Quantitative methods (UU-MTH-1005)

Course Assessment Point 3 - Final Assignment:

This is the Final Assignment, **carrying the weight of 60% towards your overall grade**. If you miss the deadline then UNICAF rules on late submission/non-submission come into effect. The exercises of this exam are worth up to total 100 points.

Instructions:

- Please download the assignment brief, create a word document for all answers and submit it using the corresponding submission link.

- Write the answer for each exercise on a separate page and indicate the number of the question on the top of the page.

- You should read the instructions of each question carefully.

- You must indicate all steps of the calculations and not only provide the answers of the calculations.

Part A-Short Questions

Part A is consisted of five (5) short questions. Each exercise weights five (5) marks.

<u>**Requested:**</u>

1) **When and why should a utility approach be applied?**
2) **Explain how utility could be used in a decision where performance is not measured by monetary value.**
3) **What are the key traits and differences of Project and Review Technique (PERT)/Critical Path Method (CPM)?**
4) **Why perform sensitivity analysis?**
5) **Explain how and why all predecessor activities must be considered when finding the earliest start time.**

Part B- Problems

Follow the instructions illustrated in the beginning of the assignment. Each exercise in Part B weights seven point five (7.5) marks.

1) Lucy is in charge of planning and coordinating a project. Following is the activity information for this project.

Activity	Preceded By	Time (weeks)		
		Optimistic	Most Likely	Pessimistic
A	--	2	2	4
B	A	8	12	16
C	A	4	8	12
D	B,C	2	4	6
E	B	4	6	8
F	A	2	4	6
G	D	2	4	6
H	G	2	4	6
I	E,F,H	2	2	2

Requested:

(a) Construct a precedence diagram.

(b) Identify the Critical Path(s) and the expected completion time.

(c) What is the probability that the training program can be completed in 26 weeks?

2) Following is a table listing the project activities, sequencing requirements and other relevant information:

Activity	Preceded By	Expected Time Regular	Expected Time Crash	Direct Cost Regular	Direct Cost Crash
A	--	6 days	2 day	$2000	$3800
B	--	12	6	2000	10000
C	A	4	2	1000	4000
D	B, C	10	6	3400	4600
E	D	8	6	2800	3900
F	E	6	2	5000	7600
G	B, C	18	8	16000	19600
H	F, G	6	4	2000	4000

Requested:

(a) **Construct a network including the Early and Late Start and Finish times.**
(b) **Identify the normal Critical Path(s) and the normal expected completion time**
(c) **Can the project be crashed to last 18 days? Which activities should be crashed and at what additional cost?**

3) Amelia Ltd. makes a plastic tricycle that is composed of three major components: a handlebar-front wheel-pedal assembly, a seat and frame unit, and rear wheels. The company has orders for 48,000 of these trikes. Current schedules yield the following information.

Component	Requirements Plastic	Time	Space	Cost to Manufacture	Cost to Purchase
Front	12	40	8	16	24
Seat/Frame	16	24	8	12	18
Rear wheel (each)	.20	8	.4	2	6
Available	100000	320000	60000		

The company obviously does not have the resources available to manufacture everything needed for the completion of 24000 tricycles so has gathered purchase information for each component.

Requested:

Develop a linear programming model to tell the company how many of each component should be manufactured and how many should be purchased in order to provide 24000 fully completed tricycles at the minimum cost.

4) A paint supply company makes three styles of Paint Rollers, regular, deluxe and heavy. All of the types of brushes must pass through 3 machines. The different types of brushes have the following contributions to profit per case and require the following times (in hours) at each machine per case:

Model	Machine 1	Machine 2	Machine 3	Profit Margin
Regular	3	2	3	$20
Deluxe	2	4	4	40
Heavy	4	4	5	70

The company has 56 hours available for machine 1, 80 hours for machine 2 and 120 hours for machine 3.

Requested:

Assuming that the company is interested in maximizing the total profit contribution, write the linear programming model for this problem.

5) A payoff table is given as

	S_1	S_2	S_3
d_1	250	750	500
d_2	300	-250	1200
d_3	500	500	600

Requested:

    a.   **What choice should be made by the optimistic decision maker?**
    b.   **What choice should be made by the conservative decision maker?**
    c.   **What decision should be made under minimal regret?**
    d.   **If the probabilities of d_1, d_2, and d_3 are .2, .5, and .3, respectively, then what choice should be made under expected value?**

6) For the payoff table below, the decision maker will use $P(s_1) = .15$, $P(s_2) = .5$, and $P(s_3) = 35$

	s_1	s_2	s_3
d_1	-5000	1000	10,000
d_2	-15,000	-2000	40,000

Requested:

    a. **What alternative would be chosen according to expected value?**
    b. **For a lottery having a payoff of 40,000 with probability p and -15,000 with probability (1-p), the decision maker expressed the following indifference probabilities.**

Payoff	Probability
10,000	.85
1000	.60
-2000	.53
-5000	.50

Let U(40,000) = 10 and U(-15,000) = 0 and find the utility value for each payoff.

    c. **What alternative would be chosen according to expected utility?**

7) A decision maker who is considered to be a risk taker is faced with this set of probabilities and payoffs.

	s_1	s_2	s_3
d_1	5	10	20
d_2	-25	0	50
d_3	-50	-10	80
probability	.30	.35	.35

For the lottery p (80) + (1 - p) (-50), this decision maker has assessed the following indifference probabilities.

Payoff	Probability
50	.60
20	.35
10	.25
5	.22
0	.20
-10	.18
-25	.10

Requested:

Rank the decision alternatives on the basis of expected value and on the basis of expected utility.

8) Three decision makers have assessed utilities for the problem whose payoff table appears below.

	s_1	s_2	s_3
d_1	500	100	-400
d_2	200	150	100
d_3	-100	200	300
probability	.2	.6	.2

Payoff	Indifference Probability for Person		
	A	B	C
300	.95	.68	.45
200	.94	.64	.32
150	.91	.62	.28
100	.89	.60	.22
-100	.75	.45	.10

Requested:

  a.   **Plot the utility function for each decision maker.**
  b.   **Characterize each decision maker's attitude toward risk.**
  c.   **Which decision will each person prefer?**

9) Burger Prince Restaurant is considering the purchase of a $100,000 fire insurance policy. The fire statistics indicate that in a given year the probability of property damage in a fire is as follows:

Fire Damage	$100,000	$75,000	$50,000	$25,000	$10,000	$0
Probability	.006	.002	.004	.003	.005	.980

Requested:

  a. **If Burger Prince was risk neutral, how much would they be willing to pay for fire insurance?**

  b. **If Burger Prince has the utility values given below, approximately how much would they be willing to pay for fire insurance?**

Amount of Loss	$100,000	$75,000	$50,000	$25,000	$10,000	$5,000	$0
Utility	0	30	60	85	95	99	100

10) Consider the following linear programming problem

$$\text{Max} \quad 8X + 7Y$$
$$\text{s.t.} \quad 15X + 5Y \leq 75$$
$$10X + 6Y \leq 60$$
$$X + Y \leq 8$$
$$X, Y \geq 0$$

Requested:

a. **Use a graph to show each constraint and the feasible region.**
b. **Identify the optimal solution point on your graph. What are the values of X and Y at the optimal solution?**
c. **What is the optimal value of the objective function?**