## SECTION 4.2 PROBLEM SET: MAXIMIZATION BY THE SIMPLEX METHOD

Solve the following linear programming problems using the simplex method.

1) Maximize z = x1 + 2x2 + 3x3

 subject to x1 + x2 + x3  12

 2x1 + x2 + 3x3  18

 x1, x2, x3  0

2) Maximize z = x1 + 2x2 + x3

 subject to x1 + x2  3

 x2 + x3  4

 x1 + x3  5

 x1, x2, x3  0

3) A farmer has 100 acres of land on which she plans to grow wheat and corn. Each acre of wheat requires 4 hours of labor and $20 of capital, and each acre of corn requires 16 hours of labor and $40 of capital. The farmer has at most 800 hours of labor and $2400 of capital available. If the profit from an acre of wheat is $80 and from an acre of corn is $100, how many acres of each crop should she plant to maximize her profit?

***SECTION 4.2 PROBLEM SET: MAXIMIZATION BY THE SIMPLEX METHOD***

Solve the following linear programming problems using the simplex method.

4) A factory manufactures chairs, tables and bookcases each requiring the use of three operations: Cutting, Assembly, and Finishing. The first operation can be used at most 600 hours; the second at most 500 hours; and the third at most 300 hours. A chair requires 1 hour of cutting, 1 hour of assembly, and 1 hour of finishing; a table needs 1 hour of cutting, 2 hours of assembly, and 1 hour of finishing; and a bookcase requires 3 hours of cutting, 1 hour of assembly, and 1 hour of finishing.
If the profit is $20 per unit for a chair, $30 for a table, and $25 for a bookcase, how many units of each should be manufactured to maximize profit?

5). The Acme Apple company sells its Pippin, Macintosh, and Fuji apples in mixes.
Box I contains 4 apples of each kind; Box II contains 6 Pippin, 3 Macintosh, and 3 Fuji;
 and Box III contains no Pippin, 8 Macintosh and 4 Fuji apples. At the end of the season, the company has altogether 2800 Pippin, 2200 Macintosh, and 2300 Fuji apples left.
Determine the maximum number of boxes that the company can make.

## SECTION 4.3 PROBLEM SET: MINIMIZATION BY THE SIMPLEX METHOD

In problems 1-2, convert each minimization problem into a maximization problem, the dual, and then solve by the simplex method.

1) Minimize z = 6x1 + 8x2

 subject to 2x1 + 3x2  7

 4x1 + 5x2  9

 x1, x2  0

2) Minimize z = 5x1 + 6x2 + 7x3

 subject to 3x1 + 2x2 + 3x3  10

 4x1 + 3x2 + 5x3  12

 x1, x2, x3  0

***SECTION 4.3 PROBLEM SET: MINIMIZATION BY THE SIMPLEX METHOD***

In problems 3-4, convert each minimization problem into a maximization problem, the dual, and then solve by the simplex method.

3) Minimize z = 4x1 + 3x2

 subject to x1 + x2  10

 3x1 + 2x2  24

 x1, x2  0

4) A diet is to contain at least 8 units of vitamins, 9 units of minerals, and 10 calories.
Three foods, Food A, Food B, and Food C are to be purchased. Each unit of Food A provides 1 unit of vitamins, 1 unit of minerals, and 2 calories. Each unit of Food B provides 2 units of vitamins,
1 unit of minerals, and 1 calorie. Each unit of Food C provides 2 units of vitamins, 1 unit of minerals, and 2 calories. If Food A costs $3 per unit, Food B costs $2 per unit and Food C costs $3 per unit, how many units of each food should be purchased to keep costs at a minimum?

## SECTION 4.4 PROBLEM SET: CHAPTER REVIEW

Solve the following linear programming problems using the simplex method.

|  |  |
| --- | --- |
| 1) Maximize z = 5x1 + 3x2  subject to x1 + x2  12 2x1 + x2  16 x1 ≥ 0; x2 ≥ 0 | 2) Maximize z = 5x1 + 8x2  subject to x1 + 2x2  30 3x1 + x2  30 x1 ≥ 0; x2 ≥ 0 |
| 3) Maximize z = 2x1 + 3x2 + x3 subject to 4x1 + 2x2 + 5x3  32 2x1 + 4x2 + 3x3  28  x1, x2, x3  0 | 4) Maximize z = x1 + 6x2 + 8x3 subject to x1 + 2x2  1200 2x2 + x3  1800  4x1 + x3  3600  x1, x2, x3  0 |
| 5) Maximize z = 6x1 + 8x2 + 5x3 subject to 4x1 + x2 + x3  1800 2x1 + 2x2 + x3  2000  4x1 + 2x2 + x3  3200  x1, x2, x3  0 | 6) Minimize z = 12x1 + 10x2  subject to x1 + x2  6 2x1 + x2  8 x1 ≥ 0; x2 ≥ 0 |
| 7) Minimize z = 4x1 + 6x2 + 7x3 subject to x1 + x2 + 2x3  20 x1 + 2x2 + x3  30  x1, x2, x3  0 | 8) Minimize z = 40x1 + 48x2 + 30x3 subject to 2x1 + 2x2 + x3  25 x1 + 3x2 + 2x3  30  x1, x2, x3  0 |

9) An appliance store sells three different types of ovens: small, medium, and large.
The small, medium, and large ovens require, respectively, 3, 5, and 6 cubic feet of storage space; a maximum of 1,000 cubic feet of storage space is available. Each oven takes 1hour of sales time; there is a maximum of 200 hours of sales labor time available for ovens. The small, medium, and large ovens require, respectively, 1, 1, and 2 hours of installation time; a maximum of 280 hours of installer labor for ovens is available monthly.
If the profit made from sales of small, medium and large ovens is $50, $100, and $150, respectively, how many of each type of oven should be sold to maximize profit, and what is the maximum profit?

***SECTION 4.4 PROBLEM SET: CHAPTER REVIEW***

10) A factory manufactures three products, A, B, and C. Each product requires the use of two machines, Machine I and Machine II. The total hours available, respectively, on Machine I and Machine II per month are 180 and 300. The time requirements and profit per unit for each product are listed below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | A | B | C |
|  Machine I | 1 | 2 | 2 |
| Machine II | 2 | 2 | 4 |
| Profit | 20 | 30 | 40 |

 How many units of each product should be manufactured to maximize profit, and what is the maximum profit?

11) A company produces three products, A, B, and C, at its two factories, Factory I and Factory II. Daily production of each factory for each product is listed below.

|  |  |  |
| --- | --- | --- |
|  | Factory I | Factory II |
| Product A | 10 | 20 |
| Product B | 20 | 20 |
| Product C | 20 | 10 |

 The company must produce at least 1000 units of product A, 1600 units of B, and 700 units of C. If the cost of operating Factory I is $4,000 per day and the cost of operating Factory II is $5000, how many days should each factory operate to complete the order at a minimum cost, and what is the minimum cost?

12) For his classes, Professor Wright gives three types of quizzes, objective, recall, and recall-plus.
To keep his students on their toes, he has decided to give at least 20 quizzes next quarter.

 The three types, objective, recall, and recall-plus quizzes, require the students to spend, respectively, 10 minutes, 30 minutes, and 60 minutes for preparation, and Professor Wright would like them to spend at least 12 hours(720 minutes) preparing for these quizzes above and beyond the normal study time.

 An average score on an objective quiz is 5, on a recall type 6, and on a recall-plus 7, and Dr. Wright would like the students to score at least 130 points on all quizzes.

 It takes the professor one minute to grade an objective quiz, 2 minutes to grade a recall type quiz, and 3 minutes to grade a recall-plus quiz.

 How many of each type should he give in order to minimize his grading time?