Converting Data to Knowledge

The Actuary looks at Experience Rating
Rick Leavitt

Data to Information in 60 Seconds
Sheila Silva

September 30, 2003
Experience Rating

What is Credibility? Why Credibility?
The Tale of Two Distributions
Reality versus the Theory
Converting Insight to Rating Practice
Experience Rating Defects

Four broad categories of short-comings

1. Market Price versus Actuarial Price
2. Invalid, Inaccurate, or Incomplete Data
3. Improper Application
4. Short-comings of the standard method
   - Risk varies over Time

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Experience Rating Theory

Credible Rate = Experience Rate * X + Manual Rate * (1 – X)

\[ X = \text{Credibility} \]

Theoretical Formula: \[ X = \frac{N}{N + K} \]

\[ N = \text{Expected Claims} \]

\[ K = 20 \text{ to } 35 \]


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Three Questions on Credibility

Question 1:
Why does credibility not depend on observed experience?

Question 2:
Should credibility depend on case characteristics?
Credibility Question

Case A: 2000 lives all head-quartered in one home office
       Uniform job functions and management
Case B: 2000 lives in 8 divisions in 8 locations
       Diverse job functions and management

Question: Should Case A experience be more or less credible than the experience for Case B?
Three Questions on Credibility

Question 1:
Why does credibility not depend on observed experience?

Question 2:
Should credibility depend on case characteristics?

Question 3:
Is credibility set at the right level?
“The LTD industry assigns higher credibility to experience than is indicated by the theory. Employers want their experience to count. This leads to credibility levels set by the market rather than by actuarial science.”

.... Disgruntled LTD Pricing Actuary
Understanding Randomness

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Unlimited Poker Chips in a Barrel

1 out of every 100 chips is Blue
99 out of every 100 chips is Red

Bob Lee selects 100 chips

Question #1: What is the expected # of blue chips?

Question #2: What is the chance he will get no blue chips?

1 blue chip? 10 blue chips?
Poisson Distribution

\[ P(n) = \frac{e^{-\mu} \mu^n}{n!} \]

Simeon Denis Poisson 1781-1840

“Life is good for only two things: to study mathematics and to teach it.”

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Poisson Distribution

Expected Claims = 1

Observed Claims

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Poisson Distribution

Expected Claims = 5

Observed Claims

Probability

0% 5% 10% 15% 20%

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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Poisson Distribution

Expected Claims = 10

Observed Claims

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Poisson versus Normal

Expected Claims = 10

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Simulation: Expected Claims = 5

Monte-Carlo Simulation: 25 Samples

- Expected
- Observed
Monte-Carlo Simulation: 250 Samples

- Expected
- Observed

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Simulation: Expected Claims = 5

Monte-Carlo Simulation: 2,500 Samples

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Random Deviation

Process Variance: Observed Experience is normally distribution about the expectation

Follows from

Assumption of Randomness:

Variance = 1 / # of Claims

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Loss Normally Distributed about Average:

\[
\text{Variance} = \frac{1}{N}
\]

\[
\text{Variance} = \frac{1.45}{N}
\]
Distribution of the Expectation

Assume you have 1000 distinct cases with the identical demographics.

What is the distribution of the expected average loss?

Key Assumption:

Expected Averages are also Normally Distributed
Experience Rating: The Best “Guess”
Theoretical Credibility

\[
\text{Credibility} \equiv \frac{\text{Variance of Expectation}}{\text{Process Variance} + \text{Variance of Expectation}}
\]

\[
\text{Process Variance} \equiv \frac{1.45}{N}
\]

Where \( N \) is the number of expected Claims

\[
\text{Credibility} \equiv \frac{N}{N + K}
\]

where \( K \equiv \frac{1.45}{\text{Var of Expectation}} \)

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Credibility Questions

Question 1:

Why does credibility not depend on observed experience?

If both assumed distributions are normal, then the best estimated loss depends only on the variances of the distributions and not on the experience itself.
Question 1

Credible Rate versus Observed Rate

Slope = Credibility
Credibility Questions

Question 2:
Should credibility depend on case characteristics?

Absolutely... A case with a single headquarters and management will have a greater spread of expectations than a diverse corporate environment.

Single Headquarters = Higher Credibility
Credibility Questions

Question 3:
Is credibility set at the right level?

\[
K = \frac{1.45}{\text{Var of Expectation}}
\]

\[K = 25\quad \text{Standard Deviation of Expected Loss} = 24\%

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What’s Wrong with the Model?

Risk Dynamics Change over Time

Manual Rates may not be Correct

Distribution of Case Rates is not Normal

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Case Rate Model

Assumptions:

Base Random Cost = 30% of Expectation

Case-Specifics

Working Impaired ranges between 10% and 30%

Working Impaired up to 25 Times more likely to file

i.e. Best Case: Factor of 0

Worst Case: Factor of 25
Effects on Credibility of Non-Normal Distribution

- **Skewed**
- **Normal**

Observed Rate vs. Credible Rate graph showing the comparison between skewed and normal distributions.
Very Good Experience

Distribution of Expected Loss

- Skewed
- Normal

Minimum Expectation

Expected Rate over Manual Rate

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Experience-Based Credibility

Normal Credibility = 97%

- Decrease Credibility for Very Good Experience

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What can the Underwriter Do?

Risk Assessment converts “Random” to “Predictable”
Selecting a Risk Adjusted Manual Rate will reduce case-specific variance.

Intelligent Risk Assessment will yield:
- More accurate starting rate
- Reduced credibility – less reliance on experience

But…. Can the Underwriter be Trusted?
(We need Training, Tracking, and Control)
Experience Rating Improvements

Experience Adjusted Credibility: To reflect actual distribution of case rates

Start with Risk Adjusted Manual Rates

Take Special Care with Changing Risk Dynamics

Claim Diagnoses can distinguish predictable from random experience.... leads to diagnosis based credibility
Data to Info in 60 seconds

Employing infrastructure and reuse concepts to boost productivity

Sheila Silva, FSA, MSCD, OCP, SCJP

September 30, 2003
Agenda

- Data – a blessing and a curse
- Infrastructure – building a strong house
- Reuse – data does heavy lifting
- Info – how to show what we know
- Questions and Comments
Data – Then and Now

In the beginning...
- Expensive
- Infrequent updates
- Limited detail

A La Carte data
- Internet delivery mechanism
- Multiple sources
Data – Making it Your Own

Credibility
- Stick by your old friends
- “I’m from Missouri”
- When steak tips become ground beef

Reliability
- Business changes, data changes
- Change over time vs. absolute value

Reconciliation
- Data to Data, not Data to Info
Infrastructure – Why Bother?

Current state
- Multiple storage mechanisms
- Multiple analysis tools
- Tower of Babel

Result: Wasted time and money
- Wildflowers vs. hot house flowers
- Stupid pet tricks
- “What does OPEN mean?”
Infrastructure – Storage

- Sales - DB2
  - Weekly

- Reserves - Access
  - Monthly

- Policies - Oracle
  - Daily

Dept DB - SQL Server
Infrastructure - Tools

- Spreadsheets – the unsung hero
- Beware snake oil salesmen
- The myth of “quick and dirty”
- The wall between tools and data
- Good data hygiene pays off
## Infrastructure – Data Definitions

### Open Claims

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<tr>
<td>LTC</td>
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### Reserve Summary

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# Infrastructure – Data Definitions

**Open Claims**

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**Reserve Summary**

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Reuse – Why Bother?

Data reuse
- Minimize reconciliation, updates
- Reinforce data definitions

Analysis reuse
- Change over time
- Common calculations
- Audits
Reuse - Implementation

- Data reuse
  - Already done!
- Analysis reuse
  - Spreadsheets
  - Common code libraries
- Documentation
“Just the facts”
The wall between display and data
Reconciliation rears its ugly head
Show off your data dictionary
Info – The Web and XML

- Broad audience
- Pull vs. push technology
- Instant gratification
- Mass customization
- Display back to data
- ACORD standards
Final Thoughts

- Always think “Reuse”
- Don’t be bullied
- Be an Info Czar
- Get involved!
- Comments and Questions