Miniproject 2: Bootstrapping the U.S. Yield Curve: From Bonds to ZCBs.

FRE 6103: Valuation
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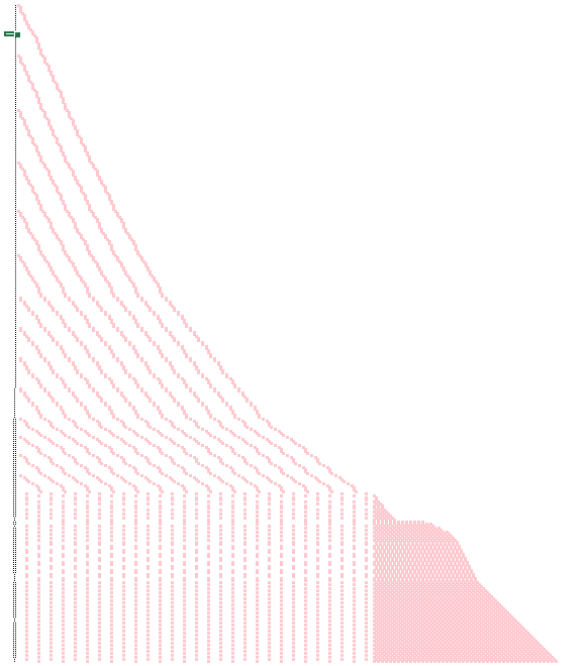
In this project, use the U.S. government bond data provided by our GA Rahul Bhagtani to build a ZCB yield curve. You should complete the project in Excel. Here are some suggestions to get you started.

1. Find a new partner for this miniproject
2. Using the data provided, compute the following items for every bond quote:

- Last coupon date
- Next coupon date
- Accrued interest (U.S. gov't Bonds use the actual/actual day convention, as you can see in the Treasury Direct screenshot below)
- Invoice price of bond (choice of bid, ask or average)
- Fitted bond value based on your model
- Time to maturity in years (t)

3. Compute all the possible dates where a coupon may be paid. Pay attention to the frequency of issues before and after 2029. Prepare a grid that shows the coupon payments with a "1" for every occurrence and 0 otherwise. If you have done it correctly, it will look something like this when shrunk if the "1's" are colored red (in each row this shows the pattern of coupon payments over time):



You have the freedom to choose any of the bootstrapping methods mentioned in class. You may get an idea from page 33 of the bonds lecture, but I warn you that that particular functional form may fail. Examine the data to determine what kind of function to use.

You should turn in your spreadsheet with the following.

- Names of both partners
- Full analysis and solution of the problem (no VBA or add-ins allowed, but you may use the Excel solver)
- A labeled graph showing a scatterplot of the fitted values vs the invoice values
- A labeled graph showing the optimized ZCB term structure

Finally, you may note that I assigned a numerical code to each possible coupon date, which made the analysis a little bit easier.

Financial Institutions

Treasury Marketable Securities

- Treasury Bills
- Treasury Notes
- Treasury Bonds
- FRNs
- TIPS
- STRIPS
- BECCS & CUBES

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Treasury Bonds

- Treasury bonds are interest-bearing securities with maturities over 10 years.
- Treasury bonds pay interest on a semi-annual basis.
- When a bond matures, the investor receives the face value.

Price vs. Yield to Maturity

The price of a fixed rate security depends on the relationship between its yield to maturity and the interest rate. If the yield to maturity (YTM) is greater than the interest rate, the price will be less than par value; if the YTM is equal to the interest rate, the price will be equal to par; if the YTM is less than the interest rate, the price will be greater than par. See an example of price vs. yield to maturity.

When purchasing a Treasury bond, any interest accrued since the last interest payment is added to the bond purchase price. At the next interest payment date the investor receives the full interest payment.

Use the following formula to figure accrued interest:

$A = P \times r (d / t)/2$	A = Accrued interest P = Face value r = interest rate of Treasury bond d = # of days since last coupon payment t = # of days in current coupon period

Example: A 5% 30-year bond ($1,000 principal) is purchased 91 days after the last coupon payment. The current coupon period contains 182 days.

A = 1000 x .05 (91/182)/2 , solving

A = $12.50