

\*\*\* The content/focus of the exam  
may be different this year!

E 120: Principles of Engineering Economics

Final Exam  
Ismail Ceylan  
December 18, 2006

Name: ~~XXXXXXXXXX~~ ~~XXXXXXXXXX~~ (please print)

SID: ~~XXXXXXXXXX~~

- 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.
- You can use formulas developed in class or specified in the textbook but no quotes from any sources (including homework and exercises from the textbook) are allowed.
- Answer each of the following questions in the space provided. If you need more space to show major computations you performed to obtain your answer for a particular problem, use the back of the preceding page.
- Present your work in an organized and neat fashion.
- Good luck!

Problem	1 (20)	2 (20)	3 (20+5bonus)	4 (20)	5 (20)	Total (100+5 bonus)
Score	20	16	18	20	9	83

100 points will be considered as perfect score.

**Problem 1 (20 points)**

XYZ Corporation is planning to buy a machine for a specific operation. The company will use this machine for 20 years and then sell it for the salvage value specified below. They can choose one of the following two machines:

**Machine A**

**Price:** \$10000 to be paid now.

**Operating costs:** \$2000 for the first year. The operating costs will increase by 2% every year. Payments are made at the end of each year (The first payment is to be made at the end of the first year).

**Salvage value at the end of 20 years:** \$5000.

**Machine B**

**Price:** \$5000 to be paid now.

**Operating costs:** Constant \$5000 paid every two years. The first payment is to be made at the end of the second year and the last payment at the end of 20 years.

**Salvage value at the end of 20 years:** 0

Machine A and machine B are otherwise the same.

Assume that the interest rate is **10% per year compounded semiannually**. If the decision is solely based on the present value criterion, which option should they choose?



**Problem 2 (20 points)**

Consider a bond with the following features:

**Bond X**

- Face value: \$1000.
- Annual coupon rate (paid once a year): 8%.
- Time to Maturity: 2 years.
- There are two coupons remaining to be paid (the first one in one year and the second one in two years)
- At the end of the first year, before receiving the first coupon you have the option to exchange the *bond X* with the following bond:
  - 7% bond with 10 years to maturity with a face value of \$1000. Coupon payments are made annually. (If you choose to make the exchange, you will receive the first coupon in one year after you get this bond.)

If you choose to make the exchange, then you will not receive the remaining two coupons and the face value associated with the *Bond X* itself. But you will receive the new bond's coupons and face value.

- Effective interest rate is 6% for the next 20 years.

Calculate the net present value of *bond X*.

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**Problem 3 (20+5 points)**

A so called "option collar" on a stock can be designed as follows:

- Buy one share of the stock at  $S_0 = \$100$ ,
- Sell one call option on this stock with a strike price \$120,
- Buy one put option on this stock with a strike price \$80.

(Assume that one option corresponds to one share of the stock).

The expiration date for all the options is in one year. The premium of both options is \$5.

Assume there is a constant positive annual interest rate,  $r_0$ , at which you can borrow and deposit unlimited amounts of money. Answer the following questions.

- (a) Let  $S_T$  be the price of the stock in one year. Suppose that we will sell the stock at the expiration date of the options. Construct the payoff table corresponding to payoff of the option collar as designed above (Include the stock in the total payoff as well).
- (b) Draw the payoff- $S_T$  graph corresponding to the option collar above.
- (c) **(5 points - bonus)** Assume that put options on this stock are not available. However, you can find call options on this stock at any strike price. Design an "option collar" with the payoffs as above without using put options.

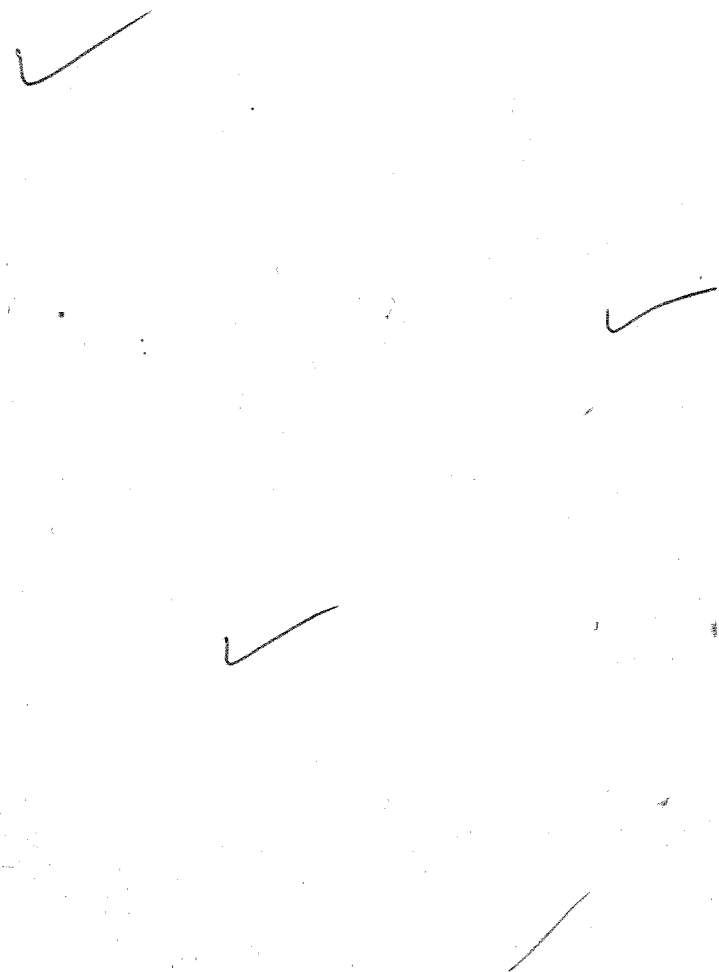
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**Problem 4 (20 points)**

The covariance between assets A and B is 0.005. The expected rate of returns, standard deviations and betas are as given below:

Asset	Expected Rate of Return	Standard Deviation	Beta
A	12%	20%	1.5
B	24%	25%	2.0

Suppose that the risk free rate per period is 5% at which you can borrow and deposit unlimited amounts of money. Let  $\omega_0$ ,  $\omega_A$  and  $\omega_B$  be the portfolio weights corresponding to the risk free asset, Asset A and Asset B, respectively.

- (a) Find the beta, expected return and the standard deviation corresponding to a portfolio with the following weights:  $\omega_0 = 0.1$ ,  $\omega_A = 0.4$  and  $\omega_B = 0.5$ .
- (b) Assume that the portfolio given in part (a) is **efficient**. Find the standard deviation of the market portfolio.
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**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 an example as appropriate.  
(no explanation – no credit)

**Note** In all the parts below, assume that there is a constant positive annual interest rate,  $r_f$ , at which you can borrow and deposit unlimited amounts of money.

- (a) If an asset has a standard deviation strictly greater than zero, then its expected return must be greater than the (risk free) interest rate  $r_f$ .
- (b) Any efficient portfolio must have a beta equal to 1 since it is a combination of the market portfolio and the risk free asset.
- (c) If the forward price on a stock is less than the current price of the same stock, it is always possible to find an arbitrage opportunity.
- (d) The premium of an American call option increases as the expiration date of the option increases.
- (e) Let bond A be a zero coupon bond with maturity  $M_1$  and let bond B be a 5% bond with maturity  $M_2$ . If  $M_1 > M_2$ , then price of bond A is always more sensitive to changes in the interest rate than the price of bond B.

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(3)

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