# UNIVERSITY OF YAOUNDE II FACULTY OF ECONOMICS AND MANAGMENT Tutorial problem set 1 Operational Research, Third year (Pr. Baye/Pr. Epo/Dr. Mark/Dr. Nana/ Dr. Saleu)

#### Exercise 1:

Faced with high demand in pastries against anniversaries, Dara pastries specialized in cake designs intends to blend four grades of flour to produce three different brands of cake to meet up with some special demands. The four grades of flour cost 750, 950, 1050 and 1000 MU per kg, respectively. The yearly quantity of flour supplied are 1500, 2500, 3500 and 4500 Kg, respectively. She sells the three different brands of cake at wholesale prices of 13000 MU, 18000 MU and 30000 MU per piece, respectively.

The following are blending restrictions which must be followed by Dara pastries.

Flour grade 1 should constitute no more than 45 percent of cake brand 2.

Flour grade 2 should constitute at least 50 percent of cake brand 1 and no more than 30% of cake brand 3.

Flour grade 3 should constitute exactly 25 percent of cake brand 1.

Flour grade 4 should constitute at least 55% of cake brand 3 and no more than 25% of cake brand 1.

The objective is to determine the number of kg for each type of flour which should be used in baking each brand of cake to maximize yearly profit. Formulate this as a Linear Programming model of Dara pastries, by carefully defining your decision variables.

### Exercise 2:

A British mining company located in Cameroon extracts 100 tons of red ore and 80 tons of black ore each week. The director of the company wishes to satisfy the increasing demand of Soft, Hard or Strong alloys. The ores extracted can be treated in different ways to produce these three different alloys. To produce 1 ton of Soft alloy, it requires 5 tons of red ore and 3 tons of black ore. The Hard alloy requires 3 tons of red and 5 tons of black ore, while the Strong alloy requires 5 tons of red and 5 tons of black ore, while the Strong alloy requires 5 tons of red and 5 tons of black ore. The profit per ton from selling the alloys (after allowing for production but not mining costs, which are regarded as fixed) are 250MU, 300 MU and 400 MU for Soft, Hard and Strong respectively.

Formulate the LP problem which could permit the director decide what quantity of each alloy to produce each week to maximize profits.

# Exercise 3.

An operations manager is trying to determine a production plan for the next week. There are three products (say, P, Q, and R) to produce using four machines (say, A and B, C, and D). Each of the four machines performs a unique process. There is one machine of each type, and each machine availability ids indicated on the table. The unit processing times for each machine is given in the Table below.

Unit Processing Time (min)						
Machine	Product P	Product O	Product R	Availability (min)		
				5 < 7		
А	20	10	10	2400		
В	12	28	16	2950		

С	15	6	16	1400
D	10	15	0	3200
Total processing	57	59	42	9950
time				

The unit revenues and maximum sales for the week are indicated in the next Table. Storage from one week to the next is not permitted.

Item	Product P	Product Q	Product R
Revenue per unit (mu)	90	100	70
Material cost per unit	45	40	20
Maximum sales	100	40	60

**Work to be done:** Here we seek the "optimal" product mix- that is, the amount of each product that should be manufactured during the present week in order to maximize profits. Formulate this as an LP.

# Exercise 4

An Italian construction company was awarded a contract by the Cameroonian government to construct three multipurpose stadiums for the AFCON that took place in 2022 in Cameroon. The construction sites are located in Limbe, Douala and Yaoundé. Due to the nature and timing of the project, the company used already manufactured huge materials coming from two Chinese companies (Zung and chungs construction) and one Italian heavy equipped industry (James and sons' construction). Each company was specialize in the production of precise items with supplies from the manufacturing companies to the construction company based on the need at the construction sites. The materials transported from Zung and Chungs in China and James and sons' construction in Italy to Cameroon incurred a shipping cost of 1.5Mu, 1.5Mu and 1Mu. Delivery cost from Kribi sea port to Limbe coming from Zung construction and Chungs construction in China and James and sons' construction in Italy is 1.5Mu, 2.5Mu and 2Mu respectively: from Kribi sea port to the construction site in Douala is 1.5 Mu, 0.5 Mu, and 0.5 Mu respectively: and from Kribi sea port to construction site in Yaounde is 0.5 Mu, 1.5 Mu and 2 Mu respectively.

Additionally, despite the Urgency in supplies, Zung and Chungs in China and James and sons construction could only produce a capacity of 25, 40 and 30 tons of material needed while demands at the construction sites are 30, 30 and 35 tons at Limbe, Douala and Yaoundé respectively. Formulate the relevant LP model.