KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

Department of Systems Engineering

ISE 307: Engineering Economic Analysis

Final Exam

Summer 2017-2018 (173)

Time: 2 hours

Name: _KEY_____

ID: _____ Section _____

- □ Dr. Syed Mujahid (Sect 1, 2)
- □ Dr. Aiman El-Maleh (Sect 3, 5)
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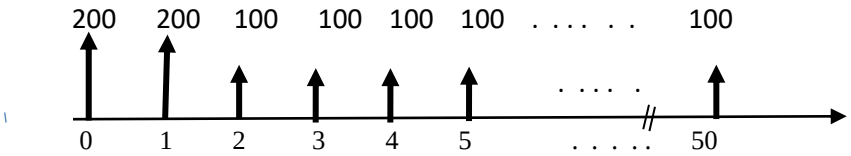
Question	Total
Points	30
Score	

Instructions:

- Mobiles are not allowed.
- Do not start before you are told to do so.
- You are not allowed to share any thing with other students.
- No questions are allowed.
- Clearly mark your answers on the answer sheet using a pencil.
- Check that you have 30 MC questions.
- Questions have equal weights.

[Question 1]

What is a single amount at year 5 equivalent to the given cash flow at an annual interest rate of 10%?

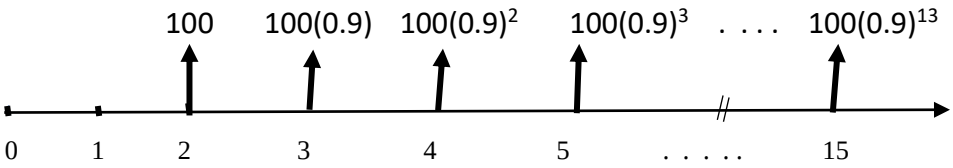


(a) 1,081.4
(b) 2,065.3
(c) 1,165.8
(d) 1,282.4

PW = 100(P/A, 10%,45)+ 100+100*1.1+100*(1.1^2)+100*(1.1^3)+200*(1.1^4)+200*(1.1^5)= 2,065.303

[Question 2]

What is the present worth of the given cash flow at an annual interest rate of 7%?



(a) 501
(b) 551
(c) 601
(d) 661

PW= [100*(1-(0.9^14) *(1.07^-14))/(0.07+0.1)](1.07)^-1=500.98

[Question 3]

Saudi Textile is planning a project. The project requires an investment of SR 300,000 in 2018. It is expected to provide a net annual income of SR 88,000 for 8 years. The company's MARR is 10%. What is the conventional payback period for the project?

(a) Between 2 and 3 years
(b) Between 3 and 4 years
(c) Between 4 and 5 years
(d) Between 5 and 6 years

0		-300000
1	88000	-212000
2	88000	-124000
3	88000	-36000
4	88000	52000

[Question 4]

Abdulla is planning to create a fund that will provide money for people in need. It will generate $90,000 every year for all future years staring three years from now. The bank's interest rate is 6%. How much does he need to deposit in the bank now to achieve this?

(a) $ 1,500,000
(b) $ 1,334,995
(c) $ 1,259,429
(d) $ 1,421,100

PW=(90,000/0.06)*1.06^-2= 1,334,994.66

[Question 5]

Dammam Aluminum Factory purchased a Press Machine for 200,000. The company is using Straight Line depreciation method to depreciate the machine over 8 years and the salvage value at the end of year 8 is 40,000. What is the book value of the machine at end of year 5?

(a) 100,000
(b) 75,000
(c) 40,000
(d) 20,000

D = (200,000-40,000)/8 = 20,000
B5= 200,000-5*20,000=100,000

[Question 6]

Jubail Brick Factory purchased a machine for mixing Cement. The Invoice price for the machine is 140,000. Installation and site preparation costs are 20,000. The company is using 150% Declining Balance depreciation method to depreciate the machine over 15 years and the salvage value at the end of useful life is 8,000. What is the book value of the machine at end of year 2?

(a) 113,400
(b) 136,800
(c) 119,700
(d) 129,600

0		160000
1	16000	144000
2	14400	129600

[Question 7]

AL-Hasa Date Plant purchased a machine for packaging dates. The cost basis for the machine is 100,000. The company is using 200% Declining Balance depreciation method. The useful life of the machine is 4 years with a salvage value of 30,000 at the end of its useful life. What is the allowable amount of depreciation in the second year?

(a) 30,000
(b) 25,000
(c) 20,000
(d) 15,000

0		100000
1	50000	50000
2	20000	30000

[Question 8]

Texas Milk Farm purchased a Cooling Machine for $80,000. It is classified as 5-year MACRS asset. It was sold at end of the third year for $18,000. Assuming a tax rate of 35%, what is the net proceeds from the sale of the machine?

(a) $13,548
(b) $22,452
(c) $19,746
(d) $16,236

Book value = 80,000*(5.76+11.52+11.52+19.2/2)/100 = 30,720
Gain = 18,000-30720=-12,720
Tax gain =-12,720*0.35= -4,452
Net proceeds = 18,000+4,452=22,452

[Question 9]

Abdullah Steel Company purchased Steal Pressing Machine for $180,000. It can be used to produce 5000 units. The salvage value at end of its useful life is $8,000. The tax rate is 35%. What is the allowed depreciation in the first year knowing that it was used to produce 700 units?

(a) $24,080
(b) $25,200
(c) $ 8,428
(d) $17,914

Dep=700/5,000*(180,000-8,000) = 24,080

[Question 10]

New York Steel (NYS) purchased a machine for $220,000. It is classified as 7-year MACRS asset. It is expected to be used for 10 years with a salvage value of $20,000. What is the allowable depreciation in year 5 for tax depreciation purpose?

(a) $19,646
(b) $20,000
(c) $17,860
(d) $15,971

D5 =22,0000*8.93/100 = 19,646

[Question 11]

Given that prices are increasing at an annual rate of 4% in the first year and 10% in the second year. Determine the average inflation rate (f) over these two years.

(a) 7.04
(b) 7.00
(c) 6.96
(d) 6.92

$(1+f)^2 = (1+0.04)\ (1+0.10)$

f = [SQRT [(1+0.04) *(1+0.10)]-1] *100 = 6.96

[Question 12]

Suppose that you borrowed an amount of money to be paid back monthly over five years at 9% yearly nominal interest rate. Assume that the average general inflation rate per month is expected to be 0.25%. Given that the monthly payment in actual dollars is $1000, compute the equivalent equal monthly payment in constant dollars.

(a) 925.59
(b) 931.49
(c) 992.62
(d) None of the above

P = 1,000(P/A, 0.09/12, 60) = 1000*48.1733735= 48,173.37
im' = (im–fm')/(1+fm') = 0.005006
A= 48,173.37(A/P, 0.005006, 60) = 48,173.37*0.01933628=931.49

[Question 13]

You invest in a piece of equipment that will be used for three years. The machine will be used for 1,000 hours during the first year, 3,000 hours during the second year and 5,000 hours during the third year. The expected annual savings associated with the use of the piece of equipment will be $15,000. If your interest rate is 15%, what would be the net savings generated per machine hour?

(a) $5.99
(b) $5.66
(c) $5.33
(d) $5.00

AE(15%)=[1,000C(P/F,15%,1) +3,000C(P/F,15%,2) +5,000C(P/F,15%,3)] (A/P,15%,3) = 2,814.25C
C = 15,000/2814.25=5.33

[Question 14]

You invest in a piece of equipment costing $50,000. The equipment will be used for three years, at the end of which the salvage value of the machine is expected to be $10,000. The expected savings associated with the use of the piece of equipment will be $30,000 during the first year, 35,000 during the second year and $40,000 during the third year. If your interest rate is 10%, what would be the annual savings associated with the use of the piece of equipment?

(a) $34,682.8
(b) $51,767.4
(c) $17,084.6
(d) $17,598.2

CR(10%)=(50,000-10,000) (A/P,10%,3)+0.10*10,000= 17,084.6
PWsavings(10%) = 30,000(P/F,10%,1)+35,000(P/F,10%,2)+40,000(P/F,10%,3)= 86,250.9
AEsavings(10%)=86,250.9(A/P,10%,3) = 34,682.8
AE(10%)= 34,682.8-17,084.6=17,598.2

[Question 15]

A machine purchased for $46,000, has a depreciable life of five years. It will have an expected salvage value of $1000 at the end of the depreciable life. Using the double-declining balance (200% DB) method with switching to straight line method, what is the depreciation amount for year 4?

(a) $3,974
(b) $4,468
(c) $4,968
(d) None of the above

n	Depreciation	Book Value	Depreciation SL	Depreciation DDB
0		46000		
1	18400.0	27600.0	9000.0	18400.0
2	11040.0	16560.0	6650.0	11040.0
3	6624.0	9936.0	5186.7	6624.0
4	4468.0	5468.0	4468.0	3974.4
5	4468.0	1000.0	4468.0	2187.2

[Question 16]

Suppose that you placed a commercial building (warehouse) in service in February 2016. The cost of the building excluding the cost of land is $200,000. Assume that the building cost depreciates in 39 years. The building was sold in October 2018 for $150,000. Determine the book value of the building at the time of sale.

(a) $196,474.36
(b) $196,581.20
(c) $185,897.44
(d) $186,324.79

One-year depreciation = 200,000/39 = 5,128.21
Total depreciation = (10.5/12+1+9.5/12) * 5,128.21=13,675.21
Book Value = 200,000-13,675.21=186,324.79

[Question 17]

Given an asset that has a cost basis of $300,000 and was sold for $350,000. The book value for the asset at the time of sale was $150,000. Assume that the capital gain tax rate is 40% while the ordinary gain tax rate is 20%. What are the net proceeds from this sale?

(a) $300,000
(b) $250,000
(c) $200,000
(d) $150,000

= 350,000 – [(350,000-300,000) *0.40 + (300,000-150,000) *0.20]
= 350,000 – [20,000 + 30,000] = 300,000

[Question 18]

Given a machine that costs $100,000 and has a service life of 5 years. The market value decreases by 20% each year. The annual net revenues for the machine after taxes are $40,000. What is the economic service life for the machine at MARR=15%?

(a) N=1
(b) N=3
(c) N=5
(d) It cannot be concluded from the given information

[Question 19]

Given a defender and a challenger that have a service life of 6 years. Assume that the economic service life for the defender, Nd*=3, and AECd* = $168,992 and that the economic service life for the challenger, Nc*=6, and AECc* = $169,757. Then, the following can be concluded about when the defender should be replaced by the challenger:

(a) The defender should be replaced immediately by the challenger
(b) The defender should be replaced by the challenger at the end of the third year
(c) The defender should not be replaced by the challenger at all
(d) It cannot be concluded from the given information

Questions 20 and 21 are related to the following scenario

Consider the data given for the following three projects:

P1	***P2***	***P3***	***P1-P2***	***P1-P3***	***P2-P1***	***P2-P3***	***P3-P1***	***P3-P2***
-320	-130	-250	-190	-70	190	120	70	-120
200	100	200	100	0	-100	-100	0	100
300	200	250	100	50	-100	-50	-50	50
500	300	400	200	100	-200	-100	-100	100
IRR = 71%	IRR = 106%	IRR = 83%	IRR = 42%	IRR = 34%	IRR = 42%	IRR = 49%	IRR = 34%	IRR = 49%

[Question 20]

Which project is the best among the above three projects, if MARR is 40%?

(a) P1
(b) P2
(c) P3
(d) None of the projects is acceptable

Compare P2 and P3 ➔ P3 is the best. Then compare P3 and P1 ➔ P3 is the best.

[Question 21]

Which project is the best among the above three projects, if MARR is 60%?

a) P1
b) P2
c) P3
d) None of the projects is acceptable

Compare P2 and P3 ➔ P2 is the best. Then compare P2 and P1 ➔ P2 is the best.

The following is related to Questions 22 and 23

The following data for a defender and a challenger in the tables given below show the market value, operation and maintenance cost (O&M Cost), capital recovery cost (CR), annual operation cost (AOC) and annual equivalent cost (AEC). Assuming 15% MARR and that the service of either machine is needed for an indefinite period of time.

Defender					
n	Market Value	O&M Cost	CR(15%)	AOC(15%)	AEC(15%)
0	$250,000				
1	$200,000	$100,000	$87,500	100000	$187,500
2	$160,000	$115,000	$79,360	106976.7	$186,337
3	$128,000	$130,000	$72,633	113606.9	$186,240
4	$102,400	$145,000	$67,059	119893.9	$186,953
5	$81,920	$160,000	$62,429	125842.2	$188,271

Challenger					
n	Market Value	O&M Cost	CR(15%)	AOC(15%)	AEC(15%)
0	$420,000				
1	$315,000	$80,000	$168,000	$80,000	$248,000
2	$236,250	$80,000	$148,465	$80,000	$228,465
3	$177,188	$80,000	$132,924	$80,000	$212,924
4	$132,891	$80,000	$120,498	$80,000	$200,498
5	$99,668	$80,000	$110,510	$80,000	$190,510

[Question 22]

What is the economic service life for the defender?

(a) N=1
(b) N=2
(c) N=3
(d) N=4

[Question 23]

Determine when the defender should be replaced by the challenger.

(a) Immediately.
(b) At the end of the third year.
(c) At the end of the fourth year.
(d) At the end of the fifth year.

Economic service life of defender, N_d*=3, and AECd* = $186,240.
Economic service life of challenger, N_c*=5, and AEC_{c*} = $190,510.
Since AEC_{d*}=$186,240< AEC_{c*} =$190,510, then we need to keep the defender for its economic service life i.e., 3 years.
Next, we need to find the cost of using the defender for the fourth year. I=$128,000, S= $102,400, OMC=$145,000
Cost=$128,000(F/P,15%,1)+$145,000-$102,400= $128,000*1.15+145,000-$102,400 = $189,800
Since $189,800 <AECc*=$190,510, we should keep the defender for the fourth year.
Next, we need to find the cost of using the defender for the fifth year.
I = $102,400, S = $81,920, OMC = $160,000
Cost=$102,400(F/P,15%,1)+$160,000-$81,920= $102,400*1.15+160,000-$81,920= $195,840
Since $195,840 >AECc*=$190,510, we should replace the defender by the end of the fourth year.

Questions 24 and 25 are related to the following scenario.

Consider the following three options to buy a car:

Option A: Purchase the vehicle at a price of $25,000 to be paid immediately from your savings.

Option B: Purchase the car at the nominal price of $30,000, that is, pay $30,000 for the vehicle over the next 36 months with equal monthly payments. The auto dealer will be charging 2% APR compounded monthly.

Option C: Purchase the vehicle through a bank. The bank will pay the car dealer and you pay the bank 8 quarterly payments the amount of $3300 starting from now.

Assume your earning interest rate is 6% compounded monthly.

[Question 24]

What is the present worth of Option-A?

(a) $30,000

(b) $28,245

(c) $21,849

(d) $23,768

$$A = 30000(A|P, \frac{2\%}{12}, 36) = 859.28$$

$$i_{earning} = 0.06/12 = 0.005$$

$$PW_{option-B} = 859.28(P|A, 0.0.005, 36) = 28{,}245.32$$

[Question 25]

Which of the three options is economically least costly w.r.t. PW criterion?

(a) Option-A only

(b) Option-B only

(c) Option-C only

(d) Both Options B and C

$$i_Q = \left(1 + \frac{0.06}{12}\right)^3 - 1 = 0.015$$

$$PW_{option-C} = 3300 + 3300(P|A, 0.015, 7) = 25{,}067.76$$

Questions 26-28 are related to the following scenario.

Consider the following mutually exclusive projects:

Project-A has an initial investment of $150,000, and the most likely values of the variables are given as follows: The net revenue per unit is 15. The project will be executed for 4 years, after that the equipment is salvaged for $10,000. The demand growth rate is 2%, and the initial demand is 2000 units per year.

Project-B has an initial investment of $100,000, and the most likely values of the variables are given as follows: The net revenue per unit is 45. The project will be executed for 4 years, after that the equipment is salvaged for $1,000. The demand growth rate is 6%, and the initial demand is 1000 units per year.

[Question 26]

Which of the following statements is correct? Ignore taxes, depreciation, and assume MARR = 10%?

(a) Project-A is more sensitive w.r.t. revenue per unit, than compared to Project-B.

(b) Project-A is less sensitive w.r.t. revenue per unit, than compared to Project-B.

(c) Project-A and Project-B are equally sensitive w.r.t. revenue per unit.

(d) Further information is needed to conduct the sensitivity analysis w.r.t. revenue per unit.

$$PW_A = -150000 + 10000\left(\frac{P}{F}, 10\%, 4\right) + X * 2000(P|A, 2\%, 10\%, 4) = -143169.87 + (6517.11)X$$

$$PW_B = -100000 + 1000\left(\frac{P}{F}, 10\%, 4\right) + X * 1000(P|A, 6\%, 10\%, 4) = -99317 + (3442.78)X$$

Slope is higher for Project A.

[Question 27]

Let us say that the demand growth rate of Project-B is uncertain, and it is varying from 2% to 8%. The other variables for Project-B are certain, and equal to the most likely values. Furthermore, let us say that for Project-A, all variables are certain, and equal to the most likely values. Which of the following statements is correct? Ignore taxes, depreciation, and assume MARR = 10%.

(a) In the worst case w.r.t. the growth rate, Project-A performs better than Project-B.

(b) In the best case w.r.t. the growth rate, Project-A performs better than Project-B.

(c) Always Project-B performs better than Project-A.

(d) Due to uncertainty, sometimes Project-B performs better than Project-A, and vice versa.

$$PW_B @\ 2\%\ growth\ rate = -100000 + 1000\left(\frac{P}{F}, 10\%, 4\right) + 45 * 1000(P|A, 2\%, 10\%, 4) = 47{,}317.92$$

$$PW_B @\ 8\%\ growth\ rate = 100000 + 1000\left(\frac{P}{F}, 10\%, 4\right) + 45 * 1000(P|A, 8\%, 10\%, 4) = 59{,}910.42$$

$$PW_A = -150000 + 10000\left(\frac{P}{F}, 10\%, 4\right) + 15 * 2000(P|A, 2\%, 10\%, 4) = -45413.26 < 0$$

[Question 28]

What is the break-even demand for Project-A? Ignore taxes, depreciation, and assume MARR = 10%?

(a) 2000 units roughly

(b) 2500 units roughly

(c) 3000 units roughly

(d) 3500 units roughly

$$PW_A = -150000 + 10000\left(\frac{P}{F}, 10\%, 4\right) + 15 * D * (P|A, 2\%, 10\%, 4) = -143169.87 + (48.88)D$$

$$=> \quad -143169.87 + (48.88)D = 0 \quad or \quad D = 2929.11$$

[Question 29]

An equipment is to be purchased at a cost of $50,000. The operating and maintenance expenses for the first year are $5000, and every year the costs increase by $2500 from the previous year. A fixed revenue of $30,000 is generated by the equipment every year. The salvage value of the equipment drops by 50% from its previous year's market value. What is the economic service life of the equipment? Ignore taxes, depreciation, and assume rate of return is 10%.

(a) 1 year
(b) 2 years
(c) 3 years
(d) More than 4 years

n	Market Value	O&M Cost	Revenue	Net Income	CR	AE(income)	AE
0	50000						
1	25000	5000	30000	25000	$30,000	$25,000	($5,000)
2	12500	7500	30000	22500	$22,857	$23,810	$952
3	6250	10000	30000	20000	$18,218	$22,659	$4,441
4	3125	12500	30000	17500	$15,100	$21,547	$6,447
5	1562.5	15000	30000	15000	$12,934	$20,475	$7,541

[Question 30]

A company is considering the acquisition of a new machine. The machine's price is $60,000. This machine falls into the MACRS five-year class. It will be sold after five years for $10,000. The machine purchase will have no effect on revenues, but it is expected to save the firm $15,000 per year in before-tax operating costs. The firm's marginal tax rate is 30%. What is the net cash flow at year 5?

(a) $20,610
(b) $20,210
(c) $22,684
(d) $22,284

	Year 5
Income Statement	
Revenues (savings)	$15,000
Expenses:	
Depreciation	3,456
Taxable Income	$11,544
Income Taxes	3,463
Net Income	$8,081
Cash Flow Statement	
Operating Activities:	
Net Income	$ 8,081
Depreciation	$ 3,456
Investment Activities:	
Investment	
Salvage	10,000
Gains Tax	(926)
Net Cash Flow	$ 20,610

Depreciation=60000(11.52%/2)=3,456
Book Value: 60000*(5.76%+11.52%/2) = 6,912
Gain (or loss): 10,000-6,912 = 3,088
Gain tax (or credit): 3,088*0.30 = 926.4