

Eng 120: Principles of Engineering Economics

Final Exam
May 15, 2009
Ismail Ceylan

Name: _____ (please print)
SID: _____

- Clearly state all the mathematical expressions that are needed to solve the problems.

No credit will be given to numerical answers without the proper setup.

- Present your work in an organized and neat fashion.

Good luck!

Problem	1	2	3	4	5	Total
	(20)	(20)	(20)	(20)	(20)	(100)
Score						

Problem 1 (20 points)

a) Your parents give you \$25,000 so that you can buy a car and pay for its maintenance costs over the next 30 years. You decide to buy a new car and deposit the rest of the money in a savings account with an interest rate of 4 percent compounded semiannually. The car will not require any maintenance for the first 5 years, but starting in the 6th year the cost of maintaining the car will be \$500 per year and this cost will increase 2% each year. Assume that the maintenance costs are paid at the beginning of the corresponding year. You want to pay the maintenance costs using the money in your savings account. After using the car for 30 years, you will donate your car. What is the purchase price of the most expensive car you can buy? (10 points)

b) Your friend, who is an expert in bond markets, advises you to invest the \$25,000 in bonds during the next two years to take advantage of the high yields. You decide to invest all the money in 8% annual-coupon bonds with a face value of \$1000, 10 years to maturity and a YTM of 8%. You will reinvest the first set of coupon payments at 6% for a year. In two years from now, you will sell the bonds after receiving the second set of coupon payments. The YTM in 2 years will be 6%. If you want to buy a new car using the **total proceedings** from this 2-year investment, what is the price of the most expensive car you can buy? Assume that the maintenance costs are zero. (10 points)

Problem 2 (20 points)

Each part of the question is independent of the others! In each part, assume that the CAPM holds and the investors use Markowitz's mean-variance criterion to choose portfolios.

- a) Stock A and Stock B are uncorrelated and they have the same expected return. The following information is given:

	Standard deviation	Beta
Stock A	10%	0.8
Stock B	20%	0.6

Consider the following two portfolios that consist of Stock A, Stock B, and the risk-free security:

	Weight of Stock A	Weight of Stock B	Weight of Risk-Free Security
Portfolio 1	0.2	0.6	0.2
Portfolio 2	0.6	0.2	0.2

Which portfolio should you choose? Explain. (5 points)

- b) An individual has \$1000 to invest and she uses Markowitz's mean-variance model to invest her money. She borrows \$500 at the risk-free interest rate. Find the beta of this portfolio. (5 points)
- c) The variance of Stock A is equal to half of the systematic risk of the market portfolio. Moreover, $\overline{r}_m - r_0 = 2(\overline{r}_A - r_0)$. What percentage of the total risk of Stock A as measured by the variance on returns on Stock A can be diversified away? (5 points)
- d) Portfolio 1 and portfolio 2 are efficient whereas portfolio 3 is not efficient. There are multiple things wrong with the figures in the table below. What are they? (5 points)

	Expected Return	Standard Deviation	Beta
Portfolio 1	15%	20%	0.6
Portfolio 2	N/A	10%	0.8
Portfolio 3	20%	15%	0.5

Problem 3 (20 points)

Suppose that the price of Stock A at time T follows a one-period Binomial model with the following parameters:

$$u = 1.25,$$

$$d = \frac{1}{u},$$

$$R_0 = 1.0067,$$

Current price of Stock A: $S_0 = \$300$

All of the prices considered in the questions below are assumed to be no-arbitrage prices.

A so called maximum option gives its owner the right, but not the obligation, to exercise **at most one** of the options below at the expiration date T:

- A European call option on Stock A with a strike price of \$300,
 - A European put option on Stock A with a strike price of \$400.
- a) What are the two possible stock prices at time T according to the Binomial model given above? (1 point)
- b) Find the replicating portfolio which has the same payoff structure as the maximum option using Stock A and the risk-free security. (15 points)
- c) What is the premium (price at the beginning) of the maximum option? (4 points)

Problem 4 (20 points)

A company is looking at a 10-year manufacturing project. The company has a building which is currently used for storage. The building was purchased three years ago for \$10 million and it was appraised last week for \$8 million. If the manufacturing project is approved, then the company will use this building for the project and rent a warehouse to be used for storage. The total rent for 10 years is \$1 million to be paid upfront. After the project is over the company will resume use of the building for storage. The equipment required for the manufacturing project will cost the company \$30 million.

The following market data reflect the target capital structure:

Debt: 10,000 7-percent coupon bonds outstanding, 15 years to maturity, selling at par; the bonds have a \$1,000 par value each and make semiannual coupon payments.

Common stock: 150,000 shares outstanding, selling for \$75 per share; the beta is 1.5.

Market: 8 percent expected market portfolio return; 5 percent risk-free rate.

The flotation cost is 9 percent on new common stock issues, and 4 percent on new debt issues. The tax rate is 35 percent. The project requires \$500,000 in initial net working capital investment to become operational. The annual operating cash flow is \$4.5 million (received at the end of each year).

- a) Assume that the increase in net working capital does not require the company to raise outside funds (i.e., the company uses the retained earnings instead). The company will issue new common stocks to raise money for the other cash flows. Calculate the project's initial cash flow at time 0 including the flotation costs. (8 points)
- b) The equipment has a 10-year tax life, and the company uses straight-line depreciation. At the end of the project, the equipment can be scrapped for \$6.5 million. What is the after-tax salvage value of this equipment? (2 points)
- c) Calculate the appropriate discount rate to use when evaluating this project if it is at the same risk level as a typical project for the company. (4 points)
- d) What is the net present value of the project? Should you accept or reject the project? (6 points)

Problem 5 (20 points)

For each of the following statements, determine whether it is *true* or *false*. Justify your answer providing either a proof or a counter-example as appropriate. (No explanation – no credit) (5 points each)

- a) Short selling a call option can be replicated by buying the underlying stock, buying a put, and investing in the risk-free security.
- b) Suppose that CAPM holds and $b \geq 0$. A portfolio that has the minimum standard deviation such that portfolio beta = b must be an efficient portfolio.
- c) Let C and P be the prices of a European call and a European put with the same underlying stock, with the same strike price K . If K is equal to the forward price of the same stock then $C < P$ (The options and the forward contract all have the same expiration dates).
- d) Suppose that the risk-free interest rate is 1 percent per month. The following two strategies have the same payoffs:

Strategy 1: Buy a put with strike price E and expiration date in one month, buy the underlying stock.

Strategy 2: Buy a call with strike price E on the same underlying stock with the same expiration date, deposit $\frac{E}{1.01}$ dollars at the risk-free interest rate.