# Business Decision Analytics under Uncertainty
# Spring 2017, Professor Eckstein
# Homework 6

### Due Wednesday, March 22 (after spring break)

## Q1: Inventory planning with quantity discounts

Over the next 12 months you anticipate the following demand for a product that you sell:

| **Month** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Demand (units)** | 4 | 5 | 6 | 6 | 7 | 3 | 4 | 2 | 8 | 5 | 4 | 3 |

At the beginning of month 1, you have 3 units in inventory. At the beginning of each month, you can order as many units of inventory as you like, and they are delivered essentially immediately. The cost is $10.00 per unit if you order 1 to 4, units, or $8.50 per unit if you order at least 5 units (also, there is no cost if you order 0 units). You have space for up to 20 units of inventory and your holding cost for each month is $0.50 per unit, applied to the average of the starting and ending inventory for the month. There is no benefit or credit for having leftover inventory at the end of month 12.

**Write a Python program that computes the lowest-cost ordering plan, considering both ordering costs and inventory costs. Print out and hand in both the source code for your program and its output. In addition, upload your source code to BlackBoard, under "Assignments" and "Homework Assignment 1, Q1".**

## Q2: Trading Strategies

Consider the following generalization of the jukebox problem you solved manually on the previous homework assignment: each month you can buy up to `maxBuy` jukeboxes at buy (bid) price, sell up to `maxSell` jukeboxes at the selling (ask) price, or do nothing. For each jukebox in inventory at the end of a month, you must pay $100 for maintenance and cleaning. For each jukebox left over at the end of the time horizon, you obtain a "salvage value" of $2000.

**(a) Write a Python program to maximize your profits in the following instance of the problem, identical to the one you solved by hand on the previous homework assignment. Print out and hand in both the source code for your program and its output. In addition, upload your source code to BlackBoard, under "Assignments" and "Homework Assignment 1, Q2(a)".**

Your inventory capacity is 2 jukeboxes, `maxBuy` = 1, `maxSell` = 1, and you start with 0 inventory. You are planning for 4 months and the selling and buying prices you expect for the next 4 months are as follows:

| **Month** | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Sell (Ask) Price** | $2500 | $2800 | $2000 | $2700 |
| **Buy (Bid) Price** | $2600 | $2900 | $2100 | $2800 |

**(b) Modify your program to maximize your profits for the following more complicated instance of the problem. (If you designed your program well, you should only need to change the data setup section at the top.) Print out and hand in both the source code for your modified program and its output. In addition, upload your source code to BlackBoard, under "Assignments" and "Homework Assignment 1, Q2(b)".**

Your inventory capacity is 8 jukeboxes, `maxBuy` = 3, `maxSell` = 3, and you start with 0 inventory. You are planning for 12 months and the selling and buying prices you expect for the next 12 months are as follows:

| **Month** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sell** | $2500 | $2800 | $2000 | $2700 | $2200 | $2050 | $2150 | $2400 | $2700 | $2850 | $2850 | $2700 |
| **Buy** | $2600 | $2900 | $2100 | $2800 | $2400 | $2300 | $2250 | $2500 | $2850 | $3000 | $2950 | $2800 |

To save on typing and avoid data-entry errors, a fragment of Python code containing these values may be downloaded from the course website.