SECTION 3.2

3.2.1: BigTop Tents LLC makes two types of tents, party tents and camping tents. Party tents need 20 square yards of cloth, 60 feet of tubing, and 80 feet of rope, earning a profit of $45, while camping tents need 32 square yards of cloth, 24 feet of tubing, and 40 feet of rope, earning a profit of $30. BigTop has available each day 1500 square yards of cloth, 1800 feet of tubing, and 2000 feet of rope.

Construct a Linear Programming problem to help BigTop determine how many of each type of tent to build each day for the most profit. DO NOT SOLVE.

3.2.2: The LunchBox catering company has two kitchens. Kitchen A can make 100 sandwiches per hour, 5 pounds of cole slaw per hour, and 3 pounds of potato salad per hour. It costs $400 to run this kitchen each hour. Kitchen B can make 80 sandwiches per hour, 2 pounds of cole slaw per hour, 6 pounds of potato salad per hour, and costs $500 per hour to run. An order is placed by the county fair organization for 2500 sandwiches, 100 pounds of cole slaw, and 120 pounds of potato salad. How many hours should LunchBox operate each kitchen to fill this order at least cost?

Construct a Linear Programming problem to help LunchBox determine how many hours to run each kitchen and what will be the least cost of filling the order. DO NOT SOLVE.

SECTION 3.3

3.3.1: Solve by Graphing: SHOW ALL WORK

$$\begin{aligned}
&Minimize: 2x+5y \quad s.t.\\
&4x+y \geq 40\\
&2x+y \geq 30\\
&x+3y \geq 30\\
&x \geq 0\ ,\ y \geq 0
\end{aligned}$$

3.3.2: Solve by Graphing: **SHOW ALL WORK**

$$\begin{aligned}
&Maximize: 400-6x+9y \quad s.t.\\
&x+2y \leq 100\\
&5x+2y \leq 200\\
&3x+2y \leq 140\\
&x \geq 0\ ,\ y \geq 0
\end{aligned}$$

3.3.3: Solve by Graphing: **SHOW ALL WORK**

$$\begin{aligned}
&Maximize: 7x+8y \quad subject\ \ to\\
&x+y\le 160\\
&2x+y\le 260\\
&2x+5y\le 650\\
&x\ge 0\ ,\ y\ge 0
\end{aligned}$$

3.3.4: Solve by Graphing: **SHOW ALL WORK**

$$\begin{aligned}
&Maximize: 1500-4x+6y \quad subject\ \ to\\
&5x+y\le 360\\
&x+3y\le 180\\
&x+y\le 80\\
&x\ge 0\ ,\ y\ge 0
\end{aligned}$$

3.3.5: Solve by Graphing: **SHOW ALL WORK**

$$\begin{aligned}
&Minimize: 2x+3y \quad subject\ \ to\\
&10x+6y\ge 60\\
&x+y\ge 8\\
&x\ge 0\ ,\ y\ge 0
\end{aligned}$$

SECTION 3.4

3.4.1: Sundown LLC makes patio heating lamps. Their factory in Topeka has 800, the factory in Dallas has 700, while the warehouse in Memphis needs 500, and the warehouse in Austin needs 650. It costs \$12 to ship each lamp from Topeka to Memphis, \$20 for Topeka to Austin, \$15 from Dallas to Memphis, and \$22 from Dallas to Austin.

Set up the Linear Programming Problem in 2-Variables to determine the least cost. **DO NOT SOLVE USE X = Topeka to Austin. State your choice for Y**

3.4.2: LeckTrick Car company builds cars at plants in Mexico, which has 800 cars, and Taiwan, which has 1000 cars. They have sales centers in the US, which needs 650, and Canada, which needs 500. It costs \$120 to ship a car from Mexico to the US, \$150 from Mexico to Canada, \$130 from Taiwan to the US, and \$100 from Taiwan to Canada. They need to fill both orders at the least total cost of shipping.

USE X = # shipped from Taiwan to Canada. Set up a Linear Programming problem to solve this. **DO NOT SOLVE**.

3.4.3: Mike has $20000 to invest and three options in which to put his money to work. A Money Market account will earn him a 3% annual return, a Municipal Bond earning 5%, and an Exchange Traded Fund earning 8%. His financial adviser wants him to put no more into the ETF than the Money Market and Muni-Bonds combined, and at least as much in Money Markets as Muni-Bonds.

USE X = Amount in the ETF. Set up a Linear Programming Problem to help Mike determine how much he should put into each investment vehicle.

SECTION 4.1

For each given Simplex Tableau, answer the questions following it. DO NOT PIVOT.

a)

$$\left[\begin{array}{ccccccc|c} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & M & \\ \hline 3 & 1 & 0 & 1 & .5 & 0 & 0 & 15 \\ -5 & 0 & 1 & 7 & -1 & 0 & 0 & 10 \\ 2 & 0 & 0 & 0 & 4 & 1 & 0 & 25 \\ \hline -2 & 0 & 0 & 15 & 2 & 0 & 1 & 125 \end{array}\right]$$

Name the Current Solution, including Slack Variables and Objective Value

Is another Pivot necessary? YES NO

Why? ____

b)

$$\left[\begin{array}{ccccccc|c} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & M & \\ \hline 3 & 1 & 0 & 1 & .5 & 0 & 0 & -15 \\ -5 & -3 & 1 & 0 & -1 & 0 & 0 & 10 \\ -2 & 0 & 0 & 0 & 4 & 1 & 0 & -2 \\ \hline 6 & 14 & 0 & 0 & 2 & 0 & 1 & 72 \end{array}\right]$$

Name the Current Solution, including Slack Variables and Objective Value

Is another Pivot necessary? YES NO

Why? ____

SECTION 4.2

Solve each LP-Problem by Simplex method
a) Appropriately add Slack variables, and construct a fully labeled Initial Simplex Tableau
b) Determine the proper Pivot Element. Pivot until reaching an Optimal Tableau
c) State the solution: X, Y, Z(if necessary), and M

4.2.1:

$$\begin{aligned}&Maximize: 7x+8y \quad subject\ \ to\\&x+y\le 160\\&2x+y\le 260\\&2x+5y\le 650\\&x\ge 0\ ,\ y\ge 0\end{aligned}$$

4.2.2:

$$\begin{aligned}&Maximize: 1500-4x+6y \quad subject\ \ to\\&5x+y\le 360\\&x+3y\le 180\\&x+y\le 80\\&x\ge 0\ ,\ y\ge 0\end{aligned}$$

SECTION 4.3

Solve by Simplex Method.
a) Convert each problem to "Standard Maximum" form, add slack variables and construct the Initial Simplex Tableau, with ALL COLUMNS properly labeled.
b) Pivot until reaching an Optimal Solution. Choose each Pivot Element correctly depending on whether the Tableau indicates we are currently Feasible or Non-Feasible
c) State the solution of X, Y, and M from your final tableau

4.3.1:

$$\begin{aligned}&Maximize: 5x+4y+2z \quad s.t.\\&x+2y+3z\le 24\\&x-y+z\ge 6\\&x\ge 0\ ,\ y\ge 0\ ,\ z\ge 0\end{aligned}$$

4.3.2:

$$\begin{aligned}&Maximize: 4x+5y \quad subject\ \ to\\&4x+2y\le 52\\&x+4y\le 48\\&y\ge 2\\&x\ge 0\end{aligned}$$

4.4.3:

$$\begin{aligned}
&Minimize: 2x+5y \quad s.t.\\
&4x+y \geq 40\\
&2x+y \geq 30\\
&x+3y \geq 30\\
&x \geq 0\ ,\ y \geq 0
\end{aligned}$$

SECTION 4.4

4.4.1: A Linear Programming problem and its Optimal Tableau are given below:
USE sensitivity analysis, NOT by redoing Simplex Method

$$\begin{aligned}
&Maximize: 4x+6y+8z \quad s.t.\\
&3x+2y+2z \leq 1200\\
&x+4y+2z \leq 1000\\
&2x+y+3z \leq 900\\
&x \geq 0\ ,\ y \geq 0\ ,\ z \geq 0
\end{aligned}$$

$$\left[\begin{array}{ccccccc|c}
x & y & z & u & v & w & M & \\
\hline
9/5 & 0 & 0 & 1 & -2/5 & -2/5 & 0 & 440\\
-1/10 & 1 & 0 & 0 & 3/10 & -1/5 & 0 & 120\\
7/10 & 0 & 1 & 0 & -1/10 & 2/5 & 0 & 260\\
\hline
1 & 0 & 0 & 0 & 1 & 2 & 1 & 2800
\end{array}\right]$$

a) If the RHS of Constraint **#2** were to be changed to 1200, determine the New Right-hand Column values. ALSO: state the New Optimal Feasible Solution: X, Y, Z, and M
b) If the RHS of Constraint **#3** were to be changed to 800, determine the New Right-hand Column values. ALSO: state the New Optimal Feasible Solution: X, Y, Z, and M
c) If the RHS of Constraint **#2** were changed by ***h***, find the range of *h* so that we are still feasible.

4.4.2: A Linear Programming problem and its Optimal Tableau are given below:
USE sensitivity analysis, NOT by redoing Simplex Method

$$\begin{aligned}
&Maximize: z=3x+5y+2z \quad s.t.\\
&2x+4y+2z \leq 34\\
&3x+6y+4z \leq 57\\
&2x+5y+z \leq 30\\
&x \geq 0\ ,\ y \geq 0\ ,\ z \geq 0
\end{aligned}$$

$$\left[\begin{array}{ccccccc|c}
x & y & z & s_1 & s_2 & s_3 & M & \\
\hline
0 & 1 & 0 & -5/2 & 1 & 1 & 0 & 2\\
0 & -1 & 1 & 1 & 0 & -1 & 0 & 4\\
1 & 3 & 0 & -1/2 & 0 & 1 & 0 & 13\\
\hline
0 & 2 & 0 & 1/2 & 0 & 1 & 1 & 47
\end{array}\right]$$

a) If the RHS of Constraint **#1** were to be changed to 32, determine the New RHS and then the new Optimal Solution. **USE sensitivity analysis, NOT by redoing Simplex Method**
b) If the RHS of Constraint **#3** were to be changed to 32, determine the New RHS and then the new Optimal Solution. **USE sensitivity analysis, NOT by redoing Simplex Method**
c) If the RHS of Constraint **#3** were changed to $30+h$, find the range of *h* so that we are still Optimal.

SECTION 4.5

Solve by Duality.

a) Construct the Dual to the problem below
b) Construct the Initial Simplex Tableau for YOUR DUAL. Indicate the Pivot Element.
c) Show the new Tableau(the second one).
d) Continue Pivoting until Optimal, and show the Final Tableau(any others after second not necessary)
e) State the Solution to the original MINIMUM problem

4.5.1:

$$\begin{aligned}
&Minimize: 2x+5y \quad s.t.\\
&4x+y \geq 40\\
&2x+y \geq 30\\
&x+3y \geq 30\\
&x \geq 0\ ,\ y \geq 0
\end{aligned}$$

4.5.2:

$$\begin{aligned}
&Minimize: 2x+3y \quad s.t.\\
&10x+6y \geq 60\\
&x+y \geq 8\\
&x \geq 0\ ,\ y \geq 0
\end{aligned}$$