ENG 106 Homework #4

Pts Benefit/Cost Ratio

8.4 The U.S. Government is considering building apartments for government employees working in a foreign country and currently living in locally owned housing. A comparison of two possible buildings indicates the following: Assume salvage value to be 60% of the first investment. (The salvage values are at the end of 20 years.) Use 10% and a 20 year study period to compute the B/C ratio on incremental investment, and make a recommendation as to the best option.

	Building X	Building Y
Original investment by government agencies	$8,000,000	$12,000,000
Estimated annual maintenance costs	$240,000	$180,000
Savings in annual rent now being paid to house emp.	$1,960,000	$1,320,000

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Building X
Benefit = $1,960,000 (P/A, 10%, 20)
= $1,960,000 (8.5136)
= $16,686,656
Cost = $8,000,000 + $240,000 (P/A, 10%, 20) - 4,800,000 (P/F, 10%, 20)
= 8M + 240,000(8.5136) - 4.8M(.1486)
= $9,329,984

Building Y
Benefit = $1,320,000 (P/A, 10%, 20)
= $1,320,000 (8.5136)
= $11,237,952
Cost = $12,000,000 + $180,000 (P/A, 10%, 20), - 7,200,000 (P/F, 10%, 20)
= 12M + 180,000(8.5136) -7.2 M(.1486)
= $12,462,528

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We must use incremental analysis for mutually exclusive alternatives. We want Delta C > 0, so look at increment Y-X rather than X-Y:
Delta C = $12,462,528 - $9,329,984 = $3.1 million
Delta B = $11,237,952 - $16,686,656 = -$5.4 million
Delta B/Delta C = -5.4/3.1 = -1.7 < 1 so reject the increment, Y-X and therefore the costlier project, Y

Building X is the better choice!

Note: Some people might subtract maint costs from bens rather than including with costs, or include salvage values as part of the benefits rather than subtracting from the costs. Either of these is perfectly valid because they do not change the net present worth. They will produce different Delta B/Delta C ratios, but will not change the decision.

#2. Using B/C ratio (correctly) as the basis for comparison and assuming the alternatives are mutually exclusive, choose the best of Projects A, B, D and E in problem 5.22. There is a 5-year period of need and the projects are repeatable, i.e. technology is stable. Assign reasonable salvage values where needed. Assume the cash flows are stated in actual $, the inflation rate f = 8%/yr, and the market MARR = 15%/yr.

	Project Flows			
n	A	B	D	E
0	-$5000	-$5000	-$5000	-$5000
1	$500	$2000	$500	$1000
2	$900	-$3000	$2000	$3000
3	$1000	$5000	$3000	$2000
4	$2000	$5000	$4000	
5	-$500	$3500	$1250	

As for any valid basis, a common analysis period must be used for mutually exclusive alternatives. Five years makes sense here, as this is the period of need and A, B and D have 5-year lives. That leaves E, which must be repeated at EOY 3 to provide the five years of required service. The second copy has an extra year of life that we don't need, so we'll assign a salvage value at EOY 5. We'll assume S = $1500 year-zero $. (An argument might be made for any value between zero and $2000 in year-three $.)

Note that all the flows are given in actual $ rather than constant $, so the amounts shown for the first copy of E won't repeat; they must be inflated. Example Calc:
Initial cost for E at EOY 3 = $6k$(1.08)^3$ = $7558.3

20 For B/C analysis we separate the flows into benefits and costs. It is arbitrary how this is done (as long as the sign of the each flow is considered correctly), but for the solution below, every positive flow was considered a benefit and every negative a cost.

	Project								
	A		B		D		E		Notes
EOY	Costs	Bens	Costs	Bens	Costs	Bens	Costs	Bens	
0	6000	0	6000	0	6000	0	6000	0	
1	0	500	0	2000	0	500	0	1000	
2	0	900	3000	0	0	2000	0	3000	
3	0	1000	0	5000	0	3000	7558.3	2000	Cost E reflects 3 years of inflation
4	0	2000	0	5000	0	4000	0	1259.7	Ben E reflects 3 years of inflation
5	500	0	0	3500	0	1250	0	5983.1	Ben E includes 3K w/3 yrs infl and 1.5k salvage w/5 yrs inflation
PW(i)	6,248.6	2,916.3	8,268.4	9,625.6	6,000.0	6,828.1	10,969.7	8,147.9	
NPW	-3,332		1,357		828		-2,822		

As a check, the NPW for each project (except E) should be as shown above, no matter how you partition the benefits and costs. The NPW for Project E will of course depend on the salvage value you assume for the second copy at EOY 5.

It is easiest to use the EXCEL NPV function to calculate the PW of costs and PW of benefits, but calcs using table factors are shown below.

Project A:
B: $500(P/F,15%,1)+ $900(P/F,15%,2)+ $1000(P/F,15%,3)+ $2000(P/F,15%,4)
B: 500(0.8696)+900(.7561)+1000(.6575)+2000(.5718) = 2916.3
C: $6000 + 500(P/F, 15%,5) = 5000 + 500(.4972) = $6248.6
NPW = B-C = 2916.3 - 6248.6 = -3332.3

Project B
B: $2000(P/F,15%,1)+ $5000(P/F,15%,3)+ $5000(P/F,15%,4)+ $3500(P/F,15%,5)
B: 2000(0.8696)+5000(.6407)+5000(.5523)+3500(.4671) = $9339.1
C: $6000 + 3000(P/F.15%,2) = 6000+3000(.7432) = $7229.6
Project D
B: $500(P/F,15%,1)+ $2000(P/F,15%,2)+ $3000(P/F,15%,3)+
$4000(P/F,15%,4)+1250(P/F,15%,5)
B: 500(0.8696)+2000(.7432)+3000(.6407)+4000(.5523)+1250(.4671) = 6636.38
C: $6000
Project E
B: $1000(P/F,15%,1)+ $3000(P/F,15%,2)+ $2000(P/F,15%,3)+
1259.7 (P/F,15%,4)+ 5983.1 (P/F,15%,5)
B: 1000(0.8696)+3000(.7432)+2000(.6407) +1259.7(.5523)+5983.1(.4671) = 8147.9
C: $6000+7558.3(.6407) = 10,969.7

20 We must use incremental analysis for mutually exclusive projects. This can be done with pairs of projects in any order, but the delta C for each increment must be positive. The analysis below starts with the least-cost project and moves towards the most expensive, but other approaches are equally valid. The result in terms of choice of the best alternative will be the same in any case.

Increment	Delta C	Delta B	Delta B/Delta C	Decision
A-D	249	-3912	-15.7 < 1	so reject A
B-D	2,268	2797	1.2 > 1	so reject D
E-B	2,701	-1478	-0.5 < 1	so reject E and choose B

Project B is the best choice.

10 5.26 Consider the following project balances for a typical investment project with a service life of five years:

(a) Fill in the blanks by constructing the original cash flows of the project and determining the terminal balance
(b) Determine the interest rate used in the project balance calculation and compute the present worth of this project at the computed interest rate.

n	A_n	Project Balance
0	-$1000	-$1000
1	**$200**	-$900
2	$490	-$500
3	**$550**	$0
4	**-$100**	-$100
5	$200	**$90**

$PB(i)_2$ = -$900 (1+ i) +$490 = -$500
Solve to find i = 10%, then use i to find unknown cash flows and final balance:
$PB(i)_1$ = -$1000 (1+ i) +$X = -$900; X=200
$PB(i)_3$ = -$500 (1+ i) +$X = $0; X = 550
$PB(i)_4$ = $0 +$X = -$100; X = -100
$PB(i)_5$ = -$100 (1+ i) +$200 = $90

PW(10%) = $90(P/F, 10%,5) = $55.88

80 (Total points)