UNIVERSITY OF COLOMBO, SRI LANKA
FACULTY OF MANAGEMENT AND FINANCE

Bachelor of Business Administration (Semester-V) Examination, July 2017

FIN-2300/ACT/MOS-2307 Management Science Applications

Three (03) Hours

Answer All Questions
Formula Sheet and the Normal Distribution Table are provided
Use of non-programmable calculators is permitted.

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01. Hendrix Manufacturing is a U.S. based company located in Sri Lanka. The company records all their financial transactions in $ U.S. They produces two products, each of which must be processed on three machines. The profits per unit on the two products are $24 and $30 respectively. Product 1 requires 4 hours processing time on machine A, 8 hours on machine B, and 2 hours on machine C. The processing times for product 2 on the three machines are 6 hours, 4 hours, and 3 hours respectively. The machine-hour capacities of the three machines in the upcoming month are 240 hours, 240 hours, and 150 hours for machines A, B and C respectively.

To determine the optimal product mix, the following LP model was formulated:

Maximize Z = $ 24_{X1} + $ 30_{X2}

Subject to:

(1) $4_{X1} + 6_{X2} <= 240$ Machine A (Hours)
(2) $8_{X1} + 4_{X2} <= 240$ Machine B (Hours)
(3) $2_{X1} + 3_{X2} <= 150$ Machine C (hours)
(4) X1, X2 >=0

Win-QSB program was used to solve this problem. The final simplex table appearing in the computer printout is shown in table next page (S1 .S2 S3 are slack variables for constraints (1), (2), and (3) respectively).

The final simplex table

Cj / Cb	Basis	Solution	24	30	0	0	0
			X1	X2	S1	S2	S3
30	X2	30	0	1	0.250	-0.125	0.00
24	X1	15	1	0	-0.125	0.188	0.00
0	S3	30	0	0	-0.500	0.000	1.00
	ZJ	1260	24	30	4.50	0.75	0
	CJ-ZJ		0	0	-4.50	-0.75	0

i. Specify the optimal X1 , X2 and Z values.
ii. What are the shadow price values?
iii. Over what range of the right-hand-side values in each shadow price valid?
iv. Over what range of unit profit on product 1 will the current product mix remains optimal?
v. Due to rise in material cost, the profit per unit on product 1 decrease to $ 21 (from $. 24). How does this affect the optimal product mix? What about the monthly profit?
vi. Suppose the machine hour capacity of Machine "A" can be increased to 275 hours per month at a total monthly cost of $ 130. Would you recommend that Hendrix undertake the capacity expansion?
vii. Suppose the machine hour capacity of Machine "A" has been increased to 275 hours per month as suggest in above (f), what would happen to the solution mix?

(Total 25 Marks)

02. Turkish National Swimming Team (TNST) coach is putting together a relay team for the 400 meter relay. Each swimmer must swim 100 meters *of* ***breaststroke, backstroke, butterfly*** **or** ***free style.*** The coach believes that each swimmer will take in the time (seconds) to complete their 100 meter as given in the table below:

Swimming style / Swimmer	Free	Breast	Fly	Back
Derya	54	54	51	53
Murat	51	57	52	52
Deniz	50	53	54	56
Ceyhun	56	54	55	53

To minimize the team's time for the race, assign each swimmer for a stroke.

(Total 13 Marks)

03. **i.** Read the following statements and write your answers (fill in the blank) in your answer book.

a. In a PERT network, the manager must estimate three times for the completion of an activity: the earliest possible completion time, called the .....; the best estimate of completion time, called the most .....; and the latest possible completion, called the .....

b. Activities which must be completed before another activity can begin are called ..... Activities: those which must be completed just before a given activity can begin are called the ..... of that activity.

c. In the CPM network, the ..... time is the time required to finish an activity of no extraordinary measures are taken, while the ..... time is the shortest possible completion time and required special effort or resources. The cost associated with thee former is always ..... than the cost of the latter.

d. The ..... Problem is concerned with finding the best way to reach all nodes in a network from some particular source node such that the total length of all branches used is a minimum.

e. The ..... is used to find the greatest volume of flow from some source node to some other sink node.

f. When combining three time estimates into a distribution of randomly distributed activity durations, we assume that the activities are ..... distributed.

g. Activities in a PERT network which are not critical are said to have free time called .....

(05 Marks)

ii. Ottawa constructions, Ltd., is preparing a PERT network for laying the foundation for a new art museum. They have the following activities to perform, with time estimates in weeks:

Activity	Description	Optimistic estimate	Pessimistic estimate	Most likely estimate	Immediate predecessors
A	Survey site	2	4	3	none
B	Excavation	9	15	12	A
C	Prepare drawings	4	8	6	none
D	Soil testing	1	1	1	B
E	Prelim report	1	3	2	C,D
F	Approve plans	1	1	1	E
G	Concrete forms	5	7	6	F
H	Procure steel	2	4	3	F
I	Order cements	1	1	1	F
J	Deliver gravels	2	4	3	G
K	Pour concrete	8	12	10	H,I,J
L	Cure concrete	2	2	2	K
M	Strength test	2	2	2	L

a. Construct the PERT network for the project and determine the critical path.

b. If Ottawa plans to include a completion date in their bid for this work, what completion time should they quote if it is their policy to ensure a 90 percent probability of being completed?

c. If the Ministry of Arts desire to have the work completed within 41 weeks, determine the probability of meeting this objective?

d. The contract specifies a Rs. 100,000/= per week penalty for each week the completion of the project extends past week 43. What is the probability Ottawa Construction will have to pay a Rs. 100,000/= penalty? What is the probability they will have to pay a Rs. 200,000/= penalty?

(20 Marks)

(Total 25 Marks)

04. Cindy and Mindy were in the same student group while studying for their BBA at UOC. They graduated together but started working as inventory managers in different but competing retailers selling air conditioners in Kandy. While in the Faculty they learned only the economic order quantity (EOQ) model for finding the optimum order sizes.

Now they are both purchasing air conditioners from Singer Sri Lanka to sell in their stores. Cindy knows that the order set up cost with Singer SL is $ 200 and the annual inventory holding cost is $ 400 per unit. Cindy expects that Mindy has the same cost figure. Cindy has accidently has learned that Mindy is ordering 10 air conditioners every time she orders.

i. Show how Cindy can use this information to find the demand Mindy faces.
ii. Explain briefly why would competitors want to know each other's demand.

(Total 12 Marks)

5. **i.** Fashion-Bug stocks and sells high fashion clothing for women. For the coming festival season, they plan to order "***designer-fashion-wear***" at a cost of Rs.5000/= per unit. These will be sold for Rs. 8500/= per unit during the festival season. At the end of the season ***fashion-ware*** must be sold at a post-festival sale for Rs. 3000/= per unit, because it will be out of fashion during the following year. Demand during the festival season is estimated as.

Demand (units)	Probability
100	0.20
200	0.30
300	0.30
400	0.15
500	0.05

a. Develop a table of conditional losses including both opportunity costs of Rs.3500/= per unit and obsolescence cost of Rs. 2000/= per unit and determine the stocking decision which minimizes expected loss.

(10 Marks)

b. Calculate the expected value of perfect information.

(02 Marks)

ii. A company which is planning to introduce a new product is considering whether they should implement a pilot plant before they construction of a large commercial facility. The output of the pilot plant provides the company with useful information on market acceptance, reduction yields, design engineering problems, and equipment difficulties etc.

The table in the next page, illustrates the sequence of decisions and state-of-nature involved in deciding whether to build a pilot plant to study process yields before mass production is begun.

Decision	Pilot Plant Yield	Further Decision	Probability of commercial plant yield	Conditional profit Rs.
Produce Commercially without pilot plant			High 0.7	12,250,000
			Low 0.3	-1,525,000
Build pilot plant	High 0.8	Produce Commercially	High 0.85	12,250,000
			Low 0.15	- 1,525, 000
		Stop	1.0	0
	Low 0.2	Produce commercially	High 1.0	12,250,000
			Low 0.9	- 1,525,000
		Stop	1.0	0
Stop		-	1.0	0

As shown in the above table, the company has an option to produce the product and commercialize it without a pilot plant and if it so, the probability of high yield in the market is 0.7 and the low yield is 0.3.

Management also has estimated that a pilot plant (if it is built) has 0.8 chance of high yield and a 0.2 chance of low yield. If the pilot plant does show a high yield, management assign a probability of 0.85 that the commercial plant will also have a high yield. If the pilot plan shows a low yield, there is only a 0.1 chance that the commercial plant will show a high yield.

The company has estimated that the pilot plant will cost Rs. 350,000=/.

The company is expecting your advice to make a decision whether they should build up the pilot plant before they introduce the new product.

Advise to the company using a decision tree analysis.

(13 Marks)

(Total 25 Marks)

FORMULA SHEET

Change in the Objective Function Coefficients (Cij)

Upper Limit	Lower Limit
$ck_u = Min\left(ck + \frac{cj - zj}{akj}\right) for\ all\ \ akj < 0$	$ck_L = Max\left(ck + \frac{cj - zj}{akj}\right) for \quad all \quad akj > 0$
Where :	Where
ck = Contribution rate of the k^{th} basic variable in the solution basis.	ck = contribution rate of the k^{th} basic variable in the solution basis.
cj-zj = the cj-zj value of the j^{th} variable that is non basic	cj-zj = the cj-zj value of the j^{th} variable that is non basic
akj = the coefficient in the k^{th} basic variable row and j^{th} variable column that is non basic.	akj = the coefficient in the k^{th} basic variable row and j^{th} variable column that is non basic.

Change in the Right-Hand-Side Values (Bi)

Upper Limit	Lower Limit
$Min\left(bi - \frac{Bk}{akj}\right) for\ \ all \quad akj < 0$	$Max\left(bi - \frac{Bk}{akj}\right) for\ all \quad akj > 0$
Where	Where
bi = the original Right Hand side values of the i^{th} constraint	bi = the original Right Hand side values of the i^{th} constraint
bk = the solution value of the k^{th} basic variable	bk = the solution value of the k^{th} basic variable
akj = the coefficient in the k^{th} row and i^{th} slack variable column where bi has been changed	akj = the coefficient in the k^{th} row and i^{th} slack variable column where bi has been changed

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964