

**ENGINEERING ECONOMICS
ECO 1192**

Practice Examination #3

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1. If you apply a breakeven analysis to two mutually exclusive projects that have the same revenues but different costs, which of the following criteria would you use to determine the range over which one project is better than another?
 - a) maximum criterion
 - b) minimum criterion
 - c) minimum and maximum criteria
 - d) none of these answers.
2. Scenario analysis allows an analyst to examine the sensitivity of a summary measure (e.g., Present Worth) to changes to individual project parameters.
 - a) True
 - b) False

QUESTIONS 3 TO 6

- **A car manufacturer must decide on purchasing or making specific car parts.**
 - **The total cost (\$) of making the car parts is $\$50,000 + 5x$.**
- **The cost of buying the car parts from a manufacturer is $C = 25x$**

where "x" represents the annual quantity of car parts.

3. What is the variable production cost of making 10,000 car parts?
 - a) \$50,000
 - b) 100,000
 - c) 150,000
 - d) None of these answers.

4. What is the fixed production cost of making 10,000 car parts?
 - a) $50,000 + 5x$
 - b) 50,000
 - c) $25x$
 - d) None of these answers.

5. What is the breakeven point between buying and making car parts?
 - a) 25
 - b) 2,500
 - c) Cannot be determined from the information given.
 - d) None of these answers.

6. Over what range is it cheaper (less costly) to make car parts?
 - a) Less than the breakeven point
 - b) More than the breakeven point
 - c) At the breakeven point
 - d) None of these answers.

7. In an uncertain future environment, the decision-maker has sufficient information to determine the probability of occurrence of future events or outcomes.
 - a) True
 - b) False

8. When an analyst examines the impact of changing one project parameter at a time on a summary measure (e.g., Present Worth), the analyst is performing
 - a) Breakeven analysis
 - b) Capital rationing
 - c) Scenario analysis
 - d) None of these answers.

QUESTIONS 9 to 11

Projects	NPW of $\$$			
	Future $\$$ of Nature			
	<u>W</u>	<u>X</u>	<u>Y</u>	<u>Z</u>
A	20	15	16	18
B	16	10	12	20
C	15	19	14	11
D	14	10	9	14
E	11	14	8	10

9. Based on the Maximax principle, the best project is

- a) A
- b) B
- c) C
- d) D
- e) E

10. Based on the Hurwicz principle (with an index of optimism = 0.6), the best project is

- a) A
- b) B
- c) C
- d) D
- e) E

11. The Maximax and Hurwicz principles are identical if the index of optimism is equal to

- a) 0
- b) 0.5
- c) 1
- d) 2
- e) None of the above answers.

QUESTIONS 12 to 18

A firm is considering the purchase of a truck for \$200,000 fully installed. It is expected to last 3 years with a salvage value of \$50,000 at that time.

- Annual revenues are expected to be \$300,000 in the first year and to grow thereafter at an annual rate of 5%.
- Annual operating and maintenance costs are expected to be \$100,000 in the first year and to grow thereafter at an annual rate of 3%.
 1. Depreciate the truck using the DB method ($d=25\%$)
 2. The half-year rule **does not** apply.
 3. The before-tax with inflation interest rate is 20%.
 4. The before-tax inflation-free interest rate is 15%.
 5. The after-tax with inflation interest rate is 10%.
 6. The after-tax inflation-free interest rate is 5%.
 7. Inflation is 5% annually.
 8. The tax rate = 50%

The firm gets a \$100,000 loan (at a 10% rate of interest) which is repaid as follows:

Loan Repayment at End of Year	Percentage of Loan Repaid
1	20%
2	30%
3	50%

Item	Years			
	0	1	2	3
1. BTCF (Actual \$)	-200,000	AA	BB	
2. BTCF (Constant \$)	CC	DD	EE	
3. Interest on Loan				
4. Depreciation				
5. Taxable Income				
6. Taxes Payable				
7. ATCF (Actual \$)				
8. ATCF (Constant \$)	FF			
9. Repayment of Loan				
3. Interest on Loan				
10. CFOE (Actual \$)				
11. CFOE (Constant \$)	GG			

12. The dollar value of **AA** is
- 200,000
 - $200,000(1+0.05)^{-1}$
 - $200,000(1+0.10)^{-2}$
 - $200,000(1+0.15)^{-3}$
13. The dollar value of **BB** is
- $300,000(1.05)-100,000(1.03)^{-1}$
 - $300,000-100,000$
 - $300,000(1.05)-100,000(1.03)$
 - $300,000(1.05)^{-1}-100,000(1.03)^{-1}$
14. The dollar value of **CC** is
- 200,000
 - $-200,000(1+0.05)$
 - $-200,000(1+0.05)^{-1}$
 - $-200,000(1+0.05)^{-2}$
 - None of the above answers.

15. The dollar value of **DD** is
a) 200,000
b) $200,000(1+0.05)^{-1}$
c) $200,000(1+0.10)^{-2}$
d) None of these answers.
16. The dollar value of **EE** is
a) $300,000(1.05)-100,000(1.03)$
b) $300,000-100,000$
c) $\{300,000(1.05)-100,000(1.03)\}(P/F,5\%,2)$
d) $300,000(1.05)^{-1}-100,000(1.03)^{-1}$
17. The dollar value of **FF** is
a) -200,000
b) $-200,000(1+0.05)$
c) $-200,000(1+0.05)^{-1}$
d) $-200,000(1+0.05)^{-2}$
e) None of the above answers.
18. The dollar value of **GG** is
a) -200,000
b) -100,000
c) $-200,000(1+0.05)$
d) $-100,000(1+0.05)$
e) None of the above answers.

QUESTIONS 19 TO 22

- Mary bought a five-year \$20,000 Guaranteed Income Certificate (GIC) on January 1, 2010 (for which she paid \$20,000).
- She will receive \$1,300 in interest income on December 31 from 2010 to 2014.
- The GIC will mature on December 31, 2014 at which time Mary will receive, in addition to her last interest payment of \$1,300, the \$20,000 that she invested on January 1, 2010.
- During this period, annual inflation is expected to be 5 percent.

19. What is Mary's precise nominal (with inflation) rate of interest on the GIC?
a) Solve for i^* from $20,000 = 1,300(P/A, i^*, 5)$
b) $100(1,300/20,000)$
c) 5.00%
d) 6.5%
20. What is Mary's precise real (inflation-free) rate of interest on the GIC?
a) $(1+\text{nominal rate})(1+\text{inflation rate}) - 1$
b) Nominal rate – inflation rate
c) $\{(1+\text{nominal rate}) \div (1+\text{inflation rate})\} - 1$
d) Inflation rate (=5.00%)
e) None of these answers
21. If the annual interest income Mary receives from the GIC can be reinvested at the nominal rate in question 18 during the 5-year life of the GIC, what will be the value of her \$20,000 investment and interest income on December 31, 2014 in current (nominal) dollars?
a) $\$20,000(P/F, \text{nominal rate}, 5)$
b) $\$20,000(F/P, \text{nominal rate}, 5)$
c) $\$1,300(F/A, \text{nominal rate}, 5)^5$
d) $\$20,000 + 5(1,300)$
e) None of the above answers.
22. What is the inflation-free dollar value of the interest income Mary receives at the end of the 4th year (i.e., on December 31, 2013)?
a) $\$1,300(P/F, 5\%, 3)$
b) $\$1,300(P/F, 5\%, 4)$
c) $\$1,300(F/P, 5\%, 4)$
d) $\$1,300(F/A, 5\%, 4)$
e) None of these answers.

QUESTIONS 23 TO 30

**P = \$100,000; SV = \$10,000; AR = \$100,000
AC = \$50,000; N = 10 years; MARR = 10%**

PRESENT WORTH VALUES

	-15%	-10%	-5%	Base Case	5%	10%	15%
P (\$)	AA						
SV (\$)							
AR (\$)							BB
AC (\$)							
N (yrs)		CC					
MARR (%)						DD	

23. The Present Worth of cell **AA** is
 a) $-100,000 + (100,000 - 50,000)(P/A, 10\%, 10)(1.15) + 10,000(P/F, 10\%, 10)$
 b) $-100,000(1.15) + (100,000 - 50,000)(F/A, 10\%, 10) + 10,000(P/f, 10\%, 10)$
 c) $-100,000(0.85) + (100,000 - 50,000)(P/A, 10\%, 10) + 10,000(P/F, 10\%, 10)$
 d) $-100,000(0.85) + (100,000 - 50,000)(P/A, 10\%, 10) + 10,000(0.85)(P/F, 10\%, 10)$
 e) None of the above answers.
24. The Present Worth of cell **BB** is
 a) $-100,000 + (100,000 - 50,000)(P/A, 10\%, 10)(1.15) + 10,000(P/F, 10\%, 10)$
 b) $-100,000(1.15) + (100,000 - 50,000)(F/A, 10\%, 10) + 10,000(P/f, 10\%, 10)$
 c) $-100,000 + (100,000(1.15) - 50,000)(P/A, 10\%, 10) + 10,000(P/F, 10\%, 10)$
 d) $-100,000 + (100,000 - 50,000)(P/A, 10\%(1.1), 10) + 10,000(P/F, 10\%(0.9), 10)$
 e) None of the above answers.
25. The Present Worth of cell **CC** is
 a) $-100,000 + (100,000 - 50,000)(P/A, 10\%, 10)(1.15) + 10,000(P/F, 10\%, 10)$

- b) $-100,000+(100,000-50,000)(P/A,10\%,10(0.9))+10,000(P/F,10\%,10(0.9))$
 c) $-100,000(0.85) + (100,000-50,000)(P/A,10\%,10)+10,000(P/F,10\%,10)$
 d) $-100,000(0.85)+(100,000-50,000)(P/A,10\%,10)+10,000(0.85)(P/F,10\%,10)$
 e) None of the above answers.
26. The Present Worth of cell **DD** is
 a) $-100,000+(100,000-50,000)(P/A,10\%(1.1),10)+10,000(P/F,10\%(1.1),10)$
 b) $-100,000(1.15)+(100,000-50,000)(F/A,10\%,10)+10,000(P/F,10\%,10)$
 c) $-100,000(0.85) + (100,000-50,000)(P/A,10\%,10)+10,000(P/F,10\%,10)$
 d) $-100,000(0.85)+(100,000-50,000)(P/A,10\%,10)+10,000(0.85)(P/F,10\%,10)$
 e) None of the above answers.
27. Which project parameter is most influential on the decision criteria (PW in this case)?
 a) Initial cost (P)
 b) Annual revenues (OR)
 c) Annual cost (OC)
 d) MARR
 e) Project life (N)
28. Which project parameter is least influential on the decision criteria (PW in this case)?
 a) Initial cost (P)
 b) Annual revenues (OR)
 c) Annual cost (OC)
 d) MARR
 e) Salvage value (SV)
29. What dollar value (nearest \$100) of the initial cost would lead to project breakeven (PW=\$0)?
 a) -\$100,000
 b) -\$200,000
 c) -\$311,100
 d) None of these answers.
30. What dollar value (nearest \$100) of the annual operating revenues would lead to project breakeven (PW=\$0)?
 a) \$65,600
 b) \$100,000
 c) \$165,600
 d) None of these answers.

QUESTIONS 31 to 32

The economic viability of a specific project depends on its deterministic and random variables.

Project managers are convinced that the three following project parameters are known with **complete certainty**:

- MARR = 10%
- Life = 10 years

The four project variables are:

1. Initial cost (three possible values as shown in the following table)
2. Annual revenues (four possible values as shown in the following table)
3. Annual cost (three possible values as shown in the following table).
4. Salvage value (two possible values as shown in the following table).

<u>Initial Cost (\$)</u>	<u>Annual Revenues</u>	<u>Annual Cost</u>	<u>Salvage Value</u>
\$5,000	\$10,000	\$4,000	\$2,000
\$6,000	\$15,000	\$6,000	\$3,000
\$7,000	\$20,000	\$8,000	
	\$25,000		

31. The 10th simulation of a project's NPW is calculated from a combination of deterministic and random variables. If the random number associated with the annual revenue variable for this simulation were 0.6, the calculation of the NPW would be based on annual revenues of
- a) \$10,000
 - b) \$15,000
 - c) \$20,000
 - d) \$25,000
32. The 50th simulation of the project's NPW is also calculated from a combination of deterministic and random variables. If the random number associated with the salvage value variable were 0.8, the calculation of the NPW would be based on a salvage value of
- a) \$2,000
 - b) \$3,000

QUESTION 33-36

This table provides information on the discrete random project variables and their probabilities of occurrence.

<u>First Cost (P)</u>		
P1 =	20,000	0.4
P2 =	32,000	0.6
<u>Net annual revenues (AR-AC)</u>		
AR1-AC1 =	15,000	0.7
AR2 - AC2 =	25,000	0.3
<u>Salvage Value (SV)</u>		
SV1 =	2,000	0.2
SV2 =	5,000	0.8
<u>MARR</u>		
MARR1 =	8%	0.9
MARR2 =	10%	0.1
<u>Project Life (N)</u>		
N1 =	5	0.7
N2 =	10	0.3

33. What is the expected first cost?
a) \$26,000
b) \$20,000
c) $(20,000+32,000) \div 2$
d) $0.4(20,000) + 0.6(32,000)$
e) None of the above answers.
34. The method of using the expected values of a project's variables to determine its NPW is known as
a) Monte Carlo simulation.
b) The expected value of the project's NPW.
c) The NPW of expected values.

- d) Sensitivity analysis.
35. The method of using all possible combinations of a project's variables to determine its NPW is known as
 a) Monte Carlo simulation.
 b) The expected value of the project's NPW.
 c) The NPW of expected values.
 d) Sensitivity analysis.
36. The method of randomly selecting a project's variables to determine its NPW is known as
 a) Monte Carlo simulation.
 b) The expected value of the project's NPW.
 c) The NPW of expected values.
 d) Sensitivity analysis.
37. Which of the following answer(s) do(es) not apply to a project's critical path?
 a) It is the project path with the longest duration.
 b) The activities on the critical path have no slack (float).
 c) The critical path can change as activities are crashed.
 d) Answers a), b) and c) apply to the critical path.
 e) Answer b) does not apply to the critical path.
38. Which of the following answers is incorrect?
 a) $EF = ES + T$
 b) $LS = LF - T$
 c) $ES = \text{Min}(EF \text{ of immediate predecessors})$
 d) $LF = \text{Min}(LS \text{ of successor activities})$
 e) $S = LS - ES = LF - EF$

Questions 39 to 50							
Activity	1	2	3	4	5	6	7
Predecessor	-	1	2	2	3,4	4	5,6
Duration (weeks)	4	3	2	4	4	5	3

39. Find the earliest start (ES) for activity 2. a) 0; b) 4; c) 7; d) 11; e) 16
40. Find the earliest start (ES) for activity 3. a) 0; b) 4; c) 7; d) 11; e) 16

41. Find the earliest start (ES) for activity 5. a) 0; b) 4; c) 7; d) 11; e) 16
42. Find the earliest finish (EF) for activity 3. a) 4; b) 9; c) 11; d) 15; e) 19
43. Find the earliest finish (EF) for activity 5. a) 4; b) 9; c) 11; d) 15; e) 19
44. Find the latest start (LS) for activity 2. a) 4; b) 7; c) 10; d) 12; e) 16
45. Find the latest start (LS) for activity 6. a) 4; b) 7; c) 10; d) 11; e) 16
46. Find the latest finish (LF) for activity 4 a) 4; b) 7; c) 11; d) 16; e) 19
47. Find the latest finish (LF) for activity 2. a) 4; b) 7; c) 11; d) 16; e) 19
48. Activities on this project's critical path are
 - a) 1,2,4,7
 - b) 1,2,4,6,7
 - c) 1,3,4,5,7
 - d) 1,2,3,5,7

Activity	Completion Time (Weeks)		Cost (Thousands \$)	
	Normal	Crashed	Normal (Cost/Week)	Weekly "Crashing" cost added to the "Normal" cost*
1	4	3	600 (150/week)	100
2	3	2	300 (100/week)	90
3	2	1	250 (125/week)	110
4	4	2	480 (120/week)	120
5	4	2	480 (120/week)	125
6	5	4	300 (60/week)	80
7	3	Not "crashable"	300	

Note *: If activity 1 were "crashed" by 1 week, for example, its completion cost would equal its normal completion cost + the cost of "crashing" the activity by 1 week = 600 + 100 = 700

49. The normal cost of completing this project is
- a) \$2100
 - b) \$2500
 - c) \$2710
 - d) \$2880
50. If the project's normal completion time were unsatisfactory to its sponsors, which activity would you crash" to reduce the project's normal completion time by 1 week?
- a) activity 1
 - b) activity 3
 - c) activity 6
 - d) activity 7

Questions 51 to 54

You are a recent University of Ottawa engineering graduate who has developed a computer service which is the envy of several established computer firms. With the considerable interest in your product, you are struggling with the decision to sell the product to the highest bidder or to set up your own company to market the product.

The Table below provides the information for a decision tree to assist you deciding on the better course of action.

Questions 51 to 54

DECISION ?	MARKET	Strong Demand (Prob. = 0.2)	Canada- wide sales	Strong Demand	Probability =0.5	Payoff (PW) = 12
				Weak Demand	Prob. = 0.5	Payoff (PW) = 1 14
			Ontario sales only	Strong Demand	Prob. =0.7	Payoff (PW) = 10
				Weak Demand	Prob. = 0.3	Payoff (PW) = -5
		Weak Demand (Prob. = 0.8)	Canada- wide sales	Strong Demand	Prob. =0.8	Payoff (PW) = 7
				Weak Demand	Prob. = 0.2	Payoff (PW) = -4
			Ontario sales only	Strong Demand	Prob. =0.6	Payoff (PW) = 8
				Weak Demand	Prob. = 0.4	Payoff (PW) = -3
	SELL			Prob. = 1	9	

51. If you decide to market your invention (instead of selling it) and market demand is projected to be strong (probability of 0.2), your expected payoff (i.e., the expected PW) is
- \$4.6
 - 6.3
 - 9
 - 13
52. If you decide to market your invention (instead of selling it) and market demand is projected to be weak (probability of 0.8), your expected payoff (i.e., the expected PW) is
- \$4.6
 - 6.3
 - 9
 - 13
53. If you decide to market your invention (instead of selling it), your expected payoff (i.e., the expected PW) is
- \$4.6
 - 6.3
 - 9

d) 13

54. If you decide to sell your invention (instead of marketing it), your expected payoff (i.e., the expected PW) is
- a) \$4.6
 - b) 6.3
 - c) 9
 - d) 13

Questions 55 to 60

The acceptance or refusal of a new project will depend on its Net Present Worth calculated from the combination of parameters and variables. Three hundred simulations (calculations of NPW were performed to determine the viability of the project.

The three project parameters are:

- MARR = 10%
- Life = 5 years
- Initial cost = \$60,000

The three variables are:

- Salvage value (See Table below for values)
- Annual operating costs (See Table below for values)
- Annual revenue (See Table below for values)

<u>Table 1</u>		
<u>Variables and values</u>		
<u>Salvage value</u>	<u>Annual Operating Cost</u>	<u>Annual Revenue</u>
\$5,000	\$5,000	\$10,000
\$10,000	\$6,000	\$15,000
	\$7,000	\$20,000
		\$25,000

Table 2 - 5th simulation

<u>Variable</u>	<u>Simulation specific random number</u>	<u>Values randomly selected</u>
Salvage value	0.244	?
Annual operating cost	0.888	?
Annual revenue	0.511	?

55. Using the information from Tables 1 and 2, which salvage value would be used in the 5th simulation of the project's Net Present Worth calculation?
a) 5,000; b) \$10,000
56. Using the information from Tables 1 and 2, which dollar value of annual operating cost value would be used in the 5th simulation of the project's Net Present Worth calculation?
a) 5,000; b) 6,000; c) 7,000
57. Using the information from Tables 1 and 2, which dollar value of annual revenue would be used in the 5th simulation of the project's Net Present Worth calculation?
a) 10,000; b) 15,000; c) 20,000; d) 25,000

Table 3 - 100th simulation

<u>Variable</u>	<u>Simulation specific random number</u>	<u>Values randomly selected</u>
Salvage value	0.844	?
Annual operating cost	0.388	?
Annual revenue	0.267	?

58. Using the information from Tables 1 and 3, which salvage value would be used in the 5th simulation of the project's Net Present Worth calculation?
a) 5,000; b) \$10,000
59. Using the information from Tables 1 and 3, which dollar value of annual operating cost value would be used in the 5th simulation of the project's Net Present Worth calculation?
a) 5,000; b) 6,000; c) 7,000

60. Using the information from Tables 1 and 3, which dollar value of annual revenue would be used in the 5th simulation of the project's Net Present Worth calculation?
 a) 10,000; b) 15,000; c) 20,000; d) 25,000

Questions 61 to 66

Your municipality is planning the construction of a new sports complex on January 1, 2018 (Yes construction is almost instantaneous!!).

You've requested by the municipal council to explain the relationship between the project actual and constant dollar flows for the project.

- The projected annual inflation rate is 3%.
- The nominal (with inflation) interest rate is 5%.
- Actual cash flows are fully sensitive to inflation (i.e., they increase at the same rate as inflation).

Projected Cash Flows		
	Cash Flows in January 1, 2018 dollars	Cash Flows in Actual Dollars
Initial Investment on January 1, 2018	AA	50,000
EOY:		
2018		20,000
2019		
2020	BB	
2021		CC
2022	DD	

61. What is the precise real (inflation-free) MARR (rounded to the 2nd decimal)?

- a) 1.94%; b) 2%; c) 3%; d) 5%.
62. What is the approximate real (inflation-free) MARR?
a) 2%; b) 3%; 5%; d) 7%.
63. What is the dollar value of **AA**?
a) 50,000; b) 50,000(P/F,inflation rate,1) c) 50,000(F/P,inflation rate,1);
c) 50,000(P/F,real MARR,1); d) 50,000(F/P,actual MARR,1)
64. What is the dollar value of **BB** (to the nearest \$100)?
a) 19,400; b) 20,000; c) 21,200
65. What is the dollar value of **CC**?
a) 20,000(P/F,inflation rate,1); b) 20,000(F/P,inflation rate,3)
c) 20,000(P/F,real MARR,1); d) 20,000
66. What is the dollar value of **DD**?
a) 19,400; b) 20,000; c) 22,500

0-0-0

<u>Question</u>	<u>Answer</u>
1	B
2	B
3	A
4	B
5	B
6	B
7	B
8	D
9	A
10	A
11	C
12	A
13	C
14	A
15	B*
16	C
17	A
18	B
19	D
20	C
21	B
22	B
23	C
24	C
25	B
26	A
27	B
28	E
29	C
30	A
31	C
32	B
33	D
34	C
35	B
36	A
37	D
38	C

39	B
40	C
41	D
42	B
43	D
44	A
45	D
46	C
47	B
48	B
49	C
50	C
51	D
52	A
53	B
54	C
55	A
56	C
57	C
58	B
59	B
60	B
61	A
62	A
63	A
64	A
65	B
66	A