ISyE 3025 Fall 2015, HW4
This homework is intended for Learning Cycle 4, leading to Quiz 4.

1. Maintenance expenses for production department XYZ were $235,000 in 1999. You are benchmarking various departments, and using 2007 dollars for the comparisons. However, data for XYZ for 2007 are not available, so you will use the 1999 data and adjust the value for inflation. The price index values for your industry are as follows:

1983	1999	2000	2001	2002	2003	2004	2005	2006	2007
100	187.6	193.2	202.9	211.0	218.4	228.2	232.8	239.2	244.8

   Determine the value of the maintenance expenses in 1999 but expressed in 2007 dollars.

2. In 1980 John Doe earned $55,000 after taxes (income tax, payroll tax, etc.). Expenses for necessities were:

Category of necessity	Expenses in 1980
rent and utilities	7,000
groceries	8,500
clothing	1,500
transportation	2,200
medical	5,600

   In 2005 his daughter Mary Doe earned $111,000 after taxes. Assume that the consumer price index (CPI, a general measure of inflation) increased by an average of 3.2% per year from 1980 to 2005.
   a. How much discretionary income (for things other than necessities, such as entertainment, vacation, investment, etc.) did John Doe have in 1980?
   b. Assume that the quality and quantity of the necessities consumed by both John and Mary were the same. Assume the CPI rate in this example applies to all types of consumer expenditures. Estimate the expenditures by Mary Doe in 2005 for each category of necessity.

Category of necessity	Expenses in 2005
rent and utilities	
groceries	
clothing	
transportation	
medical	

   c. Which one was better off, John or Mary, in terms of having more discretionary income?
   d. Now assume that the actual expenses for necessities by Mary were as shown below. Compute the actual inflation rates, on an annual basis, for each category of necessity. [Assuming no change in quality or quantity in each category.]

Category of necessity	Expenses in 2005
rent and utilities	24,000
groceries	19,000
clothing	8,000
transportation	13,000
medical	13,000

3. A company projects revenues and expenses as shown in the table (values are in thousands), but the projection is in constant dollars based on time 0. There are no depreciation expenses. The forecasts for inflation rates are as follows: general inflation rate of 3% which applies to revenue, rate of 2% for labor, and rate of 4% for materials. The general rate of 3% also applies to the MARR. The MARR is 12% for zero inflation.
   a. Convert the values in the table to actual dollars for each year, and then determine the taxable income and cash flow after tax for each year. Also, determine the MARR appropriate for the inflationary scenario, and compute the net present value of the cash flow after tax.

	Values in constant dollars		
time	Revenue	Labor	Materials
0			
1	800	300	120
2	810	320	130
3	820	330	140
4	830	340	150

   b. What would be the impact of inflation on depreciation expenses? Would the cash flow after tax be worth more or less?

4. A manufacturing company is evaluating a new product for introduction in the market. This new product would require an asset investment of $500,000, with an expected useful life of ten (10) years and $40,000 salvage value. Maintenance and energy costs of the asset are negligible. The variable costs per unit are $66 for materials and $33 for labor. The selling price is expected to be in the range $100-140, and the quantity per year in the 5,500-7,500. The MARR is 15%. All analyses are to be performed before taxes. The estimated probabilities of the six scenarios are as follows:

Scenarios	1	2	3	4	5	6
Price/unit	100	100	115	115	140	140
Quantity	5,500	7,500	5,500	7,500	5,500	7,500
Probability	0.10	0.15	0.30	0.20	0.15	0.10

   a. What is the lowest equivalent uniform value (EUV) that could occur?
   b. What is the highest equivalent uniform value (EUV) that could occur?
   c. What is the expected equivalent uniform value (EUV)?
   d. What is the probability that the EUV will be greater than zero?
   e. For what MARR would the expected EUV be equal to zero. Solve to the nearest 100^{th} of a percent. I suggest that you use a spreadsheet.

5. The situation is similar to that in Question 4, except that now the annualized fixed costs of owning the asset (EUV) are determined to be $80,000 (ignore any value for fixed costs that you computed in Problem 4). Also, we are interested in the breakeven values, as follows:
   a. If the price/unit is fixed at $105, what is the breakeven sales quantity?
   b. If the price/unit is fixed at $135, what is the breakeven sales quantity?
   c. If the sales quantity is fixed at 4,500, what is the breakeven price/unit?
   d. If the sales quantity is fixed at 7,000, what is the breakeven price/unit?

6. Repeat Question 4 using after tax cash flows. Use SYD (sum of years digits) depreciation and use a marginal tax rate of 22%.

7. A business, which uses an MARR of 5%, is uncertain about its expected revenues and expenses. The marketing and production managers have developed estimates of these cash flows and project lifetimes, along with associated probabilities. For purposes of analysis, each item with uncertainty is considered to be able to take one of three values (low, medium, high). This information is in the table below.

Item	low	medium	high
Revenue	600,000	700,000	1,100,000
Revenue probability	0.10	0.10	0.80
Labor expenses	440,000	550,000	660,000
Labor probability	0.30	0.40	0.30
Materials expenses	100,000	400,000	500,000
Materials probability	0.05	0.70	0.25
Project life, years	8	10	22
Project life probability	0.30	0.65	0.05

   a. What is the maximum NPV that could occur?
   b. What is the minimum NPV that could occur?
   c. If the labor and material expenses and the project life are each at their medium values, and only revenue is uncertain, what is the expected NPV of cash flow?
   d. What is the total number of scenarios that could occur?

8. A business wishes to select a bus type for transporting employees from remote parking lots to the workplaces. There are two types of buses, Model A and Model B. The characteristics for each type are shown in the table below, as well as the cost of fuel. The major uncertainty is the number of miles the bus would operate each day.

Category	Model A	Model B
Purchase cost	66,000	22,000
Salvage value	7,000	5,000
Lifetime, years	8	8
Operating days per year	364	364
miles/gallon	9	7
fuel cost/gallon	$2.22	$2.22

   a. With MARR = 0%, what is the breakeven number of miles/day that the bus would have to operate so that the two options have the same cost?
   b. With MARR = 15%, what is the breakeven number of miles/day that the bus would have to operate so that the two options have the same cost?
   c. If the number of miles/day is known to be 100 miles, but the fuel cost is uncertain, what is the breakeven fuel cost in $/gallon, with MARR = 0%?
   d. If the number of miles/day is known to be 100 miles, but the fuel cost is uncertain, what is the breakeven fuel cost in $/gallon, with MARR = 15%?

9. A state transportation department is considering building a toll bridge across a waterway. The investment cost, project life, annual operating costs (labor and maintenance), auto crossings, truck crossings, equivalent days per year, tolls, etc., are given in the table. [The equivalent days per year is less than 365 to reflect the lower traffic on weekend days; you would multiply equivalent days by crossings to get annual crossings.] The MARR = 10%. The information for auto crossings and truck crossings is given with probabilities for low, medium, and high annual volume (assume volume is the same for each year). After the project life the department is not allowed to charge any more tolls, and annual operating costs would come from a general transportation budget. Therefore, there is no salvage value, and you should ignore operating costs after the project life. Data for crossings and tolls is for one-way trips.

Project life, years	30
Equivalent days per year	330
Investment	77,000,000
Annual operating costs	4,000,000
Car toll/crossing ($)	4
Truck toll/crossing ($)	8

Daily crossings	Low volume	Medium volume	High volume
Probability	0.2	0.50	0.30
Car	4400	6000	9000
Truck	100	1500	1800

   a. Determine the expected net present value (NPV) of this project.
   b. Now assume that only cars would use the bridge (the investment cost and annual cost would remain the same, for simplicity.) How many daily auto crossings would be needed to obtain a net present value of zero? [use the equivalent days concept]

10. You wish to determine the amount of money that you would need to deposit into a financial account now, at time 0, to provide for your family, in case you disappear from the face of the earth. [You are departing on a risky mission, and you wish to determine the amount of life insurance you need.] The financial account, which invests in a combination of bank funds and bonds, typically pays 2.5% interest per year after adjusting for inflation. All amounts are expressed as end-of-year payments.

    The money that you deposit now needs to cover the following:
    - Mortgage payments of $33,000 a year for 16 years, first payment is at end of first year. The mortgage is a fixed rate agreement; the bank cannot change the payment amount.
    - Food and clothing of $35,000 a year for 35 years, first payment is at end of first year.

    a. What single amount would you need to deposit now to provide these payments to your family, assuming zero inflation and 2.5% interest per year?
    b. Consider a variation of Part (a) above: Assume that inflation is expected to be 3% per year. How much money would need to deposit into a financial account now, at time 0, to provide the series of payments for mortgage and food and clothing? Consider the effects of inflation on the expenses, and the interest rate paid by the financial institution.
    c. Would you need more or less life insurance as the inflation rate increases? Why?