CE167: Engineering Project Management | Fall 2007
Professor William Ibbs

MIDTERM 1 | Date: October 25, 2007

Question 1 [9 points]
1.a. Discuss one major drawback of the discounted and non-discounted payback methods. [3 points]
[3 points] Drawback: The methods ignore cash flows after the payback period. It therefore cannot assess all the benefits and costs of an alternative.

1.b. What does the term fast-track mean? Briefly discuss the relationship of it to design-build contracts? [3 points]
[1.5 points] Fast-tracking is a practice that allows the construction phase to start at the point when only limited design work has been completed. [1.5 points] Design-build is a project delivery system that can use fast-tracking to save time (and money) for the project parties.

1.c. List at least three elements that constitute a contract. [3 points]
[1 point for each] Three major elements: offer, acceptance, and consideration. However, any reasonable elements the students list should be fine, i.e. payment.

Question 2 [8 points]
A contractor submits a unit price bid to the City of Berkeley to repave an existing street. His unit price and written price extension are contradictory. Is the City allowed to correct the mistake? If "no", what would the City's next step be? If "yes", which would govern?

[2 points] The City should is allowed to correct the mistake. [5 points] The "factual determination of the low bid" rules state that the unit price would govern when there is a discrepancy between the unit price and the written price extension (See pages B156-157).

Question 3 [3 points]
A contractor submitted a bid to the Army Corps of Engineers. His submission failed to note that there had been an addendum that lengthened the contract duration by 30 days. What option(s) does the Corps have? Why?

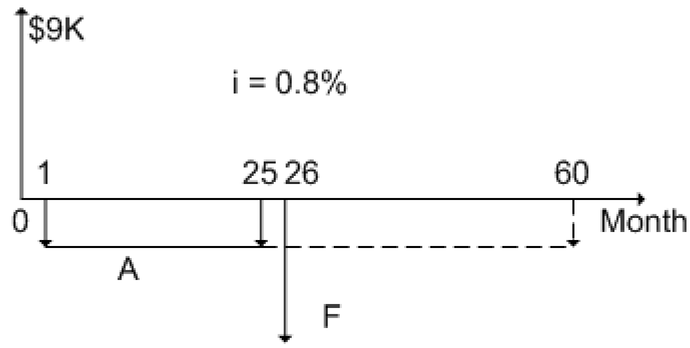
Either ACCEPT or REJECT the bid can the answer. Correct reason(s) associated with ACCEPT or REJECT will get full credits [3 points]

The Corps may ACCEPT this bid due to this **material impropriety** in its bidding documents (See page B156).

The Corps can REJECT this bid because failure to list all addenda may be considered an **irresponsive** bid (See page B154).

Question 4 [15 points]
On September l, 2005, Susan bought a motorcycle for $10,000. She paid $l,000 down and financed the balance with a five-year loan at a stated annual interest rate of 9.6 percent, compounded monthly. She started the monthly payment exactly one month after the purchase, i.e., October, 2005. In the middle of October, 2007, she got a new job and decided to pay off the loan. If the bank charges her 1 percent prepayment penalty based on the remaining loan balance, how much should she pay the bank on November l, 2007?

[1 point] Effective interest rate per month: i = 9.6%/12 = 0.8%



Cash flow diagram [2 points]

[5 points] Susan's monthly payment: $A = P(A/P, i\%, 60) = \ Px\frac{i(1+i)^n}{(1+i)^n - 1} =$

$\$9Kx\frac{0.008(1+0.008)^{60}}{(1+0.008)^{60} - 1} = \$189.46$

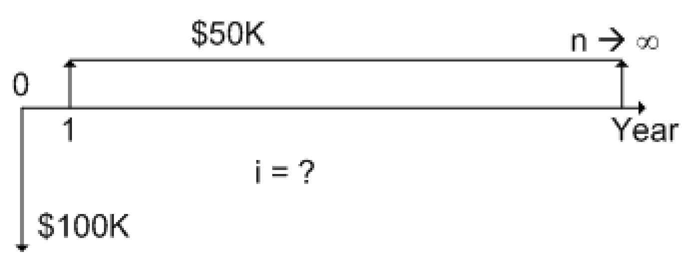
[5 points] The loan balance on November 1, 2007 (month 26):

$F = P(F/P, i\%, 26) – A(F/A, i\%, 25)x(F/P, i\%, 1) = Px(1 + i)^{26} + Ax\frac{(1+i)^{25} - 1}{i}x(1 + i)^1$

$F = \$9Kx(1 + 0.008)^{26} – \$189.46x\frac{(1+0.008)^{25} - 1}{0.008}x(1 + 0.008)^1 = \$11,071.75 – \$5,220.36 =$ $5,851.39

[2 points] Susan pays on November 1, 2007: Fx1.01 = $5,851.39x1.01 = $5,909.90.

Question 5 [10 points]
IDEC Pharmaceuticals is considering a drug project that costs $100,000 today and is expected to generate end-of-year annual cash flow of $50,000 forever, starting one year from now. At what discount rate would IDEC be indifferent between accepting and rejecting the project?



Cash flow diagram [2 points]

NPV = 0 ➔ IDEC would be indifferent between accepted and rejecting the project.
[4 points] ➔ NPV = -\$100K + \$50Kx(P/A, i%, n) = 0

$$-\$100K + \$50Kx\frac{(1+i)^n - 1}{i(1+i)^n} = 0 \Rightarrow \frac{(1+i)^n - 1}{i(1+i)^n} = 2 \Rightarrow \frac{1 - 1/(1+i)^n}{i} = 2$$

[4 points] If n → ∞ and i > 0 then $(1 + i)^n \to \infty$ or $1/(1 + i)^n \to 0$.

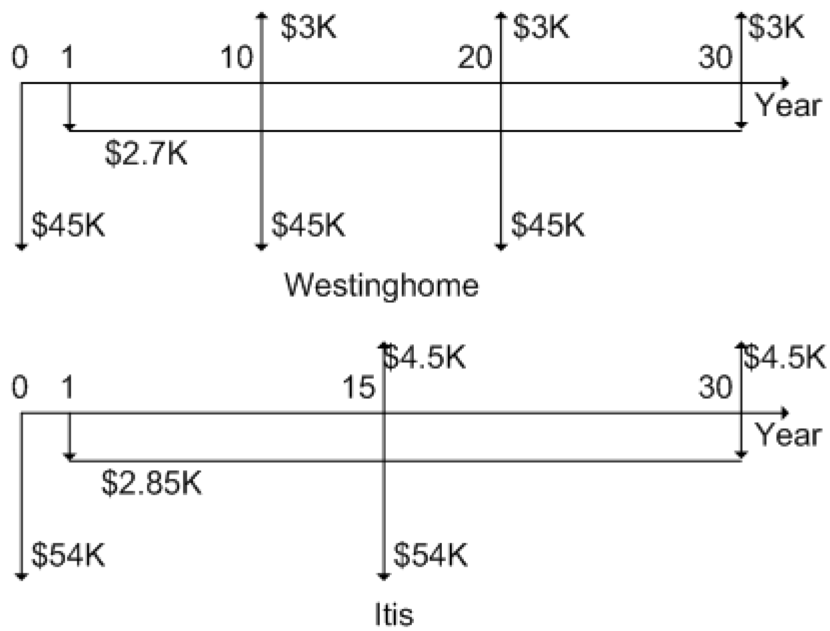
Thus, $\frac{1 - 0}{i} = 2 \Rightarrow i = 0.5 = 50\%$.

Question 6 [15 points]
An engineer has received two bids for an elevator to be installed in a new building. The bids, plus her evaluation of the elevators, are as follows:

	Bids	Engineer's estimates		
Alternatives	Installed cost	Service life, in years	Annual operating cost, including repairs	Salvage value at end of service life
Westinghome	\$45,000	10	\$2,700	\$3,000
Itis	\$54,000	15	\$2,850	\$4,500

Determine which bid should be accepted, using a NPV analysis and a 10% interest rate.

Assume the replacement at the end of service life will be the same installed cost, operating cost, and salvage value.



Cash flow diagram [2 points]

[6 points] NPV_W = -\$45K - \$42K(P/F, 10%, 10) - \$42K(P/F, 10%, 20) - \$2.7K(P/A, 10%, 30) + \$3K(P/F, 10%, 30) = -\$45K - \$42Kx0.3855 - \$42Kx0.1486 - \$2.7x9.427 + \$3Kx0.0573 = -\$92.71K

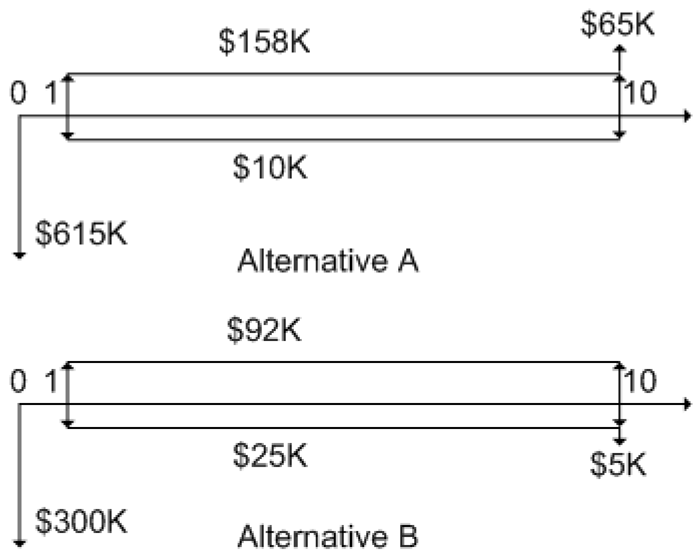
[6 points] NPV_I = -\$54K – \$49.5K(P/F, 10%, 15) – \$2.85K(P/A, 10%, 30) + \$4.5x(P/F, 10%, 30) = -\$54K - \$49.5Kx0.2394 - \$2.85Kx9.427 + \$4.5x0.0573 = -\$92.46K

[1 point] $NPV_I > NPV_W$ → Choose Itis.

Question 7 [20 points]
Two hazardous environment facilities are being evaluated, with the projected life of each facility being 10 years. The cash flows for each facility are:

	Alternative A	Alternative B
First cost	\$615,000	\$300,000
Annual maintenance cost	\$10,000	\$25,000
Annual benefit	\$158,000	\$92,000
Salvage value	\$65,000	-\$5,000

The company uses a MARR of 15%. Which alternative should be selected? Solve the problem by
5.a. Internal rate of return (IRR) analysis [14 points]
5.b. Discounted payback method [6 points]



Cash flow diagram [2 points]

5.a. Internal rate of return (IRR) analysis
[1 point] NPV_A = -\$615K + \$148(P/A, i, 10) + \$65K(P/F, i, 10) = 0
[3 points] Trial and error:
i = 20% ➔ NPV_A = -\$615K + \$148Kx4.192 + \$65Kx0.1615 = \$3.34K
i = 25% ➔ NPV_A = -\$615K + \$148Kx3.5705 + \$65Kx0.1074 = -\$79.59K
(IRR_A – 0.2)/(0.25 – 0.2) = (0 – 3.34)/(-79.59 – 3.34) ➔ IRR_A = 20.2% >15% ➔ Alt. A is viable

[1 points] NPV_B = -\$300K + \$67(P/A, i, 10) – \$5K(P/F, i, 10) = 0

[3 points] Trial and error:
$i = 15\% \Rightarrow NPV_B = -\$300K + \$67 x 5.019 – \$5K x 0.2472 = \$35.04K$
$i = 20\% \Rightarrow NPV_B = -\$300K + \$67 x 4.192 – \$5K x 0.1615 = -\$19.94K$
$(IRR_B – 0.15)/(0.2 – 0.15) = (0 – 35.04)/(-19.94 – 35.04) \Rightarrow IRR_B = 18.2\% > 15\% \Rightarrow$ Alt. B is viable

Incremental Investment (A – B):
[1 point] $NPV_{A\text{-}B} = -\$315K + \$81K(P/A, i, 10) + \$70K(P/F, i, 10) = 0$
[3 points] Trial and error:
$i = 20\% \Rightarrow NPV_{A\text{-}B} = -\$315K + \$81 x 4.192 + \$70K x 0.1615 = \$35.86K$
$i = 25\% \Rightarrow NPV_{A\text{-}B} = -\$315K + \$81 x 3.5705 + \$70K x 0.1074 = -\$18.27K$
$(IRR_{A\text{-}B} – 0.2)/(0.25 – 0.2) = (0 – 35.86)/(-18.27 – 35.86) \Rightarrow IRR_{A\text{-}B} = 23.3\%$

[1 point] $\Rightarrow IRR_{A\text{-}B} = 23.3\% > 15\% \Rightarrow$ Alt. A is preferred

5.b. Discounted payback method
[2.5 points] Alt. A:
$n = 6 \Rightarrow \$148K(P/A, 15\%, 6)/\$615K = \$148K x 3.784/\$615K = 0.911$
$n = 7 \Rightarrow \$148K(P/A, 15\%, 7)/\$615K = \$148K x 4.160/\$615K = 1.001$
$(x – 6)/(7 – 6) = (1 – 0.911)/(1.001 – 0.911) \Rightarrow x_A = 6.99$ years ≈ 7 years
(Note: *it is OK if you work only on n = 7 years*)

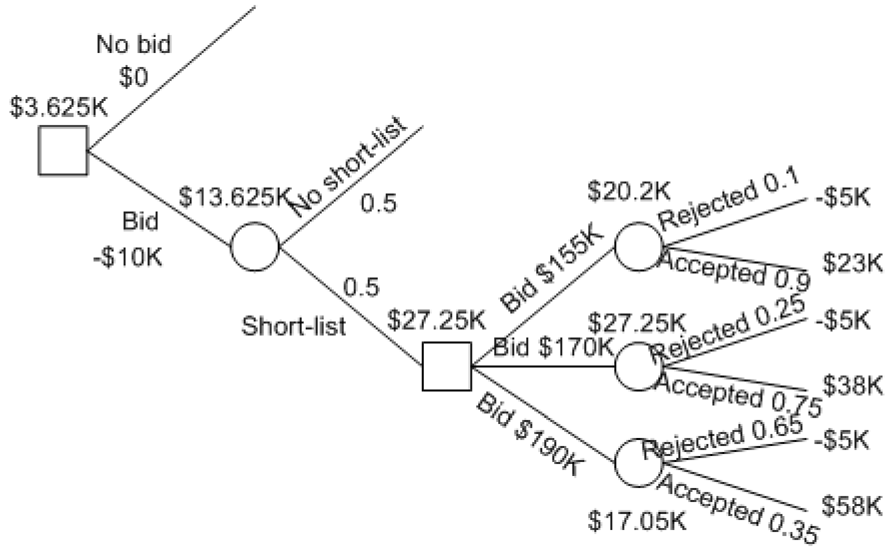
[2.5 points] Alt. B:
$n = 7 \Rightarrow \$67K(P/A, 15\%, 7)/\$300K = \$67K x 4.160/\$300K = 0.929$
$n = 8 \Rightarrow \$67K(P/A, 15\%, 8)/\$300K = \$67K x 4.487/\$300K = 1.002$
$(x – 7)/(8 – 7) = (1 – 0.929)/(1.002 – 0.929) \Rightarrow x_B = 6.97$ years ≈ 8 years
(Note: *it is OK if you work only on n = 8 years*)

[1 point] $x_A < x_B \Rightarrow$ Alt. A is preferred.

Question 8 [20 points]
A company is trying to decide whether to bid for a certain contract or not. They estimate that merely preparing the bid will cost \$10,000. They estimate that there is a 50% chance that their bid will be put on the "short-list", otherwise their bid will be rejected. Once "short-listed" the company will have to supply further detailed information (entailing costs estimated at \$5,000). After this 2nd stage their bid will either be accepted or rejected.

The company estimates that the labor and material costs for the contract are \$127,000. They are considering three possible bid prices, namely \$155,000, \$170,000 and \$190,000. They estimate that the probability of these bids being accepted (once they have been short-listed) is 0.90, 0.75 and 0.35 respectively.

What should the company do and what is the expected monetary value of your suggested course of action?



Decision tree [18 points if directly calculated on this tree]

Calculations are shown in the decision tree, for example 0.1x(-$5K) + 0.9x$23K = $20.2K
[2 points] The company should bid and bid $170,000.
[1 point] The expected value if the company bids $170,000 = $3.625K = $3,625
(Note: *Each wrong or incorrect illustration/calculation on the decision tree will be deducted 1 point but the total deduction should not exceed 17 points. Students can work on the calculation separately from the decision tree; scores should be counted the same*)