September 24th, 2012
Financial Markets and Instruments 3560
Professor Goldstein
Notes By: Omar Almajali RED NOTES AND HIGHLIGHTING By Dr. Goldstein

Financial Indicators (Source: Wall Street Journal & Yahoo Finance!):

- DJIA: 13579.47
- NASDAQ: 3179.96
- S&P: 1458.91003
- DOW: 13584
- Oil: 91.9199
- Gold: 1766.90
- EUR: 1.2929

What is on the news - WSJ:

- 'Free' Checking Costs More – Section A1
- Managers Take Timeout From Stocks – Section C1
- The Door Is Now Open to Home Builders – Section C1

Side Notes from the Professor:

a. Students need to start doing the end of chapter problems – MIDTERM COMING UP!!!!
b. Next two weeks of class will be less math-oriented (HAPPY NEWS)!
c. Go to "Entire Course" on Prof. Goldstein's website to see questions similar to the midterm. "Partial answers" next to this link is the answers to some of the questions posted.

Topic of Class continues on Duration…

- Duration is a sensitivity analysis tool that can be used to measure the changes in Bond Prices according to changes in interest rates

  - Example (1):

- New way to solve Duration quickly and with a calculator is by using the "Store" and " Recall" buttons on our calculators, as following:

  Assuming the following what is the Duration of the Bond?
- A 4 year 9% annual coupon Bond → EAR: 8%

0	1	2	3	4
	$\frac{1 \times 90}{1.08}$	$\frac{2 \times 90}{1.08^2}$	$\frac{3 \times 90}{1.08^3}$	$\frac{4 \times (90+1000)}{1.08^4}$

New Calculator method:

- N = 4
- Pmt = 90
- I % = 8
- FV = 1000
- PV = 1033.121268 → This value could then be stored into our calculators by pressing the button "STO" on the left hand side, then press any number to store it there (for eg. Number 9)… in order to retrieve this number you should then press "RCL" then number 9.

In order to use this method, it is easier to simplify the cash flows in our heads and then store them:

- CF1: $\frac{1 \times 90}{1.08}$ → $\frac{90}{1.08}$ → then store on # 1
- CF2: $\frac{2 \times 90}{1.08^2}$ → $\frac{180}{1.08^2}$ → then store on # 2
- CF3: $\frac{3 \times 90}{1.08^3}$ → $\frac{270}{1.08^3}$ → then store on # 3
- CF4: $\frac{4 \times (1000+90)}{1.08^4}$ → $\frac{4360}{1.08^4}$ → then store on # 4

- In order to then calculate the Duration we have to divide the sum all of the above cash flows over the Price of the bond, to do it in the new calculator way would be by:
- ("RCL" 1 + "RCL" 2 + "RCL" 3 + "RCL" 4) / "RCL" 5

The answer is → 3656.719184 / 1033.121268 = 3.539486890

- We previously learned that: $\Delta p = -D \times P \times \frac{\Delta r}{1+r}$ → which gives us the change in the price of the bond as a response to change in the interest rate.
- Therefore if interest rate changes from 8 % to 7 %:
- $\Delta p = -3.53948689 \times 1033.121268 \times \frac{-0.01}{1+0.08}$ = + 33.85851096
- The new bond price is then 1033.121268 + 33.85851096 = 1066.979779

- $-D \times P = total\ cashflows \times periods$ NOTE: This is just a point that this number will be the 3656.719184 number that was previously calculated.

- There is also another way for calculating Duration (which is available on Chapter 3's Presentation on Professor Goldstein's website):

$$Dur = N - \left\{ \frac{INT}{(P_o \times r)} \times \left[N - ((1+r) \times PVIFA_{r,N}) \right] \right\}$$

- $PVIFA_{r,N}$ =
- *N= 4*
- *I= 8*
- *PMT=1*
- *FV=0*
- ***PV = 3.31212684***
- Substituting our old values into this equation we will get: $4 + \{\frac{90}{1033.121268} \times [4 - (1.08 \times 3.31212684)]\}$ = 3.339923021 (off a bit from our previous calculation but still is a way to solve duration)
- This Problem is easier to be solved backwards starting from $PVIFA_{r,N}$ back to N

- The professor proved to us in class that if a person sells a bond at Duration date then they'll be immunized against losses potentially caused by change in interest rate:

33		2.5	5	50	54.19719897	47.84689	5	50	54.19719897
34		3	6	50	51.8633483	45.7865	6	50	51.8633483
35		3.5	7	50	49.62999837	43.81483	7	50	49.62999837
36		4	8	1050	997.3492496	880.4894	8	1050	997.3492496
37									
38	reinvestment		5.72	342.64	348.36	213.9096			348.36
39	bond sale		-5.65	1052.63	1046.98	1017.938			1046.98
40			0.07						
41				1395.265301	1395.33974	1231.847			1395.33974
42									
43					1395.265301	1248.622			1395.265301
44									
45					0.07	-16.77			

- Assumptions for previous spreadsheet *(Example A)*:

- Coupon Rate: 10% , Face Value: 1000 , YTM= 8%
- 348.36 and 1046.98 are the old Bonds reinvestment and Bond sales respectively before changing the interest rates
- However after raising the interest rate to 9%, the reinvestment and bond sale change to 342.43 and 1052.63 respectively. Although interest rates rose by 1%, the TOTAL AMOUNT OF MONEY YOU HAVE FROM the combination of **BOTH** the amount you invested in the bank AND the bond sale changed ONLY BY by 7 cents. That is true because the immunization trait of Duration allowed for the reinvestments to increase by an amount higher than the amount the bond sales went down.
- Even if the interest rates go up to 16% (double the original 8% so honestly, this shouldn't really work as this is WAY far off). The bond sale at Duration's period would still have higher prices than the original price. (Students can go to the spreadsheet and try different numbers to assess this fact).

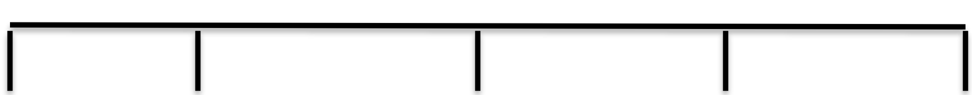
  (Example B)
- In order to further demonstrate the previous point on immunization we are going to assume our old Bond assumptions of: Coupon Rate= 10%, Face Value =1000, YTM=8% and Duration/holding period of 3.539486890
- If the bond owner sells before the duration at period "2" , then the owner would incur a loss in the sale of 146.64 as shown below in the spreadsheet screen shot:

23								
24								
25	put duration here in years						put duration here in periods	
26	2.00000000000000000				Sell at		6.831256833	
27					2			
28			cash flow	FV or PV			cash flow	FV or PV
29	0.5	1	50	56.2432	56.2432	1	50	62.84862498
30	1	2	50	54.08	54.08	2	50	60.43137017
31	1.5	3	50	52	52	3	50	58.10708671
32	2	4	50	50	50	4	50	55.87219876
33	2.5	5	50	48.07692308	48.07692	5	50	53.72326803
34	3	6	50	46.22781065	46.22781	6	50	51.65698849
35	3.5	7	50	44.44981793	44.44982	7	50	49.67018124
36	4	8	1050	897.5444006	897.5444	8	1050	1002.955583
37								
38	reinvestment	-36.01	342.64	306.63	212.3232			342.64
39	bond sale	-110.64	1052.63	941.99	1036.299			1052.63
40		-146.65						
41			1395.265301	1248.622152	1248.622			1395.265301
42								
43				1395.265301	1248.622			1395.265301
44								
45				-146.64	0.00			

Sheet1 Sheet2 Sheet3

More Exercises on Selling a Bond:

Exercise 1:

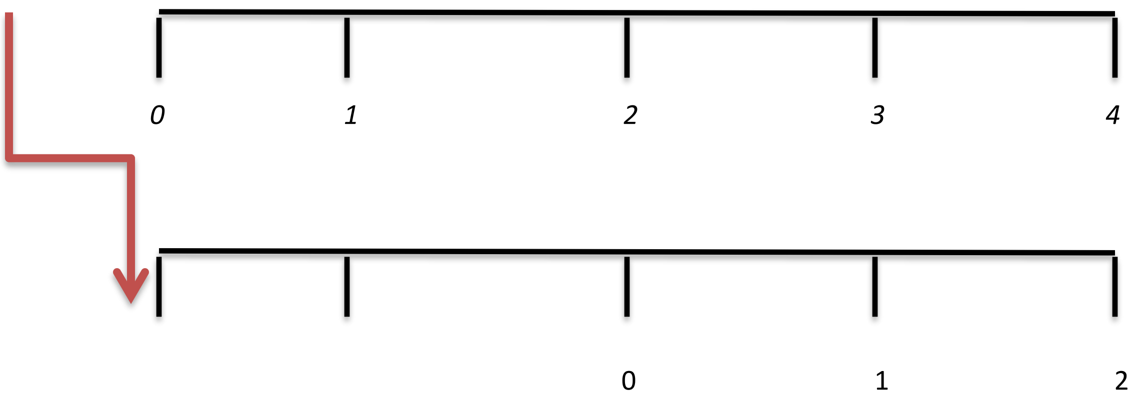


0 1 2 3 4

$\frac{90}{1.08}$ $\frac{90}{1.08^2}$ $\frac{90}{1.08^3}$ $\frac{(90+1000)}{1.08^4}$

The PV of these cash flows (as calculated earlier) is 1033.1213

What is the price of selling the bond 2 years from now? (Answer on the next page)



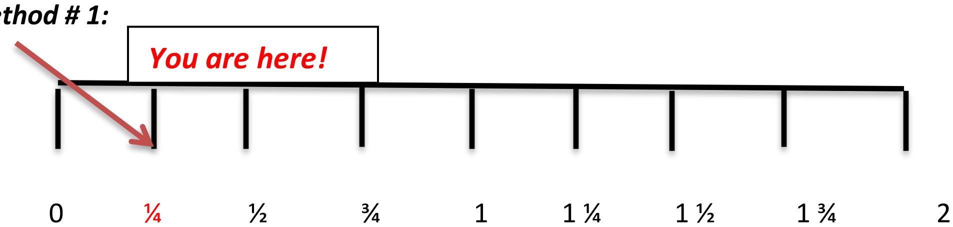
$\frac{90}{1.08}$ $\frac{1090}{1.08^2}$

- So the PV of the same bond after 2 years becomes the addition of the above cash flows = 1017.832647

Exercise 2:

Today is September 24th, 2012. On June 24, 2010 FM issues a 9% annual 4 year bond with EAR of 8%, what is the price today? NOTE: The bond was issued 2 ¼ years ago!

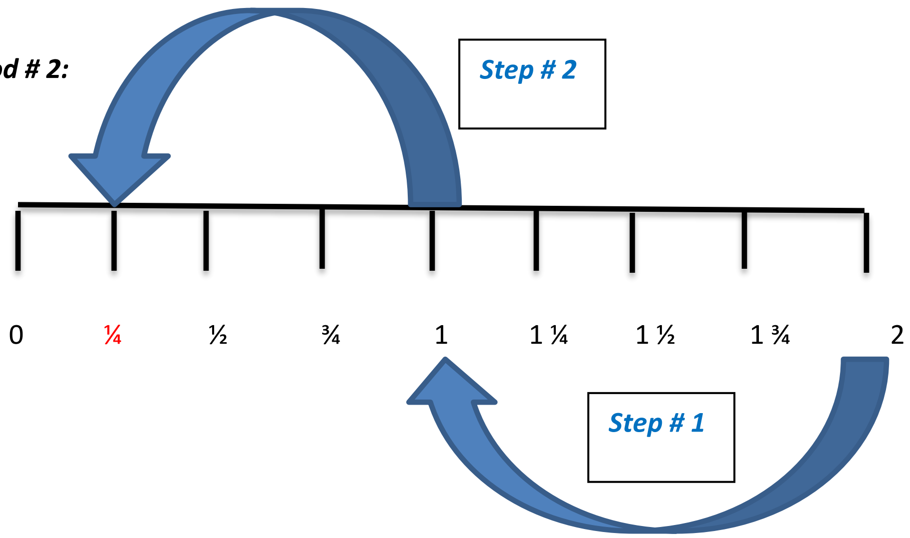
Method # 1:



So, you can value this directly, using the method we always use: Just discount each cash flow at 1+EAR raised to the number of years you are waiting for that payment:

- PV= $\frac{90}{1.08^{0.75}} + \frac{1090}{1.08^{1.75}}$ = 1037.605

Method # 2:

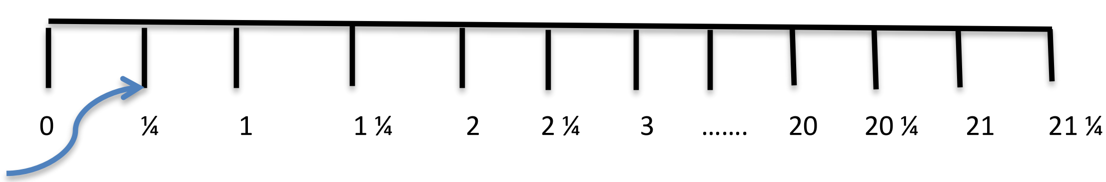


1. Pretend that today is June 2012 and therefore we are on "1" in regards of the time line.
2. We discount our "2" payment back to 1 → $\frac{1090}{1.08}$ = 1009.259 (if we sell this at 1 pm, i.e. after receiving the 3rd periods payments)
3. If, however, the time is 11 am then we have to discount the 3rds period payment + the 4ths period payment back to September as well → $\frac{1009.9259+90}{1.08^{0.75}}$ = 1037.605

NOTE: EITHER WAY, we end up with the SAME answer!

Exercise 3:

What is the price NOW of a 7% annual coupon Bond with EAR of 10% if it is going to mature 21 ¼ years from today?



1. Step 1 is to move up the first three months and exclude the payment that is received then.
2. Step 2 is discounting the bond payments for the next 21 periods as following:

- N=21
- I=10
- FV=1000
- PMT=70
- PV= 740.539

3. We add 70 to the PV we got which gives us = 810.539, then discount this value back 1/4th of a period to time 0 → $\frac{810.539}{1.1^{1/4}}$ = 791.4542 is the price now for this bond.