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EE 417 Quiz 1
Spring 2021
Friday, February 12

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Problem Number	Maximum Points	Your Score
1	12	
2	12	
Total	24	

- This is an open book, open notes 30 minute quiz. Of course, no collaboration.
- You should receive this quiz by email at or before 10:25 am.
- This will be given during a Zoom session so that you can ask questions and typos can be announced. Also, this will be a mechanism used to proctor the exam so please turn your camera on during the exam.
- Please do not write within a half inch of the edge of any page. My OneNote might cut off the writing near the edge so I have to read your original submission and it is more difficult to make comments.
- Email your exam as a PDF to me by 11:35 am. Write your name on the submitted PDF. The time of your email will serve as a timestamp. Your subject line should start with [EE 417 HW] (Yes, I will use the same folder to collect your quizzes). If you are not clear on how to transform a document into a PDF, please practice before the exam so that there isn't a long delay.
- Please make sure that your PDF is readable (not too dark)
- When grading the exam, more points will be given for correct reasoning than the answer.
- Good Luck!!

1. (12) At the beginning of month 1, Gurdal (also known as THE MAN) has \$5000 in cash. At the beginning of months 1, 2, 3, 4 and 5, Gurdal receives revenues and pays certain bills which are given in the table below (in thousands). Any money left over in any month may be invested for one, two, three, four or five months at respective interest rates 0.1, 0.2, 0.3, 0.4, or 0.5% per month. For example, money invested in month 1 for 4 months yields a return of 1.6%. In each month, money can be borrowed for exactly one month (and paid back the following month) at 0.4% interest per month. Assume that all transactions are done on the first day of each month. Formulate the problem of maximizing the cash on hand at the beginning of month 6 as a linear program. Express all dollar amounts in thousands.

Month	Revenues	Bills
1	r_1	b_1
2	r_2	b_2
3	r_3	b_3
4	r_4	b_4
5	r_5	b_5

x_i : \$ borrowed for month i

$y_{i,j}$: \$ invested for month i for j months

$i = 1, 2, 3, 4$ $j = 1, 2, 3, 4$

$$\begin{array}{l}
 \$ \text{ at start of month} \\
 \left\{ \begin{array}{l}
 M_1 = 5 + r_1 - b_1 + x_1 - y_{1,1} - y_{1,2} - y_{1,3} - y_{1,4} \\
 M_2 = r_2 - b_2 + x_2 - y_{2,1} - y_{2,2} - y_{2,3} + 1.1y_{1,1} \\
 M_3 = r_3 - b_3 + x_3 - y_{3,1} - y_{3,2} + 1.4y_{1,2} + 1.1y_{2,1} \\
 M_4 = r_4 - b_4 + x_4 - y_{4,1} + 1.9y_{1,3} + 1.4y_{2,2} + 1.1y_{3,1} \\
 M_5 = r_5 - b_5 + x_5 + 2.6y_{1,4} + 1.9y_{2,3} + 1.4y_{3,2} + 1.1y_{4,1}
 \end{array} \right.
 \end{array}$$

$$\max \quad z = M_1 + M_2 + M_3 + M_4 + M_5$$

$$y_1, y_2, y_3, y_4 \geq 0$$

$$x_1, x_2, x_3, x_4 \geq 0$$

2. (12) Suppose we have obtained the tableau below for a maximization problem. Give conditions on the unknowns $a_1, a_2, a_3, b, c_1, c_2, c_3$ that make the following true. Provide reasoning for your answers.

- (a) The current solution is optimal and there are alternative optimal solutions. Explain.
- (b) The current solution is the unique optimal. Explain.
- (c) The solution is unbounded. Explain.
- (d) The current basic solution is feasible, but the objective function can be improved by replacing x_3 as a basic variable with x_5 . Explain.

You may consider each of the above parts independent.

z	x_1	x_2	x_3	x_4	x_5	x_6	RHS
1	c_1	c_2	0	0	c_3	0	9
0	4	a_1	1	0	a_2	0	b
0	-1	-5	0	1	-1	0	2
0	a_3	-3	0	0	4	1	5

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