

Name: _____

Instructions: All solutions should be prepared carefully and neatly. All solution sets shall be completed on this packet and submitted by uploading a scan or picture of your written work to D2L by 11:59 PM on the due date below. **Submit only a single pdf file of your entire packet. Submit any Excel or Python files as well.** The mobile app called *Genius Scan* works well. Use a PENCIL and if you make a mistake, use an eraser. Careless presentation (e.g. bad handwriting, pen scribbles, doodles, wasted space, etc) will result in a deduction of points at my discretion. Submitted work that does not demonstrate clearly the process by which one arrived at the answer will not receive credit of any kind. Academic dishonesty will not be tolerated.

PROBLEM SET I

MAT 362-010 – OPERATIONS RESEARCH II

DUE: FRIDAY, FEBRUARY 16 BY 11:59 PM ON D2L

READ: SECTIONS 4.14, 6.5-6.7

Problem Number	Available Points	Your Points
1	5	
2	3	
3	3	
4	3	
5	5	
6	4	
7	4	
Total	27	

1. A company is planning the manufacture of a product for March, April, May, and June of next year. The demand quantities are 520, 720, 520, and 620 units, respectively. The company has a steady workforce of 10 employees but can meet fluctuating production needs by hiring and firing temporary workers. The extra costs of hiring and firing a temp in any month are \$200 and \$400, respectively. A permanent worker produces 12 units per month, and a temporary worker, lacking equal experience, produces 10 units per month. The company can produce more than needed in any month and carry over the surplus to a succeeding month at a holding cost of \$50 per unit per month. Develop an optimal hiring/firing policy over the 4-month planning horizon. Formulate the LP in the space below and find a solution using the Excel Solver. Submit the Excel program and report the solution below.

[(5)]

2. Find the dual of the following LP:

[(3)]

$$\text{Minimize: } z = 15x_1 + 12x_2$$

$$\text{Subject to: } x_1 + 2x_2 \geq 3$$

$$2x_1 - 4x_2 \leq 5$$

$$x_1, x_2 \geq 0$$

3. Find the dual of the following LP:

[(3)]

$$\text{Minimize: } z = 6x_1 + 3x_2$$

$$\text{Subject to: } 6x_1 - 3x_2 + x_3 \geq 2$$

$$3x_1 + 4x_2 + x_3 \geq 5$$

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

4. Find the dual of the following LP:

[(3)]

$$\text{Maximize: } z = 5x_1 + 6x_2$$

$$\text{Subject to: } x_1 + 2x_2 = 5$$

$$-x_1 + 5x_2 \geq 3$$

$$4x_1 + 7x_2 \leq 8$$

$$x_1 \text{ unrestricted, } x_2 \geq 0$$

5. An auto company manufactures cars and trucks. Each vehicle must be processed in the paint shop and body assembly shop. If the paint shop were only painting trucks, then 40 per day could be painted. If the paint shop were only painting cars, then 60 per day could be painted. If the body shop were only producing cars, then it could process 50 per day. If the body shop were only producing trucks, it could process 50 trucks per day. Each truck contributes \$300 to profit, and each car contributes \$200 to profit. The auto company need not only manufacture a single type of automobile in a single day. Formulate an LP that determines the appropriate mixture of automobile type that will maximize profits for a single day. Then, formulate the dual problem and give an interpretation of the decision variables, constraints, and objective function of the dual problem.

[(5)]

6. Consider the Giapetto's Workshop problem in the text (Section 3.1, Example 1). The LP is below along with the optimal tableau. [(4)]

Maximize: $z = 3x_1 + 2x_2$

Subject to: $2x_1 + x_2 \leq 100$

$x_1 + x_2 \leq 80$

$x_1 \leq 40$

$x_1, x_2 \geq 0$

Row	Basic	z	x_1	x_2	s_1	s_2	s_3	RHS
0	z	1	0	0	1	1	0	180
1	x_1	0	1	0	1	-1	0	20
2	x_2	0	0	1	-1	2	0	60
3	s_3	0	0	0	-1	1	1	20

Find the dual of the Giapetto problem. Use the optimal tableau of the Giapetto problem to determine the optimal solution of the dual problem. Verify that the Dual Theorem holds in this instance by showing the optimal solution to the dual is $c_{BV}B^{-1}$ and $z_{opt} = w_{opt}$.

7. Consider the Bevco problem in the text (Section 4.12, Example 4). The LP is below. The optimal tableau, found via the Big M Method is given below as well. [(4)]

Minimize: $z = 2x_1 + 3x_2$

Subject to: $\frac{1}{2}x_1 + \frac{1}{4}x_2 \leq 4$

$x_1 + 3x_2 \geq 20$

$x_1 + x_2 = 10$

$x_1, x_2 \geq 0$

Row	Basic	z	x_1	x_2	s_1	e_2	a_2	a_3	RHS
0	z	1	0	0	0	$-\frac{1}{2}$	$\frac{1-2M}{2}$	$\frac{3-2M}{2}$	25
1	s_1	0	0	0	1	$-\frac{1}{8}$	$\frac{1}{8}$	$-\frac{5}{8}$	$\frac{1}{4}$
2	x_2	0	0	1	0	$-\frac{1}{2}$	$\frac{1}{2}$	$-\frac{1}{2}$	5
3	x_1	0	1	0	0	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{3}{2}$	5

Find the dual of the Bevco problem. Use the optimal tableau of the Bevco problem to determine the optimal solution of the dual problem. Verify that the Dual Theorem holds in this instance by showing the optimal solution to the dual is $c_{BV}B^{-1}$ and $z_{opt} = w_{opt}$.