ERM Detailed Study Manual - Sample

Financial Enterprise Risk Management

Source Author: Paul Sweeting (2017)

Chapter 9: Some Useful Statistics (Background Only)

Overview of This Reading

Even though the syllabus says this chapter "background only," it's very important to be able to describe these statistics and be able to perform calculations using them

These concepts in this chapter are the basic ingredients for more advanced correlation and copula topics covered later in readings like ERM-101

Key topics for the exam include:

- Basic univariate statistical measures
  - Location measures (mean, median, mode)
  - Spread measures (variance, range)
  - Skew measures
  - Kurtosis
- Measures of correlation between two variables
  - Pearson's rho
  - Spearman's rho
  - Kendall's tau
  - Tail correlation

Location Measures

Location measure – gives an indication of the point around which observations are based

A **mean** is the most commonly used measure of central tendency in modeling (based on first moment of distribution)

Sample mean of a set of observations:

$$\overline{X} = \frac{1}{T}\sum_{t=1}^{T} X_t$$

Population mean (μ) is usually not observable, but is calculated the same as $\overline{X}$

$$\mu = \frac{1}{T}\sum_{t=1}^{T} X_t$$

Median – measure of the mid-point of a distribution (50th percentile)

- Useful for analyzing simulated data

Mode – the most common observation

- Discrete distributions:
  1. Count the number of each observation
  2. Mode = observation with highest count
- Continuous distributions: mode = maximum of density function = point at which the first derivative = 0
  - First derivative is sometimes called the "gradient"

Spread Measures

Spread measures indicate how far away an observation may fall from a location measure

- Can help establish confidence intervals

Variance is the most common spread measure (based on 2nd moment of distribution)

Population variance:

$$\sigma^2 = \frac{1}{T}\sum_{t=1}^{T}(X_t - \mu)^2$$

- Appropriate if the dataset represents all possible observations (not likely for risk management)
- Not a good estimate of the true population variance since some observations exist in the future and cannot be known
  - Biased downwards for finite samples (i.e. it tends to underestimate the true variance)
  - Bias increases as the sample size falls

Sample variance is adjusted to reduce the bias:

$$s^2 = \frac{1}{T-1}\sum_{t=1}^{T}(X_t - \overline{X})^2$$

Range = difference between the largest and smallest value in dataset

- Alternative to variance for measuring spread
- May capture information about the effect of potential extreme events
- Straightforward to calculate, but can't be used for parametric distributions or if observations are unbounded (i.e. observations can be zero to ∞)
- For unbounded distributions, one solution is to use an inter-quartile range (e.g. 75th percentile − 25th percentile)

Skew Measures

Skew – a measure of a distribution's asymmetry (based on 3rd moment)

- Skew = 0 for perfectly symmetric distributions (e.g. normal distribution)
- **Negative skew** means left tail > right tail (positive skew is the opposite)
  - This assumes the observations are increasing (i.e. worst values on the left, best values on the right)
- Mean and variance do not capture skew

Many risk distribution are negatively skewed

- Probability of a large loss > probability large gain

Problems with ignoring skew or assuming skew = 0:

1. Underestimates risk ⇒ may result in lower-than-expected profits
2. May result in profitable projects being rejected if there is a desire for large profits

Population skew:

$$\omega = \frac{1}{T}\left(\frac{\sum_{t=1}^{T}(X_t - \mu)^3}{\sigma^3}\right)$$

- Will be biased if full distribution is not available (usually it's not available)

Sample skew mitigates the bias:

$$w = \left(\frac{T}{(T-1)(T-2)}\right)\left(\frac{\sum_{t=1}^{T}\left(X_t - \overline{X}\right)^3}{s^3}\right)$$

Kurtosis

Kurtosis indicates the likelihood of extreme observations relative to those that would be expected with the normal distribution

- In other words, it measures how fat the tails are ⇒ higher kurtosis = fatter tails
- Based on the 4th moment of the distribution

Types of distributions based on the kurtosis value

1. **Mesokurtic:** kurtosis = 3 (true of the normal distribution)
2. **Platykurtic:** kurtosis < 3 ⇒ distribution has thin tails relative to the normal distribution ("negative excess kurtosis")
3. **Leptokurtic**: kurtosis > 3 ⇒ has fat tails relative to the normal distribution ("positive excess kurtosis")

- If this is not accounted for, the probability of extreme events will be underestimated
- Many risk distributions are leptokurtic

Memory tip: leptokurtic means the kurtosis "leptover" 3! :)

Population measure of excess kurtosis:

$$\kappa = \frac{1}{T}\frac{\sum_{t=1}^{T}(X_t - \mu)^4}{\sigma^4} - 3$$

- Measures the kurtosis against the normal distribution (hence subtract 3)

Sample excess kurtosis corrects for bias if the full population data isn't available:

$$k = \left(\frac{T(T+1)}{(T-1)(T-2)(T-3)}\right)\left(\frac{\sum_{t=1}^{T}\left(X_t - \overline{X}\right)^4}{s^4}\right) - \frac{3(T-1)^2}{(T-2)(T-3)}$$

Correlation Measures

Correlation is important in ERM because it measures the diversification benefits of aggregating risks

Interpretation of correlation between 2 variables

1. Strong positive correlation
   - The risk of two events occurring simultaneously is high
2. Low correlation
   - The risks can diversify one another
3. Strongly negative correlation
   - Indicates an incentive to increase the level of one risk taken in order to offset the second

Three Measures of Correlation

1. **Pearson's rho**: $\rho_{X,Y}$ (a.k.a. "linear correlation coefficient")

$$\rho_{X,Y} = \frac{\sigma_{X,Y}}{\sigma_X \sigma_Y}$$

$$\sigma_{X,Y} = \frac{1}{T}\sum_{t=1}^{T}(X_t - \mu_X)(Y_t - \mu_Y) = \text{population covariance}$$

   - Attractive, widely used, easy to calculate
   - Only a valid if the data series are jointly elliptical (i.e. related to the multiple variate normal distribution)

- If not jointly elliptical, $\rho_{X,Y} = 0$ does not necessarily mean independence
- For sample populations, use:

$$r_{X,Y} = \frac{s_{X,Y}}{s_X s_Y}$$
$$s_{X,Y} = \frac{1}{T-1}\sum_{t=1}^{T}\left(X_t - \overline{X}\right)\left(Y_t - \overline{Y}\right)$$

2. **Spearman's rho:** ${}_s\rho$ (a.k.a. Spearman's rank correlation coefficient)
   For sample populations:

$${}_s r_{X,Y} = 1 - 6 \cdot \left(\frac{\sum_{t=1}^{T}(V_t - W_t)^2}{T(T^2-1)}\right)$$
$$V_t, W_t = \text{rankings of } X_t \text{ and } Y_t, \text{ respectively}$$

   - Equals Pearson's rho if data are uniformly distributed
   - Differences from Pearson's rho:
     - Ranks can be in ascending or descending order (since rank differences are squared)
     - Spearmean's rho is independent of the statistical distribution

3. **Kendall's tau:** (τ) – compares pairs of data points
   - Suppose we have 2 observations: (X_1, Y_1) and (X_2, Y_2)
   - If $X_2 - X_1$ and $Y_2 - Y_1$ have the same sign, these pairs are **concordant**; else they are **discordant**
   - For T observations, the total number of possible pairs is

$$T\left(\frac{T-1}{2}\right)$$

   - **Sample Kendall's tau** normalizes all concordant pairs (p_c) and discordant pairs (p_d) by the total number of pairings

$$t_{X,Y} = \frac{2(p_c - p_d)}{T(T-1)}$$

   - Spearman's rho (${}_s\rho$) and Kendall's tau (τ) are related in the following way:

$$\frac{3}{2}\tau - \frac{1}{2} \le {}_s\rho \le \frac{1}{2} + \tau - \frac{1}{2}\tau^2 \qquad \text{if } \tau \ge 0$$
$$\frac{1}{2} + \tau + \frac{1}{2}\tau^2 \le {}_s\rho \le \frac{3}{2}\tau + \frac{1}{2} \qquad \text{if } \tau < 0$$

Key comparisons among the 3 correlation measures above:

- Pearson's rho is calculated directly from the data series, while Spearman's rho and Kendall's tau are rank measures
  - **Rank measure** – a statistic calculated from the position (rank) of the observations
- Pearson's rho is only valid if the data series are jointly elliptical, but rank measures are always valid since they do not depend on the distribution's shape
- Rank measures are usually combined with copulas[1]
  - Kendall's tau has simple relationships with a number of copula functions
- Limitations of the 3 correlation measures:
  - Each describes only one aspect of the variables' relationship
  - Copulas can describe correlation relationships more accurately than any of the above measures alone

Tail Correlation

The 3 correlation measures described above imply that X and Y always have the same relationship

In extreme situations (tail events), variables' relationships can change

Tail correlation looks at the variables' relationship only in the tail (e.g. lowest and highest 10% of observations)

Key problems: Determining where the "tail" begins is subjective and can cause instability in parameterization

[1] Copulas will be covered in more detail later in ERM-101 and ERM-103. We will also see how the basic correlation measures in this chapter relate to various copula methods. Copulas identify relationships among each individual variable's distribution to create a multivariate joint distribution. Among other advantages, a copula can describe how correlations change as the value of variables change—something that is very useful for risk modeling where extreme tail events can cause variables' relationships with each other to change.

Agency Theory and Asymmetric Information

Source Author: Education Committee of the Society of Actuaries (2012)

Overview

The principal-agent problem arises when one group (principals) appoint another group (agents) to carry out the terms of a contract and the incentives of the principals and agents aren't aligned.

Information asymmetry may arise and lead to the agents making decisions that are in their best interest but are suboptimal for the principals.

Key topics for the exam include:

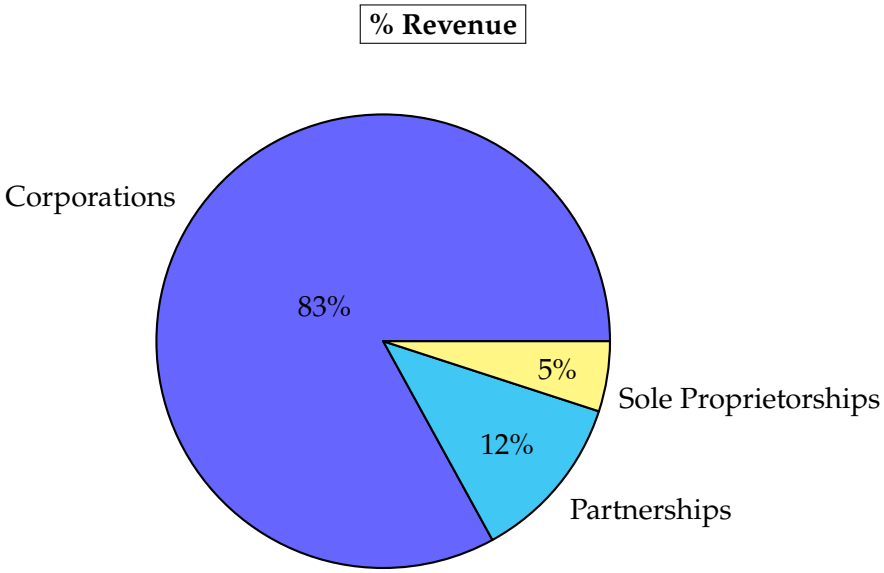
- Explain how agency theory comes into play for the three different major types of US business structures
- Define the principal-agent problem
- Describe the three key types of asymmetric information:
    1. Adverse selection
    2. Moral hazard
    3. Signaling

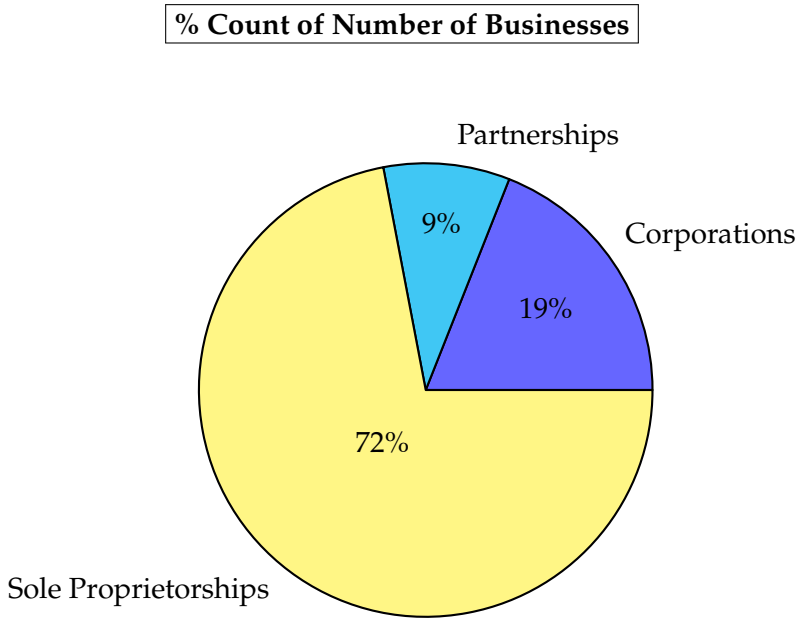
Note: In particular, this is a reading that is easier to understand by seeing many examples - and so you will see many examples in this detailed study manual and also the videos for this lesson.

Agency Theory

In the United States, there are three major types of business structures:

- Sole Proprietorships
- Partnerships
- Corporations





We see that corporations make up 19% of the number of businesses but 83% of the revenue.

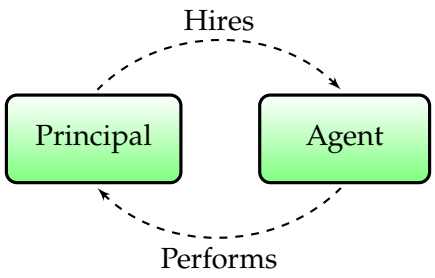
This is because:

- Corporations are separate legal entities with limited liability - the maximum amount shareholders can lose is their capital investment
- Shares in a corporation can be traded freely in the market
  - There are no restrictions to the number of shareholders
  - Very few restrictions on who can own shares
- Corporations can raise capital relatively easily by issuing additional shares

Agency theory arises because shareholders elect a board of directors to represent their interests – the board then hires and oversees the company management team.

The Principal-Agent Problem

- Conflicts may arise between principals (shareholders) and managers (agents) when agents place their own interests ahead of the principals'
- This results in agency costs such as adjusting contracts or incentive compensation



There can be **information asymmetries** and **conflicts of interest** between principals and agents.

The Contract

A contract is "a reliable promise by both parties, in which the obligations of each, for all possible contingencies, are specified".

For shareholders and management, contracts have the following features:

- The principal defines duties of the agent and their compensation for performing them
- The agent receives the offer and accepts if it provides sufficient utility
- Agent performs duties specified in the contract

There is an inherent principal-agent conflict because:

- Compensation afforded to the agent is a cost to the principal
- Any effort the agent makes to perform their contractual duties is a cost to them but a benefit to the principal

Asymmetric Information

- Contracts must be based on information that can be verified to determine if the contract has been fulfilled
- In many situations, one party may have important information the other party does not
- Three of these situations are:
    1. Adverse selection
    2. Moral hazard
    3. Signaling

#1. Adverse Selection

Adverse selection exists when the agent has information **PRIOR** to accepting the contract that gives them an advantage. The used car market illustrates this problem:

- Prior to purchase, the seller has more information about the vehicle's quality than the buyer
- The buyer obtains available information and develops subjective probabilities of the car being good or bad
- Based on these, the buyer is willing to pay the weighted average price
- Consequently, sellers of good cars will not receive a price consistent with their vehicle's superior quality and will leave the market
- Subsequently, the average quality and market price for the remaining cars in the market declines over time
- Used car dealers offer warranties and improved information to reduce buyer risk in an attempt to prevent this quality/price decline spiral
- On average, sicker people buy life insurance and healthier people buy annuities

The insurance industry also faces adverse selection since individuals facing a higher probability of loss are the ones most likely to purchase insurance which drives up insurance costs industry-wide.

Adverse Selection Example

Lenders who cannot distinguish between low and high-risk projects face adverse section

Entrepreneur A has a project requiring an initial outlay of $1,000 with two possible payoffs a year from today: $1,150 with a 99% probability and $0 with a 1% probability. If the entrepreneur needs to borrow $500 of this outlay and the bank knew the true probabilities and wanted to earn an expected return of 10%, they would determine the loan rate using:

$$(1 + r) \cdot L = (p_s \cdot (1 + r_L) \cdot L_s) + ((1 - p_s) \cdot (1 + r_L) \cdot L_{s'})$$

Where:

r = Expected Loan Rate

L = Loan amount

p_s = Probability of project success

L_s and Ls' = Amount of principal repaid under project success/failure respectively

r_L = Loan rate for project A the bank should charge

Solving the equation, we have:

$$(1 + 0.1) \cdot \$500 = ((0.99) \cdot (1 + r_L) \cdot (\$500)) + ((0.01) \cdot (1 + r_L) \cdot (\$0))$$

$$r_L = 11.11\%$$

If Entrepreneur A borrows $500 at 11.11%, the expected profit is:

$$E[\pi] = p_s \cdot [CF_s - (1 + r_L) \cdot L] - (CF_0 - L)$$

$$E[\pi] = 0.99 \cdot [\$1,150 - (1.11) \cdot \$500] - (\$1000 - \$500)$$

$$E[\pi] = \$88.51$$

Where:

CF_s = payoff for success and CF_0 = initial investment

Therefore, in this example, the bank would expect to earn their 10% required return and Entrepreneur A would make an expected profit so he would accept their terms.

Now suppose Entrepreneur B has a project that also needs a loan of $500 for a project requiring an initial investment of $1000. However, the project has a potential payoff of $1,600 with probability 0.6 and payoff $0 with a probability of 0.4.

If the bank does not know the true probabilities of the project and cannot distinguish between Project A and Project B but knows there is a 50% chance it might pick Project A and a 50% chance it will pick Project B. If they still want to make an expected rate of 10%, the bank will set their loan rate based on the average expected payback of the two projects:

Adverse Selection Example (continued)

$$(1+r)\cdot L = 0.5\left[p_s^A\cdot(1+r_L)\cdot L_s^A + p_s^B\cdot(1+r_L)\cdot L_s^B\right]$$

$$(1.1)\cdot\$500 = 0.5\left[0.99\cdot(1+r_L)\cdot\$500 + 0.6\cdot(1+r_L)\cdot\$500\right]$$

$$r_L = 38.36\%$$

At this rate, Entrepreneur A's expected profit is:

$$E[\pi^A] = p_s^A\cdot[CF_s^A - (1+r_L)\cdot L] - (CF_0 - L)$$

$$E[\pi^A] = 0.99\cdot[\$1,150 - (1.3836)\cdot\$500] - (\$1000 - \$500)$$

$$E[\pi^A] = -\$46.58$$

Entrepreneur B's expected profit is:

$$E[\pi^B] = p_s^B\cdot[CF_s^B - (1+r_L)\cdot L] - (CF_0 - L)$$

$$E[\pi^B] = 0.6\cdot[\$1,600 - (1.3836)\cdot\$500] - (\$1000 - \$500)$$

$$E[\pi^B] = \$44.80$$

At this rate, Entrepreneur A would not borrow but Entrepreneur B would. Thus, the bank would only attract high-risk projects and would not achieve their required expected return of 10%. This would cause them to further increase rates to reflect the actual risk on the books (shift the 50-50 ratio between 'good' and 'bad' projects) resulting in an adverse-selection spiral of increasingly higher rates and risky projects.

#2. Moral Hazard

Moral hazard occurs when agent's actions cannot be monitored and the agent receives private information **AFTER** the relationship has begun.

Agents who are protected from downside risk are likely to succumb to moral hazard:

- The 2008 financial crisis provides an example of this
  - Banks moved from holding the loans they wrote to packaging and selling them to investors
  - Banks received fees when loans were underwritten
  - However, they shifted all the default risk off their books so had no downside risk
  - This incentivized writing poor quality loans which was a root cause of the crisis
  - Governments promising to bail out loss-making banks can encourage banks to take on a higher level of risk
- Individuals are more likely to have costly medical test performed if they are covered by insurance

  - The individual participates in the upside of discovery of potentially crucial information
  - However, they don't have absorb any of the costs (downside) of these tests
  - Insurance deductibles are an attempt to curb this behavior
- Comprehensive insurance policies decrease the incentive to take care of your possessions

A key tenant of corporate finance is that a first should undertake a project if its net present value (NPV) is greater than 0. However, moral hazard can lead to firms taking excessive risks and undertaking projects with negative NPV, as the example below illustrates.

Moral Hazard Example

Consider a company that has:

- Debt of $1,000 payable in one year
- $100 of cash earning the money market rate of 5%
- Market value of all other assets a year from now = $700

Now consider the following investment:

Management can invest $100 of the cash that has a 50% chance of increasing the company value to $1,200 a year from now and a 50% chance of decreasing the value to $400.

Payoffs are shown below:

Stakeholder	Payoff if no investment	Payoff if investment		
		Success	Failure	Expected
Debtholders	$805	$1,000	$400	$700
Shareholders	$0	$200	$0	$100
Total Value	$805	$1,200	$400	$800
Solvency	×	✓	×	50/50 chance

Note that Solvency occurs if the debt can be paid off - so when Total Value ≥ $1,000.

The expected payoff with investment ($800) is lower than the expected payoff with no investment ($805), so the investment has a net present value of -$5.

However, the solvecy probability is 0% with no investment and 50% with the investment, so management may take this large risk to attempt to save the firm.

Clearly, management should **not** undertake this investment since it results in a lower expected value of the firm. However, since choosing not to undertake the project means the firm will be insolvent and management will lose their jobs, they are incentivized to take make the investment with the hope that it is a success. This works against the interest of debt holders resulting in moral hazard.

#3. Signaling

Signaling occurs **BEFORE** contract initiation if the agent has private information they want to signal to the principal that may result in more favorable contract terms for the agent.

Examples include:

- A firm that is willing to use internal funds for a project signals to lenders that the agents believe it will be profitable – leading lenders to offer more favorable terms
- An entrepreneur seeking a loan will receive more favorable terms if they indicate they are willing to self-fund a larger portion of the outlay required

Credentials are also an example of signaling:

- The cost of obtaining identical credentials is strictly lower for the "good" employee than it is for the "bad" employee.[2]
- Someone who is able to get the CERA credential can signal that they are a fast learner, good employee, and a better fit, all else equal, for a potential job opening - this is an example of signaling!

Conclusion

We saw the three key types of information asymmetry:

1. **Adverse selection** exists when the agent has information **PRIOR** to accepting the contract that gives them an advantage.
2. **Moral hazard** occurs when agent's actions cannot be monitored and the agent receives private information **AFTER** the relationship has begun.
3. **Signaling** occurs **BEFORE** contract initiation if the agent has private information they want to signal to the principal that may result in more favorable contract terms for the agent.

A key difference is whether the information asymmetry occurs before or after the transaction:

- For both adverse selection and signaling, the information asymmetry occurs before the transaction
- For moral hazard, the information asymmetry occurs after the transaction

[2] Accept this as a theoretical fact. On a case-by-case basis, this may not be true - but economists have done studies for various credentials and found this to be true on average.

Practice Problems

Asymmetric Information Problem

Two entrepreneurs, Zak and Eddie, have projects that require an initial outlay of \$3,000 and require a loan of \$1,000. The payoffs and associated probabilities for their projects are:

- Zak: Payoff = \$3,500 with probability 95%, \$500 with probability 5%
- Eddie: Payoff = \$4,000 with probability 70%, \$0 with probability 30%

The bank wants to earn an expected return of 15% from any loans they underwrite.

1. Calculate the interest rate that the bank offers each entrepreneur if the bank:
   (a) Knows the true probabilities and payoffs associated with each entrepreneur's project
   (b) Only knows the expected payoffs of each project but cannot distinguish between the projects at the onset
2. Describe how this leads to adverse selection and the direction interest rates would move as a result

After securing an unrestricted loan of \$1,000 from the bank at a 20% interest rate, Zak discovers a potential project which has a 10% chance of paying off \$50,000 and an 90% chance of paying off \$0.

3. Calculate the expected payoffs to the banks and to Zak under both, the originally proposed project and this new project
4. Describe how this results in moral hazard

Solution:

1. (a) For each entrepreneur, the formula from the bank's perspective is:

$$(1+r)\cdot L = (p_s \cdot (1+r_L)\cdot L_s) + ((1-p_s)\cdot(1+r_L)\cdot L_{s'})$$

For Zak, the rate is then calculated as follows:

$$(1.15)\cdot \$,1000 = (0.95\cdot(1+r_L)\cdot \$1000) + (0.05\cdot \$500)$$

$$r_L = 18.42\%$$

Note that in the event the project fails, since we are only given the payoff at the end of the project, we assume the full amount will be paid upon the loan's maturity and, as a result, we do not multiply by the discount rate factor.

For Eddie, the rate is calculated as:

$$(1.15)\cdot \$,1000 = (0.7\cdot(1+r_L)\cdot \$1000) + (0.3\cdot \$0)$$

$$r_L = 64.29\%$$

Asymmetric Information Problem Continued

1. (b) In this situation the bank will take a weighted average of the two projects' expected payoffs to determine the rate they will charge:

$$(1+r)\cdot L = 0.5\cdot((p_s^Z\cdot(1+r_L)\cdot L_s^Z)+(p_s^Z\cdot(1+r_L)\cdot L_s'^Z))+(p_s^E\cdot(1+r_L)\cdot L_s^E)$$

$$(1.15)\cdot\$1,000 = 0.5\cdot((0.95\cdot(1+r_L)\cdot\$1,000)+(0.05\cdot\$500))+(0.7\cdot(1+r_L)\cdot\$1,000)$$

$$r_L = 37.313\%$$

2. When the bank doesn't have adequate information, this outcome is clearly desirable for Eddie as he is getting a rate lower than his risk profile demands. Therefore, he will accept the loan on these terms. Conversely, Zak will reject these terms since he is being charged a much higher rate than his risk profile warrants. Therefore, he will reject the loan terms. The bank will be left with only Eddie (and other risky entrepreneurs like him) and will have to adjust their required rate upward to compensate them for this risk. Therefore, interest rates will rise as a result of this adverse selection problem.

3. The payoff profiles for both projects are shown:

Project	Outcome	Probability	Payoff to Bank	Expected Bank Payoff	Payoff to Zak	Expected Zak Payoff
Original	Success Failure	0.95 0.05	\$1,200 \$500	\$1,165	\$2,300 \$0	\$2,185
New	Success Failure	0.1 0.9	\$1,200 \$0	\$120	\$48,800 \$0	\$4,880

4. The entrepreneur is incentivized to invest in the new, riskier project which will give him a higher expected payoff. However, accepting this project would drastically reduce the expected payoff for the banks.

   While both parties have some downside risk, only the entrepreneur profits off of upside potential and, as illustrated, is likely to engage in risky opportunities at the expense of the principal (the bank). Therefore, this is an example of moral hazard.

ERM-702: ERM for Capital and Solvency Purposes

Source Author: IAA (March 2009)

Pages 9–38 Only

Overview of This Reading

This paper provides a good general introduction to ERM from an organizational and cultural perspective

One of the most prominent themes in the paper is the importance of having an ERM culture embedded in all aspects of the organization—from the very top with the Board and CEO down to the most basic functional areas

In terms of the ERM exam, this paper (like most of the readings in Section 1) reduces to a large number of fairly dry lists that you'll need to review regularly in the final weeks before the exam

I recommend not getting too bogged down in the lists and terminology on your first pass—just make a good pass over this reading, then return to it after you've processed the rest of the syllabus

For each of the 4 key sections of the paper, the authors list "key features" for that item

Key topics for the exam include:

- Key feature 1: governance and an ERM framework
  - Introduction and overview of ERM governance
  - Board vs. management: high level view
  - Board vs. management role in risk management
  - Establishing and developing an enterprise risk function
  - Importance of a common risk language in the insurer
  - Risk management culture
  - Developing an culture implementation plan
  - Upside risk management
  - Performance management and reward systems
  - Reporting and monitoring
  - Dealing with new activities
- Key feature 2: risk management policy
  - Aspects to address in the risk management policy
- Key feature 3: risk tolerance statement
  - Strategic choices in risk tolerance statement
  - Risk tolerances vs. risk limits
  - Typical roadmap of the steps to establish risk tolerance

- Key feature 4: risk responsiveness and feedback loop
  - Nature of feedback loops
  - Emerging risks
  - Scenario planning

Governance and an ERM Framework

Key Feature 1: Overall Governance Structure

- **Insurer should operate within a sound ERM framework**
  - Appropriate to the nature, scale and complexity of its business and risks
- **ERM framework should be integrated with the insurer's business operations**
  - Reflect desired business culture and behavioral expectations
  - Address all reasonably foreseeable and relevant material risks faced by the insurer
  - ERM framework should be overseen by the board and senior management
- **Quantify risk for a sufficiently wide range of outcomes using appropriate techniques**

Introduction

An ERM framework should be proportionate to the nature, scale and complexity of the insurer

- The "concept of proportionality" for ERM is based on the idea that supervision of regulated entities should be proportionate to the nature, scale and complexity of the insurer's risks

Some aspects of ERM differ between large and small insurers

- Smaller insurers tend to have consolidated management structures and fewer resources for risk management and modeling
- Large insurers have more resources, policies, and risk management tools

An absence of a supportive ERM culture will undermine the most sophisticated of ERM frameworks

- Cultural and behavioral characteristics of risk management vary by company

Risk Management and Corporate Governance Generally

Corporate governance – the processes by which organizations are directed, controlled and held to account

Link between corporate governance and risk management: board committee and/or board charter responsibilities

- Risk management's role in corporate governance is to exercise direction, control and accountability
- Board's risk responsibilities must include all risk the insurer is exposed to

Risk Management and the Role of the Board

The board has an ultimate responsibility for the insurer's risk management framework

- Approves the insurer's overall risk management strategy/policy
- Oversees the process of ensuring the insurer's responsible persons are fit and proper
- Setting the insurer's risk appetite
- Monitoring key risks and implementing suitable internal controls

The board should establish a dedicated **risk committee**

- May include risk, audit, financial reporting, and compliance staff

Risk committee's objectives:

- Help the board exercise due care, diligence, and skill in risk management
- Verify adequacy of risk management policy and internal controls

Typical committee charter responsibilities:

- Effectiveness of the insurer's risk management framework
- Compliance with supervisory requirements
- Establish an independent risk function with the authority, standing and resources to it needs to execute its mandate
- Monitor adequacy of corporate insurance covers

Processes that enable effective discharge of charter obligations:

- Direct reporting line between the committee and the most senior risk executive in the insurer
- Regular one-on-one meetings between the committee chair and the most senior risk executive outside of formal committee meetings
- Have private meetings that exclude executive management
- Consult external experts
- Transparent reporting by the insurer's risk function (no filtering of information)

Charter objectives are more likely to be met if the culture fosters rapid escalation of significant risk issues and/or bad news

Board vs. management accountabilities:

- Should reflect natural boundaries and differences in legal jurisdictions
- Board should NOT be active in day-to-day management of insurer's risks (this is management's role)
- Board's role: oversee and monitor risk management and reporting
- Risk committees should allow people to challenge risk assessment process

Characteristics of an effective risk committee:

- Member characteristics: diverse background, inquisitive minds, objective, relevant experience
- Should question reports, not just "tick the box"
- Should have board and management buy-in
- Appropriate level and volume of reporting to risk committee
- Keep track of leading practices
- Appropriate self-assessment with SMART key performance indicators
    - SMART = Specific, Measurable, Achievable, Realistic, and Time bound

Management Commitment and Leadership

CEO = critical link between the Board and management

- If the CEO doesn't think ERM is important, it will be hard to convince other stakeholders

It's best if the CEO's job description includes ERM responsibilities

- Promotes a risk management and control framework with clear and powerful risk tolerance boundaries
- Provides periodic assurance to the Board about risk management and control effectiveness
- Avoids behavior that might compromise prudent risk management practices

It's best if the CEO promotes risk management as an insurer's core competency

Establishing and Developing an Enterprise Risk Function

Often the CEO will appoint a Chief Risk Office (CRO) as a sign of leadership and commitment to ERM

- CROs often have an actuarial or mathematical background

Good characteristics of a CRO:

- Has support of the board
- Has a good relationship with the CFO

    - Ideally, they should integrate their earnings and risk management strategies
    - Goal: generate adequate returns and provide appropriate capital to protect policyholders
- Facilitates dialogue/debate at management and board level about the insurer's risk tolerance
- High visibility and authority
- Coordinates risk activities/ measurement at the company level

Challenges faced by the CRO initially:

- Must bring together different risk functions and specialists under a common framework
- Will typically encounter a fragmented series of risk structures and "sacred cows"
    - Actuarial and/or research functions in some business units
    - Internal audit function
    - Specialist business continuity team
    - Reinsurance staff
    - Treasury and credit risk function
    - Capital management function
    - HR
    - Compliance teams
- Working with existing risk-related committees

Examples of questions the CRO should ask:

- Is there a clear, shared understanding throughout the Board and management of the insurer's risk tolerance?
- Are management's incentive arrangements aligned with prudent management of risk?
- What is the quality, health and transparency of risk information flows?
- Where are the capability gaps?
- Are there elements of the insurer's business that are destroying value on a risk adjusted basis?

Initial task for the CRO: establish whether Board-approved risk tolerance exists

- If not, make one, otherwise determine if it is understood by decision makers
- Most important: determine if it is appropriate for the insurer's strategic objectives

Management Governance – Considerations

- Oversight structures should regard the following:
  - Transparency of decision making processes
  - Size/nature of the insurer and type of insurance
  - Mix of risks faced by the insurer
- Larger insurers may have separate oversight committees for key risk areas:
  - Pricing and underwriting risk
  - Balance sheet and market risks (credit, liquidity, etc.)
  - Operational risk
- Smaller insurers are more likely to have a single committee
- The risk management structure should align with management's accountability
  - Example: "end-to-end accountability" means accountability for meeting premium growth targets and managing risks associated with pursuing growth targets
- Risk management committees should be made up of senior management from business and risk management functions

Structure of the ERM Function

- Even if it is impractical to combine all risk functions, it is important for them to act in a coordinated fashion
- Avoid risk functions that operate in isolation
- Project and change management skills are just as important as technical expertise

Importance of a Common Risk Language in the Insurer

A common risk language is essential to meet increasingly global supervisory requirements, no matter the size of the insurer

Competing risk language makes ERM less effective in a number of ways:

- Inhibits business management buy-in
- Confuses people not directly involved in developing and maintaining the methodology (prevents ERM culture from being embedded)
- Reinforces a silo approach
- Focuses on form over substance ⇒ may fail to identify "real" risks
- Proliferates process inefficiencies and duplication
- Results in inconsistent risk measurement ⇒ makes aggregation harder

Attributes and practices associated with a common risk management language:

- Universally understood top-down risk rating system
    - Should relate the risk rating to the management function responsible for mitigating the risk
- Standard templates and risk categories across the insurer
- Reporting and escalation thresholds

Risk Management Culture

Key question for ERM: "What are the behaviors you want people to use in relation to management of risk?"

People need to be willing and able to use the appropriate behaviors to support risk related activities

- Avoid a culture of "shoot the messenger" and "bad news travels slowly"
- ERM should be framed as **business as usual**, not with a "big launch" that employees see as a fad

It may take 3+ years before ERM is embedded in the corporate culture

Examples of ways to **proactively** embed risk management behaviors:

- Include proactive principles in the risk management strategy and policies
- Set a corporate risk goal for senior managers based on improving a "risk culture index"
- Define behaviors in roles, performance management, and succession/talent development processes
- Training programs for managers and staff

3 Aspects of Developing a Risk Behavior Model

1. Risk management is **not about eliminating risk**—it is **choosing** the risks the organization is willing to take and managing them well
2. People need to be encouraged to **speak up** in a management context
3. People need the **skills and empowerment** to undertake the behaviors necessary to manage risk situations

These 3 aspects also suppose innovation and growth

Developing an Implementation Plan

Implementing a culture component of ERM should address the following:

- Consider and develop a risk management behavioral model that suits the insurer's broader culture and operating environment

    - Describe behaviors precisely in measurable/observable terms
- Get support of senior management and develop their risk awareness
    - Use training, focus groups, education, and briefing of executive management
    - "War stories" help understanding and engagement
- Ensure that the right behaviors are embedded in the design of frameworks and processes
- Have a realistic time frame for the implementation plan
- Reinforce behaviors through multiple influencing channels
- Benchmark behaviors before starting the implementation program
    - Measure at least annually to assess progress
    - Adjust to the design and change program if required
- Link the measures to measurable business outcomes
    - The simpler, the better

Tips for Implementing Risk Culture Change Programs

- **Leverage** – Use existing organization-wide programs rather than starting new ones
    - Lessens load of managers/staff
    - Embeds it as "business as usual" faster
- **Language** – Focus on behaviors that people can change rather than intangibles
- **Change skills** – Hire people skilled in change management, learning, HR, project management, etc.
- **Embed principles** – Ensure the culture change initiatives are embedded into the people processes
- **Measures and consequences** – Benchmark the culture then measure progress
    - Ensure the Board/Risk Committees are supportive of the program
    - Reinforce good behaviors with bonuses, etc.

Upside Risk Management

Effective ERM implies an integrated assessment of adverse effects and opportunities ("a.k.a. upside risk")

- Insurers tend to focus much more on downside risk than upside risk (i.e. opportunities)

Practices supporting integrating upside and downside risk:

- Ensure the risk function is involved in strategic planning

- Include both risks and opportunities in reports prepared by risk functions
    - Reduce costs by removing excessive or ineffective controls
    - Use risk management controls to achieve other business goals
        - Example: utilize work from home solutions not just as a BCP risk control but also to attract/retain talent
- Use reward systems that encourage calculated risk taking
- Report on emerging, industry-wide, cross-border, and longer-term risks

Effective upside risk management views views all risks as opportunities

Performance Management and Reward Systems

ERM implementation will likely fail if the company doesn't encourage managers with incentives (bonuses, etc.)

- *Keep this in mind while studying principal-agent risk later on the syllabus*

Key considerations for encouraging risk management with reward systems:

- Ensure the size of the incentive actually motivates the targeted individuals
- Decide which individuals or groups to include (include senior management at a minimum)
- Use clear, activity-based measurements (e.g., milestone completions, financial measures, VaR, etc.)
- Link risk management performance with talent management and capability development processes
- Target appropriate staff, and avoid unintended consequences
    - Example: don't link staff incentives to the results of staff surveys (*unless you want highly biased surveys*)

Reporting and Monitoring

At the highest level risk reporting should cover:

- Current and emerging key risks in the business and within the wider environment, and changes over time (the risk profile of the insurer)
- Changes in risk indicators (measures influencing risk likelihood and/or impact)
- Capability for identifying and managing risks

Examples of information provided by risk category:

Risk Category	Information
All	Risk profile, capital adeqacy ratios, signficant losses, changes in KRIs
Underwriting	Risk aggregations by region, reserve strengthening
Market	VaR, stress scenarios
Credit	Counterparty credit risk, credit rating analysis
Liquidity	Ratio of liquid to total assets
Operational	Analysis of key risks, change in KRIs, internal audit results

A succinct **dashboard** is the most effective way to report so the information can be assessed at a glance

- Top 10 residual risks
- Key risk indicators (KRIs)
- Scoring chart for risk severity and control effectiveness
- Heatmap of all substantial inherent and residual risks
- Additional commentary section
- Significant project progress

Dashboard audience: key stakeholders

- Audit Committees – Monitoring material financial risks and mitigation of those
- Executives – Reviewing risk information for completeness
- Managers – Reviewing risk information for completeness and changes in risk profile or control effectiveness
- Risk Owners – Updating risk information and escalating changes in likelihood, impact or control effectiveness as required
- Control Owners – Updating status of treatments for controls that they are responsible for
- Internal Audit – Reviewing the effectiveness of internal control measures
- External Stakeholders – Reviews by supervisory bodies

Role of Internal Audit

Insurers often delegate the development of the insurer's risk framework to the internal audit function

Why this is a bad idea:

- Unlikely to deliver effective ERM in the long-term
- Sends a message that ERM is a compliance exercise

Best practice: clearly delineate the roles of internal audit and the function tasked with developing and maintaining an insurer's ERM framework

Dealing with New Activities

An insurer's ERM framework needs to be involved at the planning stage of new activities

- Product changes and introduction of new products
- Changes in corporate and management structures
- Major projects to build and/or upgrade computer systems and networks
- Due diligence, acquisitions, etc.
- Outsourcing and off-shoring strategies

Ways that the insurer's risk function can become involved in new activities:

- Involvement in due diligence where the skills of the actuary can be utilized to identify/assess risks
- Working with the insurer's strategy team to ensure the strategy incorporates an appropriate assessment of risks
- Preparing and/or facilitating risk assessments for major projects or new product launches
- Managing engagement with relevant supervisors
- Working with newly acquired businesses to help them adapt to the insurer's risk management framework

Risk Management Policy

Key Feature 2: Risk Management Policy

- Outline the way the insurer manages each relevant and material category of risk, both strategically and operationally
- Describe the linkage with the insurer's tolerance limits, supervisory capital requirements, economic capital, and risk modeling

Aspects to Address in the Risk Management Policy

- **Most important: state the insurer's risk appetite**
- Clear risk management philosophy: explain why risk management is important and the linkages with value creation
- Relationship between risk management and the insurer's mission, values, and strategic objectives
- How risk management is embedded in capital management, pricing, reserving, and performance management
- Scope of activities covered
    - Should be sufficiently flexible for multiple ownership structures

- Appropriate supervisory requirements and considerations
- Requirements with respect to acquisition of new businesses
- Categories of risk and risk definitions
- Definitions of risk terminology
- Governance and oversight aspects
    - Board, board committee structures, responsibilities
    - Management structures, roles, responsibilities
    - Roles and responsibilities of the various corporate and business unit risk functions
    - Role of internal and external audit
    - Compliance aspects, including consequences for policy breach
- Behavioral expectations of all staff
- Minimum process-level requirements that apply universally across the operations of the insurer
    - Risk management training, risk profiling, business process documentation, etc.
- ORSA requirements
- Specific requirements for defined risk categories
- Process for reviewing and updating the policy

Avoid writing a long policy document that is not read or understood by the wider organization

Risk Tolerance Statement

Key Feature 3: Risk Tolerance Statement

- Set overall quantitative and qualitative tolerance levels
    - Based on the insurer's strategy and actively applied within the ERM framework and risk management policy
- Defines tolerance limits for each relevant and material category of risk
    - Embedded in the insurer's ongoing operations via risk management policies and procedures

Establishing the risk tolerance involves making strategic choices

- Use the same time horizon as corporate strategy (3–5 years)
    - Don't change it every year
- Set boundaries for how much risk the insurer is prepared to accept
- Make a clear link between risk tolerances and limits

- Each insurer should develop its own risk tolerance based on its own circumstances
- Risk tolerance is about which risks to take and why, not just how much risk to take

Risk Tolerances vs. Risk Limits

"Tolerance" is more high level than "limits"

- Risk tolerance broadly considers risk exposure levels that the board deems acceptable
- Limits are narrower: more specific thresholds that can be monitored on a day to day basis
  - More transparent to business managers
  - Key risk indicators (KRIs) are becoming more common

Parameters used to describe risk tolerance:

- Lines of business that the insurer will/will not accept
- Earnings volatility
- Requirements to meet supervisory criteria including allowance for unexpected events
- Desired capital strength based on a credit rating agency
- Maintaining levels of economic capital based on a "risk of ruin"
- Maintaining a capital buffer in excess of the minimum supervisory capital
- Maximum exposure to aggregation of risk
- Dividend-paying capacity
- Maximum net loss the insurer is prepared to accept in any given year in the event of a catastrophic loss

The following should be kept in mind when settling an insurer's risk tolerance:

- Must support the achievement of business strategy
- Must be supported by appropriate policies that translate risk tolerance into operational limits

Examples of risk limits:

- Counterparty credit limits for investments and reinsurers
- Overall target for credit quality for a reinsurance buying program, usually by reference to credit rating
- Concentration limits for lines of business/products, geographies and counterparties
- Underwriting and pricing principles and limits
- Insurance reserves based on an explicitly quantified probability of adequacy

- Liquidity benchmarks

Typical Roadmap of the Steps to Establish Risk Tolerance

1. Measure current qualitative appetite at senior executive level
2. Measure current risk profile using quantitative techniques
3. Merge 1 and 2 to determine current risk appetite
4. Define and assess ongoing desired risk appetite
5. Develop metrics and framework for ongoing monitoring
6. Monitor activities relative to defined appetite

Risk Responsiveness and Feedback Loop

Key Feature 4: The insurer should incorporate a feedback loop

- Based on appropriate/good quality information, management processes and objective assessment
- Enables timely action in response to changes in risk profile

The ERM framework must be able to adapt to change

Nature of Feedback Loops

The insurer's risk profile will be influenced over time by past, present, and future influences

1. **Future:** periodic risk assessments, new initiatives/strategies, and external events
2. **Present:** movements in KRIs
3. **Past:** unexpected losses, significant control failures, and incidents
    - Incidents: customer complaints, audit findings, system failures, crisis events, etc.

The ERM framework should include formal processes to collate information from the above 3 sources

- Should include formal review of incidents to determine root cause

An effective feedback loop is underpinned by:

- Thresholds for reporting significant issues
- Protocols for escalating issues to management and supervisors, if necessary
- Risk aggregation reports that identify where limits/tolerances may have been exceeded

Emerging Risks

Emerging risks – uncertain/ambiguous risks that are difficult to quantify using traditional risk assessment techniques

Why insurers want to know about emerging risks:

- Influences the organization's strategy
- Impacts underwritten portfolios: unexpected (latent) claims / claims frequency / claims costs
- Impacts OR
- May create opportunities for new types of insurance products

Common characteristics of emerging risks:

- High uncertainty: little information available, making the frequency/severity difficult to assess
- Difficult to quantify: risk is uncertain and the risk transfer may be questionable
- No industry position: no single insurer wants to make the first move for fear of losing market share
- Difficult to communicate: danger of reacting to phantom risks
- Supervisory involvement often necessary

Emerging Risks Initiative (ERI) (founded in 2005 by the CRO Forum)

- Raises awareness about emerging risks relevant to the insurance industry
- Focus is identifying, prioritizing, and communicating information

Scenario Planning

Scenario planning can help evaluate high impact/low probability events

Uses of scenario planning:

- Augment statistical models
- Prepare for specific events
- Assess impact of internal or external shocks
- Business continuity management (BCM): run crisis simulations under a range of scenarios