Last Name	Name	student ID (matricola)

n = _____ (student ID No. /// *N. matricola, per intero oppure cifre finali*)

Section 1: LINEAR PROGRAMMING

Suppose a farmer has 75 acres on which to plant three crops: wheat, barley and corn.

To produce these crops, it costs the farmer (for seed, fertilizer, etc.) $120 per acre for the wheat and $210 per acre for the barley. In addition, for the third crop, that is corn:

cost per acre	$150.75
yield per acre	125 bushels
profit per bushel	$1.56

The farmer has $15,000 available for expenses. But after the harvest, the farmer must store the crops while awaiting favorable market conditions. The farmer has storage space for 4,000 bushels. Each acre yields an average of 110 bushels of wheat or 30 bushels of barley. If the net profit per bushel of wheat (after all expenses have been subtracted) is $1.30 and for barley is $2.00, how should the farmer plant the 75 acres to maximize profit?

Questions

1.I. Formulate and write the LP math model of this problem

1.II.   Solve it by using the most convenient tool in Matlab and describe step by step the
obtainment of the **optimum**

1.III.   Determine the optimal value of the **objective function**

1.IV.   Determine the optimal values, if any, of the **decision variables**

1.V.   At the **optimum**, provide comments on special or unexpected features, if any, e.g., regarding
the role of the **decision variables**

Section 2: EMPIRICAL MODELS

The following data were stored in the file
Sect.2_EX4 PLANT DATA.txt

Questions

2.1. First, carefully look at data before using any Matlab® tool

2.2. determine one **regression model** that you consider reasonably valid

2.3. is the regression model adopted by you a LINEAR or NON-LINEAR one?

2.4. calculate and discuss the **residuals**

2.5. plot the **residuals** as a **bar chart** of their distribution

2.6. using the predictions of the regression model adopted by you, plot the **Equivalent Graph (or Parity Line)**

2.7. using the regression model adopted by you, calculate the **Extrapolated point** at a new abscissa of your choice

2.8. using the regression model adopted by you, calculate the **Accuracy Factor**

Section 3: FINITE DIFFERENCE METHODS for PDE

Solve the following parabolic PDE $\dfrac{\partial u(x,t)}{\partial t} = \Delta \dfrac{\partial^2 u(x,t)}{\partial x^2}$

with

$\Delta = n/2$

$k = 0$

$L = 5$

$t_{final} = 5$

IC: $t = 0$ $u(x,0) = x^2$

BC: $A \cdot u(x,t)\big|_{x=0} + B\dfrac{\partial u(x,t)}{\partial x}\bigg|_{x=0} = x/n$

$D \cdot u(x,t)\big|_{x=L} + E\dfrac{\partial u(x,t)}{\partial x}\bigg|_{x=L} = \sqrt{\dfrac{x}{n}}$

A=B=D=E=n

where n = _____ (student ID No. /// *N. matricola, per intero oppure cifre finali*)

Questions

3.1. which type are the **Boundary Conditions**?

3.2. adopt the **explicit method** and, using **MUC**, explain the procedure <u>briefly</u>, attach the graph and comment the final solution

3.3. discuss the stability of the used method and specify the new value for the time-step if the explicit method turns out unstable

3.4. after that, change the BC as follows, solve the PDE and compare the final profile to the previous case

BC: $A \cdot u(x,t)\big|_{x=0} = x/n$

$D \cdot u(x,t)\big|_{x=L} = \sqrt{\dfrac{x}{n}}$

Section 4: MATHEMATICAL MODELING

4.1 1st Classification of math models

a) Describe the 1st classification

b) Provide an example of a math model in the 1st classification

Section 5: TIME SERIES

With ref. to the **time series** data in the file
                    Sect.5.1_Sample dataset Guarnaccia.txt

Questions

Calculate using Matlab

a) **standard deviation** of data

Then, using the script *moving.m* or another Matlab tool

b) propose a significant value of the **span** M for an effective **moving average**

c) obtain a new **filtered time series** from the original data by adopting the above **moving average** calculation

d) plot the new **filtered time series** against the original data and comment it

e) identify the **outliers** in the original **time series,** exclude them by proposing a reasonable criterion to this end