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.

UW-Madison Risk Management & Insurance Program

- Undergraduate Insurance Program Rankings
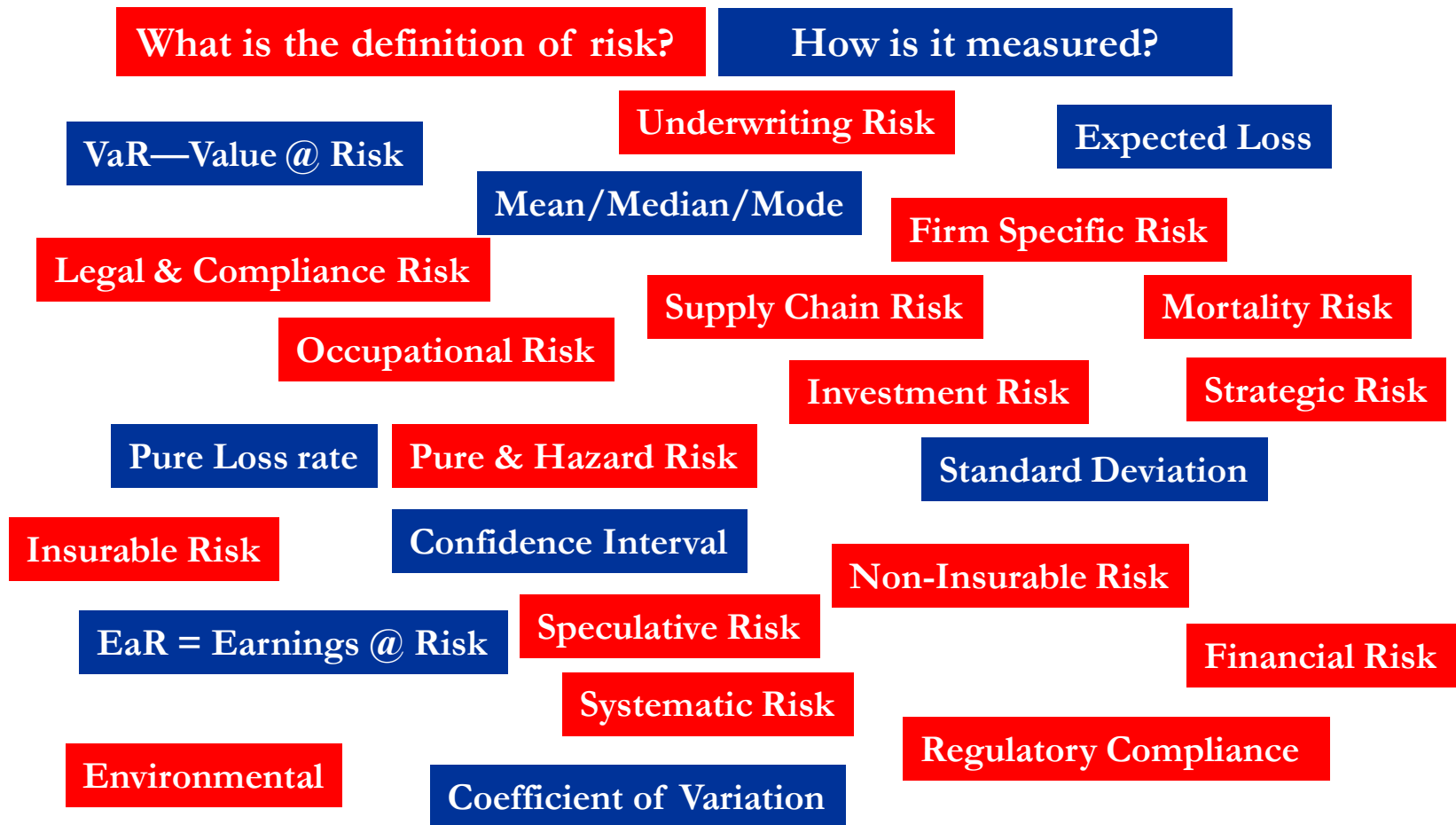
  U.S. News & World Report (2013)

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

http://colleges.usnews.rankingsandreviews.com/best-colleges/rankings/business-insurance-risk

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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

Introduction to Risk Management

What is Risk?

WISCONSIN SCHOOL OF BUSINESS

What is the definition of risk?

How is it measured?

Underwriting Risk

Expected Loss

VaR—Value @ Risk

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

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."

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
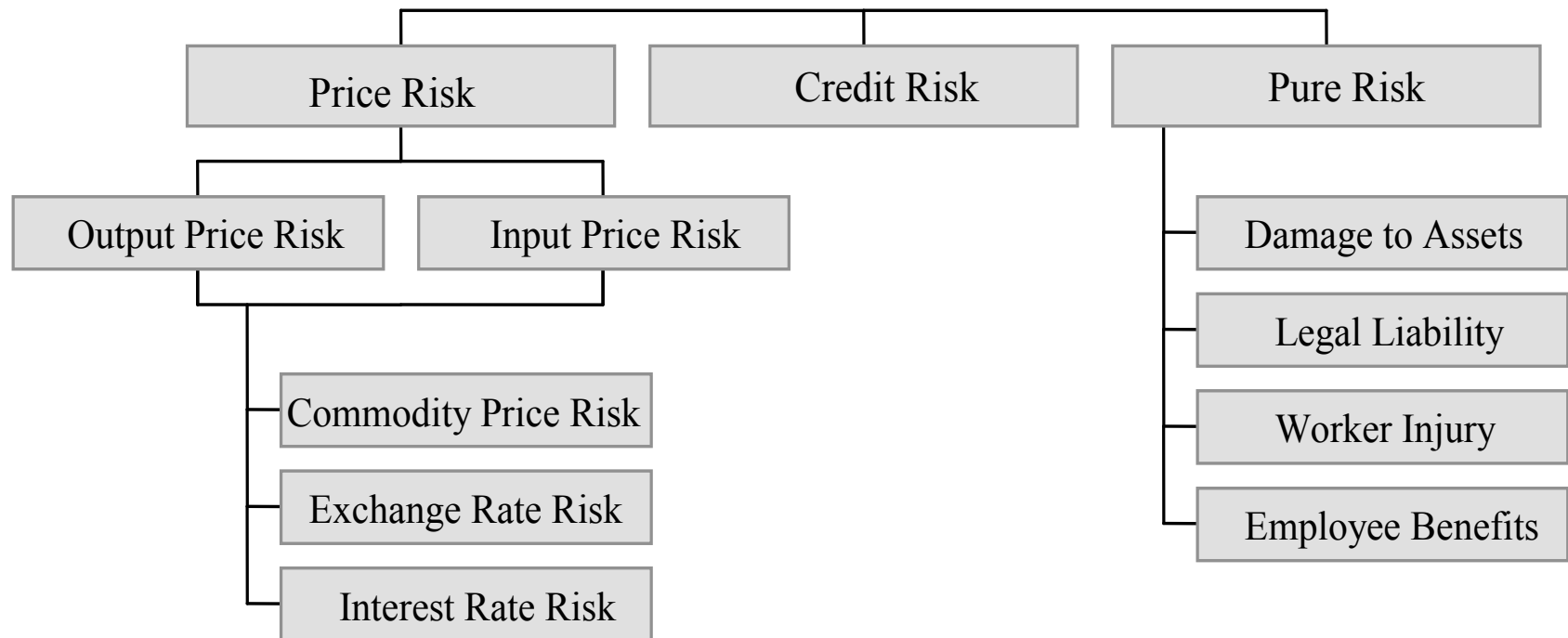
Risk Measurement

- 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

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                    ┌──────────────────┬──────────────────┐
            ┌───────────────┐  ┌───────────────┐  ┌───────────────┐
            │   Price Risk  │  │  Credit Risk  │  │   Pure Risk   │
            └───────────────┘  └───────────────┘  └───────────────┘
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| Output Price Risk | Input Price Risk |

| Commodity Price Risk |

| Exchange Rate Risk |

| Interest Rate Risk |

| Damage to Assets |

| Legal Liability |

| Worker Injury |

| Employee Benefits |

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?

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The Risk Management Process

Source: Integrated Risk Management Framework, Treasury Board of Canada, Secretariat, 2001. Reproduced with the permission of the Minister of Public Works and Government Services. Government of Canada, 2004.
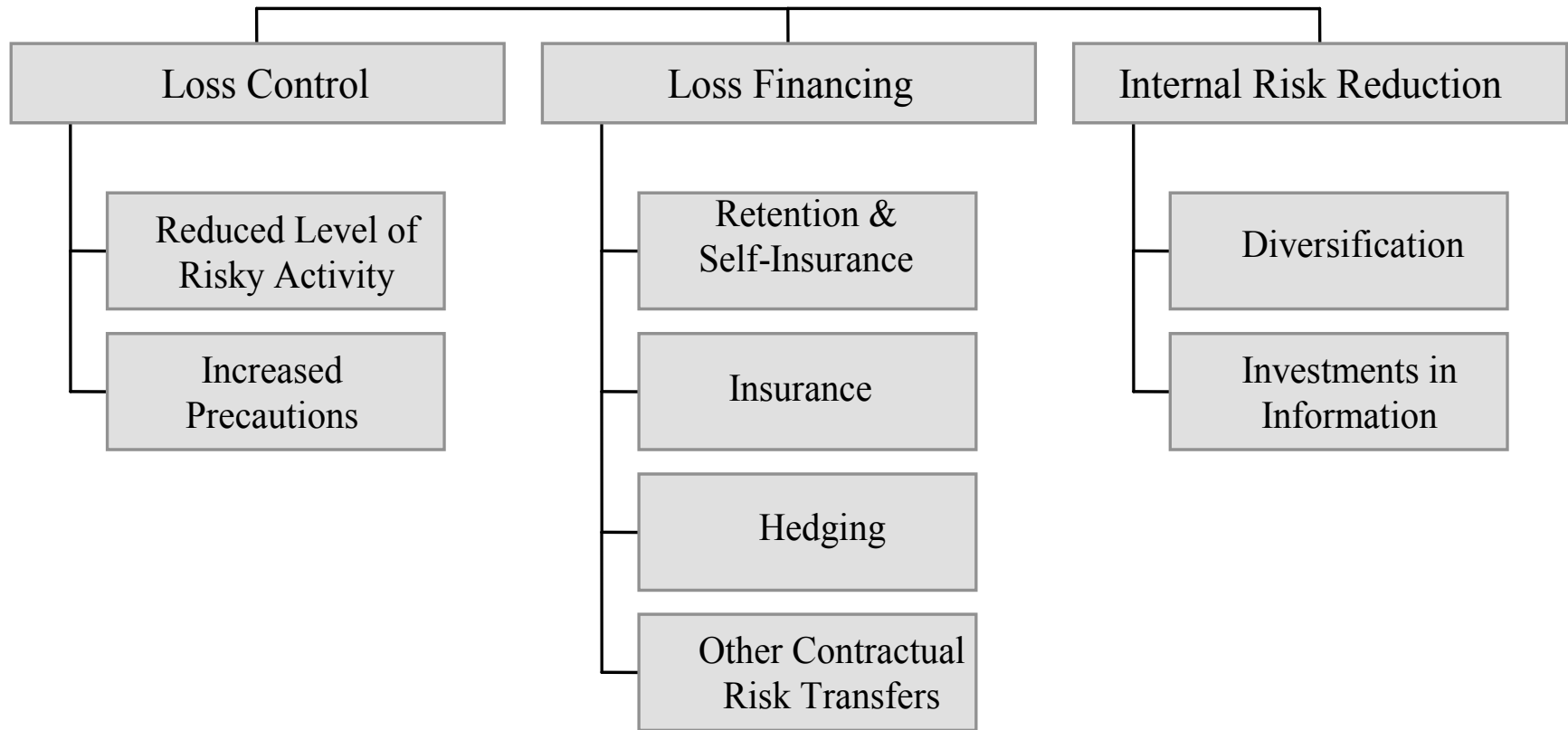
The Risk Management Process

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 <u>actuaries</u>

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

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Major Risk Management Methods

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| Loss Control | Loss Financing | Internal Risk Reduction |

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

Insurance Co.: Nexus of Contracts

owners

employees

creditors

Insurance Co.

suppliers

customers

government
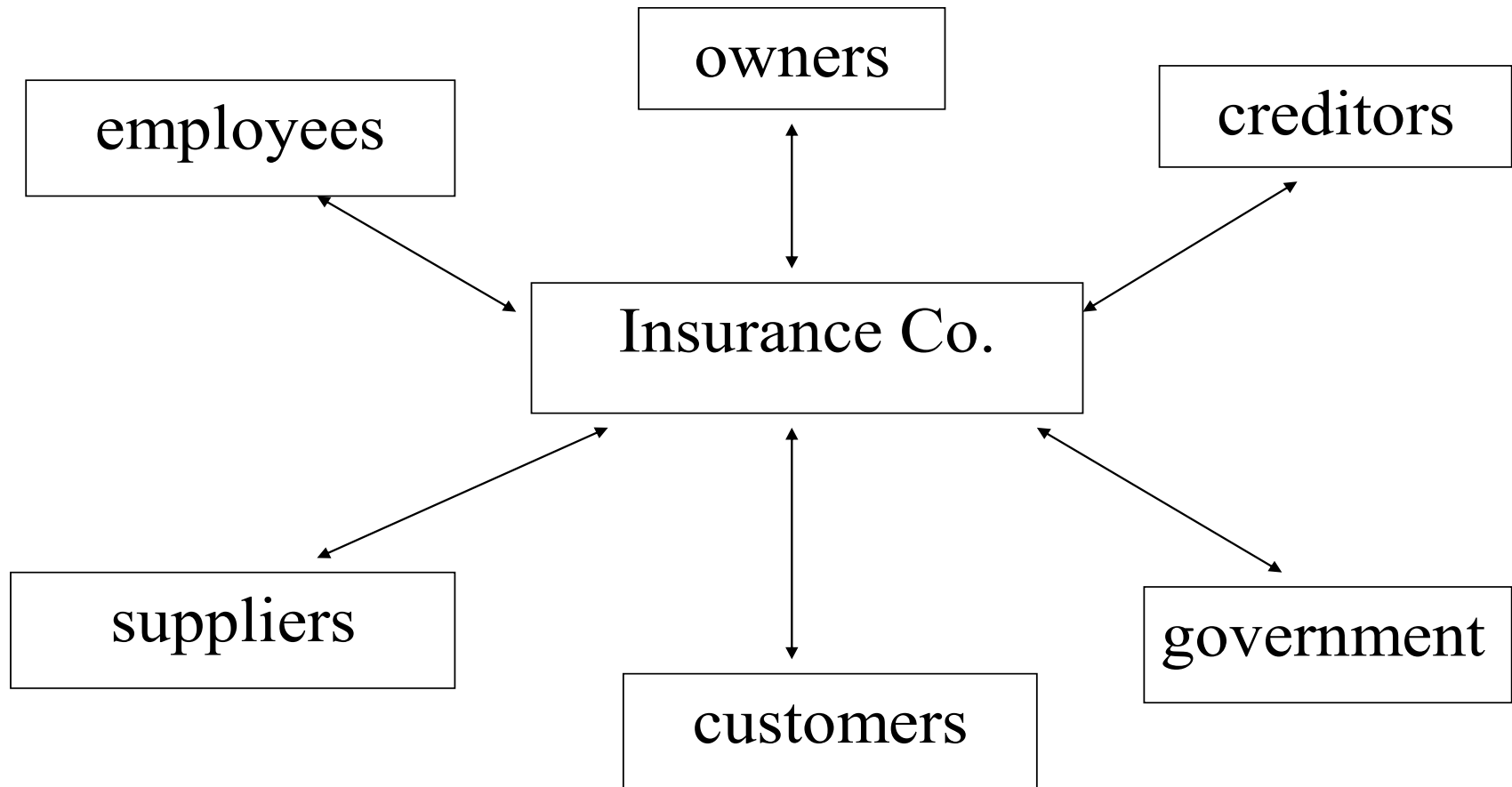
Risk Identification

- 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
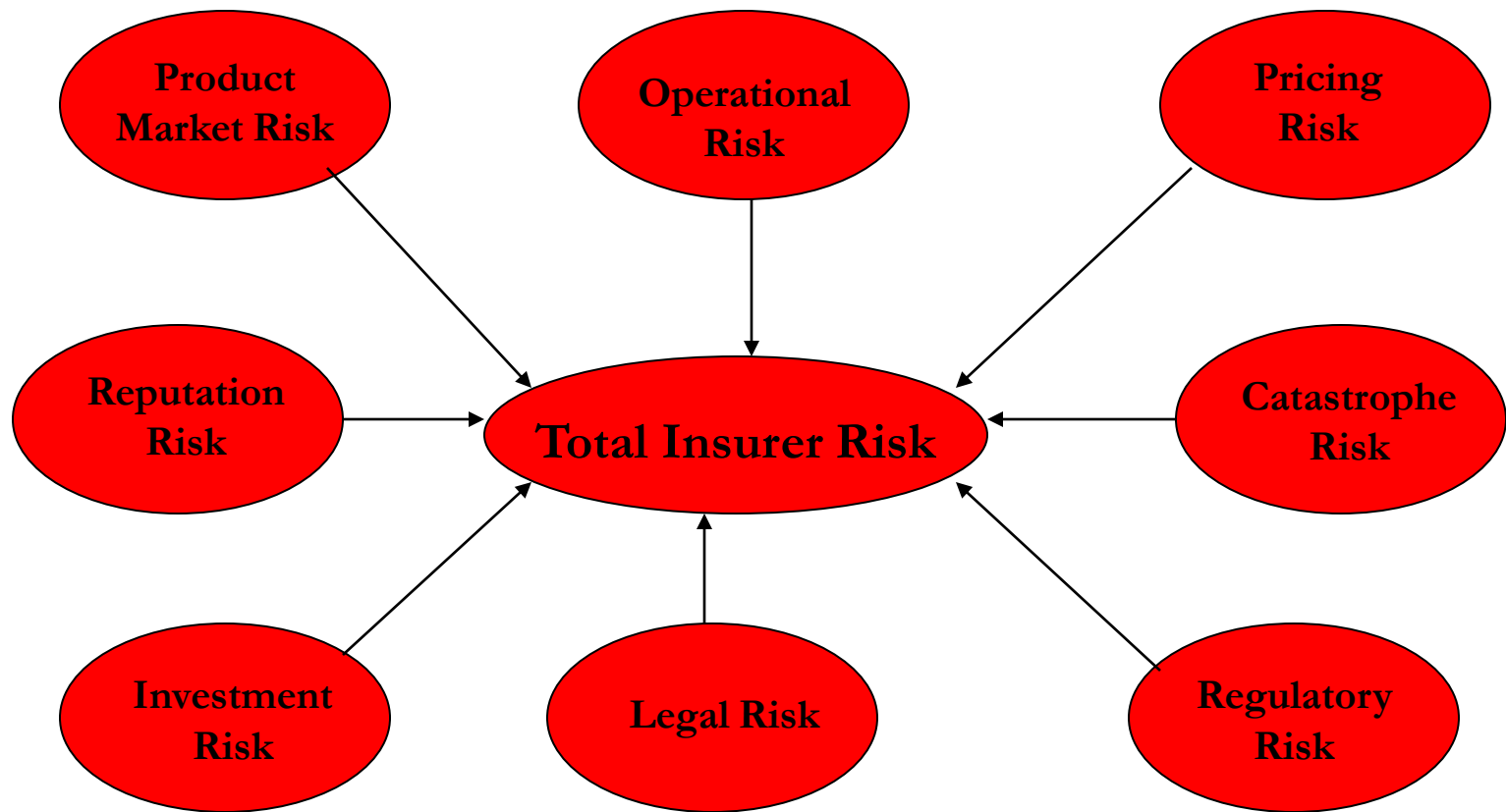
Common Insurer Risk Classification

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

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

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 <u>any</u> 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)

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

- $500 cost to replace iPad

- Current interest rate we can earn is 7%

Insurance Policy Pricing

- **What should the price of this policy be?**

- Present value of loss random variable Z

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

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

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

- $\text{Var}[Z] = E[Z^2] - E[Z]^2$
- $E[Z^2] =$
  $(0.05) \quad * [\$467.29]^2 +$
  $(0.0475) * [\$436.72]^2 +$
  $(0.0451) * [\$408.15]^2 +$
  $(0.8574) * [\$0]^2 \quad = \$27,490.45$
- $\text{Var}[Z] = \$27,490.45 - (62.52)^2 = \$23,581.70$
- 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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