the funding actuarially adequate?
- What are key or changes to assumptions
- What are the underlying trends?
- Do we have the liquidity to pay claims?
- What is the financial big picture?
In Summary

• Actuarial reports provide
  ▪ vital information on financial position of entity
  ▪ provide insights into various trends
• Results are estimates based on data, standards and judgment
• Variability of estimates necessitates financial tests to ensure solidity
• Understanding how all pieces fit is essential to making sound decisions
Questions?

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