MA3231 Linear Programming
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LP Assignment 1

Due Date: Tuesday, August 28, 2018, at the beginning of class.

Please carefully read the presentation rules below. **Any paper submitted which is sloppy or uses two sides of a page will be returned immediately with no credit.**

Provide neat and careful solutions to the following five problems.
1.) Exercise 1.2 on page 8 in our text.

2.) In the furniture LP considered in class, suppose that up to an additional 40 hours of labor are available. But this overtime decreases profit by \$10 for each hour (above the regular 80) used. By introducing a new variable for overtime hours used, write down the modified linear programming problem that models the profit maximization decision for the furniture assembly plant.

3.) An iron foundry has a firm order to produce 1000 pounds of castings containing at least 0.45 percent manganese and between 3.25 percent and 5.50 percent silicon. As these particular castings are special order, there are no suitable castings on hand. The castings sell for \$0.90 per pound. The foundry has three types of pig iron available in essentially unlimited amounts, with the following properties:

	Type of pig iron		
	A	B	C
Silicon	4 %	1 %	0.6%
Manganese	0.45%	0.5%	0.3%

Further, the production process is such that pure manganese can also be added directly to the melt. The costs of the various possible inputs are:

Pig A	\$48 per thousand lbs.
Pig B	\$60 per thousand lbs.
Pig C	\$30 per thousand lbs.
Manganese	\$8 per lb.

It costs one cent to melt down a pound of pig iron. Out of what inputs should the foundry produce the castings in order to maximize profits?

Set this up as a linear programming problem. Be sure to define your variables.

4.) A plant manufactures fertilizers F_1, F_2, F_3 and F_4, whose production involves three steps:

- manufacture of the ingredients
- mixture of the ingredients
- packaging

The table below gives the number of hours required to complete each of these steps per gallon produced and the profit per gallon for each fertilizer.

Fertilizer	Manufacture (sec.)	Mixing (sec.)	Packaging (sec.)	Profit/gal. ($)
F_1	12	16	4	.02
F_2	24	32	2	.03
F_3	16	12	4	.01
F_4	8	4	4	.02

Each week, 150 hours (540,000 seconds) are available for manufacturing, 120 hours (432,000 seconds) are available for mixing, and 50 hours (180,000 seconds) are available for packaging. Formulate a linear programming problem which establishes a production schedule that maximizes weekly profit.

5.) Your political influence campaign to convince the public that the Earth orbits around the Moon has been given an anonymous donation over the dark web of six bitcoins (6000 mB). You, as misinformation manager, must decide how to invest this among facebook likes, Twitter retweets and newspaper editor lobbying.

The second table below summarizes the options available to you, their benefits and costs (in milli-Bitcoins, mB). Your nasty facebook memes reach 2 audience members for each of the first 100,000 likes. But this is only valid for the first 100,000 likes; after this, the effect wears off and the next hundred thousand likes extend your reach by 1.2 audience members each. For between 200,000 and 300,000 likes, each additional like purchased extends

the audience by just 0.3 and audience growth is essentially zero after 300,000 likes. On the dark web, your company regularly purchases facebook likes and the going price if 3.5 mB per 1000 likes.

By the same token, here is a linear approximation for the audience coverage for retweets of your organization's deviously designed tweets:

Quantity	Num. new audience members per retweet	Cost per 1,000 retweets
First 500,000	0.8	2.65 mB
500,001-1,000,000	0.6	2.65 mB
1,000,001-1,500,000	0.1	2.65 mB
$>$ 1,500,000	0	2.65 mB

Medium	Cost (mB)	Audience reached	Staff time
1000 Facebook Likes	3.5 per1000	(2.0,1.2,0.3,0)	6 min.
1000 Twitter Retweets	2.65 per 1000	(0.8,0.6,0.1,0)	4 min.
Editors bought	1400	3600 each	5 hr.

You can only allot 45 hours of your staff's labor and, again, you have 6000 mB as your budget. Formulate (but DO NOT SOLVE) a linear programming problem that maximizes the total size of the audience reached subject to your budget and labor constraints. Be sure to define your variables and label your constraints!

(Assume that the audience members reached are all distinct: there is no overlap between media.)

BASIC RULES FOR LP ASSIGNMENTS

I) Each student must compose his/her assignments independently. However, rough work may be done in groups;

II) Write legibly and use only one side of each sheet of paper;

III) Show your work. Explain your answers using FULL SENTENCES;

IV) Late assignments will, in general, not be accepted for credit.