# Homework #6

This is an individual assignment. All work that you submit for credit must be your own.

1. Charles Sachs & Associates (CSA) is a financial services firm that manages investment portfolios for its customers. A new client has hired CSA to manage its investment portfolio which totals $800,000. The client has asked CSA to invest this portfolio in some combination of the stocks listed in the table below. Develop an optimization model in a Jupyter Notebook using Python to recommend the best investment strategy for this new client. Which constraints are binding and what are their marginal values?

| Stock | Price per Share | Annual Return per Share | Investment Limit |
|---|---|---|---|
| Standard Oil | $50 | $6 | $200,000 |
| B&O Railroad | $30 | $4 | $450,000 |
| Dunder Mifflin | $40 | $5 | $250,000 |

   a. Develop an optimization model in a Jupyter Notebook using Python to recommend the best investment strategy for this new client. (44 points)
   b. Which constraints are binding and what are their marginal values? (6 points)

2. Frandec Company manufactures material handling equipment used in warehouses and distribution centers. One product, called a Liftmaster, is assembled from four components: a frame, a motor, two supports, and a metal strap. Frandec's production schedule calls for 5,000 Liftmasters to be made next month. Frandec purchases the motors from an outside supplier, but the frames, supports, and straps may be either manufactured by Frandec or purchased from an outside supplier. Manufacturing and purchase costs per unit are shown in the table below.

| Component | Manufacturing Cost | Purchase Cost |
|---|---|---|
| Frame | $38.00 | $51.00 |
| Support | $11.50 | $15.00 |
| Strap | $6.50 | $7.50 |

   Three departments are involved in the production of these components. The time (minutes per unit) required to process each component in each

department and the available capacity (in hours) for the three departments are provided in the table below.

| Component | Department (mins/unit) | | |
|---|---|---|---|
| | Cutting | Milling | Shaping |
| Frame | 3.5 | 2.2 | 3.1 |
| Support | 1.3 | 1.7 | 2.6 |
| Strap | 0.8 | -- | 1.7 |
| Capacity (hours) | 350 | 420 | 680 |

a. Formulate this problem as a linear program and develop an optimization model in a Jupyter Notebook using Python to find an optimal solution. (36 points)
b. How much would Frandec be willing to pay for an additional hour of time in each of the three departments? (6 points)
c. Another supplier has offered to sell frames to Frandec for $45 each. Should Frandec purchase any frames from this supplier? Why or why not? (8 points)