SOMAIYA VIDYAVIHAR UNIVERSITY

Semester: June – Sep 24 **Maximum Marks: 50 Examination: ETE Exam Date: 6/11/2024 Duration: 2 Hours**		
Programme code: 1 **Programme: MBA**	**Class:** FY	**Semester/Trimester: I**
College: K. J. Somaiya Institute of Management	**Name of the department/Section/Center: Business Analytics**	
Course Code: 317P01C103	**Name of the Course: Decision Science**	

Instructions:

1. **All questions are compulsory. There is an internal choice in Que 1B and in Que 3.**
2. **Make suitable assumptions if required and state them.**
3. **Write all relevant answers and interpretations in your Excel sheet, with sufficient details in an easily readable manner to enable a fast evaluation of your answers.**
4. **Keep saving the file every ten minutes or so.**
5. **Make only 1 Excel file with different worksheets pertaining to each question.**
6. **The naming convention for the file should have your roll number and name.**
7. **Please follow the instructions of the faculty/IT staff on duty.**

Question No.		Max. Marks
1A	The Green Planet Foundation (GPF) is an environmental charity focused on reforestation projects in urban areas. Over the past few years, GPF has made significant efforts to reduce its operational costs to maximize the funds allocated toward planting trees. The data below shows the annual percentage of funds raised that were spent on administrative and fund-raising expenses from 2015 to 2021: Year / Period / Percentage of Funds Spent on Expenses 2015 / 1 / 18% 2016 / 2 / 16% 2017 / 3 / 15% 2018 / 4 / 14% 2019 / 5 / 12% 2020 / 6 / 10% a. Construct a time series plot. What type of pattern exists in the data? b. Find the parameters for the line that minimizes the Mean Squared Error (MSE) for this time series. c. Forecast the percentage of administrative expenses for 2022. d. If GPF can maintain its current trend in reducing expenses, how long will it take them to achieve a level of 5% or less?	10
1B	Steel mills in three cities produce the following amounts of steel: **Location** **Weekly Production (tons)** Bethlehem 150 Birmingham 210 Gary 320 These mills supply steel to four cities, where manufacturing plants have the following demand: **Location** **Weekly Demand (tons)** Detroit 130	5

St. Louis 70

Chicago 180

Norfolk 240

Shipping costs per ton of steel (in 100$) are as follows:

		Manufacturing Plants			
		Detroit	**St. Louis**	**Chicago**	**Norfolk**
Mills	**Bethlehem**	14	9	16	18
	Birmingham	11	8	-	16
	Gary	16	12	10	22

Because of a truckers' strike, shipments are prohibited from Birmingham to Chicago. Solve the problem to determine the minimum shipping cost.

OR

The Omega pharmaceutical firm has five salespersons, whom the firm wants to assign to five sales regions. Given their various previous contacts, the salespersons are able to cover the regions in different amounts of time. The amount of time (days) required by each salesperson to cover each city is shown in the following table:

	Region (Days)				
Salesperson	**A**	**B**	**C**	**D**	**E**
1	17	10	15	16	20
2	12	9	16	9	14
3	11	16	14	15	12
4	14	10	10	18	17
5	13	12	9	15	11

Which salesperson should be assigned to each region to minimize total time? Identify the optimal assignments and compute total minimum time.

2

A mobile manufacturer plans to launch a new product. The manufacturer must incur a fixed cost of $100,000. The mobile phone is priced at $250 per unit. The probabilistic demand is expected to follow a normal distribution with a mean of 2000 and a standard deviation of 300 mobiles. A time study conducted at their centre gives a probability distribution to direct labour cost per units as follows:

Direct Labour cost	**Probability**
50$	.15
55$	.25
60$	.35
65$	.25

a. Simulate 100 trials and compute the average profit.

b. Comment on the standard deviation of the profit.

c. What is the minimum and maximum profit values.

15

3	Innis Investments is a small, family-owned business that manages personal financial portfolios. The company manages six mutual funds and has a client that has acquired $500,000 from an inheritance. Characteristics of the funds are given in the table below:	20

Fund	Expected Annual Return	Risk Measure
1. Innis Low-priced Stock Fund	8.13%	10.57
2. Innis Multinational Fund	9.02%	13.22
3. Innis Mid-cap Stock Fund	7.56%	14.02
4. Innis Mortgage Fund	3.62%	2.39
5. Innis Income Equity Fund	7.79%	9.30
6. Innis Balanced Fund	4.40%	7.61

Innis Investments uses a proprietary algorithm to establish a measure of risk for its funds based on the historical volatility of the investments. The higher the volatility, the greater the risk. The company recommends that no more than $200,000 be invested in any individual fund, that at least $50,000 be invested in each of the multinational and balanced funds, and that the total amount invested in income equity and balanced funds be at least 40% of the total investment (i.e. $200,000). The client would like to have an average return of at least 5% but would like to minimize risk.

1. What is the portfolio that would optimise the risk?
2. What is the total % return observed by the client?
3. Identify and interpret the non-binding constraints.

OR

A company has facilities for producing 5 products which require the same raw material and same type of production, finishing and packaging facilities. The unit contribution margin and the material and labour requirements for each of the products are given here:

Product	Contribution Margin	Raw Material (kg)	Labour Hours Production	Labour Hours Finishing & Packaging
P_1	150	10	10	30
P_2	120	10	20	20
P_3	160	20	10	20
P_4	160	30	10	20
P_5	100	20	20	10
Total availability	('000)	50	80	140

The above problem is formulated as a linear programing problem below:

Let x1, x2, x3, x4 and x5 be the number of units of P1, P2, P3, P4 andP5, respectively, to be produced.

Maximise $Z = 150x_1 + 120x_2 + 160x_3 + 160x_4 + 100x_5$

Subject to

$$10x_1 + 10x_2 + 20x_3 + 30x_4 + 20x_5 \leq 50{,}000$$
$$10x_1 + 20x_2 + 10x_3 + 10x_4 + 20x_5 \leq 80{,}000$$
$$30x_1 + 20x_2 + 20x_3 + 20x_4 + 10x_5 \leq 140{,}000$$
$$x_i \geq 0,\ i = 1, 2, \ldots, 5$$

Solve the above problem using Solver and obtain the sensitivity report to answer the following:

a. The marketing manager informs that the selling price of the product P2 has to be revised downward to Rs 116. What would be the new optimal product mix and the profit at it?

b. The manager of the company insists that the products P3 and P 4 should be given priority in the production. Analyse and interpret how the optimal solution would be affected and what changes may be needed in the structure if you were to produce P3.

c. If you were to produce P4 instead of P3 how would the current optimal contribution change?

d. Is labour hours for production more sensitive to changes than labour hours for finishing & packaging ? Explain

e. Interpret the range of feasibility for available raw material.