MEC 320 Programming Assignment II

Due Date: Saturday, April 8, 2023, 11:59 PM

Instructor: Professor Foluso Ladeinde

TAs: Abdullah Al Mut Sharffudin

INSTRUCTIONS

For your report submission, please copy and paste all your materials for the task into a single Word document. If you have some hand calculations or algebraic manipulations to do before your code begins, please scan or take a high-quality picture with your phone (not blurry) and paste it into the same word document for that task. You will submit only one Word document with all of your results, code, and anything else. Additionally, copy and paste all your codes into 1 m-file and upload that single m-file, even if the codes don't actually run. Please upload your word document and your m-file to Blackboard and remember that you only get one submission attempt so don't upload it until you're done with it, and once you upload it, don't think about it anymore. Points will be taken off if you do not follow these instructions. There are too many of you for everyone to be a special case. I need you to follow these instructions. Without uploading the m-file separately, I can't give you credit for your submission.

Of course, the goal of these Programming Assignments is for you to write your own code, so you are not allowed to use the pre-programmed MATLAB functions like fzero(). Your goal should be to code the algorithms yourself.

What I consider cheating: I consider it cheating if you try to pass someone else's work as your own. For example, copy-and-pasting material from any source (for example the internet or your friend) is cheating. With this assignment, I'm asking you to do the tasks. If you don't do it, I will give you a zero. But there is at least dignity in that. You took responsibility for yourself and your shortcomings and were honest about it. But if you don't do the assignment and then try to make me think that you did, I will catch you and report you to the Committee on Academic Standing and Appeals (CASA), and recommend that if you're found guilty, your punishment be to fail the course, which will delay your graduation by a year.

With all that said, if you have trouble or get stuck, you're allowed to consult the book, the internet, your friends, the instructor, the TAs, and so on. As long as, in the end, what you turn in, is your own work. That's how the "learning" process works (1. You're taught something, 2. you try it on your own, 3. if you have questions, you get them answered somehow so that you can finish the work, 4. in the end, you will have learned the material).

Disclaimer: I will run your submissions through two plagiarism checkers, one general plagiarism checker and one specifically designed to check computer codes for similarities.

Before submitting, make sure that all of **the work you turn in** is **your own work**.

Commenting your MATLAB codes will be counted toward your grade. I don't want to see paragraphs of comments – just enough so that it explains to yourself (or to me when grading) what each line or block of code is doing.

THE PROGRAMMING ASSIGNMENT

A dairy operating on the flow diagram shown in Fig. 1 below can buy raw milk from either or both of two sources and can produce skim milk, homogenized milk, and half-and-half cream. The costs and butterfat contents of the sources and products are as shown in this table:

Item	**Designation, L/day**	**Sale or purchase cost**	**Butterfat content, volume %**
Source 1	x_1	\$0.23 per liter	4.0
Source 2	x_2	0.24 per liter	4.5
Half-and-half	x_3	0.48 per half-liter	$\geq$ 10.0
Skim milk	x_4	0.60 per two-liter	$\geq$ 1.0
Homogenized milk	x_5	0.68 per two-liter	$\geq$ 3.0

The daily quantities of sources and products are to be determined so that the plant operates with maximum profit. All units in the dairy can operate for a maximum of 8 h/day.

(a) Derive the **equation for the profit** (i.e., the objective function $Z(\boldsymbol{x})$) in terms of the design variables $(x_1, x_2, x_3, x_4, x_5)$ **[10 Points]**

(b) Develop the equation or inequality, as the case maybe, for the conservation of mass **[5 Points]**

(c) Write a <u>well-documented,</u> easy-to-read, computer program in MATLAB to implement the SIMPLEX-based linear programming method and use the computer program to solve for the plan that results in maximum profit. Of course, it should be clear how you set up the problem before you attempt to solve them with MATLAB. **[40 Points]**

(d) Use your program to reproduce the example problem used in class for Linear Programming **[5 Points]**

(e) Use your program to obtain the **optimum values of the design variables and the maximum profit [20 Points]**

(f) Submit a report for the project. A great presentation (report) is always a joy to read: clear, complete, concise, organized, and easy-to-follow. **[20 Points]**

Note that based on the problem statement the constraint equations can be written as follows:

Separator:	$x_1 + x_2$	$\leq$ 19,584
Pasteurizer:	$x_1 + 1.08x_2$	$\leq$ 20,150
Homogenizer:	x_5	$\leq$ 31,680
Packager:	$4x_3 + x_4 + x_5$	$\leq$ 48,000
Butterfat:	$-4x_1 - 4.5x_2 + 10x_3 + x_4 + 3x_5$	$\leq$ 0
Total Mass:	**You complete this**	**one**

Note: A more fine-grained grading criteria will be provided in due course of time.

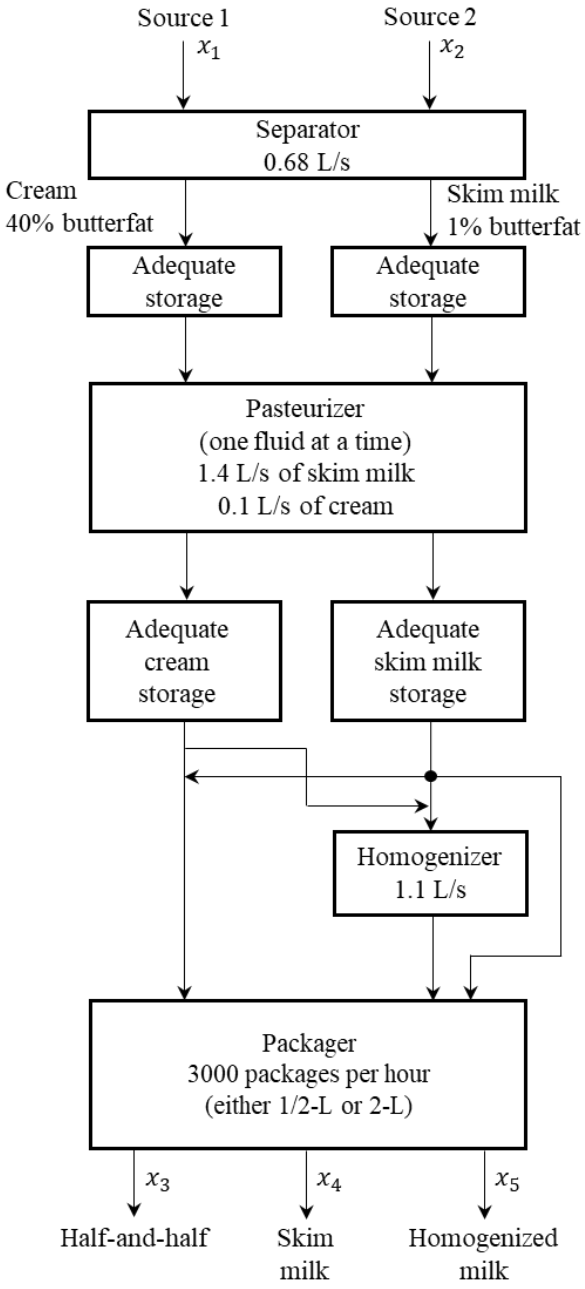

Figure 1 Flow diagram for a dairy plant