# Modeling Sheet

## Exercise 1:

The Woodell Carpentry Shop makes bookcases and cabinets. Each bookcase requires 15 hours of woodworking and 9 hours of finishing. The cabinet requires 10 hours of woodworking and 4.5 hours of finishing. The profit is $60 on each bookcase and $40 on each cabinet. There are 70 hours available each week for woodworking and 36 hours available for finishing. How many of each item should be produced in order to maximize profit?

## Exercise 2:

A company manufactures inkjet printers and laser printers. The company can make a total of 60 printers per day, and it has 120 labor-hours per day available. It takes one labor-hour to make an inkjet printer, and three labor-hours to make a laser printer. The profit is $45 per inkjet printer, and $65 per laser printer. How many of each type of printers should the company make to maximize its daily profit?

## Exercise 3:

A company manufactures two products A&B, with profit 4&3 $ per unit. A&B takes 3&2 minutes respectively to be machined. The total time available at machining department is 800 hours (100 days or 20 weeks). A market research showed that at least 10000 units of A and not more than 6000 units of B are needed. It is required to determine the number of units of A&B to be produced to maximize profit.

## Exercise 4:

An animal feed company must produce exactly 200 Kg of a mixture consisting of ingredients X1, X2. The ingredient X1 costs $3 per Kg and X2 costs $5 per Kg. No more than 80 Kg of X1 can be used and at least 60 Kg of X2 must be used. Formulate the model to minimize the cost of the mixture.

## Exercise 5:

A farmer has 10 acres to plant in wheat and rye. He has to plant at least 7 acres. However, he has only $1200 to spend and each acre of wheat costs $200 to plant and each acre of rye costs $100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the profit is $500 per acre of wheat and $300 per acre of rye, how many acres of each should be planted to maximize profits?

## Exercise 6:

A farmer is interested in feeding his cattle at minimum cost. Two feeds are used A&B. Each cow must get at least 400 grams/day of protein, at least 800 grams/day of carbohydrates, and not more than 100 grams/day of fat. Given that A contains 10% protein, 80% carbohydrates and 10% fat while B contains 40% protein, 60% carbohydrates and no fat. A costs 2 L.E/kg, and B costs 5 L.E/kg. Formulate the problem to determine the optimum amount of each feed to minimize cost.

## Exercise 7:

A firm manufactures three products A, B and C. the profits are $3, $2 and $4 respectively. The firm has two machines C1, D1 and the required processing time in minutes for each machine on each product is given below.

|  |  | Product | | |
|---|---|---|---|---|
|  |  | A | B | C |
| Machine | C1 | 4 | 3 | 5 |
|  | D1 | 2 | 2 | 4 |

Machines C1, D1 have 2000 and 2500 machine minutes respectively. The firm must manufacture 100 A's, 200B's and 50 C's, but no more than 150 A's. Setup an L.P model to maximize the profit.

## Exercise 8:

Reddy Mikks produces both interior and exterior paints from two raw materials, M1&M2. The following table provides the basic data of the problem.

|  | Tons of raw material per ton of | | Maximum daily availability (tons) |
|---|---|---|---|
|  | Exterior paint | Interior paint |  |
| Raw Material,M1 | 6 | 4 | 24 |
| Raw Material,M2 | 1 | 2 | 6 |
| Profit per ton ($1000) | 5 | 4 |  |

A market survey indicates that the daily demand for interior paint cannot exceed that of exterior paint by more than 1 ton. Also, the maximum daily demand of interior paint is 2 tons. Reddy Mikks wants to determine the optimum (best) product mix of interior and exterior paints that maximize the total daily profit.

## Exercise 9:

The manager of an oil refinery has to decide upon the optimal mix of two possible blending processes, of which the inputs and outputs per production run are as follows:

| Process | Input | | Output | |
|---|---|---|---|---|
| | Crude A | Crude B | Gasoline X | Gasoline Y |
| 1 | 5 | 3 | 5 | 8 |
| 2 | 4 | 5 | 4 | 4 |

The maximum amount available of crude A and B are 200 units and 150 units respectively. Market requirements show that at least 100 units of gasoline X and 80 units of gasoline Y must be produced. The profits per production run from process 1 and process 2 are $3 and $4 respectively. Formulate the problem as linear programming problem.

## Exercise 10:

A calculator company produces a scientific calculator and a graphing calculator. Long term projections indicate an expected demand of at least 100 scientific and 80 graphing calculators each day. Because of limitations on production capacity, no more than 200 scientific and 170 graphing calculators can be made daily. To satisfy a contract a total of at least 200 must be shipped each day. If each scientific calculator sold results in a $2 loss, but each graphing calculator produces a $5 profit, how many of each type should be made daily to maximize net profits.

## Exercise 11:

An iron ore from 4 mines will be blended. The analysis has shown that, in order to obtain suitable tensile properties, minimum requirements must be met for 3 basic elements A, B, and C. Each of the 4 mines contains different amounts of the 3 elements (see the table). Formulate to find the least cost blend for one ton of iron ore.

| Basic element | Minimum Requirements lb/ton of | Composition from each mine lb/ton | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| A | 5 | 10 | 3 | 8 | 2 |
| B | 10 | 90 | 150 | 75 | 175 |
| C | 30 | 45 | 25 | 20 | 37 |
| Cost/ton from each mine L.E/ton of ore | | 800 | 400 | 600 | 500 |

## Exercise 12:

Dorian Auto manufactures luxury cars and trucks. The company believes that its most likely customers are high-income women and men. To reach these groups, Dorian Auto has embarked on an ambitious TV advertising campaign and has decided to purchase 1-minute commercial spots on two types of programs: comedy shows and football games. Each comedy commercial is seen by 7 million high-income women and 2 million high-income men. Each football commercial is seen by 2 million high-income women and 12 million high-income men. A 1-minute comedy ad costs $50,000, and a 1-minute football ad costs $100,000. Dorian would like the commercials to be seen by at least 28 million high-income women and 24 million high-income men. Use linear programming to determine how Dorian Auto can meet its advertising requirements at minimum cost.

## Exercise 13:

O'Hagan Bookworm Booksellers buys books from two publishers. Duffin House offers a package of 5 mysteries and 5 romance novels for $50, and Gorman Press offers a package of 5 mysteries and 10 romance novels for $150. O'Hagan wants to buy at least 2,500 mysteries and 3,500 romance novels, and he has promised Gorman (who has influence on the Senate Textbook Committee) that at least 25% of the total number of packages he purchases will come from Gorman Press. How many packages should O'Hagan order from each publisher in order to minimize his cost and satisfy Gorman?

## Exercise 14:

A gold processor has two sources of gold ore, source A and source B. In order to keep his plant running, at least three tons of ore must be processed each day. Ore from source A costs $20 per ton to process, and ore from source B costs $10 per ton to process. Costs must be kept to less than $80 per day. Moreover, Federal Regulations require that the amount of ore from source B cannot exceed twice the amount of ore from source A. If ore from source A yields 2 oz. of gold per ton, and ore from source B yields 3 oz. of gold per ton, how many tons of ore from both sources must be processed each day to maximize the amount of gold extracted subject to the above constraints?

## Exercise 15:

A publisher has orders for 600 copies of a certain text from San Francisco and 400 copies from Sacramento. The company has 700 copies in a warehouse in Novato and 800 copies in a warehouse in Lodi. It costs $5 to ship a text from Novato to San Francisco, but it costs $10 to ship it to Sacramento. It costs $15 to ship a text from Lodi to San Francisco, but it costs $4 to ship it from Lodi to Sacramento. How many copies should the

company ship from each warehouse to San Francisco and Sacramento to fill the order at the least cost?

## Exercise 16:

Giapetto's Woodcarving, Inc., manufactures two types of wooden toys: soldiers and trains. A soldier sells for $27 and uses $10 worth of raw materials. Each soldier that is manufactured increases Giapetto's variable labor and overhead costs by $14. A train sells for $21 and uses $9 worth of raw materials. Each train built increases Giapetto's variable labor and overhead costs by $10. The manufacture of wooden soldiers and trains requires two types of skilled labor: carpentry and finishing. A soldier requires 2 hours of finishing labor and 1 hour of carpentry labor. A train requires 1 hour of finishing and 1 hour of carpentry labor. Each week, Giapetto can obtain all the needed raw material but only 100 finishing hours and 80 carpentry hours. Demand for trains is unlimited, but at most 40 soldiers are bought each week. Giapetto wants to maximize weekly profit (revenues - costs). Formulate a mathematical model of Giapetto's situation that can be used to maximize Giapetto's weekly profit.

## Exercise 17:

A small manufacture employs 5 skilled men and 10 semi-skilled men and makes an article in two qualities, a deluxe model and an ordinary model. The making of a deluxe model requires 2 hours work by a skilled man and 2 hours work by a semi-skilled man. The ordinary model requires 1 hour work by a skilled man and 3 hours work by a semi-skilled man. By union rules, no man can work more than 8 hours per day. The manufacturer's clear profit of the deluxe model is $10 and of the ordinary model is $8. Formulate the model of the problem to maximize the clear profit.