BUAD 311 Operations Management
Section 14906

Fall 2014

Name: (please print) _____

Email: (please print) _____

Quiz 2: Linear Programming

Time Allowed: 20 minutes

This quiz is worth 40 points. There are 4 pages, including this cover sheet.

This quiz is closed-book. No laptops. No cell phones. No electronic devices. All electronics must be turned off and stored away.

You may have only a calculator and pencil. But, you may have one 8.5x11 sheet (both sides) with notes.

Sharing notes or calculators with other students is prohibited.

There will be partial credit for some questions unless stated otherwise. But you must show all your work completely. DO NOT just put down an answer, you will not get credit.

Do not be tempted to seek inspiration from a neighbor's exam. Poor scores can be overcome, but cheating will be dealt with harshly.

Please sign here to indicate that you have adhered to university policies regarding ethical behavior in preparing for and completing this exam.

"I hereby certify that I have adhered to the university policies regarding ethical behavior in preparing for and completing this exam."

_____

Signature

1. (20 points) Gulp-a-lot Inc., a small distillery, makes three alcoholic products: Gin, Rum, and Whiskey. As part of the production process, a pollutant by-product called TOX is produced that is dumped into the ocean. Environmental laws require that the firm release no more than 1500 lbs. of TOX into the ocean each month. The net profit per gallon, the labor hours required in production, and the TOX produced per gallon for the three products were as follows:

Product	Profit ($/gallon)	Labor hours (per gallon)	TOX produced (lbs/gallon)
Rum	100	4	0.1
Gin	120	3	0.2
Whiskey	80	2	0.3

Jim Barkley, the CEO, felt that there was sufficient demand that they could sell **up to** 6000 gallons of Rum and 4000 gallons of Gin. As for Whiskey, he felt that they should aim to produce and sell **at least** 2000 gallons even though it had a lower profit figure. He figured that, in April, their total available labor hours were 30,000 hours (200 employees working 150 hours each). Jim, your boss, has asked you to develop a linear programming model to schedule production for the month of April.

a. (3 points) Define all your decision variables.

r = amount of rum to produce in gallons
g = amount of gin to produce in gallons
w = amount of whiskey to produce in gallons

b. (3 points) Formulate a linear objective function that will maximize profits for the month of April.

Max (1pt) 100r + 120g + 80w (2pts)

c. (14 points) Write down the constraints for the linear program.

$r \leq 6000$ (can't sell more than there is demand for)
$g \leq 4000$
$w \geq 2000$
$4r + 3g + 2w \leq 30{,}000$ (labor)
$0.1r + 0.2g + 0.3w \leq 1500$ (TOX)
$r,g,w \geq 0$ (or all decision variables are non-negative)

2 pts each constraint

2. (20 points) The Excel solution is shown below. **Some key values have been removed!**

Microsoft Excel Sensitivity Report

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B9	Rum	5000	0	100	60	40
C9	Gin	2000	0	120	80	30
D9	Whiskey		0	80	60	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
E2	Labor hours	30000	16	30000	2500	10000
E3	TOX produced		360	1500	250	166.6666667
C8	Demand Gin		0	4000	1E+30	2000
B8	Demand Rum	5000	0	6000	1E+30	1000
D8	Demand Whiskey		-60	2000	1000	1000

a. (5 points) What is the optimal solution (the values of the decision variables) (**Hint: Find the value of "Whiskey" in the constraints table**)? How much profit can Gulp-a-lot Inc earn each month?

Make 5000gals Rum, 2000gals Gin, and 2000gals Whiskey. (3 points)

Profit is 100*5000 + 120*2000 + 80*2000 =$900,000. (2 point)

b. (8 points) In each of the following cases, indicate in one sentence how the profit will change **and** by how much.

(i) (2 points) The number of available labor hours is increased by 10:

Profits will increase - by $16*10=$160.

(ii) (2 points) The minimum output for Whiskey is increased by 10 gallons:

Profits will decrease by $60*10=$600.