Lecture 3

1. A chair furniture manufacturer makes 21 different types of chairs, which are categorized into single-seat chairs or multiple-seat chairs. There are 5,000 machine hours and $15,000 production budget available each month. The manufacturer has recorded data for 12 months regarding its production quantities, raw materials costs, total machine hours used, and total sales for each week for each chair. This data is stored in the Excel file named *ch3_Plchairproduction*.

   a. Use a pivot table to process the operational data and calculate:
   • The average cost of raw materials for a single chair and a multiple chair
   • The average machine time for a single chair and a multiple chair
   • The average sales price for a single chair and a multiple chair

   b. Determine how many units for each category (single-seat and multiple-seat chairs) the company should produce during the next month to maximize the total expected sales:
   • Formulate an LP model to represent the above optimization problem.
   • Create an Excel template to calculate the total sales, machine hours, and cost of raw materials for a given production mix.
   • Apply Solver to generate an optimal solution.
   • Generate an Answer Report, Sensitivity Report, and Limits Report and provide recommendations for possible alternative production scenarios.

2. Use the same Excel file (*ch3_Plchairprocluction*) and the same problem description provided in the problem 1 to calculate LP parameters for each of the 21 chairs and determine how many units of each individual product should be produced during the next month. The company must produce at least 10 units of each chair to allow for production variety and to meet contractual agreements. Perform a similar analysis with an Excel template and Solver. Compare the results with those from problem 1.

3. You are the production manager at a golf club manufacturer. The company wants to determine how many iron sets to produce each month so the company can maximize the revenue. The company has allocated 20,000 machine hours to iron sets. Operational data from the last six months is recorded and can be found in the *ch_P3ironsetsproduction.xlsx* file. This data consists of average processing time, cost of raw materials, and monthly demand for the last six months. The file also contains the retail price for each set, which can be used to calculate the contribution coefficients for each set. To keep contractual agreements, the company must produce at least 500 units, but no more than 1,000 units for each iron set. The company employs workers in the iron set assembly line and each of them is payed an average of $40 per hour.

a. Using a pivot table, process the Excel file data to calculate the average processing time, cost of raw materials, and monthly demand for each iron set.
b. Prepare an Excel template that calculates the values of the average net profit for each iron set, average time usage per each iron set, the total profit for a given production set, and the actual usage of machine hours for a given production mix. Assume an initial production level of one unit for each set.
c. Use Solver to set up the objective function and constraints and generate an optimal solution.
d. Analyze the results using the Answer Report, Sensitivity Report, and Limits Report.

4. Use the same Excel file (ch_P3ironsets production) and the same problem description provided in problem 3 to solve an optimization problem with a different objective function. Now, the operations manager seeks to minimize the total materials cost and must utilize the 20,000 hours of labor. The rest of the constraints remain the same as in problem 3.
   Perform a similar analysis with an Excel template and Solver. Compare the results with those from problem 3. Which solution is better: the one that maximizes profit or the one that minimizes cost? Why would a manager be interested in fully utilizing the available labor hours?

5. Which of the following is a business situation in which linear programming models can be used?
   a. Determining a crop rotation policy in agriculture
   b. Determining an optimal subsidy management for farmers
   c. Optimizing water networks
   d. All of those answers

6. The direction of a constraint in a linear programming model can be:
   a. Less than or equal
   b. Greater than or equal
   c. Equal
   d. Any of the above

7. When incorporating a large amount of input data, the decision maker must add the following step in the process of formulating a linear programming model:
   a. Calculating model parameters

b. Defining decision variables
c. Formulating the objective function
d. Identifying the set of constraints
e. Identifying a set of non-negativity constraints

8. Which of the following functions can be performed with a pivot table?
   a. Automatically sorting data stored in a spreadsheet
   b. Automatically counting data stored in a spreadsheet
   c. Automatically averaging data stored in a spreadsheet
   d. All of those answers

9. Which of the following is a benefit provided by sensitivity analysis?
   a. Sensitivity analysis can be used to gain additional insights into the model solution.
   b. Sensitivity analysis allows the decision maker to identify the range of contribution coefficients that will not alter the solution.
   c. Sensitivity analysis allows the decision maker to identify the range of right-hand-side values that will not alter the solution.
   d. All of those answers

10. Linear programming models are considered to be:
   a. A popular tool that can be used to solve selected optimization models.
   b. An optimization tool that can be used to solve any business models.
   c. A descriptive analytics tool that can be used to analyze organizational data.
   d. All of those answers

11. In a linear programming model, the decision maker seeks to optimize an objective function while meeting the requirements of certain constraints. Which of the following is not a type of constraint?
   a. Resource constraints
   b. Non-negativity constraints
   c. Maximization constraints
   d. All of those answers are types of constraints.

12. The implementation of linear programming models as operational business intelligence tools in the era of Big Data requires that decision makers:
   a. Attract as many sources of data as possible.
   b. Adapt those data from heterogeneous sources.
   c. Feed those models directly with the most up-to-date input parameters.
   d. All of those answers

13. Process-driven models require the implementation of the MAD approach. MAD stands for:
    a. Multiplicity, approximation, and deviation
    b. Mean absolute deviation
    c. Magnetism, agility, and depth
    d. Maximization, abstraction, and deviation