

**AEM4060 Risk Simulation**  
**PV and Allied Capital Budgeting**

**PART A**

1. Your financial advisor gives you a call one day. She has an investment available that over 10 years will return on average 15% per year but with 10% standard deviation depending on the outcome of a particular tracking portfolio of stocks. The face value today is \$100 and the investment will be redeemed at the end of the 10th year. You looked at your opportunity cost which would require giving up your current investment (an ETF (index fund) tied to the S&P500) with a long run return of 6.8% and standard deviation 11.47%. You asked the broker how her fund was related to the S&P and she said it had a higher return and lower risk, but was correlated by about 0.75.
  - a) Assuming perfect certainty, what is the present value of the 10-year investment with a certain 15% return and constant discount rate (opportunity cost) of 6.8%? Show work.
2. Now assume
  - i. no correlation;
  - ii. the nominal cashflows have an initial value of \$100 today and a geometric Brownian motion with rate of return 15% and standard deviation of 10%
  - iii. the discount rate is 6.8%.
    - a) What is the mean and standard deviation of the value of the investment in year 10? Show graph.
    - b) What is the expected present value and standard deviation of the investment? Show graph.
3. Now assume
  - i. no correlation;
  - ii. the nominal cashflows have an initial value of \$100 today and a geometric Brownian motion with rate of return 15% and standard deviation of 10%
  - iii. the discount rate is normally distributed with an expected rate of 6.8% and a standard deviation of 11.47%.

- c) What is the mean and standard deviation of the value of the investment in year 10? Show graph.
  - d) What is the expected present value and standard deviation of the investment? Show graph.
  - e) What is the mean and standard deviation of the discount rate in year 10? Explain your result in the context of non-constant discount rates.
4. Now assume that the rate of return on the investment and the discount rate have 0.75 correlation. How does this change the expected rate of return and standard deviation of the present value of the investment relative parts 1 and 2 and 3? Show graphs if applicable.
  5. With respect to question 4, show evidence that the change in the value of the investment and the discount factor is actually 75%.

## **Part B**

### **ALLIED FOOD PRODUCTS (Adapted from Brigham and Houston)**

After seeing Snapple's success with non-cola soft drinks and learning of Coke's and Pepsi's interest, Allied Food Products has decided to consider an expansion of its own in the fruit juice business. The product being considered is fresh lemon juice. Assume that you were recently hired as assistant to the director of capital budgeting, and you must evaluate the new project.

The lemon juice would be produced in an unused building adjacent to Allied's Fort Myers plant; Allied owns the building, which is fully depreciated. The required equipment would cost \$200,000, plus an additional \$40,000 for shipping and installation. In addition, inventories would rise by \$25,000, while accounts payable would go up by \$5,000. All of these costs would be incurred at  $t=0$ . By a special ruling, the machinery could be depreciated under the MACRS system as 3-year property. The applicable depreciation rates are 33%, 45%, 15%, and 7%.

The project is expected to operate for 4 years, at which time it will be terminated. The cash inflows are assumed to begin 1 year after the project is undertaken, or at  $t=1$ , and to continue out to  $t=4$ . At the end of the project's life ( $t=4$ ), the equipment is expected to have a salvage value of \$25,000.

Unit sales are expected to total 100,000 cans in the first year increasing at 6% thereafter, and the expected sales price is \$2.00 per can but will increase at 5.5%/year thereafter. Cash operating costs for the project (total operating costs less depreciation) are expected to total 60 percent of dollar sales.

Allied's tax rate is 25 percent on all net income and capital gains/losses, and its weighted average cost of capital is 10 percent. Tentatively, the lemon juice project is assumed to be of equal risk to Allied's other assets.

You have been asked to evaluate the project and to make a recommendation as to whether it should be accepted or rejected. To guide you in your analysis, your boss gave you a standard form that is used in the capital budgeting process; see Tables 1 and 2.

On her orders you proceeded with a standard NPV analysis, reporting on NPV, IRR and payback. When she read your brief (which you are to provide) she started questioning you on sensitivity analysis and started to question the NPV's sensitivity to changes in variables and risk.

- 1) The \$25,000 most likely value for salvage value might range from \$5,000 to \$50,000.
  - 2) Working capital from inventories and accounts payable were reasonable for the start. Most certainly all payables will be paid, but it is possible that not all inventories will be recovered. She had no idea of how this would be distributed but suggested that inventory recovery would be no less than 80%, no more than 100% and uniformly distributed in-between.
  - 3) Although there is an expectation of likely sales in the first year to be 100,000 different opinions were raised by management with a consensus that the range of possible sales in year 1 would be no more than 120,000 units and no less than 85,000. Thereafter sales were expected to increase at a rate of 6%/year but with a standard deviation of 2%.
  - 4) Furthermore, prices in year 1 were also uncertain with a lognormal distribution with a mean of \$2/unit as in the deterministic case but with a standard deviation of \$0.25. For years 2 through 4 prices would grow by 5.5%/year but with a standard deviation of 1.25%.
  - 5) But your manager also understood demand theory and through an examination of past price-quantity relationships for other products noted that prices and sales were negatively correlated with a correlation of -.75.
  - 6) Your boss also questioned the relationship between variable costs and revenues. She thought it true that 60% was most likely but varied from year to year. For similar drinks she noted that the rate was as low as 52% but never exceeded 63%.
- A) What are the means and standard deviation of: (Use the table of summary results and then show the respective graphs under that table)
- a. Year 1 sales revenues
  - b. Year 2 sales price
  - c. Year 3 Sales revenues
  - d. Year 4 Operating costs
  - e. Terminal cash flows
  - f. Year 4 terminal cashflows
  - g. Net Present Value
  - h. IRR

i. Payback

	Mean	Standard Deviation
Year 1 sales revenues		
Year 2 sales price		
Year 3 sales revenues		
Year 4 operating costs		
Terminal cash flows		
Year 4 terminal cash flows		
Net Present Value		
IRR		
Payback		

- B) Provide and interpret the tornado graphs for NPV and IRR and Payback (regression coefficients). How are they similar and how are they different.
- C) Show the scatter plots for units sold and prices for years 1 and 4. Are these consistent with the model inputs? What do the scatter graphs indicate to you.
- D) Provide a Summary Trend for cumulative cash flows. How is this graph related to payback?
- E) Assume that Allied's average project NPV has a coefficient of variation ( $CV = \text{mean}/\text{std}$ ) in the range of 1.25 to 1.75. Would the lemon juice project be classified as high risk, average risk, or low risk? What type of risk is being measured here?
- F) Prepare an overall assessment of the investment by discussing the merits of NPV, IRR and Payback. Should they go ahead with the project and why? Include in your discussion strategic risk items such as the nature of probabilities, the probability of  $NPV < 0$  and so on. Provide figures where appropriate.

**TABLE 1      Allied's Lemon Juice Project (Total Cost in Thousands)**

<b>END OF YEAR:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>I. Investment Outlay</b>					
Equipment cost					
Installation					
Increase in inventory					
Increase in accounts payable					
Total net investment					
<b>II. Operating Cash Flows</b>					
Unit sales (thousands)					
Price/unit					
Total revenues					
Operating costs excluding depreciation					
Depreciation					
Total costs					
Operating income before taxes					
Taxes on operating income					
Operating income after taxes					
Depreciation					
Operating cash flow					
<b>III. Terminal Year Cash Flows</b>					
Return of net operating working capital					
Salvage value					
Tax on salvage value					
Total termination cash flows					
<b>IV. Net Cash Flows</b>					
Net cash flow					
<b>V. Results</b>					
NPV =					
IRR =					
Payback =					