**HW 5 – Business analytics**

This homework is due before class 6. Please submit two files: your write-up and your Excel file. If you make any additional assumptions, state them clearly.

To solve the problem, you will need to do the following:

* 1. Use the Generalized Analytics Procedure (GAP) to set up your problem as follows:
     1. Define your model in words
        1. Identify the firm’s/manager’s objective function in words
        2. Identify the decision variables in words
        3. Identify the random variables (risk sources)
        4. Identify the constraints (optional here)
     2. Formulate your model mathematically
        1. Define the decision variables
        2. Define the random variables (risk sources). What is the probability distribution of those random variables?
        3. Define objective function in terms of decision variables and random variables.
        4. Define the constraints (optional here)
     3. Solve the problem in Excel
        1. Generate **MANY (>1000)** random draws from the specified distribution (see step ii.2above)
        2. For each random draw calculate the objective function value
        3. Try different values for your decision variable and choose the value of decision variable that results in the highest objective function value, on average.
  2. Answer the questions stated in the problem (in words).

*Note: I recommend starting with the GAP (Steps i and ii above). However, if you prefer to skip the GAP and go straight to Excel, points will not be deducted.*

**Beyond Armor**

The Baltimore based company Beyond Armor (BA) is exploring a new business opportunity: selling custom screen-printed sweatshirts for college football bowl games. BA is trying to determine how many sweatshirts to produce for the upcoming Tangerine Bowl game. During the month before the game, BA plans to sell their sweatshirts for $30 each. At this price, they believe the demand for sweatshirts will be uniformly distributed between 5,000 and 15,000.

One month after the game, BA plans to sell any remaining sweatshirts to the local TJ Maxx and Marshalls outlets for $12 each. At this price, BA believes they will be able to sell either 500 units with probability 30%, or 750 units with probability 40% or 1000 units with probability 30%.

Any remaining sweatshirts will be donated to a local charity.

BA can order custom screen-printed sweatshirts for $10 per sweatshirt in lot sizes of 200. Use simulation modeling to answer the following questions.

1. Determine the expected profit that BA would earn if they ordered 10,000 sweatshirts.
2. How many sweatshirts would you recommend BA order to maximize expected profit? Use the “data table” function in Excel to find the optimal order quantity.
3. Due to an outbreak of a novel infectious disease, the governor has announced that there is a 50% chance that all sport events will now be held without a live audience. If that happens, BA will not be able to sell any sweatshirts for $30, and instead will only be able to sell to TJ Maxx and Marshalls, (in the same quantity as in the original problem formulation). How many sweatshirts would you recommend BA order to maximize expected profit? Is the venture still profitable?

Note that BA makes their order quantity decisions before they find out whether sporting events are allowed to be held.

Use the “data table” function to find the optimal order quantity.

1. Use your calculations in part c) to create a plot of the expected profit as a function of order quantity. The plot should show order quantity on X-axis and expected profit on Y-axis.

What do you observe? How sensitive are the profits to deviations from the optimal order quantity? If you deviate from the optimum, is it better to deviate up (order more than the optimum) or down (order less than the optimum)?