UCLA

A

Introduction to Technology Management for Engineers

ENG110 Final Exam Fall 2013 Meliha Bulu-Taciroglu

Last Name, First Name:_____

Signature _____ Student ID# _____ I certify I am the above listed person and this is my individual work.

Today's date is: 12/ 9 / 2013

The exam is closed book and closed notes; you may use the formula sheet provided. 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. Select your answer based solely on what you think is the best answer possible given the question as written. 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 3 hours.

Good luck!

**Multiple Choice Questions (2 points each)**

**1.** For opportunity costs to exist, which of the following is required?

a) Wealth
b) Consumer Spending
c) Scarcity
d) Money
e) Poverty

**2.** You and your friend just quit Google where you were making $120,000/year each. A third friend offers you a job at her company for $130,000 each but you both refuse to start a company of your own that will produce customized cell towers. You rent an office space for $40,000 per year, get raw materials for $60,000 /year, and spend $80,000 on other administrative, marketing and production costs. What was your total cost for your first year?

a) $420,000
b) $300,000
c) $180,000
d) $440,000
e) $310,000

*60,000+80,000+40,000+130,000+130,000 = $440,000*

**3.** Consider two companies, company A and company B, operating in a perfectly competitive environment. Each has a TVC = $5Q+Q^2/10{,}000$ and a MC = 5+Q/5,000. Company A has a fixed cost of $3 million and company B has a fixed cost of $4 million.

a) If the market price is $40, optimal production level for A is higher than that of B.
b) B obtains a higher profit at any price.
c) At the market price of $40, ATC is higher for A than it is for B.
d) At market price of $50, both firms are making negative economic profit.
e) At market price of $40, total supply by A and B is 350,000 units.

*40=5+Q/5000 gives the optimal production level, Q=175,000, at price $40 for both firms. Total supply = 2*175,000 = 350,000.*

**4.** If increasing the production level from 4000 units to 8000 units increases the ATC we can be sure that

a) Firm is experiencing diseconomies of scale.
b) MC is lower than ATC at the production level of 4000.
c) MC is higher than ATC at the production level of 4000.
d) MC is lower than ATC at the production level of 8000.
e) MC is higher than ATC at the production level of 8000.

**5.** Given everything else is the same, a firm:

a) Would prefer to have a less price sensitive demand for its product
b) Would prefer to have a more price sensitive demand for its product
c) Would prefer to have a flat demand for its product
d) Would be indifferent between having a flat or a negatively sloped demand
e) None of the above

**6.** Considering the recent economic events, which of the following is NOT correct about the U.S. economy?

a) Federal Funds Rate is considerably low.
b) Total dollar value of US imports per year exceeds that of exports.
c) US has been operating below full employment level of GDP for the past couple of years.
d) After the 2008 economic crisis, U.S. has been experiencing relatively low inflation.
e) The country with the highest GDP per capita in the world is US.

**7.** "Crowding out" refers to

a) Interest rates being too low for the monetary policy to be effective
b) Central Bank's bond buying activities creating instabilities
c) Government borrowing's possible effect on interest rates
d) Reserve Requirement Ratio being too low
e) Federal Funds Rate being too intrusive

**8.** Public transportation:

a) Is a public good since it is consumed by the public
b) Is a public good since you can exclude people from using it
c) Is a public good since its consumption by one person never affects its consumption by another person
d) Is not a pure public good
e) Is a pure private good

**9.** Your company invests $50,000 today and will receive $60,000 in two years with 50% chance. In case, you do not get it in two years, you will definitely get it in three years.
What is the expected rate of return?

a) 9.5%
b) 6.3%
c) at least 9.5%
d) 7.9%
e) less than 6.3%

*Rate of return IF the payment is made in two years: $-50{,}000+60{,}000/(1+r)^2=0$, $r=9.54\%$*
*Rate of return IF the payment is made in three years: $-50{,}000+60{,}000/(1+r)^3=0$, $r=6.27\%$*
*Expected Rate of Return = ½ * 9.54 +½ * 6.27 =7.9%*

**10.** You are presented with two mutually exclusive projects, A and B. You end up making the right decision by accepting project A when the IRR of B-A is 8 % while the market rate is 10%. Then, you can be sure that:

a) the initial cash flow of A is positive.
b) the initial cash flow of B is positive.
c) the initial cash flow of A is negative.
d) the initial cash flow of B is negative.
e) the initial cash flow of A-B is positive.

**Short Answer Questions (3 points each):**

**11.** You are working for a non-profit organization and you would like to ensure that the organization can withdraw $10,000 from its bank account in constant dollars each year (beginning next year) forever.
If the bank pays 8% APR and the projected average inflation rate is 3% per year, what amount should you deposit with the bank now?

*Please give the following answer full points:*
*Since the amount that will be withdrawn is in constant(real) dollars, we need to use the real interest rate. Using Fisher Formula:*

*1+real rate = (1+nominal rate)/(1+inflation rate)*
*real rate = (1.08/1.03)-1 =4.85%*

*Using Perpetuity (Capitalized Cost) Formula P=A/i, P=10,000/0.0485 =$206,000.*

---

*But, the correct answer should be:*
*Withdrawing $10,000 in real dollars every year, when inflation is 3%, is equivalent to withdrawing an amount that starts at $10,000 and grows at 3% each year, hence the question is equivalent to finding the present value of a geometric series that grows at 3% and discounted at 8%. To be able to use the formula, we need to have the cash flow running for a limited amount of periods, yet, the question demands a cash flow that runs forever. The limit of the following formula when $n \to \infty$, is $P=A_1(1/(i-g))$ since as n increases $(1+g)^n(1+i)^{-n}$ approaches to zero!*

$$P = A_1\left[\frac{1-(1+g)^n(1+i)^{-n}}{i-g}\right] \quad \text{where} \quad i \neq g$$

*Then, P=10,000(1/(0.08-0.03)) = $200,000*

**12.** A bank loans out $10,000 to be paid back after two months in full with interest (compounded monthly). If the bank is ready to make this loan to a customer with a chance of 5% default at an APR of 38%, what should be the APR charged to a risk-free customer (a customer with no default risk)?

*$0.95 * (10,000(1+38\%/12)^2) = 10,000(1+r/12)^2$*

*$r = 6.65\%$*

**13.** This year, the nominal per capita GDP is $48,387 in US and $13,044 in Romania. For the same year, the PPP adjusted GDP per capita is $48,387 in U.S. and $16,500 in Romania. Prices are projected to increase twice as fast in Romania as in US over the coming 3 years. If the price level is 100 in US today and increases by 2% per year, what will be the price level in Romania in three years?

*This year, if the price level in US is 100, in Romania, it is 13,044/16,500 = 79*
*The prices increase 4% per year in Romania, hence in three years $79*(1.04)^3=88.86$, approximate price level in Romania will be 89.*

**14.** The consumption function for an economy is C=180+0.75Y, and

The Potential (full-employment) GDP - The Real GDP = $4 billion.

Suppose that the government increases its spending by $2 billion and funds it by increasing the tax by an equal lump sum amount. If the government wants to reach the full employment level of GDP by further increasing its spending and funding it by borrowing, how much additional government spending is needed?

*Increasing government spending and tax by the same amount, $2 billion, increases GDP also by $2 billion since the balanced budget multiplier is 1.*

*Then GDP needs to be increased by another $2 billion to reach to the full employment level.*

*Income multiplier is 1/(1-MPC) where MPC is given as 0.75.*

*Then $2 billion / (1/(1-0.75)) = $0.5 billion is the needed extra government spending.*

**15.** Assume that there is only one bank in the economy and every individual deposits his/her money with this bank. If the reserve requirement ratio is 10% and the bank is willing to loan out only 50% of its resources available for loaning, what is the maximum amount of money that can be created by an injection (initial deposit) of $1000 into the system?

*Maximum Total Money Created*
*$=1000+1000\ (1-0.10)\ 0.50 +1000(1-0.10)^2\ 0.50^2 +1000(1-0.10)^3\ 0.50^3+\ldots$*

*$= 1000\ (1/(1-(1-0.10)\ 0.50) =$ $1,818.18*

**16.** The following table gives the nominal and real GDP for a country from year 2009 to year

2012. If the price level is 100 in year 2009, and 108.12 in 2012 what should be the real GDP in year 2012 for the price increase to be 2% from year 2011 to 2012?

| Year | Nominal GDP | Real GDP |
|---|---|---|
| 2009 | 5600 | 5600 |
| 2010 | 5800 | 5686.27 |
| 2011 | 6000 | 5660.38 |
| 2012 | 5800 | |

*Real GDP in 2012 =5800*100/108.12 = 5364.41 (2 points)*

*Real GDP = Nominal GDP*100 /GDP Deflator*
*GPD Deflator = Nominal GDP*100/Real GDP*
*2010: GDP Deflator = 580000/5686.27 = 102*
*2011: GDP Deflator = 600000/5660.38 = 106*

*Price increase from 2011 to 2012: (108.12-106)/106 = 2% (1 point)*

**17. TRUE/FALSE** Having 0% inflation is preferable to 2% inflation. Why or why not?

*A slight price increase signals growth and relatively strong demand in the economy. Producers are confident and ready to keep and maybe increase their investments for the future.*
*A very low price increase or even 0% or negative price increase is a bad signal indicating demand is weak. Producers refrain from investing, even lay off workers when there is weak demand.*

**18. TRUE/FALSE** *(1.5 points for False)* If for a particular year, both the nominal and the real GDP growth rates are negative with the absolute value of real GDP growth rate being higher than the absolute value of nominal GDP growth rate, then we can be sure that for the year under consideration, the inflation rate was negative.

*Let the nominal growth rate be –g, and the real growth rate be –G, where g and G are positive numbers between 0 and 1, and G>g.*

*Using Fisher formula: 1-G = (1-g)/(1+f)*

*f = [(1-g)/(1-G)] -1 > 0, since G>g. (1.5 points for explanation)*

**19. TRUE/FALSE** *(1.5 points for False and 1.5 points for explanation)* When there is a recession, efforts to cut down government deficit may be counter-productive. Why or why not?

*In order to cut deficit, either government spending should be reduced, or taxes should be increased or a combination of the two. However, both of these actions would work towards reducing the GDP hence reducing the tax base as people lose their income and may have an adverse effect on the total tax collected and be counterproductive.*

**20.** Briefly explain the process through which the monetary policy works when the central bank buys government bonds.

*As the Fed (Central Bank) buys government bonds, new money is injected into the economy making it easier for the private banks to make loans to the private sector, thereby, increasing the economic activity. Also, increase in the money supply may suppress interest rates which provides further incentives for the private sector to seek loans for existing/new business ventures.*

**Numeric Problems:**

**21.** To produce one car, South Korea needs 6 times as many resources as it needs to produce one computer. For China, this number is 3.

a) *(3 points)* Does South Korea have an absolute advantage in the production of either commodity? Or does it have a comparative advantage? Does China have an absolute advantage or comparative advantage in the production of either commodity? Why or why not?

*We only know the relative amount of resources needed to produce each commodity in each country:*

| *Resources Needed* | *South Korea* | *China* |
|---|---|---|
| *Car* | *6x* | *3y* |
| *Computer* | *x* | *y* |

*Then, 1 car is exchanged for 6 computers in South Korea but only 3 computers in China.*
*Conversely, 1 computer is exchanged for 1/6 cars in South Korea and 1/3 cars in China.*

*South Korea has a comparative advantage in Computer production and China has a comparative advantage in Car Production. (2 points)*

To be able to tell whether either country has an absolute advantage, we need more information. *(1 point)*
*For example, if x=1 and y=1.5, then South Korea has an absolute advantage in Computer and China in Car production.*
*However, if x=1.5 and y=1, then they only have comparative advantage.*

b) *(3 points)* What is the price range for 1 car in terms of computers for both countries to be willing to trade?

*3 computers < 1 car < 6 computers*

**22.** (10 points) You need to borrow $100, for which the interest rate is equal to 10% ($i_{\$} = 10\%$). Alternatively, you can borrow the money in Euros, for which the interest rate would be equal to r % . The current exchange rate ($e_0$) between Dollars and Euros is $ / Euros = 1/2, that is, one Euro is equivalent to two Dollars.

The loan will be repaid in two years in two equal installments in the currency of the country it is borrowed from. There is uncertainty about the exchange rate. At the end of the first year, exchange rate ($e_1$) is equally likely to be r/0.3 or r/0.2. At the end of the second year, exchange

rate ($e_2$) is equally likely to be r/0.3 or r/0.4. What should be r for the total expected cash that will leave your pockets to be less by borrowing in Euros?

*If we borrow in dollars, we need to pay A$ per year, where:*

$A= 100\,[0.10(1.10)^2/((1.1)^2-1)] = 100\,(A/P, 10\%, 2) =$ *57.62$.* *(1 point)*

*If, instead, we borrow in Euros, we need to borrow 50 Euros now. Then, we need to pay B Euros per year, where:*

$B= 50\,[r\,(1+r)^2/((1+r)^2-1)] = 50\,(A/P, r, 2)$ *(1 point)*

*To be able to compare borrowing in Dollars to borrowing in Euros, we need to know the dollar equivalent of B which depends on different realizations of the exchange rate:*

*(2 points)* $1^{st}$ *year: B is equally likely to be* $50\,[r\,(1+r)^2/((1+r)^2-1)](0.3/r) = 15(1+r)^2/((1+r)^2-1)$
*or* $50\,[r\,(1+r)^2/((1+r)^2-1)](0.2/r) = 10(1+r)^2/((1+r)^2-1)$

*(2 points)* $2^{nd}$ *year: B is equally likely to be* $50\,[r\,(1+r)^2/((1+r)^2-1)](0.3/r) = 15(1+r)^2/((1+r)^2-1)$
*or* $50\,[r\,(1+r)^2/((1+r)^2-1)](0.4/r) = 20(1+r)^2/((1+r)^2-1)$

*Total EXPECTED cash that will leave our pockets is less if we borrow in Euros only when:*

$[(1/2)15+(1/2)10+(1/2)15+(1/2)20]\,[(1+r)^2/((1+r)^2-1)] < 2*57.62$

$r > 0.16$ *(4 points)*

**23.** (8 points) You are going to be purchasing a server for $50,000 for your business. Since it is a machine based on a new design, the life is expected to vary anywhere from 4 to 7 years with the associated probabilities as shown in the table below as well as the corresponding Salvage Values. The operation and maintenance cost is expected to be about $5,000 per year. If the interest rate is 10%, what is the expected EUAC for this server?

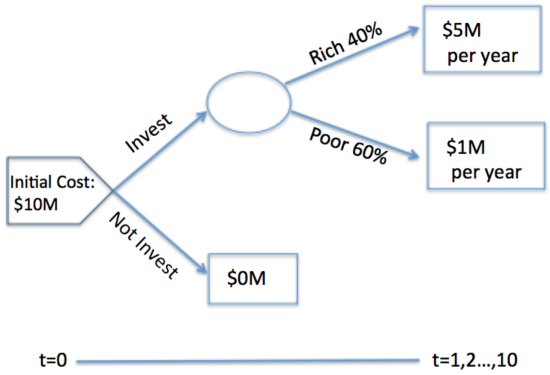
| Life, Years | 4 | 5 | 6 | 7 |
|---|---|---|---|---|
| Probability | 10% | 20% | 40% | 30% |
| Salvage Value | $20,000 | $20,000 | $30,000 | $30,000 |
| *Per year share of initial cost* | *$50,000[0.10(1.10)^2/((1.1)^2-1)] = 50,000 (A/P, 10%, 4) = $15,775* | *$50,000[0.10(1.10)^2/((1.1)^2-1)] = 50,000 (A/P, 10%, 5) =$13,190* | *$50,000[0.10(1.10)^2/((1.1)^2-1)] = 50,000 (A/P, 10%, 6) =$11,480* | *$50,000[0.10(1.10)^2/((1.1)^2-1)] = 50,000 (A/P, 10%, 7) =$10,270* |
| *Per year operation and maintenance costs* | *$5,000* | *$5,000* | *$5,000* | *$5,000* |
| *Per year share of Salvage Value* | *20,000[0.10/((1.1)^2-1)] = 20,000 (A/F, 10%, 4) =$4,310* | *20,000[0.10/((1.1)^2-1)] = 20,000 (A/F, 10%, 5) =$3,276* | *30,000[0.10/((1.1)^2-1)] = 30,000 (A/F, 10%, 6) =$3,888* | *30,000[0.10/((1.1)^2-1)] = 30,000 (A/F, 10%, 7) =$3,162* |

*Expected Equivalent Uniform Annual Cost (Expected EUAC) = 0.10*(15,775+5,000-4,310)+ 0.20*(13,190+5,000-3,276)+ 0.40*(11,480+5,000-3,888)+ 0.30*(10,270+5,000-3,162)+*

*=$13,298.5*

**24.** A mine has a 40% probability of being rich, in which case it will produce a cashflow of $5 million per year for 10 years, starting one year after the operations start. It has a 60% probability of being poor, in which case it will produce a cashflow of $1 million per year for 10 years, starting one year after the operations start. To start the operations, you need to invest $10 million. The discount rate is 10%.

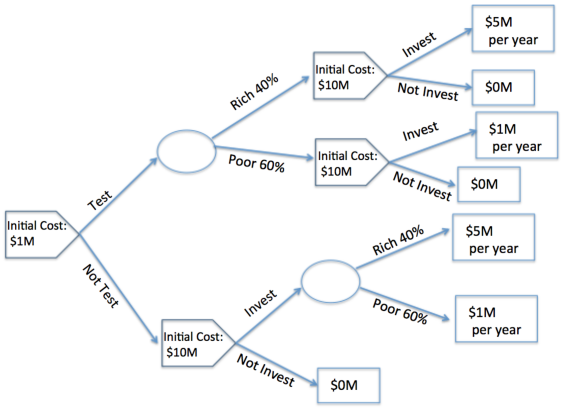
a) *(4 points)* Draw the decision tree, make sure to use the correct shapes for nodes, label them and add the probabilities when necessary and solve the decision tree (should you invest or not?)




*Expected Value of Investing = -10M + 0.40 (5M (P/A, 10%, 10) + 0.60 (1M (P/A, 10%, 10) = $5.98M*

*Since this value is positive, you should INVEST!*

b) *(6 points)* If you spend $1 million testing the mine, then, after 1 year you will learn whether the mine is rich or poor, and you can decide then whether or not to start operations. Should you test?




*If you do not test, your expected value today, at t=0, is the same as in the part (a), $5.98M.*

*If you test, your operation will be delayed for one year:*

*Expected Value of Testing = -1M+0.40 (-10M+5M (P/A, 10%, 10))/1.10 + 0.60 (0) =$10.17.*

*Expected value is higher for testing. So, you should TEST!*

**25.** (8 points) As the financial manager of a firm, you are asked to obtain $80 million for a project. You are thinking of issuing $40 million worth of bonds and issuing $40 million worth of stocks. Determine WACC (Weighted Average Cost of Capital) before and after taxes. Borrowed funds cost 10%, equity costs 20%, and the tax rate is 40%.

*Before taxes: (40/80)10%+(40/80)20% = 15%*

*After taxes: The cost of borrowed funds: $40M*10%*(1-40%) = $2.4M >>> 6%*
*The cost of funds from stocks: $40M*20% = $8M >>> 20%*
*WACC = 6% ½ + 20% ½ = 13%*

**26.** (8 points) You have three options, A, B, and, C, in the order of increasing initial costs, to install solar panels on the roof of your factory. The relevant data are shown in the table below.

| | IRR |
|---|---|
| A | 12% |
| B | 18% |
| C-B | 16 % |

Using **incremental rate of return analysis**, which alternative should you choose if MARR is 15%.

*The projects have initial costs. Then, they are "lending type". This means, we are seeking projects with IRR higher than the market rate. Since the projects are ordered in increasing costs, A has the least initial cost. When we compare A to "Do Nothing" option, we have the increment of A having 12% IRR.*

*"DO NOTHING" is preferred to A, since 15% > 12%.*

*Next step is to compare DO NOTHING to B:*

*B is preferred to DO NOTHING since 18% > 15%.*

*Next step is to compare B and C. We cannot directly compare IRRs of B and C. We need to compare them incrementally. Since the IRR of the increment (C-B) is already given, our job is easy.*
*16% > 15%, meaning Project C provides everything that project B does. Not only that, the increment of C beats the market by 1%.*

*Final Decision: Pick C!*

**I. Cost Structure and Estimation:** TC=TVC+TFC, ATC = TC/Q, MC= ΔTC /ΔQ

$$\frac{\text{Cost}_A}{\text{Cost}_B} = \frac{\text{Index}_A}{\text{Index}_B} \qquad \text{Cost}_A = \text{Cost}_B\left(\frac{\text{Size}_A}{\text{Size}_B}\right)^x$$

$T_N=T_{initial}$ x N^b, **where** b=log(learning curve rate)/log2

**II. Single Payment:**

$F = P(1+i)^n$ $F = P(F/P, i, n)$ $P = F(1+i)^{-n}$ $P = F(P/F, i, n)$

**III. Effective Rate:** $i_a = (1+\frac{r}{m})^m - 1$

**IV. Uniform Series:**

$$F = A\left[\frac{(1+i)^n - 1}{i}\right] = A(F/A, i, n) \qquad A = F\left[\frac{i}{(1+i)^n - 1}\right] = A(A/F, i, n)$$

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right] = P(A/P, i, n) \qquad P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] = A(P/A, i, n)$$

**Arithmetic Gradient Present Worth Factor:**

$$P = G\left[\frac{(1+i)^n - i\cdot n - 1}{i^2(1+i)^n}\right] = G(P/G, i, n)$$

**Arithmetic Gradient Uniform Series Factor**

$$A = G\left[\frac{(1+i)^n - i\cdot n - 1}{i(1+i)^n - i}\right]$$
$$= G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right] = G(A/G, i, n)$$

**Geometric Gradient Present Worth Factor:**

$$P = A_1\left[\frac{1-(1+g)^n(1+i)^{-n}}{i-g}\right] \quad \text{where} \quad i \neq g \qquad P = \frac{n\cdot A_1}{(1+i)} \quad \text{where} \quad i = g$$

**Capitalized Cost:** $A = Pi$

**V.** GDP = C+I+G+(X-M), Real GDP = (Nominal GDP/GDP Deflator) *100

**Fisher Formula:** (1+real rate) = (1+ nominal rate) / (1+ inflation)

**VII. Expected Value and Risk Formulas:** $Mean\ value = \frac{O+4M+P}{6}$ $1 \geq \text{Probability} \geq 0$

$\sum_{j=1 \text{ to } k} P(\text{outcome}_j) = 1$ $P(A \text{ and } B) = P(A)\times P(B)$

$$\text{Expected Value} = \sum_{\text{all } j} \text{Outcome}_j \times P(j)$$
$$= \text{Outcome}_A \times P(A) + \text{Outcome}_B \times P(B) + \cdots$$