K. J. SOMAIYA INSTITUTE OF MANAGEMENT STUDIES AND RESEARCH,
Vidyavihar, Mumbai- 400077
Program: *PGDM - Finance (Batch 2017-19) Trim VI*
Subject: Quantitative Models in Finance
(End Term Examination) (In computer lab)

Maximum Marks: 50 **Duration: 3 hours** **15th April, 2019**

Instructions

- **Write all your answers in the answer sheet clearly. Your submission in answer sheet will be primarily used for evaluation, supported by the excel submission.**
- **Use Excel and solver/SolverTable as required and keep saving your work (one single file with reference of your program and roll no) as you proceed. Follow the instructions of data centre personnel and transfer your folder to an appropriate place in the server.**
- **If you assume any data not given, please provide suitable explanation of the same.**

Part A (Answer any three out of five questions. Marks – 3*11 = 33)

1. A bank is attempting to determine where its assets should be invested during the current year. At present, $500,000 is available for investment in bonds, home loans, auto loans, and personal loans. The annual rates of return on each type of investment are known to be the following: bonds, 10%; home loans, 16%; auto loans, 13%; personal loans, 20%. To ensure that the bank's portfolio is not too risky, the bank's investment manager has placed the following three restrictions on the bank's portfolio:
   - The amount invested in personal loans cannot exceed the amount invested in bonds.
   - The amount invested in home loans cannot exceed the amount invested in auto loans.
   - No more than 25% of the total amount invested can be in personal loans.

   a. Write the formulation of an LP model which can be applied in this context.
   b. Solve the model with Solver.
   c. Do you think LP model does justice to the requirement of considering the risk associated with the instruments? What modifications and process will you suggest to take care of risk explicitly?

2. Boris Milkem's firm owns six assets. The expected selling price (in millions of dollars) for each asset is given below:

Milkem's asset data						
Data on selling prices of assets (in $millions)						
	Asset 1	Asset 2	Asset 3	Asset 4	Asset 5	Asset 6
Sold in year 1	15	16	22	10	17	19
Sold in year 2	20	18	30	20	19	25
Sold in year 3	24	21	36	30	22	29

   For example, if asset 1 is sold in year 2, the firm receives $20 million. To maintain a regular cash flow, Milkem must sell at least $20 million of assets during year 1, at least $30 million worth during year 2, and at least $35 million worth during year 3.
   Determine how Milkem can maximize his total revenue from assets sold during the next 3 years.
   a. Write the formulation of a suitable model by describing objective function, decision variables, and constraints.

b. Solve the model with Excel solver.
c. Use SolverTable to analyse the effect on the optimal solution of a change in the requirement of funds in year 1, 2, and 3 by 10 million (less/more) in each.

3. The Madison Company manufactures and retails a certain product. The company wants to determine the price that maximizes its profit from this product. The unit cost of producing and marketing this product is $ 50. Madison will certainly charge at least $50 for the product to ensure that it makes some profit. However, there is a very competitive market for this product, so that Madison's demand falls sharply when it increases its price. How should the company proceed?
   a. Estimate the best-fitting linear demand curve and best-fitting constant elasticity demand curve.
   b. Solve the two models with Excel solver.
   c. Using data tables, show that the price elasticity in the linear demand function is not constant in price and that the price elasticity is constant in the constant elasticity function.

4. Pearson & brothers, an investment company, intends to invest a given amount of money in three stocks. From past data, the means and standard deviations of annual returns have been estimated as shown in Table 7.7. The correlations among the annual returns on the stocks are listed in Table 7.8. The company wants to find a minimum-variance portfolio that yields an expected annual return of at least 0.12.

	Estimated mean	Estimated Standard deviation	Combination	Correlation	Combination	Correlation
Part a and b			Part a and b		Additional for part c.	
Stock 1	0.14	0.20	Stock 1&2	0.6	Stock 1&4	0.5
Stock 2	0.11	0.15	Stock 1 &3	0.4	Stock 2 &4	0.8
Stock 3	0.10	0.08	Stock 2&3	0.7	Stock 3&4	0.75
Additional for part c.						
Stock 4	0.16	0.25				

   a. Formulate the problem by detailing variables, constraints, and interim and final outputs.
   b. Solve with Excel Solver.
   c. Modify the model for four stocks with additional information provided and solve separately.

5. An antique collector believes that the price received for a particular item increases with its age and with the number of bidders. Data collected on these three variables for 32 recently auctioned comparable items are given in the annexure.
   a. Estimate a multiple regression model using the given data. Interpret each of the estimated regression coefficients.
   b. Interpret the standard error of estimate and the *R*-square value for these data.
   c. Is the antique collector correct in believing that the price received for the item increases with its age and with the number of bidders?

PART B (Answer any one of the following. Marks – 1*17 = 17)

6. A sweatshirt supplier is trying to decide how many sweatshirts to print for the upcoming NCAA basketball championships. The final four teams have emerged from the quarterfinal round, and there is now a week left until the semi-finals, which are then followed in a couple

of days by the finals. Each sweatshirt costs $10 to produce and sells for $25. However, in three weeks, any leftover sweatshirts will be put on sale for half price $ 12.50. The supplier assumes that the demand for his sweatshirts during the next three weeks (when interest in the tournament is at its highest) has the distribution shown below:

Demand distribution at regular price (demand in 1000s)			Demand distribution at reduced price (demand in 1000s)		
Demand	Probability		Demand	Probability	
7	0.05		2	0.20	
8	0.10		3	0.30	
9	0.25		4	0.20	
10	0.30		5	0.15	
11	0.20		6	0.10	
12	0.10		7	0.05	

The residual demand, after the sweatshirts have been put on sale, has the distribution shown alongwith. The supplier, being a profit maximize, realizes that every sweatshirt sold, even at the sale price, yields a profit. However, he also realizes that any sweatshirt produced but not sold (even at the sale price) must be thrown away, resulting in a $10 loss per sweatshirt.

a. Analyse the supplier's problem with a simulation model.
b. Run 500 trials and provide summary measures.
c. Identify probability of loss from the trials.
d. Produce a data table of average profit as a function of order quantity.
e. Review the pros and cons of simulation models Vis a Vis optimization models.

7. Suppose that a regional express delivery service company wants to estimate the cost of shipping a package (Y) as a function of cargo type, where cargo type includes the following possibilities: fragile, semifragile, and durable. Costs for 15 randomly chosen packages of approximately the same weight and same distance shipped, but of different cargo types, are provided in the annexure.
   a. Formulate an appropriate multiple regression model to predict the cost of shipping a given package.
   b. Estimate the formulated model using the given sample data, and interpret the estimated regression coefficients.
   c. According to the estimated regression model, which cargo type is the *most* costly to ship? Which cargo type is the *least* costly to ship?

d. How well does the estimated model fit the given sample data? How might the model be improved?
e. Given the estimated regression model, predict the cost of shipping a package with semifragile cargo.

Annexure of Data for questions

Data for Part A qn5					Data for Part B Qn 7		
Item	Auction Price	Age of Item	Number Bidders		Shipment	Cost of Shipment	Cargo Type
1	$946	113	9		1	$7.00	Semifragile
2	$1,336	126	10		2	$2.00	Durable
3	$744	115	7		3	$13.80	Fragile
4	$1,979	182	11		4	$11.10	Fragile
5	$1,522	150	9		5	$10.00	Semifragile
6	$1,235	127	13		6	$17.20	Fragile
7	$1,483	159	9		7	$11.50	Semifragile
8	$1,152	117	13		8	$6.50	Semifragile
9	$1,545	175	8		9	$8.50	Semifragile
10	$1,262	168	7		10	$2.10	Durable
11	$845	127	7		11	$10.90	Fragile
12	$1,055	108	14		12	$12.00	Fragile
13	$1,253	132	10		13	$7.50	Durable
14	$1,297	137	9		14	$3.40	Durable
15	$1,147	137	8		15	$1.30	Durable
16	$1,080	115	12				
17	$1,550	182	8				
18	$1,047	156	6				
19	$1,792	179	9				
20	$729	108	6				
21	$854	143	6				
22	$1,593	187	8				
23	$1,175	111	15				
24	$1,713	137	15				
25	$1,356	194	5				
26	$1,822	156	12				
27	$1,884	162	11				
28	$1,024	117	11				
29	$2,131	170	14				
30	$785	111	7				

31	$1,092	153	6				
32	$2,041	184	10				

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