Com Eng Math Lab Quiz 1

This exam has 3 questions for a total of 20 points.

This is an "open world" exam. However, please also follow the exam instructions explained in lecture regarding outside help. You may consult with your friend regarding the problem, but the solution writeup must be done on your own. You must not show your writeup to one another. You may consult anyone and the internet (except the instructors/TAs) if you mentioned the exact resource in the **pdf writeup** (urls, chatgpt link, names, etc.). Be sure to list any additional resources or collaborators you consulted for each question.

For each question, you should formulate a linear/integer program and solve it using any methods of choice (excel, python, by-hand, etc.) but **be sure to show proof of how you obtained the solution.**

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1) **[7 points]** Ham Deng

Just recently, Moo Deng, a pygmy hippopotamus from Thailand, has gone viral on the internet, attracting visitors to her zoo and drawing loads of attention from all over the world. For Hamtaro, however, this brought him problems as people's focus shifted from all of his endeavors to Moo Deng. To bring the people's attention back to him and his conglomerate, Hamtaro decided to use his knowledge and ability in genetic engineering and AI (Artificial Insemination) to create "Ham Deng", a hamster-hippopotamus hybrid in which he uses all of his efforts to make her as cute and adorable as possible, so that she could go viral as fast as possible in order to draw the world's attention to her and thus back to his conglomerate.

But just creating Ham Deng is of course not enough because, as you probably know, it is impossible for a hippopotamus to go viral by itself without any outside actions. Therefore, Hamtaro decided to invest in various advertising campaigns to help her become viral as fast as possible. The available campaigns are as follows. Note that Hamtaro could run multiple campaigns that do not conflict with other campaigns simultaneously.

Campaign	Cost	Expected new people reach	Minimum delay between each repeat campaign run	Limitations
Good morning Monday/Tuesday/etc. pictures to messaging group of elderlies	1,000	1,000	1 day (1 day means he can run this seven times in one week.)	
Short video on HamTok	10,000	50,000	1 day	
Hambook post with post boosting	10,000	20,000	1 day	
Documentary of Ham Deng on Hamtube	25,000	150,000	15 days	
#HamDeng sponsored hashtag on Y	50,000	50,000	5 days	Exclusive to each other during the entire period
Disinformation campaign on Moo Deng	600,000	500,000	2 days	

Hamtaro's first goal is to have Ham Deng seen by at least 1 million people in 30 days, as this is the first step toward further attention by bigger campaigns. From this information, how should he run the campaign for the lowest cost? Formulate this problem as an integer program and solve for the solution.

2) **[6 points]** The Buff Boss

Hamtaro needs to prepare ingredients for Boss to ensure he is ready for bodybuilding competitions in 5 days (Monday to Friday). You can only go shopping in the morning on 2 days: Monday and Wednesday. Each ingredient provides different nutrients and has an expiration date. For example, if an ingredient has a shelf life of only 1 day, it can only be consumed on the day it is purchased. The daily nutrient requirements for Boss are at least 200 grams of protein and at least 150 grams of carbohydrates. Minimize the total cost of the ingredients to meet Boss' needs.

Here is the list of ingredients, which includes their prices, shelf life, protein content, and carbohydrate content.

Ingredient	Price (THB/unit)	Shelf life (days)	Protein (gram/unit)	Carbohydrates (gram/unit)
Chicken	30	1	24	0
Pork	35	3	21	0
Jasmine rice	40	3	6	80
White rice	20	2	9	50

3) **[7 points]** Deadline Driven Development

Snoozer is a hamster who likes to sleep. However, he must complete a list of tasks to not get fired by his boss, Hamtaro. With only 14 days left until the deadline, he must complete 7 tasks in order to make a new e-commerce website, Hamzada. The conditions and timelines for the tasks are outlined in Table 1. **Each task cannot be carried over to the next day and must be done within the day.** Due to government regulations, he cannot work more than 10 hours per day. Snoozer needs to carefully plan his schedule to minimize the number of days spent. Formulate this question as a optimization problem and solve for the solution.

Task. No.	1	2	3	4	5	6	7
Estimated hours	6	4	5	3	6	2	4
Condition		Cannot be done on the same day as task No.1		Has to be done on the same day as task No.3			Can only be done after task No. 5 and 6