

UCLA Technology Management & Economics for Engineers and Scientists E110

Midterm Exam Fall 2010 Prof. Bristow Version A

Write your first and last name here: _____

Signature _____ Student ID# _____

I certify I am the above listed person.

Write your seat number here _____ and turn in your seat assignment with your exam.

Have you taken Eng 111 or 112 before this quarter? If yes, which classes have you taken?

Today's date is: ___/___/___ Time I began exam: _____ I ended at: _____

The exam is closed book and closed notes; you may use the equation page. There is no talking or questions to be asked during the exam. Only one student may go to the restroom at a time; if you go, leave your cell phone with the proctor. Check to see if your exam packet has ___ pages. Select your answers based solely on what you think is the best answer possible given the question as written. If you feel that there is an error or typo in a question or an answer, you are encouraged to write your comments on the exam. If you use the back of the exam write "answer on back" on the front of that page. All comments will be considered when grading the exam. The exams will be collected in one hour and 30 minutes.

There are ___ questions of different value, so pace yourself so that you finish on time and have time to check your work. There are multiple versions of the exam; the person next to you will not have your version of the exam. Do not even appear to be looking at your neighbor's exam.

There are no trick questions but some questions may have information that you don't require. Read the question – do not assume what is says; read it carefully.

Good luck, relax and think clearly about what you have learned. You will do well.

Short answer questions (25 points total)

Q1. (2 pts) Write out the equation to define gross domestic product (use variables):

This question is from the lecture notes

$$\text{GDP} = I + G + C + (X - M)$$

Q2. (2 pts) Define all 5 variables on the right side of the GDP equation (use words):

- I = Investments
- G = Government
- C = Consumption
- X = Exports
- M = Imports

Q3. (2 pts) Complete the following chart regarding recent US GDP data in 2010 (all numbers must be accurate to +/- .1%):

This question is form current events

	Q1 2010	Q2 2010
GDP:	3.7	1.7
Inventory:	-2.6	-0.8
GDP at final sales:	1.1	0.9

Q4. (6 pts) List the approximate historical (1926-2006) annual yields (for the 6 major categories of investments (HINT: Dow is a dozen):

This question is from lecture notes

- Private Equity: 24%
- Small Cap Stock: 18%
- Large Cap Stock: 12%
- Bonds: 6%
- T-Bills: 4%
- Inflation: 3%

Q5. (5 pts) List the 9 steps involved in the engineering economic analysis framework in their **correct order**:

This question is from chapter 1

1. Recognize the problem
2. Define the goal or objective
3. Assemble relevant data

4. Identify feasible alternatives
5. Select criterion to determine the best alternative
6. Construct a model
7. Predict each alternative's outcomes or consequences
8. Choose the best alternative
9. Audit the result

Q6. (2 pt) What is the current price of oil per barrel? (Numbers must be accurate +/- \$5)

This question is from current events

\$82 as of Monday October 25th, 2010

Q7. (2 pt) What is current US unemployment? What is considered full employment? (Numbers must be accurate to +/- 1%)

This question is from current events

9.6% for September 2010; Full employment = 6%

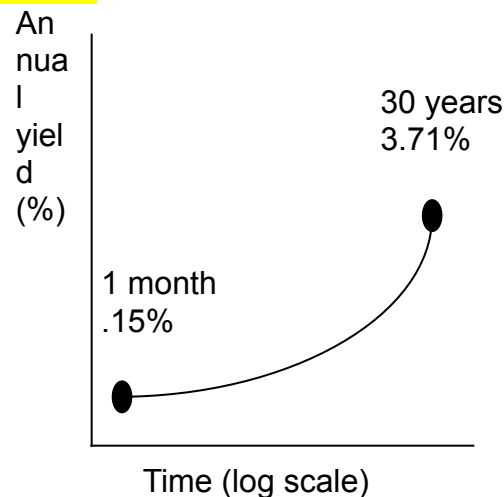
Q8. (1 pt) What is current California unemployment? (Numbers must be accurate to +/- 1%)

This question is from current events

12.4% for September 2010

Q9. (6 pts) Sketch the current yield curve as published by the US Treasury. Label both axes. Indicate scale on both axes. Mark at least 2 points on the yield curve (numbers must be accurate to +/- .25%)

This question is from lecture notes



Important features: slope/general shape, axes, and the labeled points

Multiple Choice Questions (25 points total)

Q10. (3 pts) Which of the following is **not** considered a type of business entity?

This question is from Prof King's lecture

- a) Limited Liability Company
- b) Sole Proprietorship
- c) Corporation
- d) Limited Liability Partnership
- e) Limited Liability Proprietorship

Q11. (3pts) Which of the following is the term **revenue** synonymous with?

This question is from chapter 2

- a) Sales
- b) Liability
- c) Assets
- d) Equity
- e) Profit

Q12. (3 pts) One basis point is equal to:

This question is from lecture

- a) 1
- b) 1%
- c) .1%
- d) .01%
- e) .001%

Q13. (3 pts) Complete the following equation:

$$\text{Breakeven point} = (\underline{\hspace{2cm}}) / (\text{Selling price per unit} - \text{Variable price per unit})$$

This question is from chapter 2

- a) Book cost
- b) Opportunity cost
- c) Marginal cost
- d) Fixed cost
- e) Cash cost

Q14. (3 pts) China recently raised its interest rate for the first time in recent history after a long period of no adjustments. What is a possible reason a national bank might raise its country's interest rate?

This question is from current events

- a) There are fears of an impending economic slowdown
- b) The economy appears to be experiencing inflation

- c) The country's GDP needs to grow at a faster rate
- d) There is an expectation the economy is going into a recession
- e) The country is not leading the world in GDP

Q15. (3 pts) Depreciation of an existing asset is a good example of a:

This question is from chapter 2

- a) Book cost
- b) Cash cost
- c) Variable cost
- d) Sunk cost
- e) Opportunity cost

Q16. (3 pt) The "Tech Bubble" burst was a stock market crash associated with many internet related businesses went bankrupt. What year did this happen?

This question is from Prof King's lecture

- a) 1998
- b) 1999
- c) 2000
- d) 2001
- e) None of the above

Computational Questions (51 points total)

Q17. (3 pts) Assume an annual nominal interest rate of 6% on a loan. If the interest is compounded **monthly**, find the effective **annual** interest. Use 3 significant figures.

$$\text{Ans: } i_a = \left(1 + \frac{r}{m}\right)^m - 1 = (1 + 0.06/12)^{12} - 1 = 6.168\%$$

Q18. (7 pts) You plan on starting a food truck business by buying a truck with a built in kitchen. You first ask your parents for help, and they agree to give you a \$10,000 investment for a share of your company. In order to buy all the equipment necessary you also take out a \$30,000 loan from the bank and use the money to buy the truck and cooking supplies. You still have \$5000 leftover cash as after you finish purchasing supplies.

This question is from chapter 17

(5 pts) Draw a basic diagram of your balance sheet. Include the truck, cooking supplies, the loan, the investment, and the leftover cash listed under assets, liabilities, or equity.

Assets	Liabilities
Cash	Loan
Supplies	Equity
Truck	Investment

(2 pts) Assuming $A = L + E$ and your cooking supplies cost \$2000, what was the price of the truck?

$$L + E = \$40k = \$2k + \$5k + \text{truck}; \text{truck} = \$33k$$

Q19. (9 pts) A company is deciding between renting a building for 20 years or buying a building and selling it back at the end of 20 years. Renting would cost \$10,000 each month, while buying a building would cost \$1.5 million upfront, and is expected to be sold for \$1 million after the 20 years of operation.

(3 pts) What is the NPV of each option if market interest is 0? Which option is better?

No time value of money

$$-10,000 * 12 * 20 = -2,400,000 \text{ for renting}$$

$$-1,500,000 + 1,000,000 = -500,000 \text{ for buying}$$

Buying is the correct choice

(3 pts) What is the NPV of each option if the monthly market rate is 1%? Which option is better?

$$\text{NPV (rent, paid at end of month)} = P = A \left[\frac{(1+i)^n - 1}{i(1+i)^n} \right] = -10,000 \left[\frac{(1+0.01)^{240} - 1}{0.01(1+0.01)^{240}} \right] =$$

$$-908,194.16$$

$$\text{NPV (rent, paid at beginning of month)} = -10000 \left[1 + \frac{(1+0.01)^{239} - 1}{0.01(1+0.01)^{239}} \right] = -917276.10$$

$$\text{NPV (buy)} = -1,500,000 + 1,000,000 / (1+0.01)^{240} = -1,408,194.16$$

Renting is the correct choice

Salvage future value in buying is discounted to present value with $PV = FV(1+i)^{-n}$, hence the large disparity between this and the previous part of the question

(3 pts) The company decides to buy the building by taking out a mortgage. Instead of paying all of the money upfront they will pay \$10,000 per month for 20 years. The company will still sell the building at the end of the 20 year period. Assuming a monthly market rate of 1%, what sale price of the building will result in an NPV of 0 for the entire 20 years?

NPV(mortgage) = -908,194.16 (same as above, in part 2, for renting)

$$F = PV(1+i)^n = 908,194.14 * (1.01)^{240} = \$9,892,553.62$$

Alternate solution: use future value of an annuity formula directly

$$F = A \left[\frac{(1+i)^n - 1}{i} \right] = \$10K[(1.01^{240}-1)/0.01] = \$9,892,553.62$$

Q20. (5 pts) The production of an automobile requires a large amount of manual labor. 2000 labor hours were required to produce the 1st unit in the production run and 350 hours were required to produce the 500th unit

This question is from chapter 2

(3 pts) What is the learning curve coefficient for this production process? Round your answer to the nearest 0.1.

$$T_N = T_1 \cdot N^b \text{ where } b = \ln(LC)/\ln 2 \Rightarrow \ln(T_N/T_1) = b \ln N \Rightarrow b = \ln(T_N/T_1)/\ln N$$

$$T_N = 350 \text{ hr, } T_1 = 2000 \text{ hr, and } N = 500$$

$$\Rightarrow b = -0.28 \text{ (acceptable answer)}$$

$$\text{can also solve for LC: } \ln(LC) = b \cdot \ln 2 \Rightarrow LC = \exp(b \cdot \ln 2)$$

$$\Rightarrow LC = 0.823 \text{ (also acceptable)}$$

Solving for either b or LC was acceptable.

(2pts) Suppose the same automobile production is now completely automated. No humans are directly involved in the assembly. With the same learning curve model, what would be the expected learning curve coefficient?

LC will be equal to 1 (or $b = 0$). We essentially have $T_N = T_1$ for all N , meaning the time required to produce the first unit will be equivalent to the time required to produce unit N for any point in the future. An automated process does not learn or become faster over time. Any answer that suggested this conceptual understanding was fine.

Q21. (6 pts) A company has \$10,000 in sales. If taxes are 20% of IBT, gross margins are 90% of sales, and OPEX is twice COGS, find the net income for this company.

This question is from chapter 17

$$\text{Sales} = \$10\text{K}$$

$$\text{GM} = \$9\text{K}$$

$$\text{Sales} - \text{COGS} = \text{GM} \Rightarrow \text{Sales} - \text{GM} = \$1\text{K} = \text{COGS}$$

$$\text{OPEX} = 2 * \text{COGS} = 2\text{K}$$

$$\text{GM} - \text{OPEX} = \text{IBT} = 7\text{K}$$

$$\text{IBT} * (1 - \text{tax}) = \text{Net income} = \$5.6\text{K}$$

Q22. (5pts) What amount of money deposited 50 years ago at an 8% interest rate would provide a perpetual payment of \$10,000 a year beginning this year?

This questions is for chapter 5

$$\text{Figure out the present value of the annuity in today's dollars: } P = C/r = \$10\text{k}/.08 = \$125\text{k}$$

$$\text{Discount that value back 50 years: } FV = 125\text{k} = PV(1.08)^{50}$$

$$\text{Solve for the "present" (50 yrs ago) value: } PV = \$2665.15$$

Q23. (5pts) A pump for a chemical reactor must be replaced every 5 years at a cost of \$5,000, with an end of life salvage value of \$500. A new pump is available for \$8,000 that lasts 7 years and has an end of life salvage value of \$1000. Based on an effective annual interest rate of 10% per year which pump should be used?

EUAW analysis: Annualize the costs with either present value of an annuity or future value of an annuity formula, solving for A (both methods give same numbers)

Using future value of an annuity formula (need to also compound the initial \$5000 cost into future dollars at year five):

$$\text{Old pump- EUAW} = [.1/(1.1^5-1)] * [-5000*(1.1^5)+500] = -\$1237$$

$$\text{New pump- EUAW} = [.1/(1.1^7-1)] * [-8000*(1.1^7)+1000] = -\$1538$$

=> Old pump is cheaper.

Can also use NPV analysis but must look at the process on a 35 year basis. The same conclusion would be reached, with different numbers. This alternate solution, not shown here is much more complicated and is available upon request.

Q24. (6pts) You are purchasing a machine for \$500 that will generate savings of \$200 per year for each subsequent year. You estimate the machine has a 20% chance of lasting only 3 years of use, a 40% chance of lasting only 4 years of use, and no chance of lasting more than 5 years. What is the expected NPV of the investment, assuming annual market rate of 8%?

$$20\% * (200*(1.08^3-1)/.08/1.08^3-500) = 3.08$$

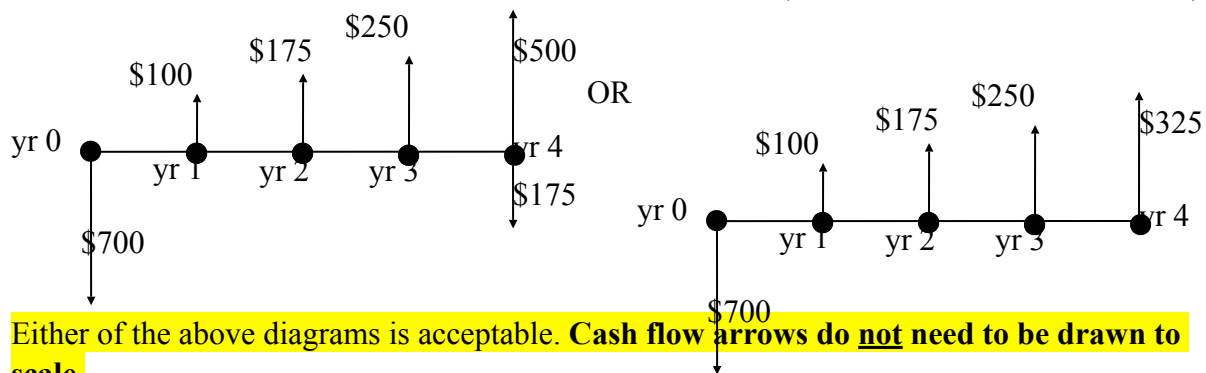
$$40\% * (200*(1.08^4-1)/.08/1.08^4-500) = 64.97$$

$$40\% * (200*(1.08^5-1)/.08/1.08^5-500) = 119.42$$

$$\text{Sum} = \$187.47$$

Can alternatively subtract out the \$500 at the very end, instead of doing it for each scenario, since you'll always pay \$500 for the machinery regardless of how long it lasts (and the probabilities sum to 1)

Q25. (5 pts) A 4 year investment includes the following cash flows: A \$700 initial investment, a \$100 cash flow on year 1, a \$175 cash flow on year 2, a \$250 cash flow on year 3, and a \$500 cash flow with a \$175 cleanup cost on year 4. **Draw** the cash flow diagram and **calculate** a rate of return that would result in a NPV of 0 for the investment (answer must be accurate +/-1%).



Either of the above diagrams is acceptable. **Cash flow arrows do not need to be drawn to scale.**

Finding the rate of return for NPV = 0 (i.e. internal rate of return):

$$NPV = -700 + \frac{100}{1+IRR} + \frac{175}{(1+IRR)^2} + \frac{250}{(1+IRR)^3} + \frac{500-175}{(1+IRR)^4} = 0 \Rightarrow IRR = 0.069 = 6.9\%$$