Assignment 10

100 Points (Due: 5:00PM Monday April 25th)

Assessment Goals: (benefit/cost ratio, incremental B/C ratio method single projects, incremental B/C ratio method multiple alternatives). Show your work. Use 2 decimals for dollar values and 4 decimals for factors if needed. Use formulas, tables, and EXCEL as you wish.

PROBLEM 1: (Problem 42 Chapter 9 - 30 points)
A consulting engineer is currently evaluating four different projects for the Department of Housing and Urban Development. The future worth of costs, benefits, dis-benefits, and cost savings is shown. The interest rate is 10% per year, compounded continuously. Determine which of the projects, if any, should be selected, if the projects are (a) independent and (b) mutually exclusive.

	Project ID			
	Good	**Better**	**Best**	**Best of All**
FW of first costs, $	10,000	8,000	20,000	14,000
FW of benefits, $	15,000	11,000	25,000	42,000
FW of dis-benefits, $	6,000	1,000	20,000	32,000
FW of cost savings, $	1,500	2,000	16,000	3,000

Solution:

From the problem statement and information provided we know that all values are provided in at the same year (FW) so they are already included the compounding values in them.

Case (a): projects are independent
In this case, projects are not compared against each other and each project can be selected based on its own merit of benefit/cost analysis. Again, since all values are provided in the same year there is no need for finding equivalents and values can be simply added or subtracted.

Project Good:
B - D = 15,000 – 6,000 = 9,000
C = 10,000 – 1,500 = 8,500
(B – D) / C = 9,000 / 8,500 = 1.06 > 1

Project Better:
B - D = 11,000 – 1,000 = 10,000
C = 8,000 – 2,000 = 6,000
(B – D) / C = 10,000 / 6,000 = 1.67 > 1

Project Best:
B - D = 25,000 – 20,000 = 5,000
C = 20,000 – 16,000 = 4,000
(B – D) / C = 5,000 / 4,000 = 1.25 > 1

Project Best of All:
B - D = 42,000 – 32,000 = 10,000
C = 14,000 – 3,000 = 11,000
(B – D) / C = 10,000 / 11,000 = 0.91 < 1

Therefore, the first three projects are justified based on cost/benefit analysis and the last one is not.

Case (b): projects are mutually exclusive
In this case, projects must be compared against each other using incremental analysis because we want to know which project is the justified to select. We know that project "Best of All" has a B/C ratio of less than one and need not to be considered. Furthermore, all three projects, "Good", "Better", and "Best" have B/C > 1, so they beat the DN alternative.

First we rank all competing alternatives based on their net cost to see which one is the Defender.

Good: 10,000 – 1,500 = 8,500
Better: 8,000 – 2,000 = 6,000
Best: 20,000 – 16,000 = 4,000

Ranking project leads to Best → Better → Good .
"Best" is Defender, "Better" is Challenger
ΔB/C = [(11,000 – 1,000) – (25,000 – 20,000)] / (6,000 – 4,000) = 2.5
Thus "Best" is eliminated.

"Better" is Defender, "Good" is Challenger
ΔB/C = [(15,000 – 6,000) – (11,000 – 1,000)] / (8,500 - 6,000) = - 1/25 < 0
Thus "Good" is eliminated.

Select project "Better"

PROBLEM 2: (Problem 43 Chapter 9 - 15 points)
From the data shown below for six mutually exclusive projects, determine which project, if any, should be selected.

	Project ID					
	A	**B**	**C**	**D**	**E**	**F**
Annual cost, $1000 per year	8	25	15	32	17	20
Annual benefits, $ per year	?	?	?	?	?	?
B/C ratio (alternative vs. DN)	1.23	1.12	0.87	0.97	0.71	1.10

Selected Incremental B/C Ratios

A versus B = 1.07
A versus C = 0.46
A versus F = 1.02
B versus D = 0.43
B versus E = 2.00
B versus F = 1.20
C versus D = 1.06
C versus F = 1.80

Solution:

Although, we are not provided annual benefits values, we do not need the as the independent B/C ratios (each against DN) is provided plus some against each other. First we need to identify projects that on their own merit are better than

the DN alternative. Projects A, B, and F have B/C ratios of larger than 1 and thus those are the only ones we will consider.
Ranking them based on annual cost per year we have A → F → B.

F vs A: $\Delta B/C = 1.02 > 1$ → eliminate A
B vs F: $\Delta B/C = 1.20 > 1$ → eliminate F

Select B.

PROBLEM 3: (Problem 44 Chapter 9 - 15 points)
Four mutually exclusive revenue alternatives are being compared using the B/C method. Which alternative, if any, should be selected?

Alternative	Initial Cost $ Millions	B/C Ratio vs. DN	Incremental B/C When Compared with Alternative			
			A	**B**	**C**	**D**
A	30	0.87	–	2.38	1.3	1.38
B	38	1.18		–	0.58	1.13
C	52	1.04			–	1.45
D	81	1.16				–

Solution:

From the problem statement and information provided and the fact that alternatives are mutually exclusive, then DN is also an option. Since we are provided the B/C ratio for each alternative vs DN, we can eliminate those that have B/C ratios of less than 1. Alternative A fits the condition and is eliminated from alternatives. Alternatives B, C, and D all have greater than 1 values for B/C ratio when individually compared to DN. Therefore, we need to perform an incremental analysis.

Ranking the three alternatives based on initial cost yields: B → C → D.

"DN" is Defender, "B" is Challenger
B/C = 1.18 > 1
Eliminate DN.

"B" is Defender, "C" is Challenger
ΔB/C = 0.58 < 1
Eliminate C.

"B" is Defender, "D" is Challenger
ΔB/C = 1.13 > 1
Eliminate B.

Select alternative "D"

PROBLEM 4: (Problem 45 Chapter 9 - 40 points)
The city of St. Louis, Missouri, is considering various proposals regarding the disposal of used tires. All of the proposals involve shredding, but the charges for the service and the handling of the tire shreds differ in each plan. An incremental B/C analysis was initiated but never completed. (a) Fill in all the missing blanks in the table. (b) Determine which alternative should be selected.

Alternative	PW of Costs, $	PW of Benefits, $	PW of Dis-benefits, $	B/C Ratio vs. DN	Incremental B/C When Compared with Alternative			
					J	**K**	**L**	**M**
J	20	?	1	1.05	–	?	?	?
K	23	28	?	1.13		–	?	?
L	28	35	3	?			–	?
M	?	51	4	1.34				–

Solution:

Case (a): First let's concentrate on finding PW of benefits for Alternative J, PW of dis-benefits for Alternative K, B/C ratio vs DN for Alternative L, and PW of costs for Alternative M. In each case, 3 pieces of information is provided and one is

missing. Using the formula for B/C ratio when those alternatives are compared vs DN we can find the missing elements. It is important to note that we can add and subtract numbers in here because ALL numbers are given in the same year, namely PW (time 0). Otherwise we should have converted them to the same year (PW, FW, or AW).

J vs DN: (B-D)/C = (B – 1) / 20 = 1.05 → B = 22 (PW of benefits)
K vs DN: (B-D)/C = (28 – D) / 23 = 1.13 → D = 2 (PW of dis-benefits)
L vs DN: (B-D)/C = (35 – 3) / 28 = 1.14 (B/C ratio vs DN)
M vs DN: (B-D)/C = (51 – 4) / C = 1.34 → C = 35 (PW of costs)

Now we can concentrate on finding missing incremental B/C when alternatives are compared versus each other.

					Incremental B/C When Compared with Alternative			
Alternative	PW of Costs, $	PW of Benefits, $	PW of Dis-benefits, $	B/C Ratio vs. DN	**J**	**K**	**L**	**M**
J	20	22	1	1.05	–	?	?	?
K	23	28	2	1.13		–	?	?
L	28	35	3	1.14			–	?
M	35	51	4	1.34				–

K vs J: ΔB/C = [(28 – 2) – (22 – 1)] / (23 – 20) = 1.67
L vs J: ΔB/C = [(35 – 3) – (22 – 1)] / (28 – 20) = 1.38
M vs J: ΔB/C = [(51 – 4) – (22 – 1)] / (35 – 20) = 1.73

L vs K: ΔB/C = [(35 – 3) – (28 – 2)] / (28 – 23) = 1.20
M vs K: ΔB/C = [(51 – 4) – (28 – 2)] / (35 – 23) = 1.75

M vs L: ΔB/C = [(51 – 4) – (35 – 3)] / (35 – 28) = 2.14

Case (b): To find the best alternative we perform the incremental analysis. Alternatives are already ranked based on their PW of costs from J to M. We begin by comparing J as “Challenger” versus DN as “Defender”.

J vs DN: $B/C = 1.05 > 1$ → eliminate DN

K vs J: $\Delta B/C = 1.67 > 1$ → eliminate J

L vs K: $\Delta B/C = 1.20 > 1$ → eliminate K

M vs L: $\Delta B/C = 2.14 > 1$ → eliminate L

Select alternative “M”