Risk Management Concepts, Insurance
Company Applications and Strategies

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Agenda

• My Background
• Introduction to Risk Management
• The Risk Management Process
• Insurance Company Risk Identification, Classification & Measurement
• The Role of an Actuary
• iPad Insurance Pricing Example
My Background

• Ph.D. in Insurance and Risk Management, The Wharton School, University of Pennsylvania
• M.S. in Actuarial Science, University of Wisconsin-Madison
• B.A. in Mathematics & Economics, Whitman College

• University of Wisconsin-Madison
• Audencia Nantes School of Management in Nantes, France

• University of Georgia
• University of North Carolina at Charlotte

• Actuarial Consultant, Employee Benefits
• Expert Witness

SEADI is a joint project of the U.S. Agency for International Development and the Republic of Indonesia.
• Undergraduate Insurance Program Rankings


1) University of Pennsylvania
2) University of Wisconsin-Madison, University of Georgia
4) Georgia State University
5) University of Texas-Austin
6) New York University, Temple University
8) Florida State University
9) University of South Carolina
10) St. Joseph’s University

UW-Madison Actuarial Science Program

- Center of Actuarial Excellence designated by the Society of Actuaries

- 300+ students in the program; 75 graduates per year

- Broad offering of courses

- Significant advantage being paired with highly rated Risk Management program; both in the School of Business

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Introduction to Risk Management
What is Risk?

What is the definition of risk?  How is it measured?

VaR—Value @ Risk  Underwriting Risk  Expected Loss
Mean/Median/Mode  Firm Specific Risk
Legal & Compliance Risk  Supply Chain Risk  Mortality Risk
Occupational Risk  Investment Risk  Strategic Risk
Pure Loss rate  Pure & Hazard Risk  Standard Deviation
Insurable Risk  Confidence Interval  Non-Insurable Risk
EaR = Earnings @ Risk  Speculative Risk  Financial Risk
Systematic Risk  Regulatory Compliance
Environmental  Coefficient of Variation

Risk Means Different Things to Different People

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What is Risk?

• Two Important Dimensions of Risk for Risk Managers
  1) Expected loss (Expected value of loss)
     - riskier → greater frequency or severity of loss
  2) Variability of loss
     - riskier → more difficult to predict

• “The possibility of an adverse deviation from a desired outcome that is expected or hoped for.”

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Categories of Risk

Types of Risk

• Pure Risk vs. Speculative Risk
  • Is this distinction meaningful?

Finance Manageable Risks

• Diversifiable Risk vs. Non-diversifiable Risk
  • Key issue: Does pooling reduce risk?
  • Note parallel to nonsystematic/systematic risk

Risk Measurement

• Subjective Risk vs. Objective Risk
Exposure vs. Peril vs. Hazard

• *Exposure* – An opportunity for loss. Something or someone facing the risk of loss.

• *Peril* - The immediate cause of loss

• *Hazard* - Condition affecting frequency or severity of loss
  • Physical hazard
  • Moral hazard
Major Types of Business Risk

Price Risk
- Output Price Risk
- Input Price Risk
  - Commodity Price Risk
  - Exchange Rate Risk
  - Interest Rate Risk

Credit Risk
- 

Pure Risk
- Damage to Assets
- Legal Liability
- Worker Injury
- Employee Benefits

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Insurance Company Risks

• Some examples....more details to come:
  ✓ Price risk – inadequate premiums
  ✓ Investment risk – return of and on invested cash flows
  ✓ Operational risk - mistakes, errors, etc.
  ✓ Regulatory risk – new or changing requirements
  ✓ Legal risk - litigation
  ✓ Reputational risk – negative press
  ✓ Pure risks – employees, equipment, etc.
The Risk Management Process
Core Managerial Functions within an Organization

• Strategic Management
  • What is our mission, our goals and objectives, our strategic plan, our means of measuring progress toward our mission?

• Operations Management
  • What are the activities that move us toward our mission?

• Risk Management
  • What are the activities that facilitate the most direct achievement of our mission?
  • How can we remove potential roadblocks or obstacles that may prevent or delay our firm from achieving its mission?
The Risk Management Process


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The Risk Management Process

1) Set Objectives for Firm/Dept.

2) Identification of Risks
   - What assets are exposed to loss?
   - What perils can cause the loss to those assets?
   - What are the potential financial consequences?

3) Evaluation of Frequency and Severity of Losses
   - Historical data, industry data, theoretical distributions, simulations
   - Expected values, std. deviations, MPL’s, VaR’s
   - Critical role for actuaries
The Risk Management Process

4) Choosing Risk Management Methods to Increase Firm/Shareholder Value
   - Risk Control
   - Risk Financing
   - Risk Avoidance

5) Implementation of the Chosen Methods

6) Monitoring the Performance and Suitability of the Methods
Major Risk Management Methods

Loss Control
- Reduced Level of Risky Activity
- Increased Precautions

Loss Financing
- Retention & Self-Insurance
- Insurance
- Hedging
- Other Contractual Risk Transfers

Internal Risk Reduction
- Diversification
- Investments in Information
Insurance Company Risk Identification, Classification & Measurement

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Insurance Co.: Nexus of Contracts

Insurance Co.

owners

employees

suppliers

customers

government

creditors

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Risk Identification

- Risk identification methods & examples
  - Risk checklists/questionnaires
  - Internal & external interviews
  - Financial statement analysis (A/L, I/E, etc.)
  - Review of strategic plans
  - Review of external analyst reports
  - On-site inspections
  - Contract analysis
  - Statistical records of past losses

- Risk identification will vary across industries & businesses. One must think broadly when identifying risks: “nexus of contracts”
Risk Classification

- Logical classification categories may vary by type of industry & even firms with the same industry
  - Insurance company
  - Technology firm
  - Automobile manufacturer
  - Pension fund management firm
  - Law firm
  - Hospital

- Number of categories must be reasonable
Risk Classification: Insurer Example

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Common Insurer Risk Classification

1) Investment (Financial) Risk
   - Market risk
   - Credit risk

2) Underwriting Risk
   - Life risk
   - Non-life risk

3) Non-financial Risk
   - Operational risk
   - Business risk

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1) Investment (Financial) Risk

- Market Risk: changes in market variables such as...
  - Interest rate risk
  - Equity risk (share prices)
  - Currency risk (exchange rates)
  - Inflation risk
  - Real estate risk or property risk
  - Private equity risk
  - Credit spread risk
1) Investment (Financial) Risk

• Credit Risk: change in counterparties abilities to fulfill obligations or change in their credit standings
  – Bonds
  – Mortgages
  – Reinsurance counterparties
  – Derivatives counterparties
2) Underwriting Risk

• Life Risk
  – different mortality than expected or change in mortality expectation
    • Mortality risk vs. longevity risk
    • Life insurance/endowments vs. annuity products
    • Volatility risk: “regular” fluctuations in mortality
    • Trend risk: changing estimated trends
    • Calamity risk: disasters or calamities (e.g. war, epidemics)
2) Underwriting Risk

• Non-life Risk
  – different or higher claims than expected or changes in expectation over time (trends)
    • Premium risk: more and/or larger claim amounts are reported than expected (in current year)
    • Reserve risk: additional provisions (money) for previous years’ reported claims are necessary (“run-off risk”)
    • Catastrophe risk: natural disasters (e.g. flood, earthquakes, volcanic eruptions)
3) Non-financial Risks

- Operational Risk: possible loss due to inadequate or failed internal processes, people or systems, or due to external events
  - Wide-ranging concept (e.g. fraud, employment practices)
  - Tough to quantify due to indirect losses, reputation, etc. (e.g. Enron, Worldcom, etc.)
  - Overlaps with underwriting and financial risks
3) Non-financial Risks

- Business Risk (Strategic Risk): possible losses due to changes in “competitive environment” or internal flexibility
  - Existing competitors, clients, new market players, government
  - Ability to respond to changing environment
Risk Measurement & Assessment

- Qualitatively and/or quantitatively describe the potential impact of the risk on the firm
  - Consider frequency and severity
  - Consider direct and indirect effects
  - May involve a “scoring” system
  - MPL & VaR are helpful measures

- Assess significance of each risk and prioritize
Risk Measurement & Assessment

• Ideally, a firm may move beyond simple frequency-severity risk scoring system
• Advanced risk analysis involves statistical methods and modeling of the risks faced by the firm (loss distributions).
• Models can allow simulations of current firm dynamics and exploration of “what if” scenarios
• Actuaries can help!
The Role of an Actuary

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What is an Actuary?

• Business professional with strong quantitative skills who works primarily at insurance companies and consulting firms

• Problem solver with expertise in understanding, measuring and managing (financial) risks

• Specialist who uses historical information and models to help predict the future
Actuarial Areas of Expertise

- Property & Casualty (Non-life) – expert in personal property risks and risks associated with businesses

- Life & Health – expert in risks of illness, disability or death

- Pension – expert in developing and analyzing retirement programs

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Time Value of Money

• Actuaries evaluate the financial impact today of events in the (sometimes distant) future

• What is the value today of the promise to pay future claims if there is an insured loss (house fire, death, etc.)?

• If a loss is reported, how much is required to set aside today for our expected obligations (liability insurance)?

• For a promised pension payment of $1,000 a month, how much money is needed today in order to assure that we can meet our obligations?

• All of these involve insurer related risks!

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Insurance Policy Pricing

• Critical actuarial function – What is the value today of the expected losses that a policy insures?

• Utilize present value concepts along with probabilities of loss events

• Identify the amount necessary to charge for the policy exposures

• Understand risks associated with this process
  – Underwriting risk: premium risk
  – Market risk
  – Operational risk
  – Financial risk
iPad Insurance
Pricing Example
Insurance Policy Pricing

Example (with simplifying assumptions):

- 3 year iPad insurance
- Covers owner against any iPad failure
- If loss occurs, entire iPad is replaced (not fixed) at the end of the year of loss and no salvage value for the original unit
- Policy only covers the initial iPad (not any replacement units)
- $500 cost to replace iPad
- Current interest rate we can earn is 7%

Pr(Failure in any year given survival to the beginning of that year) = 5%
Insurance Policy Pricing

• What should the price of this policy be?

• Present value of loss random variable $Z$

\[
Z = \begin{cases} 
500 \times (1.07^{-1}) = 467.29 & \text{if fail during 1st yr} \\
500 \times (1.07^{-2}) = 436.72 & \text{if fail during 2^{nd} yr} \\
500 \times (1.07^{-3}) = 408.15 & \text{if fail during 3^{rd} yr} \\
0 & \text{otherwise}
\end{cases}
\]

• Since payment is at the end of the year of failure, there are only three possible claim payment times.

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Insurance Policy Pricing

• Probability of failure in first year = 5%
• Conditional probability of failure in second year given that unit survived first year = 5%
• Conditional probability of failure in third year given that unit survived second year = 5%
• Of initial units sold
  – 5% fail in the first year
  – (95%)*(5%) = 4.75% fail in second year
  – (95%)*(95%)*(5%) = 4.51% fail in third year
  – 1 – 5% - 4.75% - 4.51% = 85.74% survive all 3 years
Insurance Policy Pricing

• E[Z] = PV of iPad insurance losses per unit
  = (0.05) * $467.29 +
  (0.0475) * $436.72 +
  (0.0451) * $408.15 +
  (0.8574) * $0 = $62.52 per unit

• To cover the cost of the insurance, we would have to charge an additional 12.5% (62.52/500) of the purchase price at the time of purchase.

• Or the policy could be funded by premiums at the beginning of each of the three years of the policy.

• Premium = $22.27 per year
Variance of iPad Insurance Policies

- $E[Z^2] =$
  \[ (0.05) \times [\$467.29]^2 +
      (0.0475) \times [\$436.72]^2 +
      (0.0451) \times [\$408.15]^2 +
      (0.8574) \times [\$0]^2 = \$27,490.45 \]
- $\text{Var}[Z] = \$27,490.45 - (62.52)^2 = \$23,581.70$
- Expected Value = $\$62.52$, Standard Deviation = 153.56,
- Expect wide variation on any one policy
- Look to minimize variation through writing more policies
Variance of iPad Insurance Policies

• 10,000 iPad policies
• $Y = Z_1 + Z_2 + \ldots + Z_{10,000}$
• $E[Y] = 10,000 * E[Z] = $625,200
• Assuming that $Z_1, Z_2, \ldots Z_{10,000}$ are independent (not a good assumption for this policy – design flaws, etc.)
• $Var[Y] = 10,000 * Var[(Z)] = $235,817,000
• $St Dev[Y] = 15,356$
• 95% confidence interval for $Y = [($625,200 \pm (1.96 * 15,356)) ] = [595,102, $655,298$]
Thank You

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