ISyE 3025, Quiz 2
Your name (PRINT):_____ Your 9-digit GT ID:_____

Honor Code Certification:
    I certify that I have abided by the rules of the Georgia Tech honor code for student conduct on exams and by
    the specific rules on reference materials for this exam, and that I have neither given nor received assistance
    during this examination. I certify that I have read this statement and understand it.
                                          Signature: _____

Unless explicitly stated otherwise <u>all questions are independent</u>. For questions 1 – 6 assume that the Minimum Attractive Rate of Return (MARR) is 10%, the investment horizon is ten years, and use the following table.

Investment Opportunity	A	B	C
Initial investment	$200	$400	$300
Revenue in years 1 – 10	$80	$120	$100
Operating costs in years 1 – 10	$30	$30	$40
Salvage value	$30	$220	$200

1. (10) Using the Net Present Value (NPV) method, determine which investment(s), if any, should be made if the investments are unrelated and there is a budget limitation of $500.

A:NPV = -200 + 80(P/A,10%,10) – 30(P/A,10%,10) +30(P/F,10%,10)
      = -200 + 80(6.1446)-30(6.1446)+30(0.38554)
      =118.8
B: NPV = -400+ 120(P/A,10%,10) – 30(P/A,10%,10) +220(P/F,10%,10)
      = -400 + 120(6.1446)-30(6.1446)+220(0.38554)
      =237.8
C: NPV = -300+ 100(P/A,10%,10) – 40(P/A,10%,10) +200(P/F,10%,10)
      = -300 + 100(6.1446)-40(6.1446)+200(0.38554)
      =145.8

Since budget limit is 500, A+C (200+300=500 investment) would be the best option with total NPV(A+C) = 118.8+145.8 = 264.6 > 237.8(option B)

2. (15) Using the Benefit Cost Ratio Method, determine which investment(s), if any, should be made if the investments are unrelated and there is no budget limitation.

A: NPV of Benefits = (80-30)(P/A,10%,10) + 30(P/F,10%,10)
  =50(6.1446) + 30(0.38554) = 318.8
  NPV of Cost = 200
➔ B/C = NPV of Benefits / NPV of Cost = 318.8/200 = 1.594

B: NPV of Benefits = (120-30)(P/A,10%,10) + 220(P/F,10%,10)
  =90(6.1446) + 220(0.38554) = 637.8
  NPV of Cost = 400
➔ B/C = NPV of Benefits / NPV of Cost = 637.8/400 = 1.595

C: NPV of Benefits = (100-40)(P/A,10%,10) + 200(P/F,10%,10)
  =60(6.1446) + 200(0.38554) = 445.8
  NPV of Cost = 300
➔ B/C = NPV of Benefits / NPV of Cost = 445.8/300 = 1.486

Since all B/Cs are greater than 1, and there's no budget limit, we should invest in all three opportunities.

3. (15) Determine the IRR (Internal Rate of Return) of Investment Opportunity A to the closest percentage point. You will probably want to use the tables attached at the end of the exam.

IRR is the interest rate at which the NPV = 0.

$(80-30)(P/A,i,10) + 30(P/F, i, 10) - 200 = 0$

By ignoring the salvage value we are able to get an approximation:
$50(P/A, i, 10) - 200 = 0 \Rightarrow (P/A, i, 10) = 4$

Using the tables at the end we see that this value is near 21% and 22%, this gives a starting point for trial and error. To find the answer to the closest percentage point.

For i =21%: $50(P/A,i,10) + 30(P/F, i, 10) - 200 = 50(4.05) + 30(0.162) - 200 = 7.36$
For i =22%: $50(3.92) + 30(0.137) - 200 = 0.11$
For i =23%: $50(3.80) + 30(0.126) - 200 = -6.22$

As we can see the value of NPV closest to 0 occurs at 22%.

IRR = 22%

4. (15) Considering the Investment Opportunities as mutually exclusive, adopt Investment Opportunity A as the defender and determine if you should switch to Investment Opportunity C using the Benefit Cost Ratio Method.

Consider C-A
NPV of Cost = 300 – 200 = 100
NPV of Benefits = [(100-40)-(80-30)](P/A,10%,10)+(200-30)(P/F,10%,10)
                =10(6.1446)+170(0.38554)
                =126.99

➔ B/C = NPC of Benefits / NPV of Cost
      = 126.99 / 100
      = 1.27

Since B/C > 1, switch to C.

5. (15) How would Investment Opportunity C's salvage value have to change to make you indifferent between Investment Opportunities A and C in Question 4 above?

Let C's salvage value = x
Indifferent means B/C = 1
Similar to Problem 4,
NPV of Cost = 300 – 200 = 100
NPV of Benefits = [(100-40)-(80-30)](P/A,10%,10)+(x-30)(P/F,10%,10)

➔ B/C = NPC of Benefits / NPV of Cost
        ={ [(100-40)-(80-30)](P/A,10%,10)+(x-30)(P/F,10%,10) } /100 = 1
➔ x = 130, which means we would decrease the salvage value by 70. (200-130 = 70).

6. (15) Calculate the payback period of Opportunity A
   a. using the undiscounted payback period method. Be sure to show your work.
   b. using the discounted payback period method. Be sure to show your work.

Year	Undiscounted cash flow	Undiscounted balance	Discounted cash flow	Discounted balance
0	-200	-200	-200	-200
1	50	-150	$\frac{50}{1.1} = 45.45$	-154.55
2	50	-100	$\frac{50}{1.1^2} = 41.32$	-113.23
3	50	-50	$\frac{50}{1.1^3} = 37.56$	-75.67
4	50	0	$\frac{50}{1.1^4} = 34.15$	-41.52
			$\frac{50}{1.1^5} = 31.04$	-10.48
			$\frac{50}{1.1^6} = 28.22$	17.74

Undiscounted payback period:
4 years

Discounted payback period:
6 years

7. (15) Who is likely to have a greater MARR (Minimum Attractive Rate of Return)? Why?
   a. Alina, who graduated from GA Tech five years ago and has paid off all her debts a year ago and has just started investing in the stock market as an amateur (without professional advice).
   b. Jane, a GATech student who just used her credit card to buy a plane ticket home for the summer and has no idea how she is going to pay her minimal credit card payment next month.

When considering an investment opportunity (say of $1) Alina would obtain the money by investing one less dollar in the stock market as an amateur investor and Jane would have to borrow one more dollar from the credit card company. Since armature investors have a lower rate of return than the interest charged by credit card companies we see that Jane has a greater MARR.