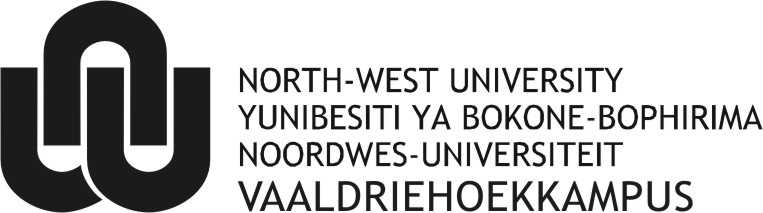
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **0Requirements for this paper:** | | | | | | | |  |  | | | | |
|  | Multiple choice cards: |  | Non-programmable calculator: | | X |  | |  | Open book examination | |  |  | |
|  |  |  |  | |  |  | |  |  | |  |  | |
|  | Graph paper: |  | Laptop: | |  |  | |  |  | |  |  | |
|  |  |  |  | |  |  | |  |  | |  |  | |
| EKSAMEN/ EXAMINATION: | | | | Semester Test 2  *Semestertoets 2* | | | kwalifikasie rigting/ QUALIFICATION | | | **B.Sc.** | | |
|  | | | |  | | |  | | |  | | |
| modulekode/ Module CODE: | | | | **ITRW214** | | | duur/ duration: | | | 120 min | | |
| module beskrywing/ MODULE DESCRIPTION: | | | | Decision Support Systems I *Besluitsteunstelsels I* | | | maks./max.: | | | 50 | | |
|  | | | |  | | |  | | |  | | |
| EKSAMINATOR(E)/ examiner(s): | | | | Mr. W H Van Blerk | | | datum/ date: | | | **15/03/2017** | | |
|  | | | |  | | |  | | |  | | |
| moderator: | | | | Mr J Prinsloo | | | tyd/time: | | | **08:00 – 10:00** | | |



**Show all calculations and graphs (where applicable) /**

***Wys alle berekeninge en grafieke (waar van toepassing)***

**Question 1(14 Marks)**

Your manager asked you to propose a cabinet mix solution for optimizing the daily profit for your department. The company manufacture two types of cabinets, a Cape Dutch and Ultra-modern cabinet. Each of these cabinets must go through three departments: carpentry, painting and finishing. The company has a contract to produce a minimum of 300 of each cabinet per week. There are 5 days in a week.

Below are all relevant information, per day, for this problem.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cabinet Type** | **Carpentary**  **(Hrs/Cabinet)** | **Painting**  **(Hrs/Cabinet)** | **Finishing (Hrs/Cabinet)** | **Profit / Cabinet (R)** |
| Cape Dutch | 3 | 1.5 | 0.75 | 28 |
| Ultra-modern | 2 | 1 | 0.75 | 25 |
| Department capacity (hours) | 360 | 200 | 125 |  |

1. Please formulate a linear programming model to solve the above problem. (14)

**Solution: (Question 1)**

**Variables:**

*X*1 = number of Cape Dutch cabinets produced each day

*X*2 = number of Ultra-modern cabinets produced each day

**✓**

**✓**

**Objective function**: **maximize** revenue = R28*X*1 + R25*X*2

**Subject to:**

**✓**

**✓**

**✓**

**✓**

**✓**

3*X*1 + 2*X*2 ≤ 360 hours  (carpentry department)

**✓**

**✓**

1*X*1 + 1*X*2 ≤ 200 hours  (painting department)

*X*1 + *X*2 ≤ 125 hours  (finishing department)

**✓**

**✓**

*X*1  ≥ 60 units  (contract requirement)

**✓**

*X*2 ≥ 60 units  (contract requirement)

**✓**

**✓**

*X*1, *X*2 ≥ 0

**Question 2(17 marks)**

You are a dietician for the local soccer team. You want to determine a balanced nutritional lunch for all players participating in soccer practice. The following is the national nutritional accepted requirements for a proper lunch for athletes:

- Calories - between 900 and 1500

- Iron - at least 5 MG

- Fat - no more than 50 GM’s

- Protein - at least 26 GM’s

- Carbohydrates - between 30 and 60 GM’s

You select a menu from 7 basic food items with corresponding national nutritional value for each food item. It is summarized as follows:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table for food values and associated cost** | | | | | | |
| **Food Item** | **Calories / Kg** | **Iron (MG/Kg)** | **Fat (GM/Kg)** | **Protein (GM/Kg)** | **Carbs (GM/Kg)** | **Cost/Kg (R)** |
| **Milk** | 295 | 0.2 | 16 | 16 | 22 | 0.60 |
| **Meat** | 1216 | 0.2 | 96 | 81 | 0 | 2.35 |
| **Chicken** | 394 | 4.3 | 9 | 74 | 0 | 1.15 |
| **Fish** | 358 | 3.2 | 0.5 | 83 | 0 | 2.25 |
| **Beans** | 128 | 3.2 | 0.8 | 7 | 28 | 0.58 |
| **Spinach** | 118 | 14.1 | 1.4 | 14 | 19 | 1.17 |
| **Potatoes** | 279 | 2.2 | 0.5 | 8 | 63 | 0.33 |

You wants to optimize your menu by meeting the nutritional requirements, while minimizing the total cost per serving.

1. Please formulate a linear programming model for this blending problem. (17)

**Solution: (Question 2)**

**Objective function**:

**✓**

**✓**

Minimize total cost = 0.60*X*1 + 2.35*X*2 + 1.15*X*3 + 2.25*X*4 + 0.58*X*5 + 1.17*X*6 + 0.33*X*7

**Variables:**

x1 = Milk

x2 = Meat

x3 = Chicken

x4 = Fish

x5 = Beans

x6 = Spinach

x7 = Potatoes

**Subject to:**

**✓**

**✓**

295*X*1 + 1,216*X*2 + 394*X*3 +358*X*4 + 128*X*5+ 118*X*6 + 279*X*7 ≤ 1,500

295*X*1 + 1,216*X*2 + 394*X*3 +358*X*4 + 128*X*5+ 118*X*6 + 279*X*7 ≥ 900

**✓**

**✓**

**✓**

**✓**

.2*X*1 + 121.2*X*2 + 4.3*X*3 + 3.2*X*4 + 3.2*X*5 + 14.1*X*6 + 2.2*X*7 ≥ 5

**✓**

**✓**

16*X*1 + 1,296*X*2 + .4.9*X*3 + 0.5*X*4 + 0.8*X*5+ 1.4*X*6 + 0.5*X*7 ≤ 50

**✓**

**✓**

16*X*1 + 81*X*2 + 74*X*3 + 83*X*4 + 7*X*5+ 14*X*6 + 8*X*7 ≥ 26

**✓**

**✓**

22*X*1 + 28*X*5 + 19*X*6 + 63*X*7 ≤ 60

**✓**

**✓**

22*X*1 + 28*X*5 + 19*X*6 + 63*X*7 ≥ 30

All *Xi* ≥ 0

**✓**

**Question 3(19 marks)**

You have to set up an advertising campaign and selected four types of advertising, TV, Radio, Billboards and Newspapers. A summary of the cost per AD to reach the selected audiences, minimum number of audiences to reach and the minimum AD’s per AD type is summarized below:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | **Cost** | **Audience** | **Minimum** |
| **Type of AD** | **Per AD** | **Reached per AD** | **Number per AD** |
| TV | R800 | 30 000 | 10 |
| Radio | R400 | 22 000 | 10 |
| Billboards | R500 | 24 000 | 10 |
| Newspapers | R100 | 8 000 | 10 |

**Additional information:**

- There should be not more than six ADS on TV **or** Radio **or** some combination of the two.

- Amount spend on billboards and newspapers must be at least the amount spend of TV AD’s.

- Amount spend on TV and Radio must not exceed 50% of the expenditure on Billboards.

- Monthly budget for advertising is R15 000.00. You are requested to use the entire budget.

a) Formulate the above scenario into a LP solution to show how many AD’s should you place to maximize the total number of people reached. (19)

**Solution: (Question 3)**

**Let:**

**✓**

*X*1 = number of TV ads

**✓**

*X*2 = number of radio ads

**✓**

*X*3 = number of billboard ads

**✓**

*X*4 = number of newspaper ads

**Objective function:**

**✓**

**Maximise exposure total audience** = 30,000*X*1 + 22,000*X*2 + 24,000*X*3 + 8,000 *X*4

**✓**

**Subject to :**

**Constraints :**

**✓**

*X*1 *X*2 *X*3 *X*4

**✓**

*X*1≥

**✓**

*X*2≥

**✓**

*X*3≥

**✓**

*X*4≥

**✓**

**✓**

*X*1 *X*2≤

**✓**

**✓**

*X*3*X*4≥

**✓**

**✓**

**✓**

**✓**

*X*1*X*2≤

*X*1 *X*2 *X*3 *X*4≥

Total : 50