CRM | ANALYSIS OF RISK

STUDY GUIDE

EXAM PREP AND ANSWER KEY

- **Knowledge Checks**
- **Check-Ins**
- **Self-Quizzes**
- **Sample Exam Questions**
- **Glossary of Terms**

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STUDY GUIDE

EXAM PREP AND ANSWER KEY

This Study Guide has been prepared to enhance your learning experience. It contains all of the Check-In questions, Knowledge Checks, and Self-Quizzes contained within the course, along with an Answer Key and Glossary. Use it as a tool to help practice and assess your knowledge of the course material, but *do not* mistake it for a comprehensive "short-cut" to preparing for the final exam.

Be sure to take a look at the Appendix that follows the Answer Key in this Study Guide. It contains valuable suggestions for test preparation and study techniques, as well as some sample exam questions and a glossary of terms.

Your path to success in passing the final exam will come from your attentiveness during the course and the effort you put into preparation.

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Answer Key

Tools to Assess Your Knowledge

Check-Ins, Knowledge Checks,
and Self-Quizzes by Topic

Section 1: Introduction to Risk Analysis in the Risk Management Process

Key Uses of Risk Analysis

Knowledge Check

Peter is preparing a presentation for the board on his analysis of current exposures. He will use classification scales to present his data. Explain how classification scales are used in data analysis and provide the scales for severity.

_____

_____

_____

Peter will also show how financial assessment is used as a risk analysis tool. Explain the use of financial assessment in risk analysis.

_____

_____

_____

Types of Risk Analysis
(Purpose, Characteristics, Methods)

Knowledge Check

1. Distinguish between the two types of risk analysis.

_____

_____

_____

2. Explain how qualitative factors and consideration can affect risk management decisions.

_____

_____

_____

3. The risk management team at your organization presents you with a risk analysis for a new project. After creating in-depth loss projections and a thorough cost-benefit analysis, they feel that your organization should take on the project. Has the team conducted a complete risk analysis? Explain why or why not.

_____

_____

_____

Section 1: Self-Quiz

Directions: Check all that apply.

1. Which of the following is an example of a use for risk analysis?
   - ☐ A risk manager reviews loss data to identify loss exposures.
   - ☐ A team collaborates to prioritize the seven risk factors.
   - ☐ A claims adjuster reviews a single loss case.
   - ☐ A risk management team compares expected cash inflows with expected cash outflows to determine if a project will have a net benefit for the company.
   - ☐ A manager wants to compare employee performance in order to determine annual bonuses.
   - ☐ A risk manager uses loss projections to negotiate policy renewals.

Directions: State whether each tool/method shows qualitative or quantitative analysis.

1. Loss projections _____
2. Risk mapping _____
3. Cost-Benefit Analysis _____
4. Delphi Method _____
5. Loss Data Assessment _____
6. Cash Discounting Calculations _____
7. Root Cause Analysis _____
8. TCOR Calculations _____
9. Financial Assessment _____
10. NPV Calculations and Analysis _____

Section 2: Qualitative Analysis

Qualitative Risk Assessment Areas

Knowledge Check

1. You are a new risk manager with a new software/technology startup. Choose three of the seven main areas of qualitative risk assessment that you feel might be priorities for this type of company and explain their significance.

_____

_____

_____

2. Your company is especially concerned with profitability. Explain the type of qualitative assessment that might be most important to your organization and describe its main components.

_____

_____

_____

Qualifying Data for Analysis

Knowledge Check

1. Safe Products, Inc., acquires the cleaning products operation of ABC Corporation. When analyzing losses for this new acquisition, the risk management team also includes loss data on ABC Corporation's pharmaceutical operation. Explain why the loss data on the pharmaceutical operation should not have been collected, and how it might impact analysis.

_____

_____

_____

_____

2. You have recently started working as a risk manager with ABC Corporation. You discover they routinely use data sets collected over the course of only one or two years. Moreover, the data often includes different types and causes of loss. Which characteristic(s) of quality loss data are missing, and how might this impact data analysis?

_____

_____

_____

_____

Qualitative Analysis Tools

Check-In

Directions: Match the letter of the logical classification on the left with its corresponding loss example on the right.

A. Property	_____ An employee is seriously injured in an on-the-job accident, and files a worker's compensation claim for medical expenses.
B. Human Resources	_____ A deep freeze and blizzard results in significant property damage to a company headquarters, including burst pipes and a partial roof collapse
C. Liability	_____ A company must upgrade its entire computer network and invest in new data security features after a hacking incident. The cost is significant and affects the annual revenue.
D. Net Income	_____ A skincare company is faced with a class action lawsuit after customers suffer adverse reactions from a new line of lotion

Knowledge Check

1. Describe a risk map and its uses.

_____

_____

_____

_____

2. Your coworker exclaims, "There is no point to using qualitative assessment because all the company really needs to know is the financial impact of a risk." Explain to your coworker three categories of potential impact that can be assessed qualitatively.

_____

_____

_____

_____

Root Cause Analysis

Knowledge Check

Jeff is a district manager who oversees a warehouse distribution center. Recently, there has been an increase in workplace accidents at the warehouse. Several employees have sustained injuries, ranging from minor (cuts, scrapes, bruises) to more serious (a broken arm and a concussion). Additionally, stock was damaged in a recent forklift accident. Jeff visits the warehouse and notices that the lighting is dim. "I'll just bring in brighter bulbs, and that should solve the issue," Jeff says.

1. Explain the flaw in Jeff's thinking. What might he be missing by not conducting a root cause analysis?

_____

_____

_____

_____

2. Explain which RCA method you think could be most helpful to Jeff in this instance, and why.

_____

_____

_____

_____

Risk Modeling

Knowledge Check

Directions: State whether each of the following scenarios is an example of predictive analytics or catastrophe modeling and explain your reasoning.

1. A homeowners' insurance company uses a computer-based model to predict the likelihood of tornadoes in various regions and uses this information when calculating rates.

_____

_____

2. An auto insurance company has an incentive program in which drivers can get discounts by using an app that monitors their driving safety. The insurance company uses this data to forecast accident risks.

_____

_____

Directions: Provide one additional example of how each of these risk modeling techniques might be used.

_____

Section 2 Self-Quiz

Directions: Answer the questions below. There may be more than one correct choice.

1. Which of the following is/are an example(s) of qualitative assessment? (Select all that apply.)
   - ☐ Financial assessment
   - ☐ Cost-benefit analysis
   - ☐ Insurance market analysis
   - ☐ Loss data analysis
   - ☐ NPV (net present value) analysis
   - ☐ Root cause analysis

2. Which of the following is/are NOT one of the seven main areas of qualitative risk assessment? (Select all that apply.)
   - ☐ Human resources and employee safety issues
   - ☐ Social responsibility and citizenship
   - ☐ Management's appetite for risk
   - ☐ Company mission, vision, and values statements
   - ☐ Innovation, product development, and marketing
   - ☐ Insurance underwriting guidelines

3. Which of the following is/are an example(s) of a characteristic of quality loss data? (Select all that apply.)
   - ☐ A significant data sample collected over five years or more
   - ☐ Data collected for the same types of loss during the same policy year
   - ☐ Data collected for all operations in the last 15 years, including areas that are no longer part of the organization
   - ☐ Data that has been checked for input accuracy
   - ☐ Data that is organized by policy year only

Directions: Use the words from the word bank to fill in the blanks. Answers may only be used once, and not all answers will be used.

risk mapping	**job hazard analysis**	**risk register**	**catastrophe modeling**
predictive analytics	**logical classifications**	**Pareto Principle**	**heat mapping**
maximum probable loss	**root cause analysis**	**Ishikawa diagram**	**maximum possible loss**
hazard identification indexing	**risk modeling**	**RMIS**	**Delphi method**

1. Property, human resources, liability, and net income are examples of _____ of exposures.

2. _____ is a visual analytic tool used to identify risks and understand their impact. In its simplest form, it consists of a graph divided into four quadrants, with the y-axis representing severity, and the x-axis representing frequency of risks.

3. A(n) _____ lists known or anticipated risks in rows, and impact or anticipated severity in columns, and can be used to track and prioritize risks, as well as potential impact and mitigating measures.

4. A(n) _____ is one method of root cause analysis, which typically lists a problem statement and then branches off into six categories in order to explore possible causes of an issue.

5. _____ uses colors to indicate patterns or groupings, providing a visual representation of complex data sets.

6. _____ is the most likely loss to occur for a given peril, while _____ is the greatest damage that could occur in a loss.

7. The _____ states that 80% of problems stem from 20% of causes.

risk mapping	**job hazard analysis**	**risk register**	**catastrophe modeling**
predictive analytics	**logical classifications**	**Pareto Principle**	**heat mapping**
maximum probable loss	**root cause analysis**	**Ishikawa diagram**	**maximum possible loss**
hazard identification indexing	**risk modeling**	**RMIS**	**Delphi method**

8. The _____ uses a series of questionnaires to refine expert opinions and move toward consensus.

9. _____ uses computers to generate a very large set of simulated events to estimate losses arising from disastrous events, while _____ uses machine learning to find patterns in large volumes of historical data to forecast future losses.

Section 3: Quantitative Analysis Tools

Measures of Central Tendency

Knowledge Check

1. Calculate the three measures of central tendency for the following seven numbers:

1, 4, 2, 1, 1, 7, 5

Mean	
Median	
Mode	

2. Recalculate the three measures of central tendency for the following eight numbers:

1, 4, 2, 1, 1, 7, 5, 100

Mean	
Median	
Mode	

3. Compare the measures of central tendency that you recalculated in question 2 to your answers from question 1. Explain what impact (if any) extreme outliers can have on the mean, median, and mode.

_____

_____

_____

_____

4. Calculate the three measures of central tendency using the following information:

Total Return on the S&P 500

Year	Percentage
2018	31.23
2017	16.34
2016	5.67
2015	18.54
2014	31.06
2013	5.97
2012	22.31
2011	20.37
2010	(4.85)
2009	31.48

Mean	
Median	
Mode	

Measures of Dispersion

Knowledge Check

Given the following array of numbers,

7 25 6 34 55 30

1. Calculate the range

_____

2. Calculate the variance

A. _____

B.

C.

			=	
			=	
			=	
			=	
			=	
			=	

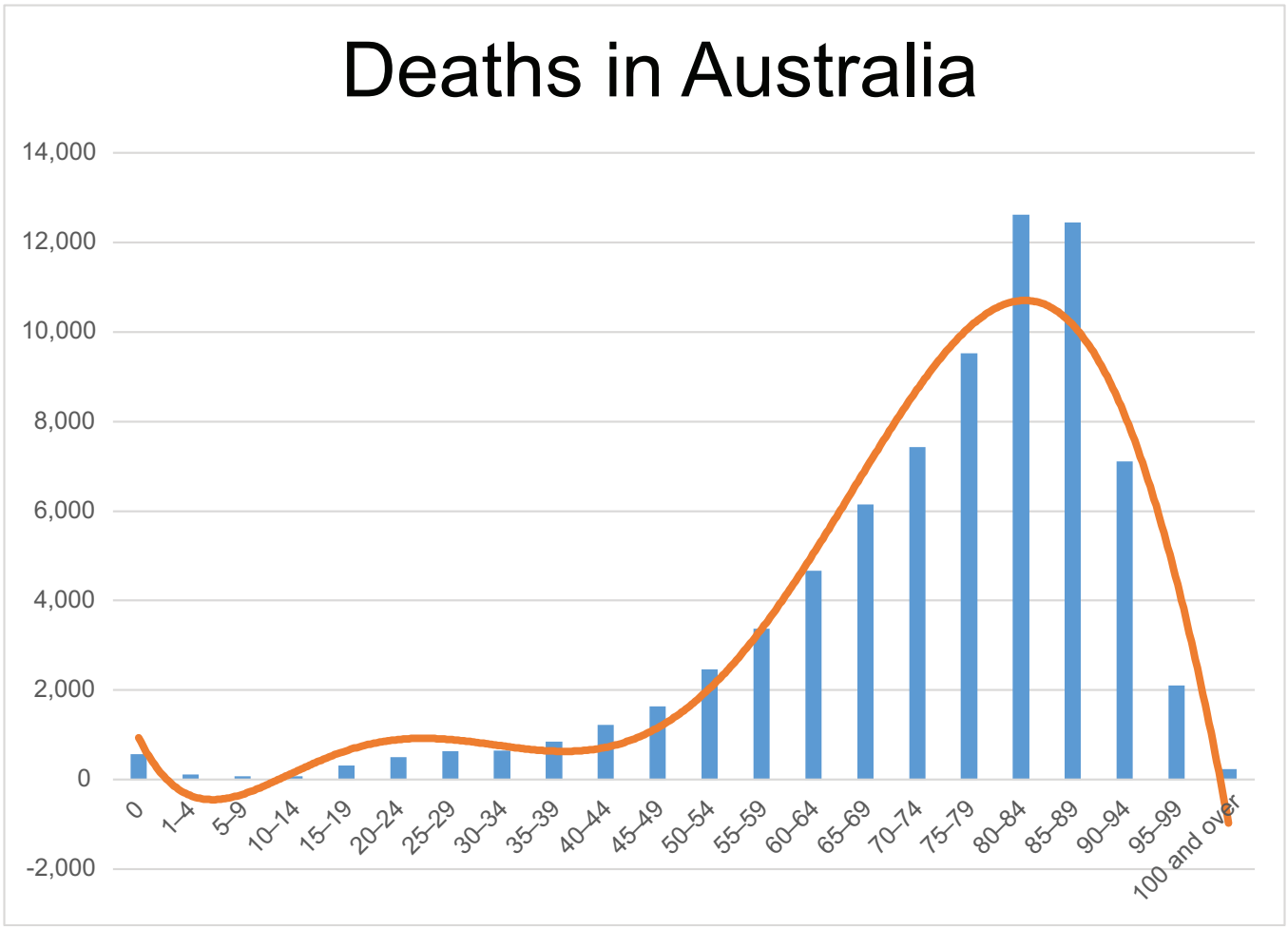
D. _____

E. _____

Empirical Rule and Confidence Intervals

Knowledge Check

Directions: Use the graph to answer the questions.



1. Does this graph show a positive or negative skew?

_____

2. What does the skew of this graph tell us about the relationship of age to the average death rate?

_____

_____

3. Does the empirical rule apply to this graph? Why or why not?

_____

_____

4. Which type of skew is most common in risk management? Explain why.

_____

_____

Histograms

Knowledge Check

1. Create a histogram using the loss data provided.

Losses (in $1,000's)							
30	40	30	75	50	100	10	60

Work Area

2. Provide a brief explanation of the histogram and what it conveys.

_____

_____

_____

_____

Forecasting Losses Using Confidence Intervals

Knowledge Check

1. With the following claim information and the standard deviation of 74.96 (round to 75) calculate the high/low claim projections for the upcoming year using 95% confidence.

Claim Values:				
125	234	152	340	204

_____

_____

_____

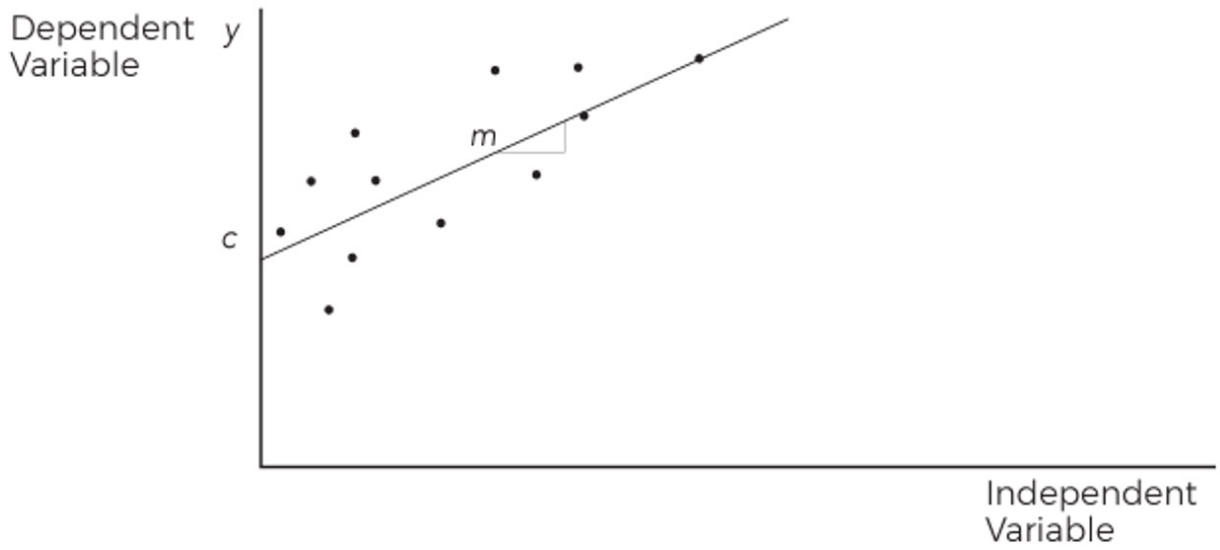
2. For each of the following r^2 values, state whether linear regression or confidence intervals would be more appropriate for forecasting.

r^2 Values	Linear Regression	Confidence Intervals
.6		
.8		
.32		

Section 3 Self-Quiz

Directions: Match the definition or description on the right with the term or phrase on the left.

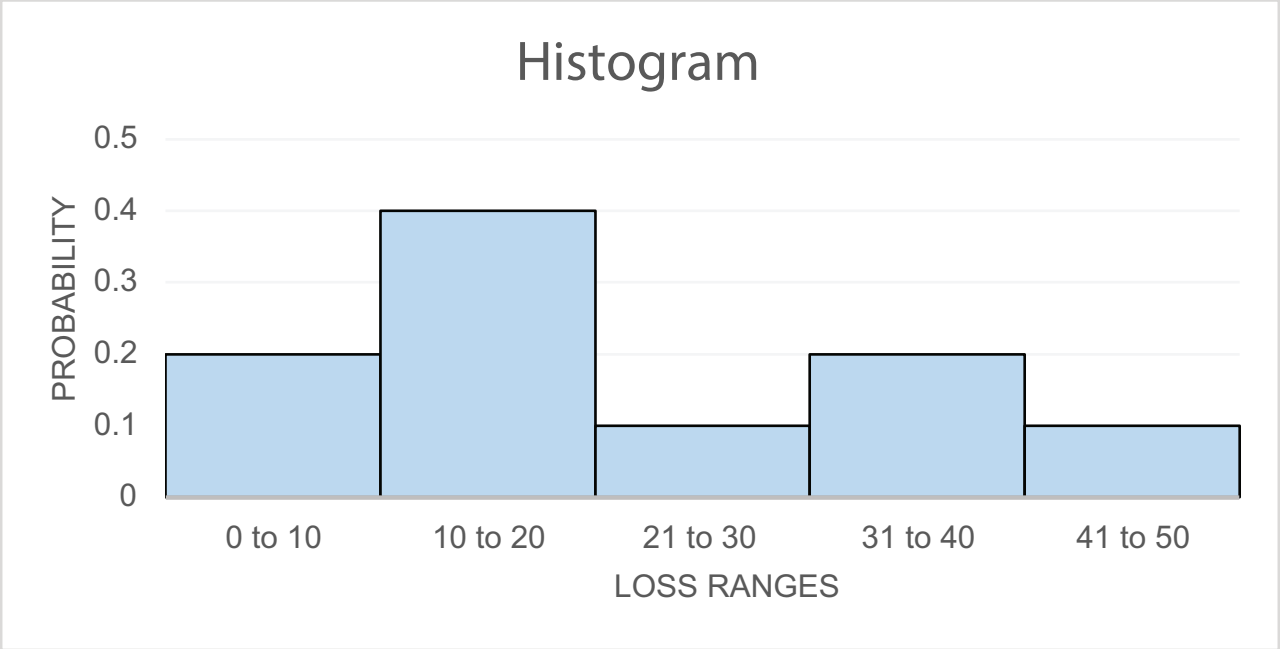
A. Mean	_____ The square root of the variance
B. Median	_____ Statistical technique of modeling the relationship between variables by fitting the "best" line to a scatter of dots
C. Mode	_____ The measure of the degree of asymmetry or distortion from a symmetrical bell curve of a frequency distribution
D. Range	_____ When there is an appropriately large sample, (30 or more values), that sample's average can be treated as if it were drawn from a normal distribution
E. Variance	_____ The midpoint of the observations ranked in order of value
F. Standard Deviation	_____ The amount of dispersion in a set of data values
G. Empirical Rule	_____ The sum of all observations divided by the number of observations
H. Skewness	_____ A group of continuous adjacent values that is used to estimate a statistical parameter
I. Central Limit Theorem	_____ The observation with the highest frequency of occurrence in a sample
J. Linear Regression	_____ States that nearly all values will lie within three standard deviations of the mean
K. Confidence Intervals	_____ The difference between the largest and smallest values



Directions: For each item below, select the best answer choice(s).

1. Which of the following statements are TRUE about the scatter plot shown above?
   - ☐ The data shows an apparent trend.
   - ☐ A confidence interval is most appropriate for forecasting losses in this case.
   - ☐ Linear regression is most appropriate for forecasting losses in this case.
   - ☐ The risk manager can determine with 95% confidence that losses in year 8 will be $500,000.
   - ☐ The data shows no apparent trend.

2. Which of the following data sets is correctly depicted by the histogram shown below?



☐

Losses (in $1000s)									
0	5	7	8	10	15	25	29	45	50

☐

Losses (in $1000s)									
5	7	10	15	15	18	25	35	37	50

☐

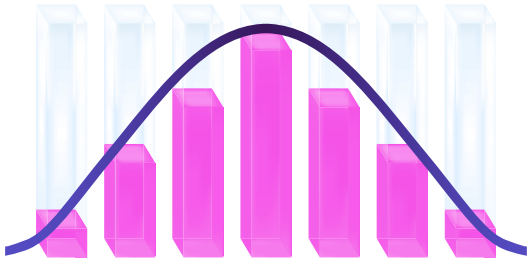
Losses (in $1000s)									
5	7	8	10	15	15	18	25	35	47

☐

Losses (in $1000s)									
0	5	10	15	15	18	20	25	35	50

3. Which of the following depicts a distribution curve for which the empirical rule could apply? (Choose all that apply)

☐



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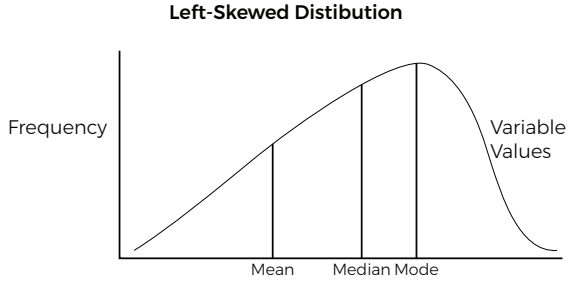
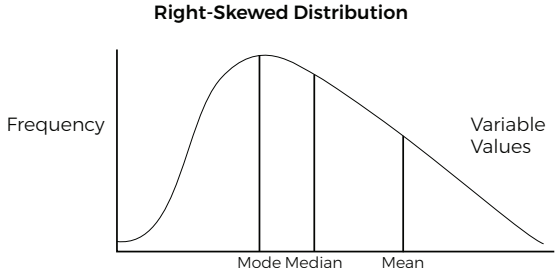
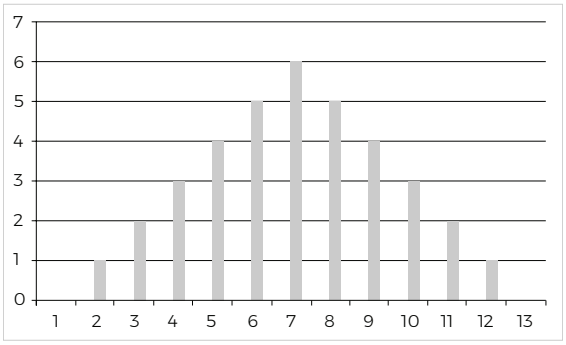


☐



☐



Section 4: Introduction to Loss Forecasting

Reserves

Check-In

Directions: State whether each scenario is an outcome of under-reserving or over-reserving.

1. A company overstates their income, making their financial health look better than it really is.

   Under-reserving Over-reserving

2. A company is unable to invest in a new project because they have allocated too much of their capital to reserves.

   Under-reserving Over-reserving

3. An accounting consultant reviews a company's books and notices a large redundancy in reserves.

   Under-reserving Over-reserving

4. A company must use adverse development to account for claims that exceed initial estimates.

   Under-reserving Over-reserving

Knowledge Check

1. Explain the difference between case reserves and IBNR reserves.

_____

_____

_____

2. Why is it necessary to have both?

_____

_____

_____

Ultimate Losses

Knowledge Check

1. In the example above, explain why the LDFs are applied the way they are.

_____

_____

_____

2. Apply the following LDFs and calculate the ultimate total Losses

2.60 1.17 2.75 1.40 1.00

	a	b	(a x b)
Year	Total Incurred $	Development Factor (given)	Ultimate Total Losses $
X1	386,550		
X2	469,091		
X3	125,986		
X4	291,555		
X5	357,171		

Necessary Data Adjustments for Loss Forecasting

Knowledge Check

Stability is an important variable in loss projections, and operational changes can significantly impact loss projections. For example, let's look at a trucking company that has been in business for several years. The historical loss data shows that one accident for every forty thousand miles driven is a reliable projection. However, the company merged with another company at the beginning of its third year in business, and this merger basically doubled the size of the fleet.

Loss History Chart

Year	Miles Driven Per Year	Number of Accidents	Number of Accidents Per Mile
1	400,000	10 / per year	1 / 40,000
2	600,000	15 / per year	1 / 40,000
3 Year of Merger– Larger Fleet	1,200,000	20 / per year	1 / 60,000

1. How would you interpret these results?

_____

_____

_____

_____

Knowledge Check *(continued)*

2. The table below shows the ultimate total losses for Company X. Using an inflation index of 10%, calculate the indexed ultimate losses for years X1–X5..

	a	b	(a x b)
Year	**Ultimate Total Losses**	**Inflation Index (10%)***	**Indexed Ultimate Losses $**
X1	115,780		
X2	378,220		
X3	499,430		
X4	450,300		
X5	700,120		

3. Use the indexed ultimate losses you calculated in step 1 to develop the loss rate and calculate the mean.

Year	Indexed Ultimate Losses (a)	Revenue (in $1000) (b)	Loss Rate (Losses /$1,000 revenue) (a)/(b)
X1		$2,500	
X2		$2,600	
X3		$3,000	
X4		$3,800	
X5		$4,300	
Mean			
X6 Budgeted		**$4,950**	

4. Calculate the loss forecast for X6.

_____

Knowledge Check

Directions: Using the data provided, calculate a 95% confidence interval for the ultimate total dollar losses, including the mean.

Mean Loss Rate: 150
Standard Deviation $45
Budgeted Revenue (per $1000): $4,500

_____

_____

_____

_____

_____

_____

_____

Resources for Obtaining Loss Development Factors

Knowledge Check

You want to calculate loss development factors for your organization. You have assembled the following loss data and entered it into the basic triangulation format. (The intent of this exercise is to make you more comfortable with the process, so do not worry about the small amount of data.

X/Months	12	24	36	48
X1	50	75	100	130
X2	40	60	80	
X3	60	80		
X4	30			

1. What steps will you take to calculate age-to-age development factors?

_____

_____

_____

_____

Calculate the development factors

	Age-to-Age Development Factors			
Year	**12–24**	**24–36**	**36–48**	**48–60**
X1	50	75	100	130
X2	40	60	80	
X3	60	80		
X4	30			
Total				
Average	1.44	1.33	1.30	

2. What steps will you take to calculate age-to-ultimate development factors?

_____

_____

_____

_____

Calculate the development factors

	Age-to-Ultimate Development Factors			
Year	**12–24**	**24–36**	**36–48**	**48–60**
Total				
Average				
Development to Ultimate Factor				

Challenges in Calculating and Forecasting Ultimate Losses

Check-In

Which of the following are NOT challenges in forecasting ultimate losses? (Choose all that apply)

- ☐ Ultimate loss and reserve estimates change with each new valuation period.
- ☐ IBNR development is static and new information is rarely available.
- ☐ Organizational changes such as mergers, acquisitions, or evolving case reserve philosophy can significantly impact the triangulation process.
- ☐ Reserve estimates are subject to qualitative assessment methods and can vary depending on who is actually calculating and forecasting losses.
- ☐ The triangulation process is an exact science and can be difficult for new risk managers to understand.

Section 4 Self-Quiz

Directions: Answer the following questions. Some questions may have more than one correct answer choice.

1. Which of the following statements is true about reserves? (Choose all that apply.)

   - ☐ Case reserves are loss reserves that are held for claims that have been incurred, but not reported.
   - ☐ The bulk reserve is composed of four elements: adverse development, reopened claims reserves, incurred but not reported, and reported but not recorded.
   - ☐ Companies who under-reserve their losses will eventually experience adverse development.
   - ☐ ALAE reserves are those expenses not specifically allocated or charged to a particular item.
   - ☐ Case reserves are generally set by a claims adjuster on individual claims.

2. In year X1, Company A incurred $200,000 in total losses. Given a development factor of 1.50, calculate the ultimate total losses for year X1.

   - ☐ $100,000
   - ☐ $133,333
   - ☐ $250,000
   - ☐ $300,000

3. Renisha is a risk manager for Company A. She wants to use the past five years of ultimate loss data to forecast losses for the current year (X6). What step(s) will Renisha need to take in order to accurately forecast this year's losses?

   - ☐ Collect loss data from other organizations in her industry
   - ☐ Adjust other companies' ultimate losses for inflation
   - ☐ Adjust Company A's total incurred losses for each year to ultimate total losses using loss development factors
   - ☐ Index Company A's previous ultimate losses for inflation
   - ☐ Adjust for Company A's changing exposures over time

4. Which of the following shows the correct formula for forecasting losses?

   - ☐ (Fully developed loss rate) x (# projected exposures next period)
   - ☐ (Fully developed loss rate) x (Indexed ultimate losses)
   - ☐ (Indexed ultimate losses) ÷ (Revenue)
   - ☐ (Indexed Ultimate Losses) ÷ (# Projected exposures next period)

5. Which of the following statements is true regarding loss forecasting using confidence intervals and linear regression? (Choose all that apply.)

   - ☐ The lower confidence interval represents the "best-case scenario," while the upper confidence interval represents the "pessimistic-case scenario."
   - ☐ In a normal distribution, the 95th percentile confidence range is estimated by calculating three standard deviations below and above the mean.
   - ☐ When r^2 is .70 or greater, linear regression is likely to yield a better result than the confidence interval approach.
   - ☐ Confidence intervals are more accurate when there is an obvious trend in the data.
   - ☐ Confidence intervals assume that loss data is right-skewed.

6. Which of the following statements are FALSE regarding resources for obtaining loss development factors (LDFs)?

   - ☐ LDFs can be generated from loss history data using a triangulation process.
   - ☐ When calculating period-to-period development, tail factors represent all additional loss data beyond the last data available.
   - ☐ Period-to-period development is calculated by starting with the oldest period and then cross-multiplying forward to the most recent year of known data.
   - ☐ A RMIS system is required for calculating development factors.
   - ☐ Payout triangles are used to show how much an organization paid by year.

Section 5: Time Value of Money Concepts

Financial Decision-Making Concepts

Knowledge Check

When your oldest child starts kindergarten, you realize that you need to start planning for the expense of college. Currently, the tuition at your alma mater is $30,000 per year. When you were a student 20 years ago, the tuition was $4,000 per year. You know you must plan to have much more than $30,000 per year. You are worried that in 13 years, the tuition will be $50,000 per year or more.

1. In terms of the tuition dollars, what is the present value of the college tuition per year?

_____

2. What is your predicted future value of the college tuition?

_____

3. If you plan on having a systematic plan to set aside an equal amount every year for college, what is the TVOM term for describing that savings plan?

_____

4. Your investment advisor has offered you a plan that would guarantee 4% interest for 13 years. What is the TVOM term for that guaranteed rate of interest?

_____

Calculating the Present and Future Values

Knowledge Check

The insurance carrier has promised to reduce the premium by $10,000 at the end of the third policy term. The CFO says the discount rate is 10%. How much is that future value worth today?

1. Determine the values to use in the calculation:

FV	
Discount rate (*i*)	
Number of periods (*n*)	

2. Using the PV of $1 table, below, find the PV factor for the given discount rate (*i*) and number of periods (*n*).

   PV factor = _____

Present Value of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567
6	0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322

3. Find the PV:

   PV = FV x PV factor

   PV = _____ x _____

   PV = _____

Knowledge Check

The insurance carrier has indicated the premium will be reduced by $5,000 at the end of each of the next five policy terms. The CFO says the discount rate is 9%. How much is that premium reduction worth today?

1. Determine the values to use in the calculation:

PYMT	
Discount rate (*i*)	
Number of periods (*n*)	

2. Using the Present Value of an Annuity of $1 table, below, find the PVA factor for the given discount rate (*i*) and number of periods (*n*).
   - PV of an annuity factor = _____

Present Value of an Annuity of $1												
n*	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**	**11%**	**12%**
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605

3. Find the PVA:

   PVA = PYMT x PVA factor

   PVA = _____

   PVA = _____

Knowledge Check

The insurance carrier has indicated the premium will be reduced by $2,000 at the end of the first year, $3,000 at the end of the second year, and $4,000 at the end of the third year. The CFO says the discount rate is 9%.

1. How much is that premium reduction worth today?

n = 1	2,000	x	0.917	=	$1,834
n = 2	3,000	x	0.842	=	$2,526
n = 3	4,000	x	0.772	=	$3,088

2. How would you calculate if all payments were equal?

Present Value of an Annuity of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605

Evaluating Capital Investment Projects

Knowledge Check

1. Calculate the ARR and payback for the following projects:

Net Expected Cash Flows			
	Year	**Project A**	**Project B**
Investment Outflow	0	($100)	($200)
Cash Inflows	1	$10	$140
	2	$60	$100
	3	$80	$40

2. Does the type of calculation (ARR vs. payback) impact which project you would select? Explain how the tools used can impact financial decisions.

Knowledge Check

You are the risk manager for a nonprofit organization that is tax exempt under IRC 503(c)(3). You are considering purchasing safety equipment at a cost of $100,000. Your insurance broker has obtained an estimate of premium savings from the underwriter for the next five years (assuming that exposures and premiums remain the same) of $27,000 a year. The CFO says the organization's cost of capital is 10%.

1. Assume all premiums are paid at the end of the year. Should you purchase the equipment?

Yes **No**

n = 5

i = 10%

PV of payments 1-5: _____

Less cost _____

NPV _____

2. Now assume all premiums are paid at the beginning of the year. Should you purchase the equipment?

Yes **No**

n = 4

i = 10%

PV of first payment _____

PV of payments 2-5: _____

Total benefit (discounted) _____

Less cost _____

NPV _____

Section 5 Self-Quiz

Directions: Match the definition or description on the right with the term or phrase on the left.

A. Annuity	_____ Calculated using the mathematical expression FV /(1 + *i*%)*n*
B. Present Value	_____ Measurement of the PV of future cash inflows compared to the net investment of a project, using organization's discount rate as *i*.
C. Future Value	_____ A stream of equal payments made over a specified period of time
D. Discount Rate	_____ Measurement of the length of time needed to recoup the cost of a capital investment (when flows break even with costs)
E. Payback	_____ Created as a result of compounded interest earnings on the present value
F. Accounting Rate of Return	_____ Measurement of discounted values of inflows divided by the net investment using in comparing the NPV of various projects
G. Net Present Value	_____ Discount rate where PV of outflows equals the PV of inflows NPV = $0
H. Benefit/Cost Ratio	_____ The average annual cash flow divided by the initial investment.
I. Internal Rate of Return	_____ The organization's cost of capital; also known as WACC

Directions: Select the BEST answer choice for each question. Use the tables, if needed, to help you calculate your answers.

Present Value of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567

Present Value of an Annuity of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605

1. The insurance carrier has promised to reduce the premium by $10,000 at the end of the fifth policy term. The CFO says the discount rate is 9%. How much is that future value worth today?

   - ☐ $3,890
   - ☐ $3,791
   - ☐ $6,210
   - ☐ $6,500

2. The insurance carrier has indicated the premium will be reduced by $1,000 at the end of the first year, $3,000 at the end of the second year, and $5,000 at the end of the third year. The CFO says the discount rate is 8%. How much is that premium reduction worth today?

   - ☐ $7,146
   - ☐ $7,467
   - ☐ $19,160
   - ☐ $23,193

3. The insurance carrier has indicated the premium will be reduced by $6,000 at the end of each of the next three policy terms. The CFO says the discount rate is 10%. How much is that premium reduction worth today?

   - ☐ $3,726
   - ☐ $4,506
   - ☐ $14,922
   - ☐ $22,746

Directions: For each project description below, indicate whether you should accept or reject the project.

1. Project A: BCR of 0.954.

Accept **Reject**

2. Project B: BCR of 1.38

Accept **Reject**

3. Project D: PV inflows= 897,321; PV Outflows= 543,210

Accept **Reject**

Section 6: Risk Analysis Applications

Review of Analytical Techniques

Knowledge Check

XYZ Corporation is considering investing in a new third-party training program for its management staff. Though the cost of the program is significant, reviews indicate that it has helped similar organizations to reduce the frequency and severity of employment practices liability claims.

1. Explain how an NPV cost-benefit analysis might be used in this situation to determine whether this program is a good fit for XYZ Corp.

_____

_____

_____

_____

2. Name at least one potential inflow and one potential outflow that the risk manager should evaluate.

_____

_____

Calculating NPV Cost-Benefit Analysis for Equipment and Training Investment Decisions

Knowledge Check

Directions: For each step in the process, describe one example of how Mary carried out the step.

NPV

COST-BENEFIT ANALYSIS

1 STEP	Determine cash outflows	1.
2 STEP	Determine cash inflows	2.
3 STEP	Calculate NPV and compare outflows and inflows	3.
4 STEP	Calculate impact of taxes on outflows and inflows, including after-tax effect of depreciation	4.
5 STEP	Calculate PV of tax impact on cash outflows and inflows	5.
6 STEP	Determine after-tax NPV by comparing after-tax NPV of cash outflows and inflows	6.

Calculating NPV Cost-Benefit Analysis for Risk Financing Decisions

Knowledge Check

Directions: Answer the questions and complete the necessary calculations using the information provided.

Scenario 1: Incurred losses (valued as of 12/31/X5), including reserves for loss adjustment expenses, are as follows:

01/01/X3–12/31/X3 $67,000

01/01/X4–12/31/X4 $49,000

01/01/X5–12/31/X5 $41,000

Revenues have been stable. Frequency has been relatively consistent.

1. Are you satisfied that losses are improving? Explain.

_____

_____

2. Development factors (to ultimate total loss) are 1.2, 1.4, and 1.8 for three years. Compute developed losses, and enter your answers in the worksheet provided.

3. Adjust the losses for inflation (based on 5% annually) to reflect X6 dollars, and enter your answers in the worksheet provided.

Worksheet

Year	Loss $	x Dev	= Ultimate Total Loss $	x Index	= Indexed Ultimate Total Loss $
X3					
X4					
X5					
X6					

Scenario 2: Total projected losses for next year are $82,000, assuming operations are the same as in the past.

You believe you can install various safety measures, e.g., new machine guards, strips on floors for traction, and new ergonomic computer tables, which will significantly reduce losses.

The cost of these measures is $50,000 (assume this is paid immediately). Assume losses less than $1,000 per occurrence will be reduced to $10,000 annually for each of the next three years, which is much lower than in the past.

As a result, consider a $1,000 deductible program. Presume the deductible losses are remitted to the carrier after an average of one year's use of funds (assume 100% losses paid in each policy year).

The insurance program will change as follows, assuming loss improvement occurs as expected. Over time, less frequency should also result in less severity.

X6	Deductible credit of $15,000
X7	Deductible credit of $15,000 and experience credit of $15,000
X8	Deductible credit of $15,000 and experience credit of $20,000

1. Calculate the combined results of both introducing loss control measures and accepting a deductible. Assume a 10% cost of capital (discount rate).

Inflows:	$	Discount Factor	PV $ of Inflows
X6 (current)			
X7			
X8			
Total			

Outflows:	$	Discount Factor	PV $ of Outflows
X6 (current)			
X7			
X8			
X9			
Total			

NPV_____

Knowledge Check (continued)

Scenario 3: DCRI's automobile liability program is renewing in several months. The current fleet of 206 vehicles consists of private passenger autos (100), limousines (52), vans (30), and SUVs (24).

The following data is from premium audits and loss reports:

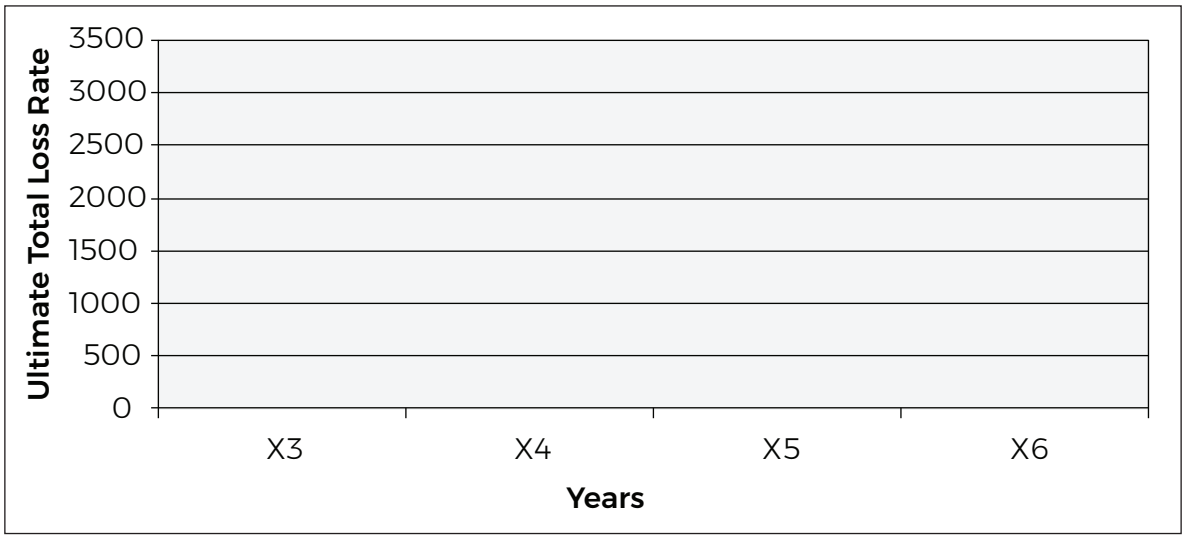
Year	# of Units	Total Incurred Liability Losses ($)	# of Losses
X3	140	250,000	13
X4	145	277,000	15
X5	163	224,000	20
X6	206		

Mary, the risk manager, calls Lucas Pacioli, the actuary with whom she has a business relationship, and Lucas gives her the loss development factors of 1.1, 1.3, and 2.0 for severity and an index (inflation) factor of 4% each year.

1. How should Mary develop the Indexed ultimate total loss rate projected for year X6—the coming year?

Year	Freq	Total Incurred	Dev. Factor	Ultimate Total Loss $	Inflation Index Factor	Indexed Ultimate Total Loss $	Exposure Units	Indexed Ultimate Total Loss Rate
X3								
X4								
X5								
X6								

2. How would Mary develop indexed ultimate total losses projected for year X6?



Knowledge Check (continued)

Scenario 4: Mary has received two renewal quotes.

Year	Indexed Ultimate Total Loss $	Exposure (Payroll $)	Indexed Ultimate Total Loss Rate (f / g)
	(f)	(g)	(h)
X1	221,987	12,350,000	0.0180
X2	819,568	13,910,000	0.0589
X3	706,034	15,204,000	0.0464
X4	574,007	17,112,000	0.0335
X5	1,004,079	18,080,000	0.0555
(Projection) X6	837,556	19,707,200	0.0425

Quote 1 is for a fully insured (guaranteed cost) plan. The premium is $950,000, payable the first of the month in 12 equal installments.

Quote 2 is for a deductible plan having a $25,000 deductible per loss with no aggregate. The underwriter believes of the $837,556 of total losses expected in X6 that $217,500 will fall within the deductible range. The premium for this deductible plan is $625,000 and is to be paid in 12 equal installments. The projected payout of losses within the deductible is as follows:

0–12 mos.	12–24 mos.	24–36 mos.	36–48 mos.	48–60 mos.
$52,200	$58,725	$19,575	$63,075	$23,925

Mary makes the assumption that the payout is made at year-end of each year

Sarah, the CFO, advised Mary that the discount rate she should use is 12%.

Tips:

- Consider using the PV of an annuity when calculating the discounted payment streams.
- Assume the annual 12% discount rate will translate to a monthly discount rate of 1%.

1. Which quote should Mary accept and why?

Worksheet for Quote #1

Premium first month		÷		=		
11 following months		x		=		
Total discounted payments						

☐ Fully Insured Plan (Quote 1)

_____

_____

Worksheet for Quote #2

Premium first month		x		=		
11 following months		x		=		
Total Discounted Payments						
Losses (assuming payout made at year end)						
Paid 0-12 months		x		=		
Paid 12-24 months		x		=		
Paid 24-36 months		x		=		
Paid 36-48 months		x		=		
Paid 48-60 months		x		=		
Total Discounted Paid Losses						
Total						

☐ Deductible Plan (Quote 2):

_____

_____

Issues Related to Quantitative and Qualitative Analyses

Knowledge Check

Mary is planning to conduct a full-scale quantitative and qualitative analysis to determine how her company should finance the risk created by offering delivery service withing a 30-mile geographic radius. The cost of the service would be based on distance, weight of the merchandise and the purchase price.

1. Name three potential issues Mary should keep in mind with respect to data and explain how they might impact her analysis.

   a) _____

   b) _____

   c) _____

Section 6 Self-Quiz

Directions: List the steps of conducting an NPV cost-benefit analysis when investing in equipment or training.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

6. _____

_____

Directions: Use the word bank to fill-in-the blanks. Terms will be used only once, and not all terms will be used.

capping	**NPV**	**cost-benefit analysis**	**forecast**
after-tax	**inflation**	**loss rates**	**confidence intervals**
industry	**regression**	**payout pattern**	**triangulation**

Steps in the process when selecting risk financing options

1. Develop losses through _____ using the organization's own data, as well as using _____ factors.

2. _____ losses using the following methods:

3. Trend losses (index for _____).

4. Develop _____ using exposures.

5. Forecast losses, using average loss rates or _____.

6. Consider using ranges based on _____ or high-low estimates.

7. Consider _____ losses.

8. Determine _____ of projected losses using the organization's own data as well as _____ factors. (

9. Calculate and compare the _____ of each option.

Answer Key

Section 1: Introduction to Risk Analysis in the Risk Management Process

Key Uses of Risk Analysis

Knowledge Check

Peter is preparing a presentation for the board on his analysis of current exposures. He will use classification scales to present his data. Explain how classification scales are used in data analysis and provide the scales for severity.

Sample Answer:

Classification scales are used to show the frequency (the number of times a loss occurs) and severity (the dollar amount of each loss). Severity is usually categorized as low, medium, or high.

Peter will also show how financial assessment is used as a risk analysis tool. Explain the use of financial assessment in risk analysis.

Sample Answer:

Financial assessments seek to evaluate hard-to-quantify, broad loss exposures that can impact the organization in areas such as profitability, revenue growth, and financial capacity.

Types of Risk Analysis
(Purpose, Characteristics, Methods)

Knowledge Check

1. Distinguish between the two types of risk analysis.

Sample answer:

Quantitative analysis uses accepted methods to precisely measure the impact of potential risks, while qualitative analysis measures risks that are difficult to quantify but can still financially impact an organization. Qualitative analysis answers the question, "What?", while quantitative analysis answers, "How much?"

2. Explain how qualitative factors and consideration can affect risk management decisions.

Sample answer:

Qualitative factors such as brand image, corporate social responsibility, and management's appetite for risk can have a great impact on risk management decisions. Even if quantitative analysis suggests that a particular decision would be financially prudent, management may opt not to select that decision based on these types of qualitative considerations.

3. The risk management team at your organization presents you with a risk analysis for a new project. After creating in-depth loss projections and a thorough cost-benefit analysis, they feel that your organization should take on the project. Has the team conducted a complete risk analysis? Explain why or why not.

Sample answer:

The team has not conducted a thorough risk analysis because they have only used quantitative methods. They should employ qualitative methods and/or assessments in order to consider exposures that are harder to quantify.

Section 1: Self-Quiz

Directions: Check all that apply.

1. Which of the following is an example of a use for risk analysis?
   - [x] A risk manager reviews loss data to identify loss exposures.
   - [x] A team collaborates to prioritize the seven risk factors.
   - [ ] A claims adjuster reviews a single loss case.
   - [x] A risk management team compares expected cash inflows with expected cash outflows to determine if a project will have a net benefit for the company.
   - [ ] A manager wants to compare employee performance in order to determine annual bonuses.
   - [x] A risk manager uses loss projections to negotiate policy renewals.

Explanation:

Risk analysis uses a combination of quantitative and qualitative measures to analyze organizational risks on a broad scale. Thus, risk analysis would involve evaluating data from a significant number of losses rather than a single loss case. A manager may use quantitative and qualitative methods to measure employee performance, but this is performance analysis, not risk analysis. For more information, see "Key Uses of Risk Analysis" in Section 1 of the Learning Guide.

Directions: State whether each tool/method shows qualitative or quantitative analysis.

1. Loss projections Quantitative
2. Risk mapping Qualitative
3. Cost-Benefit Analysis Quantitative
4. Delphi Method Qualitative
5. Loss Data Assessment Qualitative
6. Cash Discounting Calculations Quantitative
7. Root Cause Analysis Qualitative
8. TCOR Calculations Quantitative
9. Financial Assessment Qualitative
10. NPV Calculations and Analysis Quantitative

Explanation:

The methods labeled as qualitative focus on considerations that are not easily measured. For example, risk mapping uses a frequency and severity scale to measure risk factors that cannot be quantified through traditional mathematical methods. If two different risk managers created risk maps for the same exposures, they might get different results, because there is always a degree of subjectivity to qualitative methods. The methods labeled as quantitative, such as cost-benefit analysis, utilize mathematical formulas and traditional, acceptable methods to calculate precise numerical values for potential risks. For more information, see "Types of Risk Analysis" and "Risk Analysis Tools" in Section 1 of the Learning Guide.

Section 2: Qualitative Analysis

Qualitative Risk Assessment Areas

Knowledge Check

1. You are a new risk manager with a new software/technology startup. Choose three of the seven main areas of qualitative risk assessment that you feel might be priorities for this type of company and explain their significance.

Answers will vary, but should include three of the seven Qualitative Assessment Areas and should give a concrete explanation as to why they are important.

2. Your company is especially concerned with profitability. Explain the type of qualitative assessment that might be most important to your organization and describe its main components.

Sample Answer:

Financial assessment would likely be most important to this organization. Its main components include profitability (adequate financial return), revenue growth relative to growth in expenses and fixed costs, and financial capacity (ability to fund necessary or desired activities and investments).

Qualifying Data for Analysis

Knowledge Check

1. Safe Products, Inc., acquires the cleaning products operation of ABC Corporation. When analyzing losses for this new acquisition, the risk management team also includes loss data on ABC Corporation's pharmaceutical operation. Explain why the loss data on the pharmaceutical operation should not have been collected, and how it might impact analysis.

Sample Answer:

The loss data from the pharmaceutical operation should not have been collected because it is not relevant to the analysis. The loss data for pharmaceuticals will have different types and causes of loss, as well as different rates of frequency and severity. As such, including this data will reduce the accuracy of analysis of the cleaning products operation.

2. You have recently started working as a risk manager with ABC Corporation. You discover they routinely use data sets collected over the course of only one or two years. Moreover, the data often includes different types and causes of loss. Which characteristic(s) of quality loss data are missing, and how might this impact data analysis?

Sample Answer:

The data is lacking in completeness, as two years does not constitute a large enough data sample. Additionally, the data is lacking in consistency because it contains multiple types and causes of loss. The lack of these characteristics will make it difficult to conduct a thorough and meaningful analysis.

Qualitative Analysis Tools

Check-In

Directions: Match the letter of the logical classification in the left-hand column with its corresponding loss example in the right-hand column.

A. Property	**B** An employee is seriously injured in an on-the-job accident, and files a worker's compensation claim for medical expenses.
B. Human Resources	**A** A deep freeze and blizzard results in significant property damage to a company headquarters, including burst pipes and a partial roof collapse.
C. Liability	**D** A company must upgrade its entire computer network and invest in new data security features after a hacking incident. The cost is significant and affects the annual revenue.
D. Net Income	**C** A skincare company is faced with a class action lawsuit after customers suffer adverse reactions from a new line of lotion.

Knowledge Check

1. Describe a risk map and its uses.

Sample Answer:

A risk map is a tool that can be used to visually analyze potential risks. Risks are placed into one of four quadrants based on their degree of frequency and severity. Risk managers can use risk maps to aid in risk control and risk financing decisions, as well as to model future risk exposures or track changes in exposure over time. They can also serve as a visual tool to accompany risk management treatment plans.

2. Your coworker exclaims, "There is no point to using qualitative assessment because all the company really needs to know is the financial impact of a risk." Explain to your coworker three categories of potential impact that can be assessed qualitatively.

Answers will vary, but may include financial assessment (profitability, revenue growth, financial capacity), insurance market analysis, loss data analysis, the seven areas of qualitative assessment, etc.

Root Cause Analysis

Knowledge Check

Jeff is a district manager who oversees a warehouse distribution center. Recently, there has been an increase in workplace accidents at the warehouse. Several employees have sustained injuries, ranging from minor (cuts, scrapes, bruises) to more serious (a broken arm and a concussion). Additionally, stock was damaged in a recent forklift accident. Jeff visits the warehouse and notices that the lighting is dim. "I'll just bring in brighter bulbs, and that should solve the issue," Jeff says.

1. Explain the flaw in Jeff's thinking. What might he be missing by not conducting a root cause analysis?

Sample Answer:

Jeff does not know for sure that dim lighting is the sole cause of the accidents. By not conducting a root cause analysis (RCA), he might focus only on replacing the lightbulbs and miss other factors that could be contributing to the problem. An RCA can help Jeff to clearly identify what happened, how it happened, and why it happened, so he can prevent more accidents from occurring.

2. Explain which RCA method you think could be most helpful to Jeff in this instance, and why.

Sample Answer:

A job hazard analysis might be most helpful to Jeff in this instance because it is specifically designed to identify potential workplace hazards and reduce accidents. Jeff can involve employees in the process, which may help him to more effectively identify the source of accidents. He can use this tool not only for accident investigation, but also to train employees in safety procedures.

Risk Modeling

Knowledge Check

Directions: State whether each of the following scenarios is an example of predictive analytics or catastrophe modeling and explain your reasoning.

1. A homeowners' insurance company uses a computer-based model to predict the likelihood of tornadoes in various regions and uses this information when calculating rates.

Sample Answer:

Catastrophe modeling—used for predicting the likelihood of flooding in coastal cities and/or predicting the likelihood of wildfires in Western U.S. states

2. An auto insurance company has an incentive program in which drivers can get discounts by using an app that monitors their driving safety. The insurance company uses this data to forecast accident risks.

Sample Answer:

Predictive analytics—an e-tailer (retailer selling goods via electronic transactions on the internet) gathers data on how frequently website visitors purchase products based on their advertising campaigns and uses the data to revise and better target their marketing

Directions: Provide one additional example of how each of these risk modeling techniques might be used.

Answers will vary. See above section for examples and definitions.

Section 2 Self-Quiz

Directions: Answer the questions below. There may be more than one correct choice.

1. Which of the following is/are an example(s) of qualitative assessment? (Select all that apply.)
   - [x] Financial assessment
   - [ ] Cost-benefit analysis
   - [x] Insurance market analysis
   - [x] Loss data analysis
   - [ ] NPV (net present value) analysis
   - [x] Root cause analysis

Explanation:

Financial assessment, insurance market analysis, loss data analysis, and root cause analysis are all qualitative assessment methods because they involve evaluating risk factors that cannot be quantified using traditional mathematical methods. Conversely, cost-benefit analysis and NPV analysis involve using mathematical formulas to assign numerical, monetary values to risks. For more information, see "Financial Assessment," "Insurance Market Analysis," "Loss Data Analysis," and "Root Cause Analysis" in Section 2 of the Learning Guide.

2. Which of the following is/are NOT one of the seven main areas of qualitative risk assessment? (Select all that apply.)
   - [ ] Human resources and employee safety issues
   - [ ] Social responsibility and citizenship
   - [ ] Management's appetite for risk
   - [x] Company mission, vision, and values statements
   - [ ] Innovation, product development and marketing
   - [x] Insurance underwriting guidelines

Explanation:

To review the main areas of qualitative risk assessment, see "Qualitative Risk Assessment Areas" in Section 2 of the Learning Guide.

3. Which of the following is/are an example(s) of a characteristic of quality loss data? (Select all that apply.)

- [x] A significant data sample collected over five years or more
- [x] Data collected for the same types of loss during the same policy year
- [ ] Data collected for all operations in the last 15 years, including areas that are no longer part of the organization
- [x] Data that has been checked for input accuracy
- [ ] Data that is organized by policy year only

Explanation:

To ensure the validity of loss data, data must be complete (a sample collected over five or more years), consistent (same types of loss, same policy year, etc.), reliable, relevant, and organized in a way that meaningful to the analysis. For more information, see "Evaluating and Insuring the Quality and Credibility of Loss Data," and "Characteristics of Quality Loss Data" in Section 2 of the Learning Guide.

Directions: Use the words from the word bank to fill in the blanks. Answers may only be used once, and not all answers will be used.

risk mapping	**job hazard analysis**	**risk register**	**catastrophe modeling**
predictive analytics	**logical classifications**	**Pareto Principle**	**heat mapping**
maximum probable loss	**root cause analysis**	**Ishikawa diagram**	**maximum possible loss**
hazard identification indexing	**risk modeling**	**RMIS**	**Delphi method**

1. Property, human resources, liability, and net income are examples of logical classifications of exposures.

2. Risk mapping is a visual analytic tool used to identify risks and understand their impact. In its simplest form, it consists of a graph divided into four quadrants, with the y-axis representing severity, and the x-axis representing frequency of risks.

3. A(n) risk register lists known or anticipated risks in rows, and impact or anticipated severity in columns, and can be used to track and prioritize risks, as well as potential impact and mitigating measures.

4. A(n) Ishikawa diagram is one method of root cause analysis, which typically lists a problem statement and then branches off into six categories in order to explore possible causes of an issue.

5. Heat mapping uses colors to indicate patterns or groupings, providing a visual representation of complex data sets.

6. Maximum probable loss is the most likely loss to occur for a given peril, while maximum possible loss is the greatest damage that could occur in a loss.

7. The Pareto Principle states that 80% of problems stem from 20% of causes.

risk mapping	**job hazard analysis**	**risk register**	**catastrophe modeling**
predictive analytics	**logical classifications**	**the Pareto Principle**	**heat mapping**
maximum probable loss	**root cause analysis**	**Ishikawa diagram**	**maximum possible loss**
hazard identification indexing	**risk modeling**	**RMIS**	**Delphi method**

8. The Delphi method uses a series of questionnaires to refine expert opinions and move toward consensus.

9. Catastrophe modeling uses computers to generate a very large set of simulated events to estimate losses arising from disastrous events, while predictive analytics uses machine learning to find patterns in large volumes of historical data to forecast future losses.

Section 3: Quantitative Analysis Tools

Measures of Central Tendency

Knowledge Check

1. Calculate the three measures of central tendency for the following seven numbers:

1, 4, 2, 1, 1, 7, 5

Mean	3
Median	2
Mode	1

2. Recalculate the three measures of central tendency for the following eight numbers:

1, 4, 2, 1, 1, 7, 5, 100

Mean	15.13
Median	3
Mode	1

3. Compare the measures of central tendency that you recalculated in question 2 to your answers from question 1. Explain what impact (if any) extreme outliers can have on the mean, median, and mode.

Sample Answer:

The extreme outlier of 100 had a strong effect on the mean, as it increased from 3 to 15.13. There was a minimal effect on the median, which increased from 2 to 3. There was no impact on the mode, which remained at 1.

4. Calculate the three measures of central tendency using the following information:

Total Return on the S&P 500

Year	Percentage
2018	31.23
2017	16.34
2016	5.67
2015	18.54
2014	31.06
2013	5.97
2012	22.31
2011	20.37
2010	(4.85)
2009	31.48

Mean	17.8
Median	19.4
Mode	N/A

Measures of Dispersion

Knowledge Check

Given the following array of numbers,

7 25 6 34 55 30

1. Calculate the range.

The range is the difference between the highest and lowest number: 55 – 6 = 49.

2. You are examining the loss data from two organizations—Smooth-On and Jumping Jack.

Smooth-On	Year	Jumping Jack
240	X1	120
260	X2	383
230	X3	247
270	X4	301
250	X5	199

Your Excel spreadsheet program gave you the averages and standard deviations of the population.

Average	250	250
Std. Dev.	14.1	89.2

Which organization has more variability in its losses? Why is that so?

Sample Answer:

Jumping Jack has the greater variability of losses with no discernable trend.

3. If you had to make a loss forecast for these organizations, which organization's forecast would you be more comfortable in making? Why?

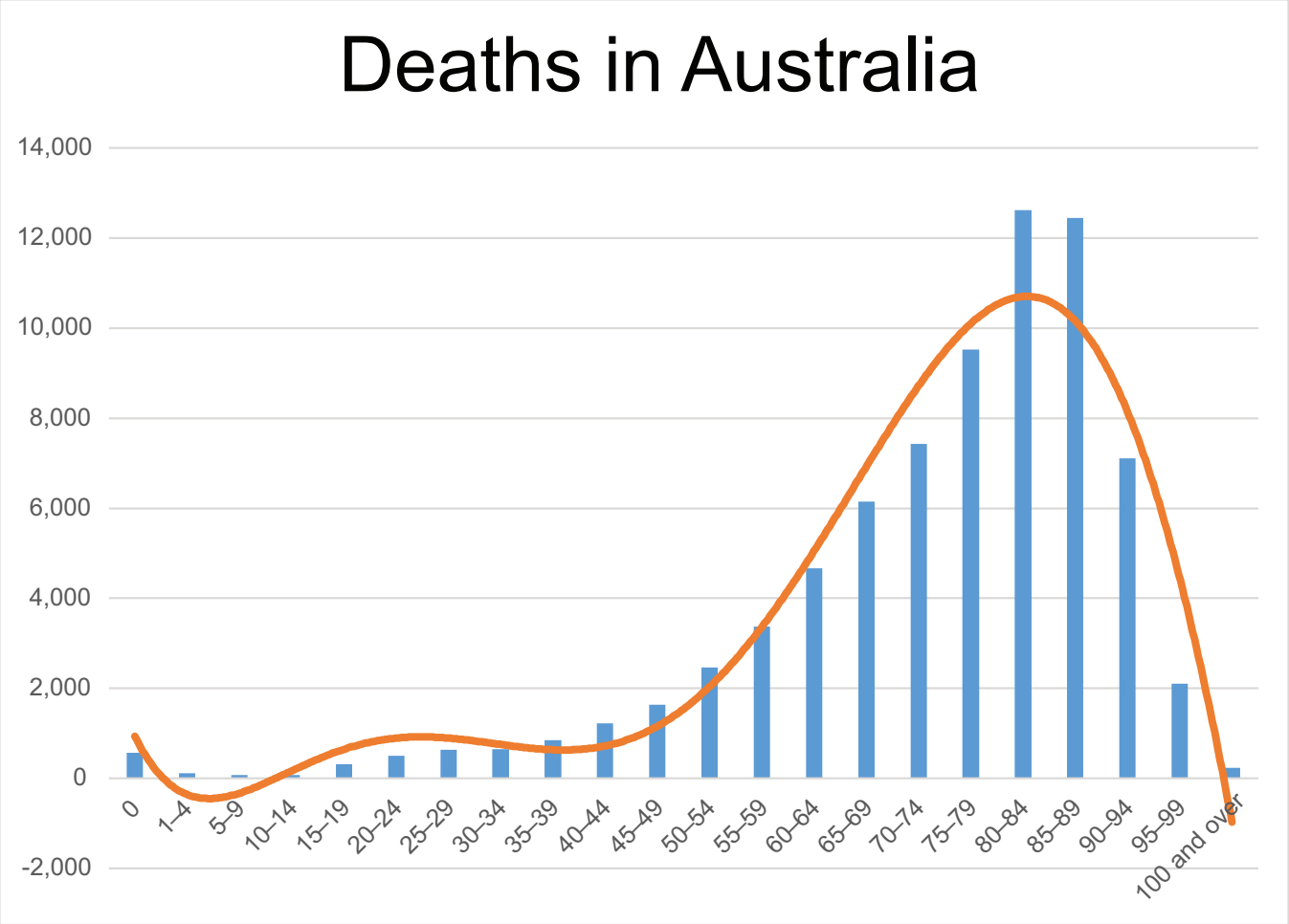
Sample Answer:

A more reliable forecast can be made for Smooth-On. There is very little variability of losses; also, a low standard deviation.

Empirical Rule and Confidence Intervals

Knowledge Check

Directions: Use the graph to answer the questions.



1. Does this graph show a positive or negative skew?

Negative skew

2. What does the skew of this graph tell us about the relationship of age to the average death rate?

Sample Answer:

The negative skew shows that death is more common among older individuals.

3. Does the empirical rule apply to this graph? Why or why not?

Sample Answer:

No. The empirical rule does not apply to this graph because it only applies to normal distributions.

4. Which type of skew is most common in risk management? Explain why.

Sample Answer:

Right-skewed, positive distributions are the most common. This is because individual loss distributions tend to have a positive skew, as most losses are small, relative to the maximum possible loss.

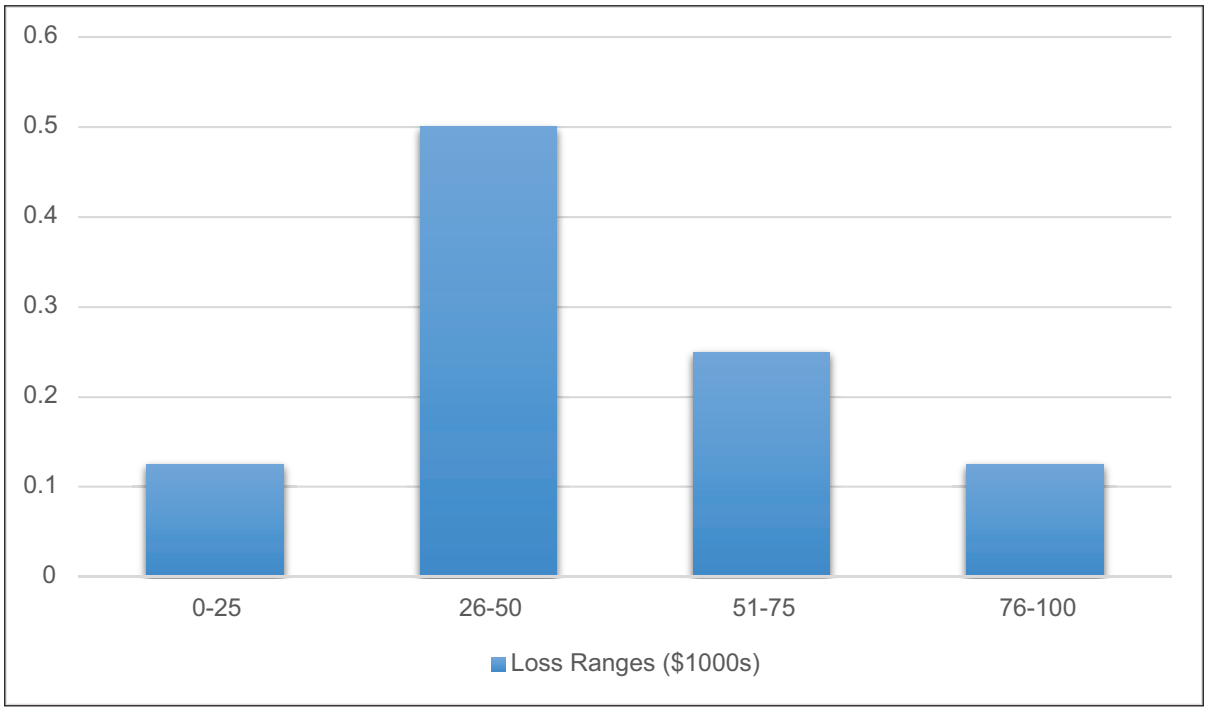
Histograms

Knowledge Check

1. Create a histogram using the loss data provided.

Losses (in $1,000's)							
30	40	30	75	50	100	10	60

Work Area



2. Provide a brief explanation of the histogram and what it conveys.

Sample Answer:

The histogram shows that losses in the ranges of 0–25 and 76–100 have a probability of 0.125. Losses in the range of 26–50 have a probability of 0.5, and losses in the range of 51–75 have a probability of 0.25.

Forecasting Losses Using Confidence Intervals

Knowledge Check

1. With the following claim information and the standard deviation of 74.96 (round to 75) calculate the high/low claim projections for the upcoming year using 95% confidence.

Claim Values:				
125	234	152	340	204

Population standard deviation = 74.96 (round to 75)

211 150 = 61 Low end

+150 = 361 High end

2. For each of the following r^2 values, state whether linear regression or confidence intervals would be more appropriate for forecasting.

r^2 Values	Linear Regression	Confidence Intervals
.6	X	X
.8	X	
.32		X

Explanation:

.6 = This r^2 is a fair predictor. Linear regression or confidence intervals can be used.

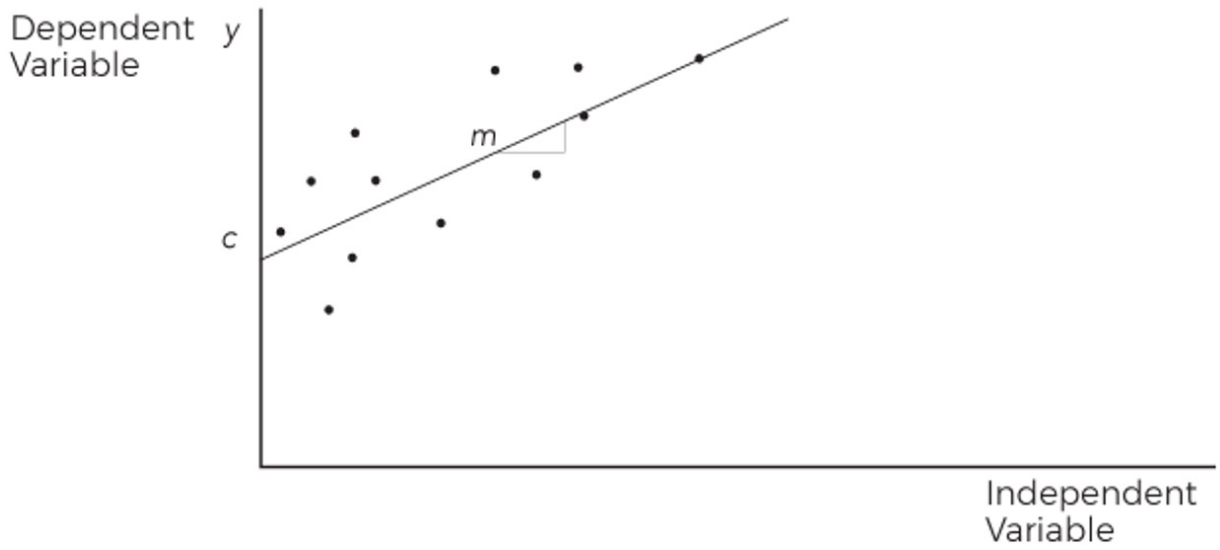
.8 = This r^2 is a good predictor. Linear regression can be used.

.32 = This r^2 is a poor predictor. Confidence intervals can be used instead.

Section 3 Self-Quiz

Directions: Match the definition or description on the left with the term or phrase on the right.

__F__ The square root of the variance	**A.** Mean
__J__ Statistical technique of modeling the relationship between variables by fitting the "best" line to a scatter of dots	**B.** Median
__H__ The measure of the degree of asymmetry or distortion from a symmetrical bell curve of a frequency distribution	**C.** Mode
__I__ When there is an appropriately large sample, (30 or more values), that sample's average can be treated as if it were drawn from a normal distribution	**D.** Range
__B__ The midpoint of the observations ranked in order of value	**E.** Variance
__E__ The amount of dispersion in a set of data values	**F.** Standard Deviation
__A__ The sum of all observations divided by the number of observations	**G.** Empirical Rule
__K__ A group of continuous adjacent values that is used to estimate a statistical parameter	**H.** Skewness
__C__ The observation with the highest frequency of occurrence in a sample	**I.** Central Limit Theorem
__G__ States that nearly all values will lie within three standard deviations of the mean	**J.** Linear Regression
__D__ The difference between the largest and smallest values	**K.** Confidence Intervals



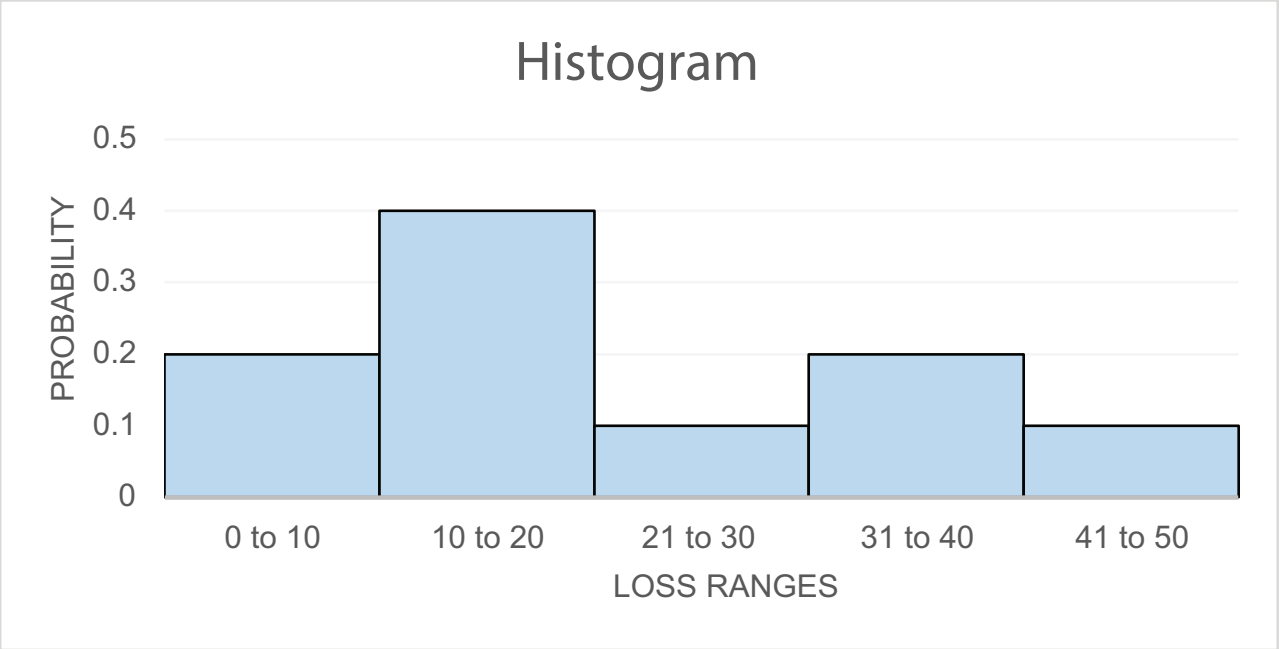
Directions: For each item below, select the best answer choice(s).

1. Which of the following statements are TRUE about the scatter plot shown above?
   - [x] The data shows an apparent trend.
   - [ ] A confidence interval is most appropriate for forecasting losses in this case.
   - [x] Linear regression is most appropriate for forecasting losses in this case.
   - [ ] The risk manager can determine with 95% confidence that losses in year 8 will be $500,000.
   - [ ] The data shows no apparent trend.

Explanation:

The data points form a straight line, indicating an apparent trend. In this case, linear regression is the most appropriate/effective method for forecasting losses (confidence intervals are the appropriate choice when there is no apparent trend. See the topic, "Forecasting Future Losses," in Section 3 of the Learning Guide for more information.

2. Which of the following data sets is correctly depicted by the histogram shown below?



☐

Losses (in $1000s)									
0	5	7	8	10	15	25	29	45	50

☑

Losses (in $1000s)									
5	7	10	15	15	18	25	35	37	50

☐

Losses (in $1000s)									
5	7	8	10	15	15	18	25	35	47

☐

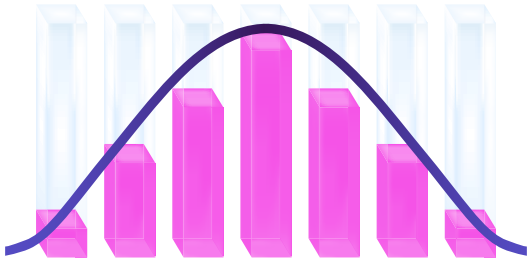
Losses (in $1000s)									
0	5	10	15	15	18	20	25	35	50

Explanation:

The table shown in answer choice B shows the correct distribution of data, with 2/10 instances occurring in the 0–10 range, 4/10 in the 11–20 range, 1/10 in the 21–30 range, 2/10 in the 31–40 range, and 1/10 in the 41–50 range. See the topic, "Histograms," in Section 3 of the Learning Guide for more information.

3. Which of the following depicts a distribution curve for which the empirical rule could apply? (Choose all that apply)

☑



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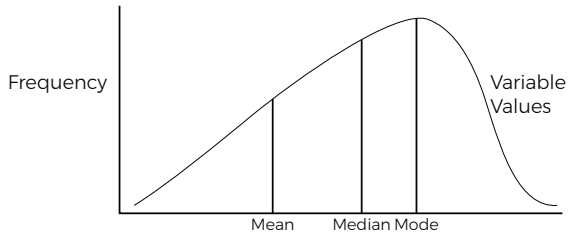

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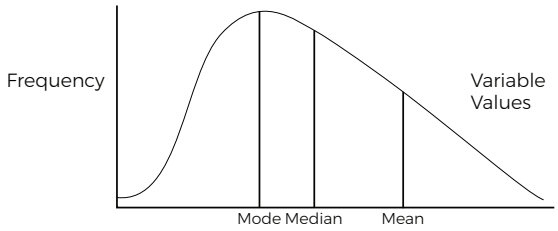

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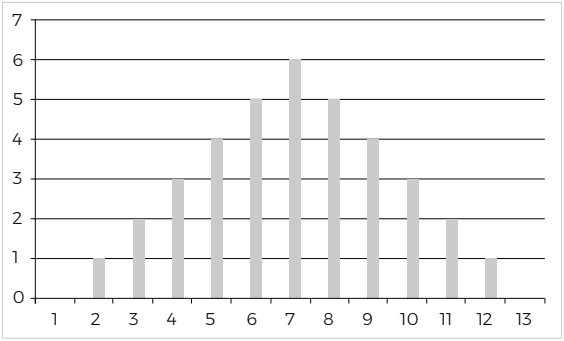


Explanation:

The empirical rule (which states that nearly all data lies within three standard deviations of the mean) only applies to data in a normal distribution (bell curve). See the topic, "Empirical Rule and Confidence Intervals," in Section 3 of the Learning Guide for more information.

Section 4: Introduction to Loss Forecasting

Reserves

Check-In

Directions: State whether each scenario is an outcome of under-reserving or over-reserving.

1. A company overstates their income, making their financial health look better than it really is.

   Under-reserving (circled) Over-reserving

2. A company is unable to invest in a new project because they have allocated too much of their capital to reserves.

   Under-reserving Over-reserving (circled)

3. An accounting consultant reviews a company's books and notices a large redundancy in reserves.

   Under-reserving Over-reserving (circled)

4. A company must use adverse development to account for claims that exceed initial estimates.

   Under-reserving (circled) Over-reserving

Knowledge Check

1. Explain the difference between case reserves and IBNR reserves.

Sample answer:

Case reserves are reserves those established for the payment of individual claims. They are usually set by claims adjusters and are estimates of what the claim might cost. IBNR (incurred, but not reported) reserves are typically determined by actuaries and reflect the total ultimate losses expected to be paid out over time.

2. Why is it necessary to have both?

Sample Answer:

Case reserves are necessary to ensure there is capital to pay individual claims. However, they are insufficient to estimate an organization's ultimate liability. IBNR reserves are required to ensure sufficient reserves for an organization's total liability, including incurred but not reported claims, claims in transit, claims that have been reopened, and additional adverse development of known claims.

Ultimate Losses

Knowledge Check

1. In the example above, explain why the LDFs are applied the way they are.

Sample Answer:

The year X5 has the largest development factor because it is the furthest away from full development. The development factors decrease, approaching 1.00 as the years mature, because more information about the individual claims becomes known. The year X1 has a development factor of 1 because, by this point, all claims from that year have been reported and closed.

2. Apply the following LDFs and calculate the ultimate total losses.

2.60 1.17 2.75 1.40 1.00

	a	b	(a x b)
Year	Total Incurred $	Development Factor (given)	Ultimate Total Losses $
X1	386,550	1.00	386,550
X2	469,091	1.17	548,836
X3	125,986	1.40	176,380
X4	291,555	2.60	758,043
X5	357,171	2.75	982,220

Necessary Data Adjustments for Loss Forecasting

Knowledge Check

Stability is an important variable in loss projections, and operational changes can significantly impact loss projections. For example, let's look at a trucking company that has been in business for several years. The historical loss data shows that one accident for every forty thousand miles driven is a reliable projection. However, the company merged with another company at the beginning of its third year in business, and this merger basically doubled the size of the fleet.

Loss History Chart

Year	Miles Driven Per Year	Number of Accidents	Number of Accidents Per Mile
1	400,000	10 / per year	1 / 40,000
2	600,000	15 / per year	1 / 40,000
3 Year of Merger– Larger Fleet	1,200,000	20 / per year	1 / 60,000

1. How would you interpret these results?

Sample Answer:

Looking at the chart, we see the loss history for years one and two, prior to the merger. During these years there was one accident for every forty thousand miles driven. During year three, the year of the merger, the loss data shows one accident for every sixty thousand miles driven. That is a very good result for year three. The number of miles that were driven doubled, but the frequency of accidents decreased from one accident every forty thousand miles to one accident every sixty thousand miles.

Knowledge Check

1. The table below shows the ultimate total losses for Company X. Using an inflation index of 10%, calculate the indexed ultimate losses for years X1–X5.

	a	b	(a x b)
Year	Ultimate Total Losses	Inflation Index (10%)*	Indexed Ultimate Losses $
X1	115,780	1.611×1.100^5	186,522
X2	378,220	1.464×1.100^4	553,714
X3	499,430	1.331×1.100^3	664,741
X4	450,300	1.210×1.100^2	544,863
X5	700,120	1.100	770,132

2. Use the indexed ultimate losses you calculated in step 1 to develop the loss rate and calculate the mean.

Year	Indexed Ultimate Losses (a)	Revenue (in $1000) (b)	Loss Rate (Losses /$1,000 revenue) (a)/(b)
X1	186,522	$2,500	74.61
X2	553,714	$2,600	212.97
X3	664,741	$3,000	221.58
X4	544,863	$3,800	143.39
X5	770,132	$4,300	179.10
Mean			166.33
X6 Budgeted		**$4,950**	

3. Calculate the loss forecast for X6.

$823,334

Knowledge Check

Directions: Using the data provided, calculate a 95% confidence interval for the ultimate total dollar losses, including the mean.

Mean Loss Rate: 150
Standard Deviation $45
Budgeted Revenue (per $1000): $4,500

Sample Answer:

Two standard deviations: ±$90

Low Loss Rate: $150 − 90

High Loss Rate: $150 + 90

Loss Rate Range: $60–240

Low Expected Losses: $4,500 x 60

High Expected Losses: $4,500 x 240

Expected Loss Range: $270,000–$1,080,000; Midpoint: $675,000

Resources for Obtaining Loss Development Factors

Knowledge Check

You want to calculate loss development factors for your organization. You have assembled the following loss data and entered it into the basic triangulation format. (The intent of this exercise is to make you more comfortable with the process, so do not worry about the small amount of data.)

X/Months	12	24	36	48
X1	50	75	100	130
X2	40	60	80	
X3	60	80		
X4	30			

1. What steps will you take to calculate age-to-age development factors?

Sample Answer:

Calculate the amount of change between intervals (Year X1).

Divide the 24-month value by the 12-month value: 1406 ÷ 116 = 1.26

Divide the 36-month value by the 24-month value: 154 ÷ 146 = 1.05

Divide the 48-month value by the 36-month value: 156 ÷ 154 = 1.01

Divide the 60-month value by the 48-month value: 156 ÷ 156 = 1.00

Repeat for each year (X2–X5).

Total each column and calculate the average for each column.

Calculate the development factors.

	Age-to-Age Development Factors			
Year	**12–24**	**24–36**	**36–48**	**48–60**
X1	50	75	100	130
X2	40	60	80	
X3	60	80		
X4	30			
Total	4.33	2.66	1.30	
Average	1.44	1.33	1.30	

2. What steps will you take to calculate age-to-ultimate development factors?

Sample Answer:

Start with the tail factor in the last year of known data (60 months).

Multiply by the 46–60-month average (1.05 x 1 = 1.05).

Multiply by 36–48-month average (1.05 x 1.03 = 1.08).

Continue to cross-multiply backwards for the remaining periods.

Calculate the development factors.

	Age-to-Ultimate Development Factors			
Year	**12–24**	**24–36**	**36–48**	**48–60**
Total	4.33	2.66	1.30	
Average	1.44	1.33	1.30	
Development to Ultimate Factor	2.49	1.73	1.30	

Challenges in Calculating and Forecasting Ultimate Losses

Check-In

Which of the following are NOT challenges in forecasting ultimate losses? (Choose all that apply.)

- ☐ Ultimate loss and reserve estimates change with each new valuation period.
- ☑ IBNR development is static and new information is rarely available.
- ☐ Organizational changes such as mergers, acquisitions, or evolving case reserve philosophy can significantly impact the triangulation process.
- ☐ Reserve estimates are subject to qualitative assessment methods and can vary depending on who is actually calculating and forecasting losses.
- ☑ The triangulation process is an exact science and can be difficult for new risk managers to understand.

Section 4 Self-Quiz

Directions: Answer the following questions. Some questions may have more than one correct answer choice.

1. Which of the following statements is true about reserves? (Choose all that apply.)

- ☐ Case reserves are loss reserves that are held for claims that have been incurred, but not reported.
- ☑ The bulk reserve is composed of four elements: adverse development, reopened claims reserves, incurred but not reported, and reported but not recorded.
- ☑ Companies who under-reserve their losses will eventually experience adverse development.
- ☐ ALAE reserves are those expenses not specifically allocated or charged to a particular item.
- ☑ Case reserves are generally set by a claims adjustor on individual claims.

Explanation:

Case reserves are typically set by claims adjusters based on loss estimates for individual claims. IBNR reserves are developed by actuaries and represent total expected ultimate losses. Gross IBNR reserves (also known as bulk reserves) include adverse development, reopened claims, incurred but not reported, and reported but not recorded. ALAE (allocated loss adjustment expenses) are directly assigned to, or arise from, a particular claim, while ULAE (unallocated loss adjustment expenses) are not specifically charged to a particular claim. For more information, see the topics, "Reserves" and "Types of Reserves," in Section 4 of the Learning Guide.

2. In year X1, Company A incurred $200,000 in total losses. Given a development factor of 1.50, calculate the ultimate total losses for year X1.

- ☐ $100,000
- ☐ $133,333
- ☐ $250,000
- ☑ $300,000

Explanation:

Multiply total losses by the development factor to calculate ultimate total losses. $200,000 x 1.5 = $300,000. For more information, see the topic, "Ultimate Losses," in Section 4 of the Learning Guide.

3. Renisha is a risk manager for Company A. She wants to use the past five years of ultimate loss data to forecast losses for the current year (X6). What step(s) will Renisha need to take in order to accurately forecast this year's losses?

- ☐ Collect loss data from other organizations in her industry
- ☐ Adjust other companies' ultimate losses for inflation
- ☑ Adjust Company A's total incurred losses for each year to ultimate total losses using loss development factors
- ☑ Index Company A's previous ultimate losses for inflation
- ☐ Adjust for Company A's changing exposures over time

Explanation:

Because Renisha is forecasting losses for her company only, she does not need to collect loss data from other companies. Ultimate total losses are calculated using loss development factors. After that, ultimate total losses must be indexed for inflation. In addition to inflation, Renisha must also consider any additional changing exposures that could impact her loss forecasts. For more information, see the topics, "Ultimate Losses" and "Necessary Data Adjustments for Loss Forecasting," in Section 4 of the Learning Guide.

4. Which of the following shows the correct formula for forecasting losses?

- ☑ (Fully developed loss rate) x (# projected exposures next period)
- ☐ (Fully developed loss rate) x (Indexed ultimate losses)
- ☐ (Indexed ultimate losses) ÷ (Revenue)
- ☐ (Indexed Ultimate Losses) ÷ (# Projected exposures next period)

Explanation:

When calculating loss projections, the risk manager must first calculate the loss rate by year, and select and appropriate method of obtaining the fully developed loss rate (the average over a certain number of years or the average excluding the highest and lowest values). This fully developed loss rate is then multiplied by the projected exposures for the next period. For more information, see the topic, "Steps to Calculate Forecasted Losses," in Section 4 of the Learning Guide.

5. Which of the following statements is true regarding loss forecasting using confidence intervals and linear regression? (Choose all that apply.)

- [x] The lower confidence interval represents the "best-case scenario," while the upper confidence interval represents the "pessimistic-case scenario."
- [ ] In a normal distribution, the 95th percentile confidence range is estimated by calculating three standard deviations below and above the mean.
- [x] When r^2 is .70 or greater, linear regression is likely to yield a better result than the confidence interval approach.
- [ ] Confidence intervals are more accurate when there is an obvious trend in the data.
- [ ] Confidence intervals assume that loss data is right-skewed.

Explanation:

Because confidence intervals show a range, the lowest value can be considered the optimistic scenario, while the highest value can be considered the pessimistic scenario. A 95th percentile confidence range is estimated by calculating two standard deviations above and below the mean. One challenge of confidence intervals is that they assume a normal data distribution, whereas loss data is more commonly right-skewed. Linear regression is more accurate when there is an obvious trend in the data. As such, when r2 is greater than or equal to .70, linear regression will likely yield a better result. For more information, see the topic, "Quantitative Tools in Forecasting," in Section 4 of the Learning Guide.

6. Which of the following statement(s) is/are FALSE regarding resources for obtaining loss development factors (LDFs)?

- [ ] LDFs can be generated from loss history data using a triangulation process.
- [ ] When calculating period-to-period development, tail factors represent all additional loss data beyond the last data available.
- [x] Period-to-period development is calculated by starting with the oldest period and then cross-multiplying forward to the most recent year of known data.
- [x] A RMIS system is required for calculating development factors.
- [ ] Payout triangles are used to show how much an organization paid by year.

Explanation:

Period-to-period development is calculated by starting with the most recent period and cross-multiplying backward to the oldest year of known data. Loss development factors can be obtained from external sources such as rating bureaus, actuarial consultants, insurance companies, agents, or brokers, etc. For more information, see the topic, "Resources for Obtaining Loss Development Factors," in Section 4 of the Learning Guide.

Section 5: Time Value of Money Concepts

Financial Decision-Making Concepts

Knowledge Check

When your oldest child starts kindergarten, you realize that you need to start planning for the expense of college. Currently, the tuition at your alma mater is $30,000 per year. When you were a student 20 years ago, the tuition was $4,000 per year. You know you must plan to have much more than $30,000 per year. You are worried that in 13 years, the tuition will be $50,000 per year or more.

1. In terms of the tuition dollars, what is the present value of the college tuition per year?

$30,000

2. What is your predicted future value of the college tuition?

$50,000 (or more)

3. If you plan on having a systematic plan to set aside an equal amount every year for college, what is the TVOM term for describing that savings plan?

Annuity

4. Your investment advisor has offered you a plan that would guarantee 4% interest for 13 years. What is the TVOM term for that guaranteed rate of interest?

i (discount rate)

Calculating Present and Future Values

Knowledge Check

The insurance carrier has promised to reduce the premium by $10,000 at the end of the third policy term. The CFO says the discount rate is 10%. How much is that future value worth today?

1. Determine the values to use in the calculation:

FV	$10,000
Discount rate (*i*)	10%
Number of periods (*n*)	3

2. Using the PV of $1 table, below, find the PV factor for the given discount rate (*i*) and number of periods (*n*).

   PV factor = 0.751

Present Value of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567
6	0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322

3. Find the PV:

   PV = FV x PV factor

   PV = 10,000 x 0.751

   PV = 7,510

Knowledge Check

The insurance carrier has indicated the premium will be reduced by $5,000 at the end of each of the next five policy terms. The CFO says the discount rate is 9%. How much is that premium reduction worth today?

1. Determine the values to use in the calculation:

PYMT	$5,000
Discount rate (*i*)	9%
Number of periods (*n*)	5

2. Using the Present Value of an Annuity of $1 table, below, find the PVA factor for the given discount rate (*i*) and number of periods (*n*).
   - PV of an annuity factor = 3.890

Present Value of an Annuity of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605

3. Find the PVA:

   PVA = PYMT x PVA factor

   PVA = $5,000 x 3.890

   PVA = $19,450

Knowledge Check

The insurance carrier has indicated the premium will be reduced by $2,000 at the end of the first year, $3,000 at the end of the second year, and $4,000 at the end of the third year. The CFO says the discount rate is 9%.

1. How much is that premium reduction worth today?

n = 1	2,000	x	0.917	=	$1,834
n = 2	3,000	x	0.842	=	$2,526
n = 3	4,000	x	0.772	=	$3,088
					$7,448

2. How would you calculate if all payments were equal?

Present Value of an Annuity of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605

As an annuity

Evaluating Capital Investment Projects

Knowledge Check

1. Calculate the ARR (accounting rate of return) and payback for the following projects:

Net Expected Cash Flows			
	Year	**Project A**	**Project B**
Investment Outflow	0	($100)	($200)
Cash Inflows	1	$10	$140
	2	$60	$100
	3	$80	$40

Sample Answer:

ARR:

Project A average annual cash flow = (10 + 60 + 80) ÷ 3 = 50

Project B average annual cash flow = (140 + 100 + 40) ÷ 3 = 93

Project A ARR = $50 ÷ $100 = 50% *(Accept)*

Project B ARR = $93 ÷ $200 = 46.5%

Payback:

Project A payback = two years plus $30 ÷ $80 = 2.4 years

Project B payback = one year plus $60 ÷ $100 = 1.6 years *(Accept)*

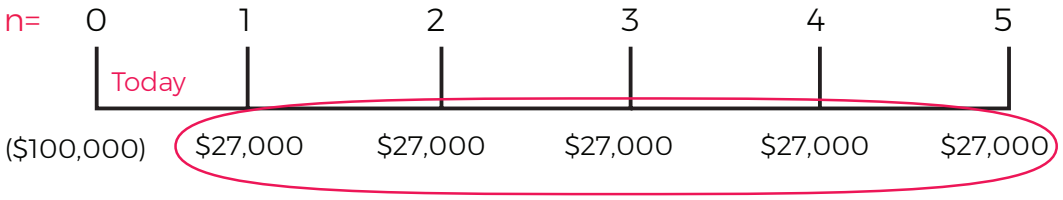
2. Does the type of calculation (ARR vs. payback) impact which project you would select? Explain how the tools used can impact financial decisions.

Sample Answer:

Based on the results from the ARR calculations, Project A should be selected. Based on the payback calculations, Project B should be selected. These tools use different measures of return on investment. ARR measures the average annual rate of return, while payback measures the speed with which the investment will be recouped. Thus, if a risk manager wanted the larger overall return on investment, she should select Project A. If she wanted the fastest return on investment, she should select project B.

Knowledge Check

You are the risk manager for a nonprofit organization that is tax exempt under IRC 503(c)(3). You are considering purchasing safety equipment at a cost of $100,000. Your insurance broker has obtained an estimate of premium savings from the underwriter for the next five years (assuming exposures and premiums remain the same) of $27,000 a year. The CFO says the organization's cost of capital is 10%.



1. Assume all premiums are paid at the end of the year. Should you purchase the equipment?

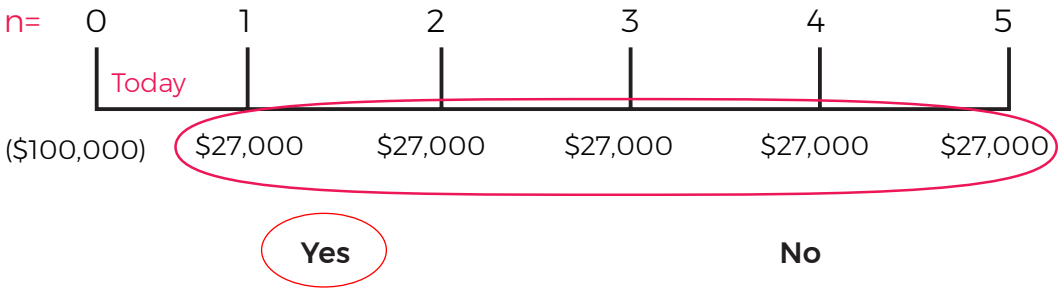
Yes **No**

n = 5

i = 10%

PV of payments 1-5: **($27K x 3.791)**	$ 102,357
Less cost	($ 100,000)
NPV	$ 2,357

2. Now assume all premiums are paid at the beginning of the year. Should you purchase the equipment?



n = 4

i = 10%

PV of first payment:	$ 27,000
PV of payments 2–5: **($27K x 3.170)**	$ 85,590
Total benefit (discounted)	$ 112,590
Less cost	($ 100,000)
NPV	$ 12,590

Section 5 Self-Quiz

Directions: Match the definition or description on the right with the term or phrase on the left.

A. Annuity **B.** Present value **C.** Future value **D.** Discount rate **E.** Payback **F.** Accounting rate of return **G.** Net present value **H.** Benefit/cost ratio **I.** Internal rate of return	**B** Calculated using the mathematical expression FV ÷ (1 + *i*%) *n* **G** Measurement of the PV of future cash inflows compared to the net investment of a project, using organization's discount rate as *i* **A** A stream of equal payments made over a specified period of time **E** Measurement of the length of time needed to recoup the cost of a capital investment (when flows break even with costs) **C** Created as a result of compounded interest earnings on the present value **H** Measurement of discounted values of inflows divided by the net investment using in comparing the NPV of various projects **I** Discount rate where PV of outflows equals the PV of inflows; NPV = $0 **F** The average annual cash flow divided by the initial investment **D** The organization's cost of capital; also known as WACC

Directions: Select the BEST answer choice for each question. Use the tables, if needed, to help you calculate your answers.

Present Value of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567

Present Value of an Annuity of $1												
*n**	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605

1. The insurance carrier has promised to reduce the premium by $10,000 at the end of the fifth policy term. The CFO says the discount rate is 9%. How much is that future value worth today?

- ☐ $3,890
- ☐ $3,791
- ☐ $6,210
- ☑ $6,500

Explanation:

Using the present value of $1 table, we find that

$\left\{\frac{1}{(1+i)^n}\right\}$ = 0.650. We multiply this by the future value ($10,000) to get $6,500.

For more information, see the topic, "Present Value of a Single Sum," in Section 5 of the Learning Guide.

2. The insurance carrier has indicated the premium will be reduced by $1,000 at the end of the first year, $3,000 at the end of the second year, and $5,000 at the end of the third year. The CFO says the discount rate is 8%. How much is that premium reduction worth today?

   - ☐ $7,146
   - ☑ $7,467
   - ☐ $19,160
   - ☐ $23,193

Explanation:

Use the present value of $1 table to calculate the present value of each discount, and then add together.

$1,000 x 0.926 =	$ 926
$3,000 x 0.857 =	$ 2,571
$5,000 x 0.794 =	$ 3,970
	$ 7,467

For more information, see the topic, "Present Value of a Single Sum," in Section 5 of the Learning Guide.

3. The insurance carrier has indicated the premium will be reduced by $6,000 at the end of each of the next three policy terms. The CFO says the discount rate is 10%. How much is that premium reduction worth today?

   - ☐ $3,726
   - ☐ $4,506
   - ☑ $14,922
   - ☐ $22,746

Explanation:

Using the Present Value of an Annuity of $1 table, we find a PVA factor of 2.487. We multiply by $6,000 to arrive at $14,922. For more information, see the topic, "Present Value of an Annuity of Equal Payments," in Section 5 of the Learning Guide.

Directions: For each project description below, indicate whether you should accept or reject the project.

1. Project A: BCR of 0.954.

Accept **Reject**

2. Project B: BCR of 1.38

Accept **Reject**

3. Project D: PV inflows= 897,321; PV Outflows= 543,210

Accept **Reject**

Explanation:

Projects A and B: BCR decision rule states to accept if BCR is >1. Project C: IRR decision rule states to accept the project if IRR is greater than or equal to the cost of capital. Project D: NPV decision rule states to accept of PV inflows exceed PV outflows. For more information, see the topic, "The Financial Decision Toolbox," in Section 5 of the Learning Guide.

Section 6: Risk Analysis Applications

Review of Analytical Techniques

Knowledge Check

XYZ Corporation is considering investing in a new third-party training program for its management staff. Though the cost of the program is significant, reviews indicate that it has helped similar organizations to reduce the frequency and severity of employment practices liability claims.

1. Explain how an NPV cost-benefit analysis might be used in this situation to determine whether this program is a good fit for XYZ Corp.

Sample Answer:

An NPV cost benefit analysis can be used to evaluate whether the expected inflows (i.e., revenue or reduction in cost) exceed the expected outflows (cost of the program). An NPV cost-benefit analysis uses present value calculations to account for the time value of money.

2. Name at least one potential inflow and one potential outflow that the risk manager should evaluate.

Sample Answer:

Inflows: Reduction in losses from employment practices liability claims

Outflows: Cost of the training program, cost of time spent in training

Calculating NPV Cost-Benefit Analysis for Equipment and Training Investment Decisions

Knowledge Check

Directions: For each step in the process, describe one example of how Mary carried out the step.

Sample Answer:

NPV

COST-BENEFIT ANALYSIS

1 STEP — Determine cash outflows	1. Mary determines that it will cost $300,000 to install lifts at all locations.
2 STEP — Determine cash inflows	2. Mary receives a projection of a 20% reduction in losses once the units are in place and staff are trained.
3 STEP — Calculate NPV and compare outflows and inflows	3. Mary calculates the NPV of insurance savings at discount rates of 12%, 15%, and 20%.
4 STEP — Calculate impact of taxes on outflows and inflows, including after-tax effect of depreciation	4. Mary calculates the after-tax effect of depreciation on insurance savings for the discount rates of 12%, 15%, and 20%.
5 STEP — Calculate PV of tax impact on cash outflows and inflows	5. Mary calculates the PV of tax impact on cash outflows and inflows at each of the three discount rates.
6 STEP — Determine after-tax NPV by comparing after-tax NPV of cash outflows and inflows	6. Mary compares inflows and outflows at each of the three discount rates. Only the discount rate of 12% will have a positive NPV after taxes.

Calculating NPV Cost-Benefit Analysis for Risk Financing Decisions

Knowledge Check

Directions: Answer the questions and complete the necessary calculations using the information provided.

Scenario 1: Incurred losses (valued as of 12/31/X5), including reserves for loss adjustment expenses, are as follows:

01/01/X3–12/31/X3	$67,000
01/01/X4–12/31/X4	$49,000
01/01/X5–12/31/X5	$41,000

Revenues have been stable. Frequency has been relatively consistent.

1. Are you satisfied that losses are improving? Explain.

Sample Answer:

The indexed ultimate total loss column shows that losses are improving.

2. Development factors (to ultimate total loss) are 1.2, 1.4, and 1.8 for three years. Compute developed losses, and enter your answers in the worksheet provided.

3. Adjust the losses for inflation (based on 5% annually) to reflect X6 dollars, and enter your answers in the worksheet provided.

Worksheet

Year	Loss $	x Dev	= Ultimate Total Loss $	x Index	= Indexed Ultimate Total Loss $
X3	67,000	1.2	80,400	1.158	93,103
X4	49,000	1.4	68,600	1.103	75,666
X5	41,000	1.8	73,800	1.050	77,490
X6				1.0	

Knowledge Check (continued)

Scenario 2: Total projected losses for next year are $82,000, assuming operations are the same as in the past.

You believe you can install various safety measures, e.g., new machine guards, strips on floors for traction, and new ergonomic computer tables, which will significantly reduce losses.

The cost of these measures is $50,000 (assume this is paid immediately). Assume losses less than $1,000 per occurrence will be reduced to $10,000 annually for each of the next three years, which is much lower than in the past.

As a result, consider a $1,000 deductible program. Presume the deductible losses are remitted to the carrier after an average of one year's use of funds (assume 100% losses paid in each policy year).

The insurance program will change as follows, assuming loss improvement occurs as expected. Over time, less frequency should also result in less severity.

X6	Deductible credit of $15,000
X7	Deductible credit of $15,000 and experience credit of $15,000
X8	Deductible credit of $15,000 and experience credit of $20,000

1. Calculate the combined results of both introducing loss control measures and accepting a deductible. Assume a 10% cost of capital (discount rate).

Inflows:	$	Discount Factor	PV $ of Inflows
X6 (current)	15,000	1.000	15,000
X7	30,000	0.909	27,270
X8	35,000	0.826	28,910
Total			71,180

Outflows:	$	Discount Factor	PV $ of Outflows
X6 (current)	50,000	1.000	(50,000)
X7	10,000	0.909	(9,090)
X8	10,000	0.826	(8,260)
X9	0	0.751	(7,510)
Total			(74,860)

NPV (3.680)

Knowledge Check (continued)

Scenario 3: DCRI's automobile liability program is renewing in several months. The current fleet of 206 vehicles consists of private passenger autos (100), limousines (52), vans (30), and SUVs (24).

The following data is from premium audits and loss reports:

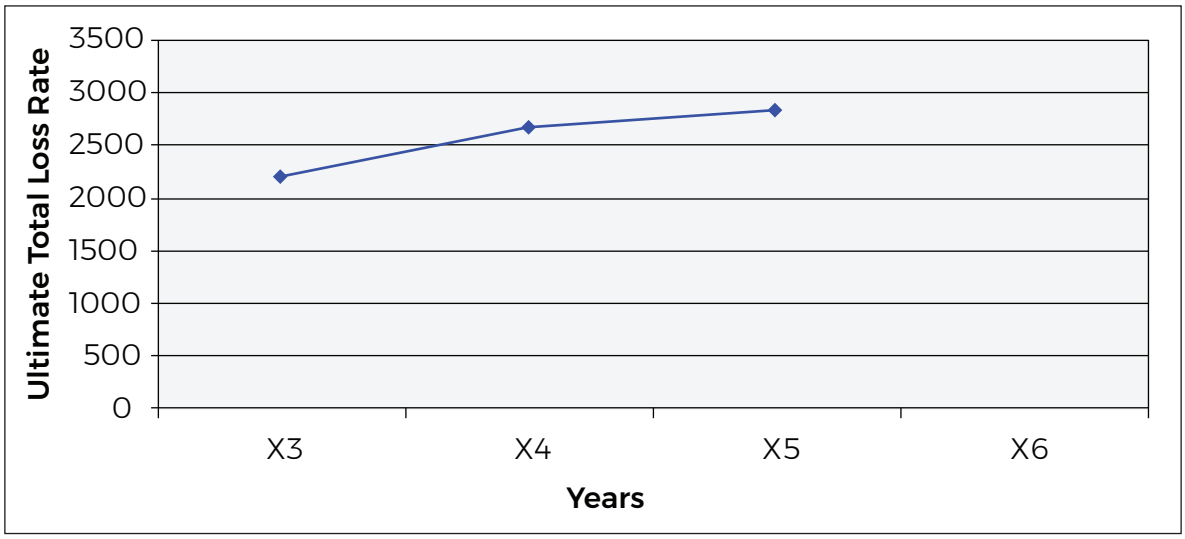
Year	# of Units	Total Incurred Liability Losses ($)	# of Losses
X3	140	250,000	13
X4	145	277,000	15
X5	163	224,000	20
X6	206		

Mary, the risk manager, calls Lucas Pacioli, the actuary with whom she has a business relationship, and Lucas gives her the loss development factors of 1.1, 1.3, and 2.0 for severity and an index (inflation) factor of 4% each year.

1. How should Mary develop the indexed ultimate total loss rate projected for year X6—the coming year?

Year	Freq	Total Incurred	Dev. Factor	Ultimate Total Loss $	Inflation Index Factor	Indexed Ultimate Total Loss $	Exposure Units	Indexed Ultimate Total Loss Rate
X3	13	250,000	1.1	275,000	1.125	309,375	140	2,210
X4	15	277,000	1.3	360,100	1.082	389,628	145	2,687
X5	20	224,000	2.0	448,000	1.040	465,920	163	2,858
X6							206	

2. How would Mary develop indexed ultimate total losses projected for year X6?



Sample Answer:

The projected indexed ultimate total loss rate for X6 is approximated (eyeballed) at $3,200 per vehicle. Therefore, projected total incurred losses are 3,200 x 206 = $659,200.

Knowledge Check (continued)

Scenario 4: Mary has received two renewal quotes.

Year	Indexed Ultimate Total Loss $	Exposure (Payroll $)	Indexed Ultimate Total Loss Rate (f / g)
	(f)	(g)	(h)
X1	221,987	12,350,000	0.0180
X2	819,568	13,910,000	0.0589
X3	706,034	15,204,000	0.0464
X4	574,007	17,112,000	0.0335
X5	1,004,079	18,080,000	0.0555
(Projection) X6	837,556	19,707,200	0.0425

Quote 1 is for a fully insured (guaranteed cost) plan. The premium is $950,000, payable the first of the month in 12 equal installments.

Quote 2 is for a deductible plan having a $25,000 deductible per loss with no aggregate. The underwriter believes of the $837,556 of total losses expected in X6, that $217,500 will fall within the deductible range. The premium for this deductible plan is $625,000 and is to be paid in 12 equal installments. The projected payout of losses within the deductible is as follows:

0–12 mos.	12–24 mos.	24–36 mos.	36–48 mos.	48–60 mos.
$52,200	$58,725	$19,575	$63,075	$23,925

Mary makes the assumption that the payout is made at year-end of each year.

Sarah, the CFO, advised Mary that the discount rate she should use is 12%.

Tips:

- Consider using the PV of an annuity when calculating the discounted payment streams.
- Assume the annual 12% discount rate will translate to a monthly discount rate of 1%.

1. Which quote should Mary accept and why?

Worksheet for Quote #1

Premium first month	$950,000	÷	12	=	$79,167	(not discounted)
11 following months	$79,167	x	10.368	=	$820,803	(PV of Annuity, i = 1%, n = 11)
Total discounted payments					$899,970	

☐ Fully Insured Plan (Quote 1)

Worksheet for Quote #2

Premium first month	$ 625,000	x	12	=	$ 52,083	(not discounted)
11 following months	$ 52,083	x	10.368	=	$ 539,997	(PV of Annuity, i = 1%, n = 11)
Total discounted payments					**$592,080**	
Losses (assuming payout made at year end)						
Paid 0–12 months	$ 52,200	x	0.893	=	$ 46,615	(PV, i = 12%, n = 1)
Paid 12–24 months	$ 58,725	x	0.797	=	$ 46,804	(PV, i = 12%, n = 2)
Paid 24–36 months	$ 19,575	x	0.712	=	$ 13,937	(PV, i = 12%, n = 3)
Paid 36–48 months	$ 63,075	x	0.636	=	$ 40,116	(PV, i = 12%, n = 4)
Paid 48–60 months	$ 23,925	x	0.567	=	$ 13,565	(PV, i = 12%, n = 5)
Total discounted paid losses					$ 161,037	
Total					$ 753,117	

☑ Deductible Plan (Quote 2):

Sample Answer:

Mary should accept Quote 2—the deductible plan—because it is less expensive than the fully insured (guaranteed cost) plan.

Issues Related to Quantitative and Qualitative Analyses

Knowledge Check

Mary is planning to conduct a full-scale quantitative and qualitative analysis to determine how her company should finance the risk created by offering delivery service withing a 30-mile geographic radius. The cost of the service would be based on distance, weight of the merchandise, and the purchase price.

1. Name three potential issues Mary should keep in mind with respect to data, and explain how they might impact her analysis.

Sample Answers:

Answers will vary, but factors may include:

- Data used in making cost projections may be flawed, affecting the amount to be financed.
- Projections of miles driven on an annual basis may not be correct; an increase in demand for delivery services could require the hiring of additional drivers or purchase of additional vehicles.
- The fuel efficiency of the vehicles is not guaranteed by the manufacturer, so her costs for fuel may be greater than projected, even if prices remain unchanged.
- Customer payment practices can impact overall cashflow.
- Inaccurate, incomplete, or insufficient data may skew calculated loss projections.
- The data analysis may suffer issues related to credibility.
- Choices of discount rate and flow assumptions are critical to cash discounting calculations.
- There are many variables that can impact financial transfer and retention modeling, and analysis results may vary depending on who completes the analysis.
- Qualitative considerations can sometimes outweigh quantitative results.

Section 6 Self-Quiz

Directions: List the steps of conducting an NPV cost-benefit analysis when investing in equipment or training.

Sample Answer:

1. Determine cash outflows.
2. Determine cash inflows.
3. Calculate NPV and compare outflows and inflows.
4. Calculate PV of tax impact on cash outflows and inflows, including after-tax effect of depreciation.
5. Calculate PV of tax impact on outflows and inflows.
6. Determine after-tax NPV by comparing after-tax NPV of cash outflows and inflows.

Directions: Use the word bank to fill-in-the blanks. Terms will be used only once, and not all terms will be used.

capping	**NPV**	**cost-benefit analysis**	**forecast**
after-tax	**inflation**	**loss rates**	**confidence intervals**
industry	**regression**	**payout pattern**	**triangulation**

Steps in the process when selecting risk financing options:

1. Develop losses through triangulation using the organization's own data, as well as using industry factors.

2. Forecast losses using the following methods:

3. Trend losses (index for inflation).

4. Develop loss rates using exposures.

5. Forecast losses, using average loss rates or regression.

6. Consider using ranges based on confidence intervals or high-low estimates.

7. Consider capping losses.

8. Determine the payout pattern of projected losses using the organization's own data as well as industry factors.

9. Calculate and compare the NPV of each option.

Appendix

Preparing for the Final Exam

For many learners, test preparation is stressful. Please keep in mind that the most important measure of your knowledge will be witnessed in your service to your organization. Think of a test as a tool. Use it to come to an understanding of what you know, how it affects your work, and what more you would like to know to have even greater success in the workplace.

The testing period for the Final Exam is 2 ½ hours long. The test itself is composed of 17–21 short-answer questions for a total of 200 possible points. Questions appear in the order of presentation of the topics.

Remain aware of the time as you take the test. Pace yourself and be aware that unanswered questions are considered incorrect.

Study Techniques

There are some techniques you can use to help you prepare for the end-of-course test. Apply the same techniques to each chapter in your learning guide.

1. Review the Section Goal.

2. Review each Learning Objective.

3. Change each header and subhead into a question. Then answer the question. For example,

   Header: Components of a Formal Training Plan

   Question: What are the components of a formal training plan?

4. Review each diagram, graph, and table. Interpret what you see. Ask yourself how it relates to a specific Learning Objective.

5. Check your answers to each Check-In. Correct your original answers, if necessary.

6. Check your answers to each Knowledge Check. Consider ways to improve your original answers.

7. Re-read the summary at the end of each section.

8. Check your answers to each question in the Self-Quizzes at the end of each section. Correct your original answers, if necessary.

9. Review any comments, highlights, or notes you made in each section.

10. Rewrite important ideas in your own words. Find ways to connect those ideas to your own work experiences.

11. Make flash cards to help you review important vocabulary.

Sample Test Questions

1. Freddy Temple, the risk manager of a growing restaurant chain, has heard that a competitor just changed insurance brokers. Freddy wishes to look into selecting a different broker, but the current account executive is the nephew of a Board member. Provide three reasons Freddy might give to the CEO to justify selecting another broker.

Sample Answers:

1) It gives the appearance of a conflict of interest - nepotism
2) There is a potential for confidential information to be shared/divulged
3) The broker may have little incentive to recommend the most cost effective policy as it might affect his commission

2. Your CEO is interested in how an effective risk management program can have a positive impact on the organization. Please explain four positive impacts of an effective risk management program.

Sample Answers (any four):

a. It raises awareness of the importance of risk management and promotes understanding and acceptance of risk management policies and procedures throughout the organization
b. It supports managerial objectives:
   - Improves planning and budgeting
   - Reduces frequency and severity of incidents, accidents, losses and claims
   - Projects future losses
   - Increases awareness of indirect losses
c. It improves morale and productivity among the work force.
d. It improves quality, processes, and technology.
e. It increases profitability (reduced costs or increased revenues):
   - Reduces claims management and legal costs
   - Optimizes cost of risk
   - Protects cash flow, assets and financial statements
f. It protects the organization's reputation and brand.

3. Ben Volio, the risk manager of Verona Markets, has accumulated a number of years of loss data related to his workers compensation exposures. He plans to use measures of statistical central tendency to determine the likely number of workers compensation losses the organization will face in the typical year.

   A. Identify and briefly describe two measures of statistical central tendency (based on normal distributions) that Ben should use.

Sample Answers (any two):

- Mean average, or arithmetic mean, or sum of all values divided by the number of observations (any of the underlined terms)
- Median 50th percentile or half the values lie below and half the values lie above or middle value (any of the underlined terms)
- Mode observation occurring most often or observation occurring most frequently (any of the underlined terms)

   B. Using the following values, calculate the two measures of statistical central tendency you listed above. Give the name of the measure of statistical central tendency and show your calculations.

Values: 1 4 2 1 1 7 5 3

Sample Answers (any two):

- Mean: Sum = 24, 24 ÷ 8 = 3
- Median: 1, 1, 1, 2, 3, 4, 5, 7 = 2.5
- Mode: 1, 1, 1, 2, 3, 4, 5, 7 = 1

Glossary of Terms

accounting rate of return (ARR) measurement of the percentage return of average annual cash flows on initial investment; the ARR is the average annual cash flow divided by the initial investment

annuity a stream of periodic payments made over a specified period of time

benefit/cost ratio (BCR) measurement of discounted values of inflows divided by the net investment using in comparing the NPV of various projects

catastrophe modeling a computerized system that generates a very large set of simulated events to estimate the likelihood, magnitude or intensity, location, degree of damage, and ultimately, insured and uninsured losses arising from a catastrophe event such as a hurricane, earthquake, tornado, flood, wildfire, winter storm, terrorism, war, pandemics, or cyberattack

causality the relationship between one variable and another variable in which the second variable is a direct consequence of the first. However, correlation between two variables does not necessarily imply causality

coefficient of determination r^2 is a descriptive measure of the strength of the regression relationship or how well the regression line fits the data; it measures the percentage of the variation in the dependent variable explained by the regression

correlation measure of the strength of a linear relationship between two variables

delphi method a series of surveys/questionnaires used to form a consensus opinion on the anticipated impact of a risk

discount rate the organization's cost of capital; also known as the hurdle rate, the weighted average cost of capital or WACC, or the required rate of return

Empirical Rule states that nearly all values will lie within three standard deviations of the mean in a normal distribution

financial capacity the organization's ability to fund projects, activities, etc.

future value (FV) or compound value tomorrow's value of today's cash flow

heat mapping a visual representation of complex sets that uses colors to concisely indicate patterns or groupings, thus making the data more actionable

histograms a graphical representation of the distribution of data that is used to illustrate the spread of numerical data

Ishikawa diagram (fishbone diagram) a systematic method used to determine underlying and contributing causes of losses

Law of Large Numbers in statistics, as the sample size increases, the average of the sample gets closer to the average of the whole population

left skew negative skew

linear regression a statistical technique of modeling the relationship between variables by fitting the "best" line to a scatter of dots

loss development the process by which data is adjusted to account for lag time to settle claims, recognize Incurred But Not Reported Losses (IBNR) and index for inflation

loss development factor used to adjust (multiply) known claims to determine the anticipated value for claims over a specific time period

mean the sum of all observations divided by the number of observations (also known as the average or arithmetic mean)

median the midpoint of the observations ranked in order of value; half the observations lie below and half above the middle value (also known as the 50th percentile); if an even number of observations, the median is the average of the middle two

mode the observation that occurs most often in the sample; the highest frequency. There may be none, one or more than one mode. The population mode is the observation that has the highest probability of occurring.

outlier an extreme value that is much higher or lower than the other values in the data set

net present value (NPV) a measurement of the PV of future cash inflows compared to the net investment of a project, using organization's discount rate as *i*

payback a measurement of the length of time needed to recoup the cost of a capital investment

population the entire group of observations

predictive analytics use of statistical techniques ranging from data mining and modeling through analyzing current and historical facts and transactions to make predictions of future unknown events

present value (PV) today's value of a tomorrow's cash flow

present value factor (PV Factor) predetermined factor that can be used to simplify present value calculations

present value of an annuity factor (PVA Factor) predetermined factor that can be used to simplify present value of annuities calculations

qualitative analysis the analysis of loss exposures that cannot be measured precisely, including non-monetary considerations such as the organization's reputation and brand image

quantitative analysis the use of widely accepted statistical methods to calculate numerical values for risks and loss exposures

range the difference between the largest and smallest values

right skew positive skew

risk analysis the assessment of the potential impact of various exposures on an organization; it is an essential part of the risk management process

risk mapping a visual analytical tool from which all risks of an organization can be identified, and their potential impact can be understood

risk modeling the use of relevant historical data and past behaviors to find correlations and extrapolate data to predict future losses based on assumptions as determined by experts

risk register another risk analysis method that prioritizes risks based on a scale of anticipated potential impact

root cause analysis a systematic method to drill down to the root cause of an incident

sample a subset of a larger group having the same characteristics of the group

skewness the measure of the degree of asymmetry or distortion from a symmetrical bell curve of a frequency distribution

standard deviation of a population of losses the amount of variation or dispersion in a set of data values

time value of money (TVOM) the value of money over a given amount of time considering a given amount of interest

triangulation a study of the historical changes over time in frequency, severity, and payout patterns