Project 3 - Debt Analysis (Due Date: Nov 30, 2015)

Instruction: I only want one copy of your work from each group. Please write down your answers to Q1 and Q2(g) on a separate page, along with your Excel printout. Please keep numbers or percentages to 2 decimal places. (15 points in total)

1. Use the "project3.xlsx" (Problem 1) to calculate how bond prices vary over time when the YTM is held constant at three different levels (YTM=5%, 10%, and 15%) or when the YTM also changes randomly over time (i.e., the future interest rate varies over time). Answer the following four questions. (4 points for the four columns of pricing formulas in the Excel file; 4 points for the following 4 questions)
   (a) When YTM = Coupon Rate, does the bond price "increases/decreases/remains unchanged" over time?
   (b) When YTM > Coupon Rate, does the bond price "increases/decreases/remains unchanged" over time? When YTM < Coupon Rate, does the bond price "increases/decreases/remains unchanged" over time?
   (c) Note that YTM=5% and YTM=15% are deviating from YTM=10% by the same amount, 5%. Are the price trajectories for YTM=5% and YTM=15% symmetric about the par value (the $100 horizontal line)? Why is so?
   (d) What is the expected holding period return from 1/1/2019 to 1/1/2020 if we believe that the YTM happen to be 0.08 and 0.05 on those two days (highlighted in green)? Don't forget the coupon payment in your HPR calculations.

2. Use the "Project3.xlsx" (Problem 2) to perform the following tasks (3-year $100 bond with annual coupon rate 8% and YTM 10%). (7 points)
   (a) Fill in the cells $\boxed{\text{D8:D10}}$ with the PV of all three payments. Calculate the bond price in $\boxed{\text{D12}}$ as the summation of all PV of three payments. Calculate the weights in $\boxed{\text{F8:F10}}$ which will be used to calculate duration. Make sure the weights sum up to 1 in $\boxed{\text{F13}}$.
   (b) The <u>duration</u> is equal to the PV-weighted average of maturity for each payment. Calculate "weights * time to payment" in $\boxed{\text{H8:H10}}$. Sum them up in $\boxed{\text{H14}}$ to get

duration. Divide the duration by (1+YTM) to obtain the modified duration in $\boxed{\text{H15}}$.

(c) If maturity of each payment is represented by Year(i), the convexity is equal to the PV-weighted average of [Year(i)*(Year(i)+1)]. First calculate [Year(i)*(Year(i)+1)] in $\boxed{\text{J8:J10}}$. Then calculate "weights * [Year(i)*(Year(i)+1)]" in $\boxed{\text{L8:L10}}$. Sum them up into $\boxed{\text{L16}}$ to get convexity. Divide the convexity by (1+YTM)^2 to obtain the modified convexity in $\boxed{\text{L17}}$.

(d) Based on the old price in $\boxed{\text{C26}}$ and the new price in $\boxed{\text{C29:C49}}$, calculate the actual percentage change in bond price: $\frac{\Delta P}{P} = \frac{P_1 - P_0}{P_0}$

(e) Calculate the approximate percentage change in bond prices by using the duration rule: $\frac{\Delta P}{P} \approx -D^* \Delta y$, where D^* is the modified duration in $\boxed{\text{H15}}$.

(f) Calculate the approximate percentage change in bond prices by using both the duration and the modified convexity: $\frac{\Delta P}{P} \approx -D^* \Delta y + \frac{1}{2}\text{Convexity}^* \Delta y^2$, where Convexity^* is the modified convexity in $\boxed{\text{L17}}$. Note that the "Convexity" in Equation (11.5) on Page 346 of the textbook actually refers to the modified convexity in $\boxed{\text{L17}}$.

(g) Which approximation (the approximation based on Duration alone in e or the approximation based on both Duration and Convexity in f) is better and closer to the actual percentage change in bond price in d?