Last Name **Name** **student ID (matricola)**

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

Section 1: LINEAR PROGRAMMING

The "Fantasy" Company produces two toys labeled: I and II.
The space needed for storage, raw material requirements, production rates per each working hour are given in the Table.

	Product	
	I	II
Storage space (ft^2/unit)	4	5
Raw material (lb/unit)	5	3
Production rate (units/hr)	60	30

The total amount of **raw material** available per day for both toys is 1575 1b.
The total storage space for all toys is 1500 ft^2,
and the manpower allows a maximum of 7 hr/day for production.
Regarding income from the **sales**, the data are available in terms of "fractional part of one toy corresponding to the value of 1 US$", according to the following Table:

fractional part of one toy that has the monetary value of 1 US$	I	II
$(US\$)^{-1}$	0.0769	0.091

Questions

1.I. Formulate and write the LP math model of this problem, with ref. to 1 production day

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

In an experiment, the following observations were made and stored in the EXCEL file
Sect.2_SLJR-7.xlsx

Questions

First, carefully look at data and then use Matlab® tools:

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

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

2.3. calculate and discuss the **residuals**

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

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

2.6. using the regression model adopted by you, calculate the **Extrapolated point** at a new abscissa of $\left(\frac{n-0.05}{n+0.05} \cdot 10\right)$

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

Section 3: FINITE DIFFERENCE METHODS for PDE

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

with

$\Delta = \left(\frac{n-0.05}{n+0.05} \cdot 5\right)$

$k = 0$

$L = 10$

$t_{final} = 1$

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

BC: $A \cdot u(x,t)\big|_{x=0} + B\frac{\partial u(x,t)}{\partial x}\Big|_{x=0} = n^{1/2}$

$D \cdot u(x,t)\big|_{x=L} + E\frac{\partial u(x,t)}{\partial x}\Big|_{x=L} = \sqrt{\frac{t}{n+1}}$

A=D=n

B=E=0

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**, attach the necessary graphical views from **MUC** to show (and discuss) the issue of "*physical incongruence*" of the **explicit method**

3.3.What is the role of Delta_x? How much is Delta_x ?

3.4.What is the role of Delta_t? How much is Delta_t ?

Section 4: MATHEMATICAL MODELING

4.1 Classification of a model

Look at the below model:

$$\dot{y}_1 = (1 - \frac{y_2}{\mu_2})y_1$$
$$\dot{y}_2 = -(1 - \frac{y_1}{\mu_1})y_2$$

a) Which math model is this?

b) Provide all possible classifications for it

c) How many and what are the parameters?

Section 5: TIME SERIES

With ref. to the **time series** data in the EXCEL file
sect.5.1_prova_aggressive_2013-02-07.xlsx

Questions

Calculate

a) mean

b) standard deviation (of the sample)

c) skewness

d) kurtosis

e) identify the **outliers** in the original **time series** and explain the criterion/tool you adopt to reasonably recognize/exclude them

f) obtain a new **time series** by removing the **outliers** from the original one

g) propose a significant value of the **span** M for a **moving average** calculation

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

i) plot the new **filtered time series** against the previous data and comment it

NB:
You may use whatever Matlab tool and the script *moving.m*