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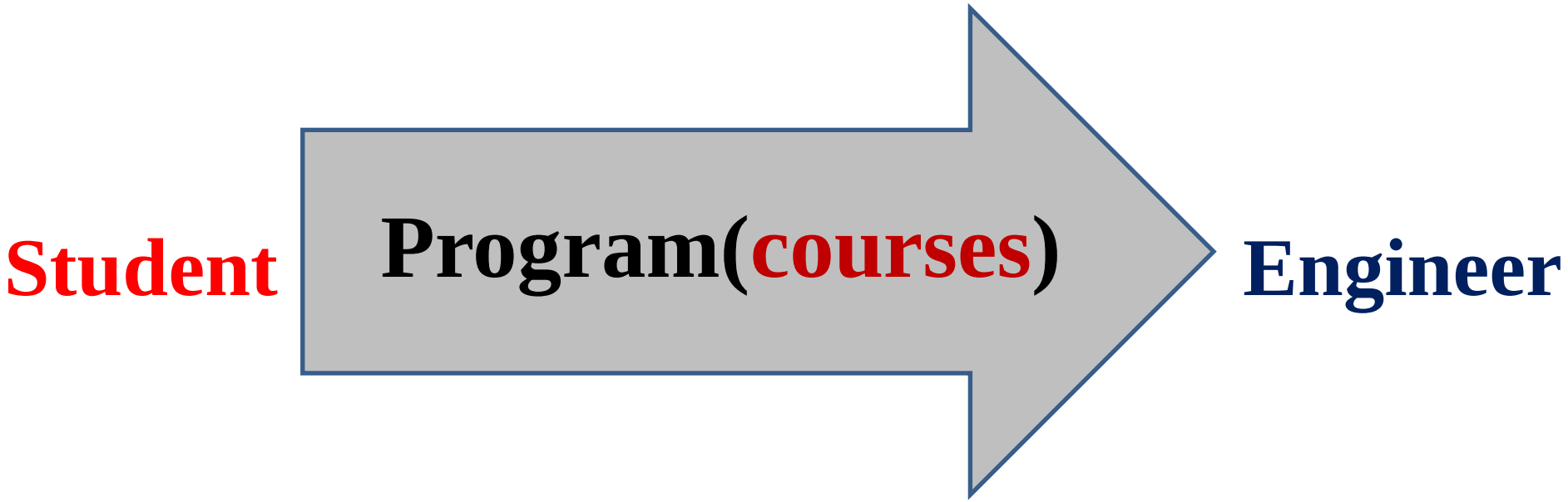


Scientific Approach: المنهج العلمى

To create new يبدع

Invent	يخترع
Innovate	يبتكر
Discover	يكتشف
Clarify	يوضح
Specify	يصف
Refine	يهزب / ينقح
Develop	يطور

Intended Learning Outcomes (ILO's)

1. **Knowledge and Understanding**
2. **Intellectual Skills**
3. **Professional and Practical Skills**
4. **General Skills**

Course Aims : Math IV

- **Provide the students principals of PDEs, Methods of solution and applications.**
- **Provide the students principals of Probability and Statistics.**
- **Apply mathematical techniques for modeling, solving and analyzing real problems.**

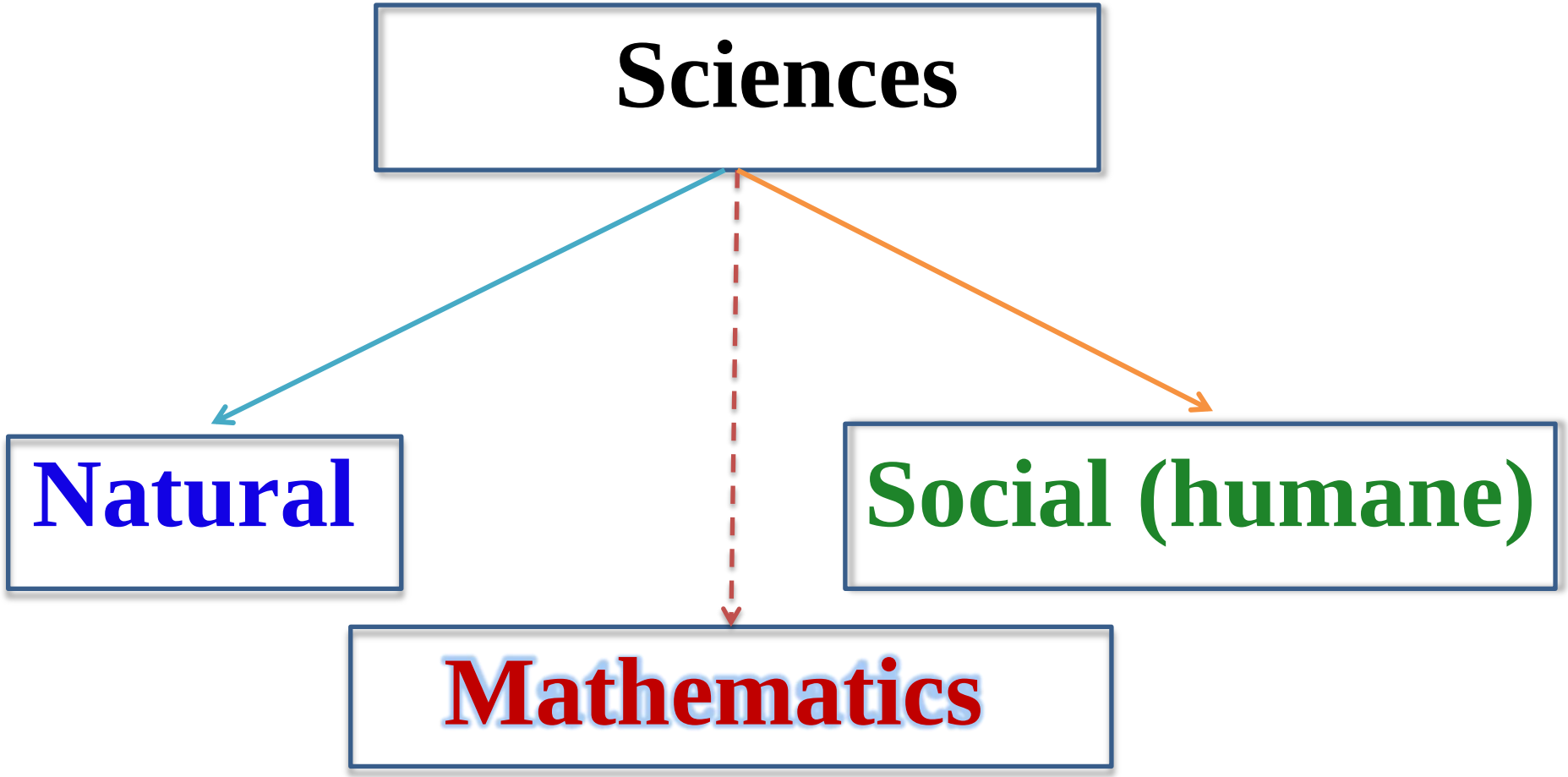
List of References

1- Course Notes

Lectures and Sheets of Exercises.

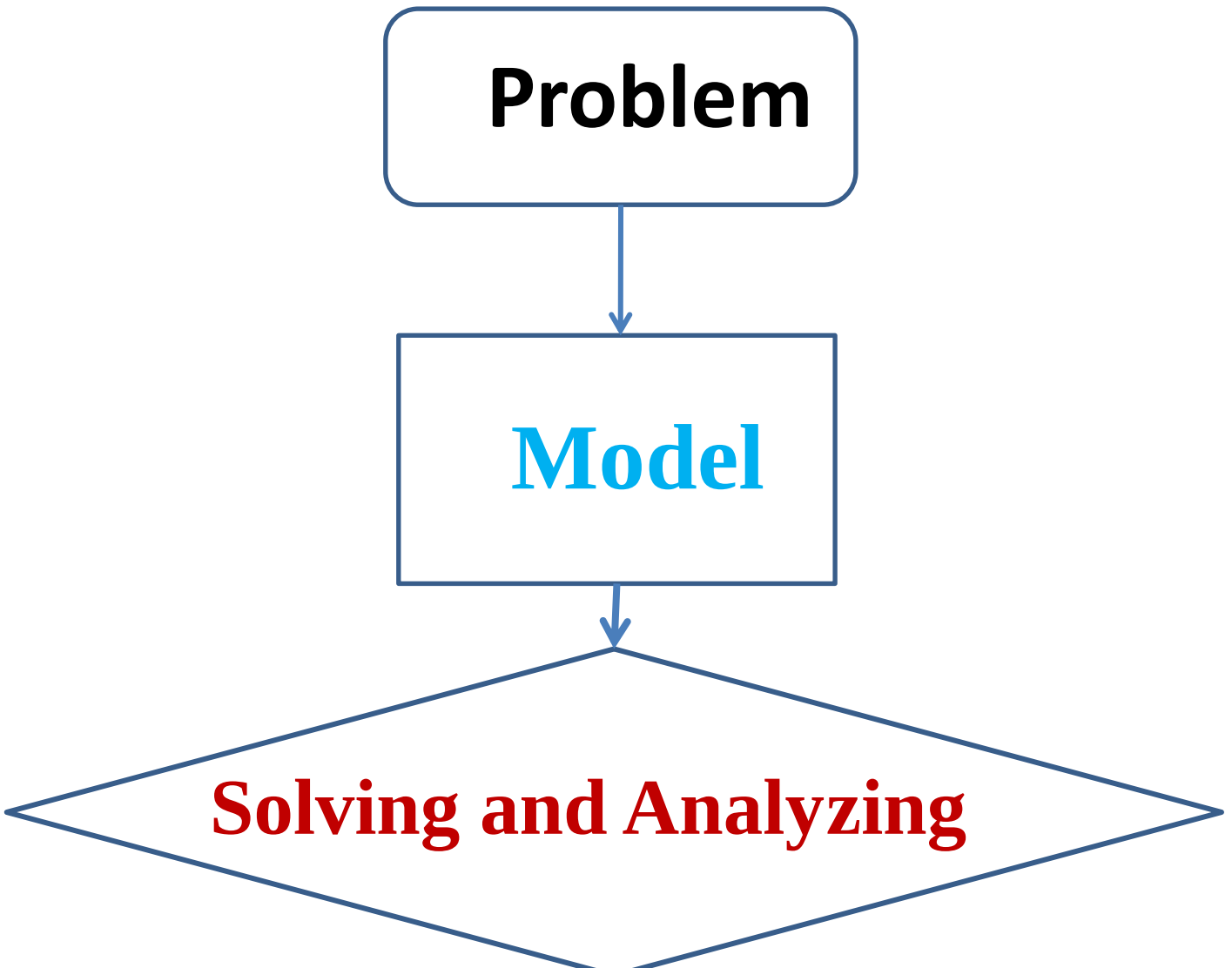
2- Recommended Book

Advance Eng. Mathematics, 9th Edition, Erwin Keryszig, John Wiley & Sons, Inc., Oho, 2006.



Mathematics is the science of modeling and treatment problems and phenomena via explicit criteria

Mathematics



Rate of Change

Example: An amount of sugar (100 gm) in solution is decomposed in a chemical reaction into other substance through the presence of acids, and the rate at which the reaction takes place is proportional to the mass of sugar still unchanged.

Write the mathematical model.

Find the time at which all amount is decomposed

تتحلل كمية من السكر (100 جم) في محلول في تفاعل كيميائي إلى مادة أخرى من خلال وجود الأحماض،

و معدل التغير يتناسب مع كتلة السكر المتبقية.

The original amount of sugar is 100 gm.

Assume that **x** is the amount of sugar converted at time t.

Then $100 - x$ is the amount still unchanged

Then $\frac{dx}{dt} = k(100 - x)$, K is constant, k =1

Then $\frac{dx}{x - 100} = -dt$ Diff. equation

Then $\ln(x - 100) = -t + c$

Then $x - 100 = e^{-t+c} = C.e^{-t}$

The decomposition starts when t = x = 0

Then $0 - 100 = C.e^{0} = C$

Then $x = 100 - 100e^{-t} = 100(1 - e^{-t})$

is the mathematical relation.

(Increasing relation)

From $x(t) = 100(1 - e^{-t})$

t / minute	x / gm
1	63.2
2	86.5
4	98.2
5	99.99

All amount of sugar is converted when x = 100 gm, t approaches infinity

Example

A metal bar at a temperature of 100^0 F is placed in a room at a constant temp. 0^0 F. After 20 minutes the temp. of the bar is 50^0

Find the time at which the temp. of the bar is 25^0

Find the temp. of the bar after 10 minutes.

Assume that u is the temp. of the bar at time t.

From Newton's law of cooling

$$\frac{du}{dt} = -k(\text{temp.of bar} - \text{temp.of its surrounding})$$

$$= -k(u - 0)$$

Then $\frac{du}{u} = -kdt$ Then $\ln u = -kt + c$

Then $u = e^{-kt+c} = e^{c}.e^{-kt} = C.e^{-kt}$

Since $u(0) = u(\text{time} = 0) = 100^{0}$

$u(20) = u(\text{time} = 20) = 50^{0}$

Then $100 = C.e^{0} = C$

$50 = 100e^{-20k}$, then $k = 0.035$

The mathematical relation is:

$$u(t) = 100e^{-0.035t}$$

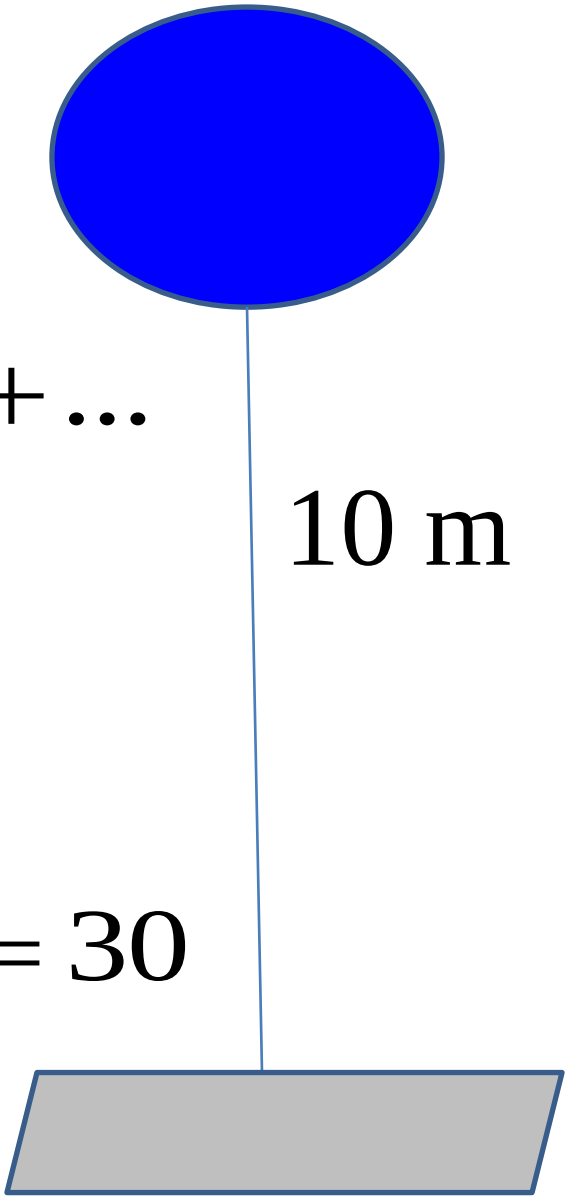
When the temp. of the bar is 25^{0}

Then $25 = 100e^{-0.035t}$, then $t = 39.6$ min

After 10 minutes, the temp. of the bar is:

$$u(10) = 100e^{-0.035(10)} = 70.5^{0}\ F$$

Example (Series)



$$S = 10 + 10.\frac{1}{2}.2 + 10.\frac{1}{2}.\frac{1}{2}.2 + \ldots$$

$$= 10 + 10[1 + \frac{1}{2} + \frac{1}{2}.\frac{1}{2} + \ldots]$$

$$= 10 + 10\frac{1}{1 - 0.5} = 10 + 20 = 30$$

Assignment Problem (Matrix)

In a factory three machines. Each one can manufacture three products.

The cost of the products by the first 5, 7, 9 pounds, respectively.

The cost of products by the second 14, 10, 12 pounds.

The cost of the products by the third, 15, 13, 16 pounds.

Find the minimum cost of production by assigning a machine to manufacture one product.

فى مصنع ثلاث ماكينات. تسطيع كل واحدة تصنيع ثلاث منتجات.

تكاليف المنتجات بواسطة الأولى 5 و 7 و 9 جنيهات على الترتيب.

تكاليف المنتجات بواسطة الثانية 14 و 10 و 12 جنيها.

تكاليف المنتجات بواسطة الثالثة 15 و 13 و 16 جنيها.

احسب أقل تكلفة للانتاج بتخصيص ماكينة لكل منتج.

Products

M1	5	7	9
M2	14	10	12
M3	15	13	16

Minimum cost = 5 + 12 + 13 = 30

Example (Linear System)

A chemical compound is available in three concentrations:

The first of concentration: 1 mg /bottle

The second of concentration: 2 mg /bottle

The third of concentration: 3 mg /bottle

If we wante to produce 14 bottles of concentration 2.5 mg / bottle by mixing whole several bottles of each type. Find all possible solutions.

Assume that :

x = number of bottles taken from the first

y = number of bottles taken from the second

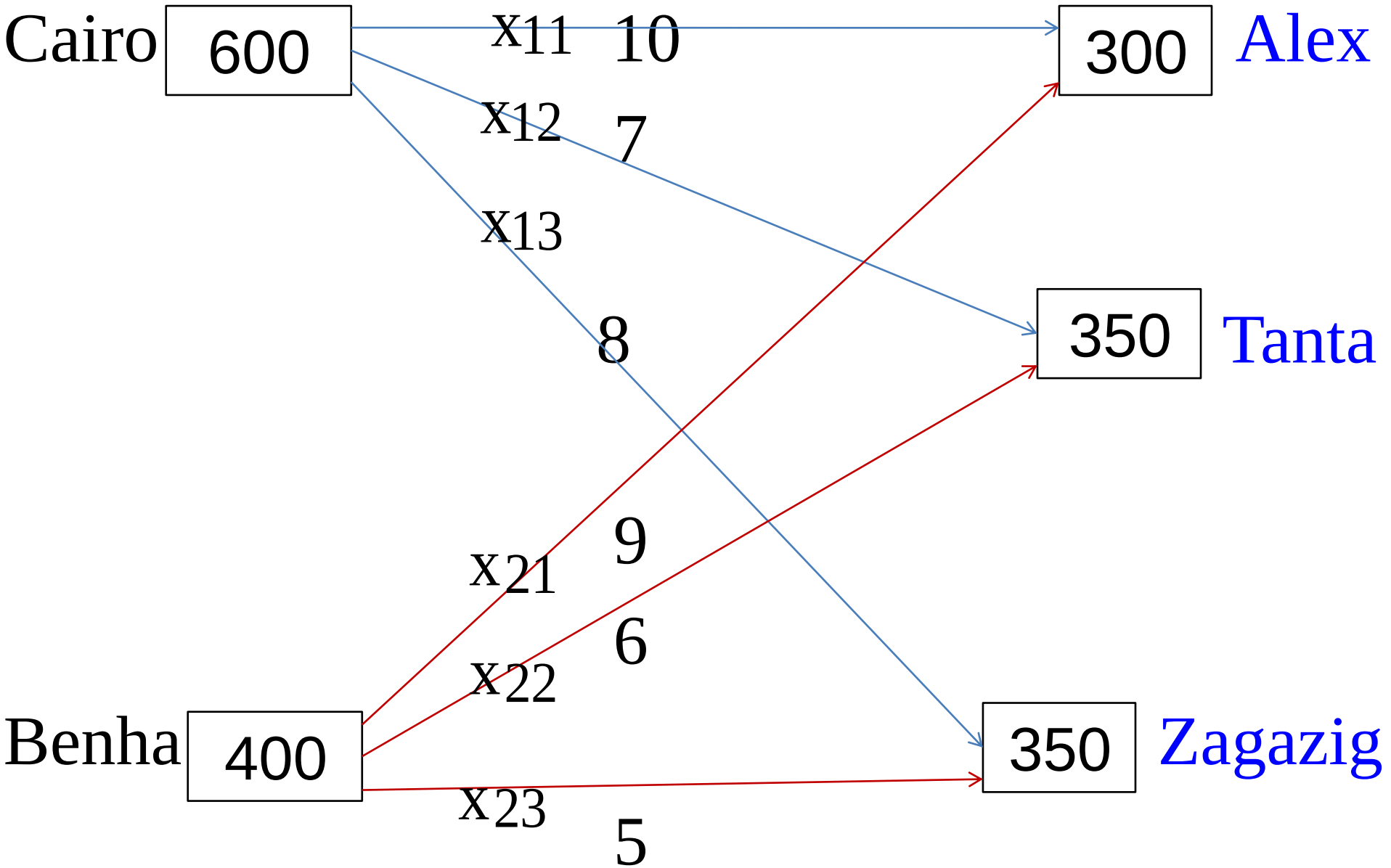
z = number of bottles taken from the third

Then $x + y + z = 14$,

$x + 2y + 3z = 14(2.5) = 35$, $x, y, z \geq 0$, integers

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x \\ 7-2x \\ 7+x \end{bmatrix} = \begin{bmatrix} 0 \\ 7 \\ 7 \end{bmatrix}, \begin{bmatrix} 1 \\ 5 \\ 8 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \\ 9 \end{bmatrix}, \begin{bmatrix} 4 \\ -1 \\ 11 \end{bmatrix}$$

Optimization Problem (Linear Programming)



Mathematical Model

$$\text{Minimize } f = 10x_{11} + 7x_{12} + 8x_{13} + 9x_{21} + 6x_{22} + 5x_{23}$$

s.t

$$x_{11} + x_{12} + x_{13} = 600$$

$$x_{21} + x_{22} + x_{23} = 400$$

$$x_{11} + x_{21} = 300$$

$$x_{12} + x_{22} = 350$$

$$x_{13} + x_{23} = 350$$

$$x_{11},\ x_{12},\ x_{13},\ x_{21},\ x_{22},\ x_{23} \geq 0$$

Write a brief summary of this lecture and what you want from this course.

أكتب نبذه مختصرة عن هذه المحاضرة و ما تريده من هذا المقرر.

For more information, visit the website

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