

國立清華大學命題紙

97 學年度工業工程與工程管理學系(所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 / 頁 \*請在【答案卷卡】內作答

註：不得使用計算器；滿分 100 分。

**Part A. Analysis Questions (50 points) 分析題**

**Q1-Q12** Multiple choice, choose the best option. (2 points each; total 24 points)

Jack, a ring maker, is interested in determining which items he should make for the upcoming month. His three most popular selections are a star sapphire cocktail ring, a royal ruby friendship band, and a single diamond placed in a Tiffany setting. These items require various combinations of diamonds, sapphires, rubies, and gold as indicated below.

Item	Unit Selling Price	Material Requirement			
		Diamonds	Sapphires	Rubies	Gold (grains)
Star Sapphire Ring	1465	2	1	2	160
Royal Ruby Band	1500	2	0	3	180
Single Tiffany Diamond	400	1	0	0	150
Unit Cost		\$250	\$175	\$200	\$.375
Current Stock		60	45	50	10000

Note that the costs and on-hand availability of each raw material are also provided in the table above. Jack estimates that he can sell at most 70 star sapphire rings and at most 40 royal ruby friendship rings in the upcoming month. He is obligated to sell at least 25 Tiffany diamond rings in this time period.

The problem can be formulated to determine the product mix that maximize profit by defining S, R, and T to represent the number of sapphire rings, ruby bands, and Tiffany diamonds, respectively, to make for the upcoming month. The following linear programming results. (Note, we don't require the integer solution in this particular problem)

$$\text{Max } ?S + 332.5R + 93.75T$$

Subject to

$$2S + 2R + T \leq 60$$

$$S \leq 45$$

$$2S + 3R \leq 50$$

國 立 清 華 大 學 命 題 紙

97 學年度工業工程與工程管理學系 (所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 2 頁 \*請在【答案卷卡】內作答

$$160S+180R+150T \leq 10000$$

$$S \leq 70$$

$$R \leq 40$$

$$T \geq 25$$

$$S, R, T \geq 0$$

When the problem is solved using Microsoft Excel, the following Answer Report and Sensitivity Report are obtained.

Target Cell (Max)

Cell	Name	Original Value	Final Value
\$D\$2	OBJ	0	

Adjustable Cells

Cell	Name	Original Value	Final Value
\$A\$2	S	0	2.5
\$B\$2	R	0	15
\$C\$2	T	0	25

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
\$D\$5	Diamond Availability	60	\$D\$5<=\$E\$5	Binding	0
\$D\$6	Sapphire Availability	2.5	\$D\$6<=\$E\$6	Not Binding	42.5
\$D\$7	Ruby Availability	50	\$D\$7<=\$E\$7	Binding	0
\$D\$8	Gold Availability	6850	\$D\$8<=\$E\$8	Not Binding	3150
\$D\$9	Upper Limit on S	2.5	\$D\$9<=\$E\$9	Not Binding	67.5
\$D\$10	Upper Limit on R	15	\$D\$10<=\$E\$10	Not Binding	25
\$D\$11	Lower Limit on T	25	\$D\$11>=\$E\$11	Binding	0

國立清華大學命題紙

97 學年度工業工程與工程管理學系 (所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 3 頁 \*請在【答案卷卡】內作答

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$A\$2	S	2.5			2.5	45.83333333
\$B\$2	R	15	0	332.5	68.75	2.5
\$C\$2	T	25	0	93.75	68.75	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$D\$5	Diamond Availability	60	162.5	60	15	1.666666667
\$D\$6	Sapphire Availability	2.5		45		
\$D\$7	Ruby Availability	50	2.5	50	2.5	15
\$D\$8	Gold Availability	6850		10000	1E+30	3150
\$D\$9	Upper Limit on S	2.5	0	70	1E+30	67.5
\$D\$10	Upper Limit on R	15	0	40	1E+30	25
\$D\$11	Lower Limit on T	25	-68.75	25	1.666666667	15

- What is the unit profit of a sapphire ring?
  - 220
  - 110
  - 330
  - 150
- What is the optimal objective value?
  - S=2.5, R=15, T=25
  - 8156.25
  - 18000
  - 5001
- What is the shadow price of gold availability?
  - 2
  - 1
  - 3.5
  - 0

國 立 清 華 大 學 命 題 紙

97 學年度工業工程與工程管理學系(所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 4 頁 \*請在【答案卷卡】內作答

4. What is the reduced cost of S?
  - (a) The reduced cost is positive because S is at its upper bound.
  - (b) The reduced cost is zero .
  - (c) The reduced cost is positive because it is worth while to produce S.
  - (d) The reduced cost is negative.
  
5. What is the shadow price of Sapphire?
  - (a) 130
  - (b) it is a positive value and we can use it to calculate the opportunity cost.
  - (c) it is a negative value.
  - (d) It is zero since Sapphire availability is a non binding constraint.
  
6. What is the allowable increase of Sapphire availability?
  - (a) it is infinite since the Sapphire availability is a slack constraint.
  - (b) it is zero since Sapphire availability is a non binding constraint.
  - (c) it is a positive number.
  - (d) We don't know unless we see the excel output.
  
7. What is the allowable decrease of Sapphire availability?
  - (a) It is zero since the Sapphire availability is a slack constraint.
  - (b) It is a positive number.
  - (c) 42.5
  - (d) It is infinite since the Sapphire availability is a slack constraint.
  
8. Which statement is true?
  - (a) The Sensitivity Analysis is not available if there is an integer constraint.
  - (b) There is no alternate optimal solution in this problem because the allowable increase of T is  $1E+30$ .
  - (c) The Sensitivity Analysis is available even with an integer constraint.
  - (d) There is an alternate optimal solution in this problem .
  
9. If the unit price of the royal ruby friendship band increases to \$1550
  - (a) The optimal solution will change and we have to resolve the problem to know the new optimal solution.

國 立 清 華 大 學 命 題 紙

97 學年度工業工程與工程管理學系 (所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 5 頁 \*請在【答案卷卡】內作答

- (b) The optimal solution will not change because the increase in profit is less than the allowable increase.
  - (c) The optimal solution will change because the increase in profit exceeds the allowable increase.
  - (d) The optimal solution will not change since we only change one parameter at a time.
10. What happened if the minimum number of Tiffany Diamonds Ring obligated to sell in the upcoming month is reduced from 25 to 20?
- (a) Unless we resolve the problem, we don't know what is the new optimal solution and new optimal objective value.
  - (b) The new optimal objective value will change, the new value is 7812.5, and we need to resolve the problem to know the new optimal solution.
  - (c) The new optimal objective value will change, the new value is 8500, and we need to resolve the problem to know the new optimal solution.
  - (d) The new optimal objective value will change, the new value is 8500, and the optimal solution will not change.
11. By how much can the price of gold decrease without affecting the optimal solution?
- (a) 1.4535 cents
  - (b) 1.5112 cents
  - (c) 1.3533 cents
  - (d) 1.7634 cents
12. Suppose Jack can produce a rainbow engagement ring that consists of 2 diamonds, 2 sapphire, 2 rubies, and 150 grains of gold. What is the minimum selling price at which this new ring would have to be priced in order for it to be included in the optimal product mix?
- (a) 1636.25
  - (b) 1600.70
  - (c) 1720.11
  - (d) can not tell, since decreases of two diamonds already exceed the allowable increase of 1.66

國立清華大學 命題紙

97 學年度工業工程與工程管理學系 (所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 6 頁 \*請在【答案卷卡】內作答

Q13-Q14

The Formosa Air Cargo has expanded its shipping capability by purchasing 120 cargo airplanes from a competitor that went bankrupt. The company subsequently located 40 of the purchased airplanes at each of its shipping warehouses in Taipei, Taichung, and Tainan. The company makes shipments from each of these warehouses to terminals in Tokyo, Soul, and Hanoi. Each airplane is capable of making one shipment per day.

The terminal managers have each indicated their capability for extra shipments. The manager at Tokyo can accommodate 40 additional airplanes per day, the manager at Soul can accommodate 60 additional airplanes, and the manager at Hanoi can accommodate 50 additional airplanes.

Because of the differences in distance, products shipped, and transport rate, the profit differs. The profit the company makes per airplane from each warehouse to each terminal is listed in the following table.

Warehouse	Terminal		
	Tokyo	Soul	Hanoi
Taipei	\$1200	\$1900	\$1500
Taichung	\$1300	\$500	\$800
Tainan	\$1700	\$600	\$2100

For example, for each airplane shipment from Taipei to Tokyo, the company will make a profit of \$1200, and for each shipment from Tainan to Hanoi, the company will make a profit of \$2100.

The company wants to know how many airplane to assign to each route (i.e. warehouse to terminal) to maximize profit.

Let  $X_{ij}$  be the number of airplane assigned to fly from warehouse  $i$  to terminal  $j$ . We index warehouse Taipei, Taichung, and Tainan as warehouse 1, 2, and 3 and terminal Tokyo, Soul, and Hanoi as terminal 1, 2, and 3 with respectively. Answer the following questions.

13. Which of the following is true? (3pts) Note, this problem could have multiple correct answers and you have to answer this question correctly to continue to answer the next question.

國立清華大學 命題紙

97 學年度工業工程與工程管理學系 (所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 7 頁 \*請在【答案卷卡】內作答

- (a) The objective function is  

$$\text{Max } 1200x_{11} + 1300x_{12} + 1700x_{13} + 1900x_{21} + 500x_{22} + 600x_{23} + 1500x_{31} + 800x_{32} + 2100x_{33}$$
- (b) The objective function is  

$$\text{Max } 1200x_{11} + 1300x_{21} + 1700x_{31} + 1900x_{12} + 500x_{22} + 600x_{32} + 1500x_{13} + 800x_{23} + 2100x_{33}$$
- (c) The objective function is  $\max \sum_{i=1}^3 \sum_{j=1}^3 c_{ij} x_{ij}$ ,  $c_{ij}$  is the profit the company makes for each shipment from warehouse  $i$  to terminal  $j$ .
- (d) The objective function is  $\max \sum_{i=1}^3 \sum_{j=1}^3 c_{ij} x_{ji}$ ,  $c_{ij}$  is the profit the company makes for each shipment from warehouse  $i$  to terminal  $j$ .

14. Present the network graph and write down the complete formulation including decision variables, objective function, and constraints. (10 points)

**Q15-16**

Tsing Hua Energy (THE) is attempting to decide if it should introduce a new alternative energy called Galaxy Power. The company can test market the Galaxy Power in selected geographic areas or by pass the test market and introduce the product nationally. If the company conducts the test market, it must wait to see the results before deciding whether or not to introduce the Galaxy Power nationally. The probability of a positive test market result is estimated to be 0.6. Alternatively, the company cannot conduct the test market and make the decision to introduce the Galaxy Power or not. If the Galaxy Power is introduced nationally and are a success, the company estimates it will realize an annual profit of \$1.6 million dollars while if the Galaxy Power fail, it will incur a loss of 0.7 million dollars.

The company believes the probability of success for the Galaxy Power is 0.5 if it is introduced without the test market. If the company does conduct the test market and it is positive, the probability of successfully introducing the Galaxy Power increases to 0.8. If the test market is negative and the company introduces the Galaxy Power anyway, the probability of success drops to 0.3.

國立清華大學命題紙

97學年度工業工程與工程管理學系(所) 丁組 碩士班入學考試

科目 管理學 科目代碼 1701 共 8 頁第 8 頁 \*請在【答案卷卡】內作答

15. What is the expected monetary value without test market? (3 points, choose the best options. Note! You have to answer this question correctly to answer the following question.)
- (a) 1600000
  - (b) Nothing
  - (c) 450000
  - (d) 684000
16. Up to how much are you willing to pay for the test market? Construct a decision tree and explain your answer. (10 points)

**Part B. Brief Statements (10 points each; total 50 points) 簡述題**

Please briefly state the **reasons or conditions** for Yes and No answers for the following questions. *Some questions may have both Yes and No answers depending on the conditions.* (10% each)

請依題號順序精簡說明“是”及“否”之答案的理由或狀況。有些題目因狀況不同可因狀況而同時答覆“是”及“否”(每題10%)。

17. A company's strategy, organization, and leadership *determine* a company's success.
18. When you get the *authority* you get the *power* in an organization.
19. In the knowledge economy, the technology makes information more *accessible* and hence less *valuable*.
20. Most organizational relationships are rooted in *knowledge-based trust*. This is the highest level of trust when there is no *emotional connection* between the parties.
21. The general *business strategy* (such as low cost, differentiation, and focus) can also be used by the *universities* in the global competition