



Al Imam Mohammad Ibn Saud Islamic University
College of Computer and Information Sciences
Information Systems Department

Course Title:	Decision Support Systems
Course Code:	IS350
Course Instructor:	Pavlos Nikolaidis, Mozaherul Hoque
Exam:	Project
Semester:	Spring 2022
Due Date:	7/05/2022
Marks:	20
Privileges:	<input type="checkbox"/> Open Book <input type="checkbox"/> Open Notes <input type="checkbox"/> Calculator Permitted <input type="checkbox"/> Laptop Permitted

Group No:	4
Section ID:	22903
Section No.:	171

Instructions:

1. Answer all requirements; there are **(4) requirements in (3) pages**.
2. Upload on the Blackboard a zip file of your project folder (report included).
3. *You are required to have a project presentation (discussion) with your instructor (date TBA)*

Official Use Only		
Question	Student Marks	Question Marks
Task 1 (a)		4
Task 1 (b)		6
Task 2 (a)		6
Task 2 (b)		4
Total		20



In this project you will solve a Linear Programming problem using Excel Solver.

Olympic Bike company is introducing two new lightweight bicycle frames, the Deluxe and the Professional, to be made from special aluminium and steel alloys. The anticipated unit profits are \$100 for the Deluxe, \$150 for the Professional and \$200 for Supreme. The number of kilograms of each alloy needed per bike frame is summarized in the table below. A supplier delivers 100 kg of the aluminium alloy and 80 kg of the steel alloy weekly. The requirement for making aluminium and steel alloys per bike are given below:

	Aluminium Alloy (kg)	Steel Alloy (kg)
Deluxe	2	3
Professional	4	2
Supreme	2	1

Total sales of Deluxe and Professional bikes together must be at least 25 units whereas Supreme bikes can be sold at most 10 units. Olympic Bikes wants to determine the optimal number of bikes it should produce to maximize the profit.

➤ **Task 1**

- a. Model the above problem as an optimization problem maximizing the weekly profit contribution:

1) define the decision variables [1 mark]

X1 : Number of deluxe frames produced weekly.

X2 : Number of professional frames produced weekly.

X3 : Number of supreme frames produced weekly.

2) define the objective function [1 mark]

$$\text{Maximize } Z = 100x_1 + 150x_2 + 200x_3$$

3) state **ALL** the constraints [2 marks]

$$2x_1 + 4x_2 + 2x_3 \leq 100 \text{ kg aluminium alloy}$$

$$3x_1 + 2x_2 + 1x_3 \leq 80 \text{ kg of steel alloy}$$

$$x_1 + x_2 \geq 25 \text{ units}$$

$$x_3 \leq 10 \text{ unit}$$

$$x_1, x_2, x_3 \geq 0$$



b. Solve the problem using Excel Solver [6 marks]

	A	B	C	D	E	F	G	H
4								
5								
6								
7								
8								
9								
10		Task 1-B						
11		X1 : Number of deluxe frames produced weekly.						
12								
13		X2 : Number of professional frames produced weekly.						
14								
15		X3 : Number of supreme frames produced weekly.						
16								
17		Maximize $Z = 100x_1 + 150x_2 + 200x_3$						
18								
19			Deluxe	Professional	Supreme			
20			X1	X2	X3	total		limit
21		Decision variables	15	12.5	10			
22		Objective	100	150	200	\$ 5,375		
23		Alumnium alloy (Kg)	2	4	2	100	<=	100
24		Steel alloy (Kg)	3	2	1	80	<=	80
25		sales of Deluxe and Professional	1	1		27.5	>=	25
26		Sales of Supreme			1	10	<=	10
27		nonnegativity restrictions	x1 , x2 , x3 >= 0					
28								
29		Solution:						
30			X1	X2	X3	Z		
31		Results:	15	12.5	10	5375		



➤ **Task 2** (Consider question **a** and **b** are independent)

- a.** If the company gives a discount on Supreme bikes which will reduce the profit to \$100 per unit, the sales can be increased to at most 20 units of Supreme.

- 1) Is the above solution in Task 1 (the value of the decision variables) will still remain the same if they give the discount?

The new solution values of decision variables will not be the same for the new solution when the company gives discount.

- 2) Do you suggest the company should give this discount? Justify your answer. [1+2 marks]

No, the number of total sales is increasing but, the total profit is decreasing, the total profit before the discount was \$5375 and the new profit after discount is \$4500 which is less than the first profit, they should not give discounts!

- 3) Provide the updated model [2 marks]

	A	B	C	D	E	F	G	H
1								
2								
3								
4								
5								
6								
7								
8								
9								
10		Task 2-A						
11		X1 : Number of deluxe frames produced weekly.						
12		X2 : Number of professional frames produced weekly.						
13		X3 : Number of supreme frames produced weekly.						
14								
15		Maximize $Z = 100x_1 + 150x_2 + 100x_3$						
16								
17								
18								
19			Deluxe	Professional	Supreme			
20			X1	X2	X3	total		limit
21		Decision variables	15	10	15			
22		Objective	100	150	100	\$ 4,500		
23		Aluminium alloy (Kg)	2	4	2	100	<=	100
24		Steel alloy (Kg)	3	2	1	80	<=	80
25		sales of Deluxe and Professional	1	1		25	>=	25
26		Sales of Supreme			1	15	<=	20
27		nonnegativity restrictions	$x_1, x_2, x_3 \geq 0$					
28								
29		Solution:						
30			X1	X2	X3	Z		
31		Results:	15	10	15	4500		



- b. Suppose the company wants to increase the aluminium supply by 100 extra kilograms.

- 1) What is your suggestion for the company? Justify your answer.
[1+2 marks]

When we increase the Aluminium alloy by 100kg, we only use extra 60kg and 40kg is not being used, the company should increase the aluminium alloy by 60kg which will increase the profit by \$1875 and the total profit will be \$7250.

- 2) Provide the updated model [1 mark]

	A	B	C	D	E	F	G	H
7								
8								
9								
10		Task 2-B						
11		X1 : Number of deluxe frames produced weekly.						
12								
13		X2 : Number of professional frames produced weekly.						
14								
15		X3 : Number of supreme frames produced weekly.						
16								
17		Maximize $Z = 100x_1 + 150x_2 + 200x_3$						
18								
19			Deluxe	Professional	Supreme			
20			X1	X2	X3	total		limit
21		Decision variables	0	35	10			
22		Objective	100	150	200	\$ 7,250		
23		Alumnum alloy (Kg)	2	4	2	160	<=	200
24		Steel alloy (Kg)	3	2	1	80	<=	80
25		sales of Deluxe and Professional	1	1		35	>=	25
26		Sales of Supreme			1	10	<=	10
27		nonnegativity restrictions	$x_1, x_2, x_3 \geq 0$					
28								
29		Solution:						
30			X1	X2	X3	Z		
31		Results:	0	35	10	7250		



Submission Guidelines:

1. Write your answer in this Word file.
2. Make all the updated models in a single Excel file.
3. Submit the Word and Excel files in LMS