Understanding Financial Management: A Practical Guide
Problems and Answers

Chapter 9
Risk Analysis

9.1 Types of Risk in Capital Budgeting

1. Schweser Inc. is evaluating a new project. Based on experience, industry data, and economic indicators, a financial manager has estimated the project's possible returns and associated probabilities as follows:

Return ($)	-10,000,000	0	5,000,000	12,000,000	25,000,000
Probability (%)	10	20	40	20	10

   A. What is the expected return of the project?
   B. What is the standard deviation of the return?
   C. What is the coefficient of variation?

2. An analyst at Sinergo Inc. was asked to evaluate three project proposals. Based on symmetrical return distributions for each project, the analysts calculated the following expected values and standard deviations.

Project	**A**	**B**	**C**
Expected value	$2,000,000	$500,000	$850,000
Standard deviation	720,111	462,106	603,462

   A. Which of these projects has the lowest absolute or total risk?
   B. Which of these projects has the lowest relative risk?

9.2 Assessing Single-Project Risk

3. Primus Corporation operates in a fast-growing market. Management is considering buying new equipment, which would increase the firm's operational capacity and efficiency. The new equipment is expected to increase the firm's annual operating revenues by $1,200,000, while increasing annual operating costs, excluding depreciation, by $600,000 for each of the next six years. Net working capital is expected to increase by $50,000 in year 0 and to be recovered at the end of year 6. The depreciable basis of the new equipment is $1,500,000. The new equipment belongs in the 5-year MACRS property class and has an expected salvage value of $100,000 at the end of year 6. The firm's marginal tax rate is 40%. Management is uncertain about its cost of capital for this normal-risk expansion project. Although the most likely estimate is 15.0%, management believes the firm's cost of capital could be as low as 13.5% or as high as 16.5%. What effect do

these assumptions involving the cost of capital have on the NPV and the decision involving the purchase of the new equipment?

4. An analyst at Orbit Company identified four key input variables to a project and developed the following NPVs.

Change from Most Likely Value	Net Present Value			
	Operating Revenues	**Operating Costs**	**Discount Rate**	**Salvage Value**
-10%	$142,442	$192,595	$185,819	$159,452
Most Likely	165,000	165,000	165,000	165,000
10%	188,274	138,689	144,266	170,235

A. What is the NPV percentage change from the most likely scenario for each input variable?
B. For what input variable is the NPV most sensitive to changes?

5. Gymtech Corporation is evaluating a new product line. Over its 5-year life, company analysts expect that the project will generate annual operating revenues of $12 million with operating cost at 40% of revenues. Analysts call this the base-case scenario. Under the best-case scenario, there is a 20% chance that the new product will have higher sales than expected, generating $20 million in annual operating revenues. Under the worst-case scenario, analysts estimate a 30% probability that the new product will generate annual revenues of $2 million, despite an increase in marketing expenses, driving operating costs to 50% of operating revenues. Gymtech would buy $5 million in new machinery for the project and fully depreciate the machinery over its 5-year life using straight-line depreciation. Analysts expect the machinery to have a zero salvage value at the end of its 5-year life. Gymtech's cost of capital is 12% and its marginal tax rate is 40%.

A. What is the NPV of the project under each scenario?
B. What is the expected NPV of the project?

6. Riddick Inc. plans to introduce a new product. The company has estimated the project's cash flows under three scenarios:

Scenario	Pessimistic	Most Likely	Optimistic
Probability	20%	60%	20%
Project life	4 years	4 years	4 years
Initial investment	$550,000	$500,000	$450,000
Salvage value	$0	100,000	$150,000
Annual operating revenues	$200,000	420,000	$600,000
Annual operating costs	$150,000	200,000	$280,000

Riddick uses straight-line depreciation and assumes that the estimated and actual salvage value is the same. The firm's cost of capital is 12% and its marginal tax rate is 36%.

A. What is the NPV of the project under each scenario?
B. What is the expected NPV of the project?
C. What is the standard deviation of the project's NPV and its coefficient of variation?

7. A manager calculated a project's initial investment and year-end cash flows under three different scenarios. The probability that the pessimistic and optimistic scenario will occur are 30% and 20%, respectively. The company's cost of capital is 12%.

Scenario	Expected Year-End Cash Flows						
	0	**1**	**2**	**3**	**4**	**5**	**6***
Pessimistic	-$1,150,000	$220,000	$270,000	$300,000	$305,000	$200,000	$390,000
Most Likely	-1,150,000	250,000	310,000	320,000	330,000	220,000	450,000
Optimistic	-1,150,000	285,000	334,000	344,000	350,000	270,000	480,000
* Year 6 includes both operating and terminal cash flows.							

A. What is the project's NPV under each scenario?
B. What is the project's expected NPV?
C. What is the standard deviation of the project's NPV?
D. What is the project's coefficient of variation? If firm's CV_{NPV} for average risk projects is between 0.5 and 0.7, what is the project's riskiness (below average, average, above average)?

9.3 Assessing Market Risk

8. Private Investments Corporation (PIC), an all equity firm, is considering investing in two independent projects using pure-play betas. Project X is a replacement project and has a beta of 1.25. Project Y is a new product investment and has higher beta of 1.80 because of its higher risk. The current rate on U.S. Treasury bills is 4% and the expected rate of return on the market is 8%.

A. Using the CAPM, what are the required rates of return for Projects X and Y?
B. If PIC has a debt-to-equity ratio of 0.25 and a marginal tax rate of 40%, what are the unlevered betas for Projects X and Y?

9. The financial manager at Calvert Inc. decided to use the CAPM to determine the discount rate for evaluating a new project. The beta of the new project is 1.8 and the expected risk-free rate is 6%. Analysts differ in their forecasts of the expected return on the market, predicting 12%, 13%, and 15%. What is the project's required rate of return for each of the market return forecasts?

10. Tomkin Industries plan to establish a new division in the aluminum recycling business. Alumix, the only publicly-traded company in this business, has beta of 0.75 and debt-equity ratio of 0.35. The firm's marginal tax rate is 36%. The expected risk-free rate and market return are 6% and 14%, respectively. What discount rate should Tomkin use to evaluate this project?

11. First Western Corporation plans to expand its operations into a new line of business. The financial manager at First Western has identified three publicly-traded companies (South Company, West Company, and East Company) in similar lines of business as the new project. The table below summarizes their betas, debt-equity ratios, tax rates, and the weights assigned to them based on their degree of similarity to the proposed project. Using the pure-play method, what is the approximate unlevered beta of the new project?

Company	Beta	Debt-equity Ratio (%)	Marginal Ta Rate (%)	Weight (%)
South	1.8	20	34	50
West	2.5	40	36	30
East	2.2	60	40	20

12. Investment Capital Holdings (ICH) identified three companies (OptionDeals, ClickStocks, and TradeWorld) in the online trading business as potential acquisition targets. The appropriate risk-free rate is 5.5%. Analysts expect a market rate of return of 9%.

Company	OptionDeals	ClickStocks	TradeWorld
Beta	2.8	2.1	1.9
Expected return (%)	18.0	13.0	11.0

A. What is the required rate of return for each investment?
B. Which investments, if any, should IFC accept?

9.4 Adjusting for Risk

13. Seabrook Company, an all equity firm, is evaluating whether to invest in a project that is riskier than its average projects. The firm will factor in a risk premium of 2 percentage points above its cost of equity. The risk-free rate on U.S. T-bills is 5%, the market risk premium is 6%, and the firm's beta is 1.8. The estimated net cash flows for the project follow.

Expected Year-End Cash Flows					
0	**1**	**2**	**3**	**4**	**5**
-$440,000	$150,000	$110,000	$140,000	$160,000	$130,000

A. Using the CAPM method without adjusting for risk, should the firm accept the project?
B. Using the RADR method, should the firm accept the project?

14. When conducting NPV analysis, Saadi Corporation uses the risk-adjusted discount rate (RADR) method. The firm adds 2 percentage points to its cost of capital to adjust for high risk projects and subtracts 2 percentage points from its cost of capital to adjust for low risk projects. Which of the following independent projects, if any, should the firm accept if its cost of capital is 14%?

	Project A	Project B	Project C
Risk	Average	High	Low
Life of the project	8 years	3 years	5 years
Initial investment	$1,000,000	$500,000	$100,000
Annual cash flows	$250,000	$200,000	$40,000

15. TSL Company had to discontinue production of one of its products because of environmental concerns. To make use of the vacated facility, TSL plans to introduce a new product, which it has recently developed at a cost of $200,000. TSL could use either of two methods to produce the new product. Method A would require an initial investment of $1,250,000 and would generate expected annual cash flows of $400,000. Method B would require an initial investment of only $300,000, but its high operating costs would result in annual cash flows of only $130,000. TSL expects the new product to be marketable for five years. TSL's management believes this project has above average risk and decides to add 5 percentage points to the firm's cost of capital of 11% to compensate for the greater risk. Should TSL produce the new product and, if so, which method it should use?

16. The financial manager at Stella Inc. needs to identify an appropriate risk-adjusted discount rate for a new project. The risk-free rate is 6% and investors require an 8% risk premium as compensation for investing in the firm. Stella's beta is 1.2 and the new project's beta is 1.8. What is the appropriate risk-adjusted discount rate for the new project?

17. Lexon Corporation is evaluating an investment opportunity with the following characteristics:

Year	**0**	**1**	**2**	**3**
Cash flow	-$600,000	$150,000	$300,000	$400,000
Certainty equivalent factor	1.00	0.95	0.85	0.75

Should Lexon adopt this project if the risk-free rate is 5.3 percent?

18. A firm is considering two independent projects of different risks: a less risky replacement project and a more risky new project. The risk-free rate is 4%.

A. Using the certainty equivalent approach, what is the NPV of each project?
B. What is the accept/reject decision for each project?

Expected Year-End Cash Flows (CFs) and Certainty Equivalent Factors (CEFs)						
Project	0	1	2	3	4	5
Expansion CF	-$700,000	$200,000	$220,000	$180,000	$190,000	$200,000
Expansion CEF	1.00	0.98	0.96	0.94	0.92	0.90
New product CF	-$380,000	$80,000	$90,000	$120,000	$120,000	$100,000
New product CEF	1.03	0.95	0.90	0.85	0.80	0.75

19. Bridgewood Inc. is considering a project that requires initial investment of $1,000,000 and is expected to generate $300,000 in annual cash flows for five years. The project is more risky than the firm's average projects. The expected risk-free rate is 5% and the expected market risk premium is 8%. The firm adds 3 percentage points to its cost of capital when evaluating projects of above-average risk. Analysts estimate the certainty equivalent factors as follows: Year 1 = 0.90, Year 2 = 0.80, Year 3 = 0.70, Year 4 = 0.60, and Year 5 = 0.50.

A. What is the NPV_{RADR}?
B. What is the NPV_{CE}?
C. Should Bridgewood accept the project?

Answers

1A. The expected return of the project, which is the weighted average of the possible returns, is calculated in millions as:

$$E(X) = \sum_{i=1}^{n} p_i X_i = (0.10)(-\$10) + (0.20)(\$0) + (0.40)(\$5) + (0.20)(\$12) + (0.10)(\$25)$$

$$= -\$1 + \$0 + \$2 + \$2.4 + \$2.5 = \$5.9 \text{ million}$$

1B. The standard deviation of the expected return is calculated in millions as:

$$\sigma = \sqrt{\sum_{i=1}^{n} p_i [X_i - E(X)]^2}$$

$$= \sqrt{0.10(-\$10.0 - \$5.9)^2 + 0.20(\$0) + 0.40(\$5.0 - 5.9)^2 + 0.20(\$12.0 - \$5.9)^2 + 0.10(\$25.0 - 5.9)^2}$$

$$= \sqrt{25.281 + \$0 + \$0.324 + \$7.442 + \$36.481} = \sqrt{\$69.528} = \$8.338 \text{ million}$$

1C. The coefficient of variation is calculated in millions as:

$$CV = \frac{\sigma}{E(X)} = \frac{\$8.339}{\$5.900} = 1.413$$

2A. Standard deviation is a measure of absolute or total risk. Thus, Project B has the lowest absolute risk because it has the lowest standard deviation.

2B. Coefficient of variation is a measure of relative risk. $CV = \frac{\sigma}{E(X)}$

Project A: \$720,111/\$2,000,000 = 0.360
Project B: \$462,106/\$500,000 = 0.924
Project C: \$603,462/\$850,000 = 0.710

Project A has the lowest relative risk, which means that it exposes the company to the lowest risk per unit of return.

3. The incremental cash flows of the new equipment are as follows:

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Investment in:							
Equipment	(1,500,000)						
Net working capital (NWC)	(50,000)						
Operating revenues		1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
- Operating costs		600,000	600,000	600,000	600,000	600,000	600,000
- Depreciation*		300,000	480,000	288,000	172,800	172,800	86,400
Taxable income		300,000	120,000	312,000	427,200	427,200	513,600
- Taxes (40%)		120,000	48,000	124,800	170,880	170,880	205,440
Net income		180,000	72,000	187,200	256,320	256,320	308,160
+ Depreciation		300,000	480,000	288,000	172,800	172,800	86,400
Operating cash flows		480,000	552,000	475,200	429,120	429,120	394,560
Salvage value							100,000
Tax on salvage value (40%)							(40,000)
Recovery of NWC							50,000
Net cash flows	(1,550,000)	480,000	552,000	475,200	429,120	429,120	504,560

*Depreciation rates (rounded) using MACRS for 5-year property are: Year 1 = 20.00%, Year 2 = 32.00%, Year 3 = 19.20%, Year 4 = 11.52%, Year 5 = 11.52%, and Year 6 = 5.76%.

Given these incremental cash flows the NPV is $348,826.32 at a cost of capital of 13.5%, $274,068.77 at 15.0%, and $204,003.04 at 16.5%. For each cost of capital, the decision should be to invest in the new equipment because the NPV is positive. If the cost of capital exceeds the project's IRR of 21.49%, management should reject the project because its NPV becomes negative.

4A. The following table shows the NPV percentage change from the most likely scenario for each input variable:

Net Present Value % Change				
Change from Most Likely Value	**Change in NPV (%)**			
	Operating Revenues	**Operating Costs**	**Discount Rate**	**Salvage Value**
-10%	-13.67	16.72	12.62	-3.36
Most Likely	--	--	--	--
10%	14.11	-15.95	-12.57	3.17

4B. The NPV is most sensitive to changes in the operating costs variable because the range of the percentage changes 32.67%, from -15.95% to 15.72%, is the greatest of the four variables.

5A. The following table shows the cash flows for each scenario.

Scenario Analysis	**Base-case**	**Best-case**	**Worst-case**
Year 0:			
Initial cash outflow	$5,000,000	$5,000,000	$5,000,000
Years 1 – 5:			
Operating revenues	12,000,000	20,000,000	2,000,000
- Operating cost	4,800,000	8,000,000	1,000,000
- Depreciation	1,000,000	1,000,000	1,000,000
Taxable income	6,200,000	11,000,000	0
- Taxes (40%)	2,480,000	4,400,000	0
Net income	3,720,000	6,600,000	0
+ Depreciation	1,000,000	1,000,000	1,000,000
Cash flows	4,720,000	7,600,000	1,000,000

The NPV of the project under each scenario is:

Base-case: $NPV = \sum_{t=1}^{5} \frac{\$4,720,000}{(1.12)^t} - \$5,000,000 = \$12,014,544$

Best-case: $NPV = \sum_{t=1}^{n} \frac{\$7,600,000}{(1.12)^t} - \$5,000,000 = \$22,396,299$

Worst-case: $NPV = \sum_{t=1}^{5} \frac{\$1,000,000}{(1.12)^t} - \$5,000,000 = -\$1,395,224$

5B. The expected NPV of the project is:

($12,014,544)(0.5) + ($22,396,299)(0.2) + (-$1,395,224)(0.3)
= $6,007,272 + $4,479,260 - $418,567 = $10,067,965

6A. The NPV of the project under each scenario is:

Pessimistic scenario

Year	**0**	**1**	**2**	**3**	**4**
Initial Investment	-$550,000				
Operating revenues		$200,000	$200,000	$200,000	$200,000
- Operating costs		150,000	150,000	150,000	150,000
- Depreciation		137,500	137,500	137,500	137,500
Taxable Income		-87,500	-87,500	-87,500	-87,500
+ Tax refund (36%)		31,500	31,500	31,500	31,500
Net Income		-56,000	-56,000	-56,000	-56,000
+ Depreciation		137,500	137,500	137,500	137,500
+ Salvage value					0
Net cash flows	-550,000	81,500	81,500	81,500	81,500
PV of net cash flows	-550,000	72,768	64,971	58,010	51,795
NPV	-$302,456				

Most likely scenario

Year	0	1	2	3	4
Initial investment	-$500,000				
Operating revenues		$420,000	$420,000	420,000	$420,000
- Operating costs		200,000	200,000	200,000	200,000
- Depreciation		100,000	100,000	100,000	100,000
Taxable income		120,000	120,000	120,000	120,000
- Taxes (36%)		43,200	43,200	43,200	43,200
Net income		76,800	76,800	76,800	76,800
+ Depreciation		100,000	100,000	100,000	100,000
+ Salvage value					100,000
Net cash flows	-500,000	176,800	176,800	176,800	276,800
PV of net cash flows	-500,000	157,857	140,944	125,843	175,911
NPV	$100,555				

Optimistic scenario

Year	0	1	2	3	4
Initial investment	-$450,000				
Operating revenues		$600,000	$600,000	$600,000	$600,000
- Operating costs		280,000	280,000	280,000	280,000
- Depreciation		75,000	75,000	75,000	75,000
Taxable income		245,000	245,000	245,000	245,000
- Taxes (36%)		88,200	88,200	88,200	88,200
Net income		156,800	156,800	156,800	156,800
+ Depreciation		75,000	75,000	75,000	75,000
+ Salvage value					150,000
Net cash flows	-450,000	231,800	231,800	231,800	381,800
PV of net cash flows	-450,000	206,964	184,790	164,991	242,641
NPV	$349,385				

6B. The project's expected NPV is:

$$EV = \sum_{i=1}^{n} p_i X_i = 0.2(-\$302{,}456)) + 0.6(\$100{,}555) + 0.2(\$349{,}385)$$

$$= -\$60{,}491 + \$60{,}333 + 69{,}877 = \$69{,}719$$

6C. The project's standard deviation is:

$$\sigma = \sqrt{\sum_{i=1}^{n} p_i [X_i - E(X)]^2}$$

$$= \sqrt{0.2(-\$302{,}456 - \$69{,}719)^2 + 0.6(\$100{,}555 - \$69{,}719)^2 + 0.2(\$349{,}385 - \$69{,}719)^2}$$

$$= \$209{,}561$$

The project's coefficient of variation is: $CV = \frac{\sigma}{E(X)} = \frac{\$209{,}561}{\$69{,}719} = 3.01$

7A. The NPVs under the pessimistic, most likely, and optimistic scenarios are $-19,980.48, $110,652.95, and $234,398.96, respectively.

7B. The sum of the probability distribution of NPVs yields an expected NPV of $96,239.

Scenario	**NPV @ 12%**	**Scenario Probabilities**	**Distribution of NPVs (rounded)**
Pessimistic	-$19,890	0.3	-$5,967
Most Likely	110,653	0.5	55,326
Optimistic	234,399	0.2	46,880
Total		1.0	96,239
Expected NPV	$96,239		

7C. The standard deviation of the NPVs is $89,259.75.

$$\sigma_{NPV} = \sqrt{\sum_{t=1}^{n} P_i\left[NPV_i - E(NPV)\right]^2}$$
$$= \sqrt{0.3(-\$19{,}890 - \$96{,}239)^2 + 0.5(\$110{,}653 - \$96{,}239)^2 + 0.2(\$234{,}399 - \$96{,}239)^2}$$
$$= \$89{,}259.75$$

7D. The project's coefficient of variation is:

$$CV_{NPV} = \frac{\sigma_{NPV}}{E(NPV)} = \frac{\$89{,}260}{\$96{,}239} = 0.93$$

The project's riskiness is above average because its coefficient of variation of 0.93 is higher than the firm's CV_{NPV} for average-risk projects.

8A. Using the CAPM, the required rate of return for each project is:

Project X: k_X = 4% + 1.25(8% - 4%) = 9.0%
Project Y: k_Y = 4% + 1.8(8% - 4%) = 11.2%

8B. With a debt-to-equity ratio of 0.25, the unlevered betas for Projects X and Y are 1.09 and 1.57.

$$\beta_{UX} = \frac{1.25}{1 + (1 - 0.40)(0.25)} = \frac{1.25}{1.15} = 1.09$$

$$\beta_{UY} = \frac{1.80}{1 + (1 - 0.40)(0.25)} = \frac{1.80}{1.15} = 1.57$$

9. $k_i = R_f + \beta_i(R_m - R_f)$

R_m = 12% $\Rightarrow$ k = 6% + 1.8(12% – 6%) = 16.8%
R_m = 13% $\Rightarrow$ k = 6% + 1.8(13% – 6%) = 18.6%
R_m = 15% $\Rightarrow$ k = 6% + 1.8(15% – 6%) = 22.2%

10. Calculate the pure-play beta and plug it into the CAPM equation:

$$\beta_u = \frac{\beta_{pp}}{1+(1-T_{pp})\frac{D_{pp}}{E_{pp}}} = \frac{0.75}{1+(1-0.36)(0.35)} = 0.61$$

$$k_i = R_f + \beta_i(R_m - R_f) = 6\% + 0.61(14\% - 6\%) = 10.88\%$$

11. The approximate unlevered beta of the new project is the weighted average of unlevered betas of comparable firms: $\sum_{i=1}^{n} p_i \beta_{Ui}$ where $\beta_u = \frac{\beta_{pp}}{1+(1-T_{pp})\frac{D_{pp}}{E_{pp}}}$

$$\text{Approximate unlevered beta}$$
$$= 0.50\left(\frac{1.8}{1+(1-0.34)(0.20)}\right) + 0.30\left(\frac{2.5}{1+(1-0.36)(0.40)}\right) + 0.20\left(\frac{2.2}{1+(1-0.40)(0.60)}\right)$$
$$= 0.80 + 0.60 + 0.32 = 1.72$$

12A. Using the CAPM, the required rates of return are:

$$k_i = R_f + \beta_i(R_m - R_f)$$

OptionDeals: 5.5% + (2.8) (9% – 5.5%) = 15.30%
ClickStocks: 5.5% + (2.1) (9% – 5.5%) = 12.85%
TradeWorld: 5.5% + (1.9) (9% – 5.5%) = 12.15%

12B. IFC should accept investments whose expected returns exceed their required returns.

OptionDeals:	18.00% > 15.30%	Accept
ClickStocks:	13.00% > 12.85%	Accept
TradeWorld:	11.00% < 12.15%	Reject

13A. Using the CAPM, the firm's unadjusted discount rate is: k = 5% + 1.8(6%) = 15.80%. With a discount rate of 15.80%, the project's NPV of $13,131.50 and IRR of 17.06% make the project acceptable.

13B. To account for the added risk of the project, the firm must add a 2 percentage point risk premium to the unadjusted discount rate: RADR = 15.80% + 2.00% = 17.80%. The NPV and IRR using the RADR of 17.80% are -$7,357.39 and 17.06%, respectively. Thus, the firm should not accept the project. The IRR is the same for the unadjusted and risk-adjusted methods because the cash flows do not change.

14. Use the risk-adjusted discount rate in calculating the NPV of each project.

$$NPV_A = \frac{\$250,000}{(1+0.14)^1} + \frac{\$250,000}{(1+0.14)^2} + \frac{\$250,000}{(1+0.14)^3} + \frac{\$250,000}{(1+0.14)^4} + \frac{\$250,000}{(1+0.14)^5} + \frac{\$250,000}{(1+0.14)^6} + \frac{\$250,000}{(1+0.14)^7} + \frac{\$250,000}{(1+0.14)^8} - \$1,000,000 = \$159,716$$

$$NPV_B = \frac{\$200,000}{(1+0.16)^1} + \frac{\$200,000}{(1+0.16)^2} + \frac{\$200,000}{(1+0.16)^3} - \$500,000 = -\$50,822$$

$$NPV_C = \frac{\$40,000}{(1+0.12)^1} + \frac{\$40,000}{(1+0.12)^2} + \frac{\$40,000}{(1+0.12)^3} + \frac{\$40,000}{(1+0.12)^4} + \frac{\$40,000}{(1+0.12)^5} - \$100,000$$
$$= \$44,191$$

The firm should accept Projects A and C because they have positive NPVs based on risk-adjusted discount rates.

15. The R&D cost associated with developing the new fertilizer is a sunk cost and is not reflected in the analysis of the two mutually exclusive projects. The risk-adjusted NPV for each project are:

$$NPV_A = \frac{\$400,000}{(1+0.16)^1} + \frac{\$400,000}{(1+0.16)^2} + \frac{\$400,000}{(1+0.16)^3} + \frac{\$400,000}{(1+0.16)^4} + \frac{\$400,000}{(1+0.16)^5} - \$1,250,000 = \$59,717$$

$$NPV_B = \frac{\$130,000}{(1+0.16)^1} + \frac{\$130,000}{(1+0.16)^2} + \frac{\$130,000}{(1+0.16)^3} + \frac{\$130,000}{(1+0.16)^4} + \frac{\$130,000}{(1+0.16)^5} - \$300,000 = \$125,658$$

The positive NPV of each alternative method suggests that TSL should undertake the new project because it compensates for its risk. TSL should use Method B to produce the new product because it is expected to add more in value to the firm due to its higher NPV.

16. Using the CAPM equation, determine the required rate of return on the market and use it to calculate the appropriate risk-adjusted discount rate for the new project.

$k_i = R_f + \beta_i (R_m - R_f)$

14% = 6% + 1.2(R_m – 6%) $\Rightarrow$ R_m = 12.67%

k* = 6% + 1.8(12.67% – 6%) $\Rightarrow$ k* = 18.01%

17. The NPV of the project using the certainty equivalent method is.

Year	0	1	2	3
Cash flows	-$600,000	$150,000	$300,000	400,000
CE factor	1.00	0.95	0.85	0.75
Risk-adjusted CFs	($600,000)	$142,500	$255,000	$300,000
PV of risk-adjusted CFs	($600,000)	$135,328	$229,976	$256,943
NPV_{CE}	$22,247			

Lexon should adopt this project because it compensates for its risk as shown by the positive NPV_{CE} of $22,247.

18A. The NPV_{CE} for the replacement project is:

$$NPV_{CE} = \sum_{t=1}^{n} \frac{\alpha_t CF_t}{(1+R_f)^t} + \alpha_0 I_0 =$$

$$= \frac{0.98(\$200{,}000)}{(1+0.04)^1} + \frac{0.96(\$220{,}000)}{(1+0.04)^2} + \frac{0.94(\$180{,}000)}{(1+0.04)^3} + \frac{0.92(\$190{,}000)}{(1+0.04)^4} + \frac{0.90(\$200{,}000)}{(1+0.04)^5}$$
$$-1.00(\$700{,}000)$$
$$= \$188{,}462 + \$195{,}266 + \$150{,}418 + \$149{,}420 + \$147{,}947 - \$700{,}000 = \$131{,}513$$

The NPV_{CE} for the new project is:

$$NPV_{CE} = \sum_{t=1}^{n} \frac{\alpha_t CF_t}{(1+R_f)^t} + \alpha_0 I_0 =$$

$$= \frac{0.95(\$80{,}000)}{(1+0.04)^1} + \frac{0.90(\$90{,}000)}{(1+0.04)^2} + \frac{0.85(\$120{,}000)}{(1+0.04)^3} + \frac{0.80(\$120{,}000)}{(1+0.04)^4} + \frac{0.75(\$100{,}000)}{(1+0.04)^5}$$
$$-1.03(\$380{,}000)$$
$$= \$73{,}077 + \$74{,}889 + \$90{,}678 + \$82{,}061 + \$61{,}645 - \$391{,}400 = -\$9{,}050$$

18B. The firm should accept the replacement project because the NPV_{CE} of \$131,513 is positive and adds value but reject the new project because the NPV_{CE} of -\$9,050 is negative and reduces value.

19A. The risk-adjusted discount rate is:

$k^* = R_f + R_1 + R_2 \Rightarrow$ k* = 5% + 8% + 3% = 16%

The NPV_{RADR} is:

$$NPV_{RADR} = \sum_{t=1}^{n} \frac{CF_t}{(1+k^*)^t} - I_0$$
$$= \frac{\$300{,}000}{(1+0.16)^1} + \frac{\$300{,}000}{(1+0.16)^2} + \frac{\$300{,}000}{(1+0.16)^3} + \frac{\$300{,}000}{(1+0.16)^4} + \frac{\$300{,}000}{(1+0.16)^5} - \$1{,}000{,}000$$
$$= -\$17{,}712$$

19B. Using the risk-free rate as the discount rate, the NPV_{CE} is:

$$NPV_{CE} = \sum_{t=1}^{n} \frac{\alpha_t CF_t}{(1+R_f)^t} + \alpha_0 I_0 =$$

$$= \frac{0.90(\$300{,}000)}{(1+0.05)^1} + \frac{0.80(\$300{,}000)}{(1+0.05)^2} + \frac{0.70(\$300{,}000)}{(1+0.05)^3} + \frac{0.60(\$300{,}000)}{(1+0.05)^4} + \frac{0.50(\$300{,}000)}{(1+0.05)^5}$$
$$-\$1{,}000{,}000$$
$$= \$257{,}143 + \$217{,}687 + \$181{,}406 + \$148{,}086 + \$117{,}529 - \$1{,}000{,}000$$
$$= -\$78{,}149$$

19C. Bridgewood should reject the project because the NPV_{RADR} and NPV_{CE} are both negative. Thus, accepting the project would destroy wealth.