

Midterm Exam #1 – Solutions
Finance 325
September 28, 2010

Name: _____

Exam Instructions:

- This exam should have 6 pages (including this one) and 5 questions. The point value is given for each problem. The entire exam is worth 100 points.
- You may use a calculator and the provided formula sheet on this exam.
- You must show your work in order to receive credit for your answers. Partial credit will be given for partially correct answers.
- If a question asks “Why/Explain”, you should give an explanation that would convince a skeptic.
- You may use the back of a page if you need additional space to write an answer.

Suggestions:

- Use your time wisely. Move on to another problem if you feel like you’re stuck.
- You may ask me questions if you are unclear about a problem. I may be able to clarify the problem for you.

GOOD LUCK!!

Throughout the exam, assume that inflation is 4.8% APR, compounded monthly.

1. Explain why the yield curve is usually upward-sloping. (12 pts)

There are 3 reasons why interest rates differ depending on maturity:

- 1) **Future interest rates may be expected to be higher or lower than current interest rates**
- 2) **Longer-term interest rates subject investors to more interest rate risk. Due to this risk, long-term interest rates are higher than short-term interest rates. This is called the term premium.**
- 3) **Investors prefer to invest in shorter-term (more liquid) investments, while borrowers prefer to borrow for longer-term periods. Thus, long-term rates are higher than short-term rates to entice investors to lend for longer periods. This is called the liquidity premium.**

The term premium and liquidity premium are always present and cause the yield curve to be upward-sloping most of the time.

2. Schweitzer Engineering is considering a perpetual sponsorship deal with WSU to advertize at every home Apple Cup (in other words, every other year and lasting forever.) The deal would start this year, and would involve Schweitzer paying \$50,000 this year for the rights to paint their corporate logo on the field at Martin Stadium for the 2010 game. As part of the negotiations, the cost (per-game) will not increase in the future. Schweitzer's cost of capital is a nominal rate of 6%, compounded annually. What is the PV of this deal to Schweitzer? (8 pts)

The cash flows of this investment are:

Today (2010)	2011	2012	2013	2014	2015	2016	...
50,000		50,000		50,000		50,000	...

This is a regular perpetuity, but the period between cash flows is 2 years. Thus, we need the discount rate that accrues over a 2 – year period:

$$r = (1 + 0.06)^2 - 1 = 0.1236 = 12.36\%$$

Then, we use the perpetuity formula, adding the 50,000 from today as a separate term:

$$PV = \frac{50,000}{0.1236} + 50,000 = \$454,530.74$$

3. Why must we adjust accounting data (earnings and book values) when performing financial analysis? Explain. (10 pts)

Financial analysis depends on using market values and cash flows. Market value represents the current value of an asset, while book value represents historical cost. Earnings are backwards looking, not cash-based and can be manipulated, while cash flows represent the cash available to pay investors.

4. I want to start a college fund for my youngest son (who is 7 months old). For this problem, assume that he will start college 18 years from today. My wife and I have \$3,000 that we can invest today. We also want to make monthly contributions to his fund until he enters college... but due to other financial obligations, we will start monthly contributions 3 years from next month. We think that we can earn a nominal rate of 8% APR, compounded monthly, on his college fund investments.

We anticipate that he will attend WSU for college. Tuition today is \$8,600 per year and we expect tuition rates to increase with inflation (in other words, it will stay constant in REAL value.) We want to save enough money to fully fund 5 years of education for our son.

- a. If we make our contributions so that we invest the same NOMINAL amount each month, how much will our monthly contributions be? (12 pts)

First, let's value the 5 years of college tuition (CFs are real):

Today	1	2	...	18	19	20	21	22
				8,600	8,600	8,600	8,600	8,600

In order to value these annual CFs with the annuity formula, we need an annual real interest rate... this would be the real EAR:

$$1 + \text{real}_{EAR} = \frac{1 + \text{nominal}_{EAR}}{1 + \text{inflation}_{EAR}} = \frac{\left(1 + \frac{0.08}{12}\right)^{12}}{\left(1 + \frac{0.048}{12}\right)^{12}} = 1.03234$$

$$\text{real}_{EAR} = 0.03234$$

Now, we use the annuity formula, remembering to discount back 17 years (since the annuity formula gives us the value of the annuity CFs as of year 17):

$$PV = 8600 \left(\frac{1}{0.03234} - \frac{1}{0.03234(1.03234)^5} \right) \left(\frac{1}{(1.03234)^{17}} \right) = 22,773.74$$

This is the PV of what we need to save. Looking at the CFs of how we will save:

Years:	0	...	...	...	...	3	...	...	...	18
Months:	0	1	2	3	...	36	37	38	...	216
CFs:	3,000						CF	CF	...	CF

The PV of this stream of CFs must equal \$22,773.74. Since these CFs are nominal, we need a monthly-compounded interest rate to use in the annuity formula... which we are given in the problem. The only other thing to remember is that the annuity formula will give us the value of the annuity one period prior to the first CF... or 3 years from today. So the annuity formula must be discounted back 3 years:

$$22773.74 = 3,000 + CF \left(\frac{1}{0.08/12} - \frac{1}{0.08/12 (1 + 0.08/12)^{12 \times 15}} \right) \left(\frac{1}{(1 + 0.08/12)^{12 \times 3}} \right)$$

$$CF = 240.03$$

So... we would need to save \$240.03 per month in order to have enough saved for his college fund.

- b. If we make our contributions so that we invest the same REAL amount each month (in today's dollars), what will be the NOMINAL value of the first contribution (3 years and 1 month from today)? (12 pts)

Just like the last problem, here are the cash flows:

Years:	0	...	...	...	...	3	...	...	...	18
Months:	0	1	2	3	...	36	37	38	...	216
CFs:	3,000						CF	CF	...	CF

The PV of this stream of CFs also must equal \$22,773.74 so that the college fund can cover 5 years of college tuition. The only difference is that now the monthly CF savings are REAL CFs (not nominal). So in order to use the annuity formula, we need a monthly-compounded real interest rate. We have the real EAR (from above), so we use this to find the real APR, compounded monthly:

$$1 + \text{real}_{EAR} = \left(1 + \frac{\text{real}_{APR}}{12}\right)^{12}$$

$$1.03234 = \left(1 + \frac{\text{real}_{APR}}{12}\right)^{12}$$

$$1 + \frac{\text{real}_{APR}}{12} = (1.03234)^{\frac{1}{12}} = 1.002656$$

$$\text{real}_{APR} = 0.03187$$

$$22773.74 = 3,000 + CF \left(\frac{1}{0.03187/12} - \frac{1}{0.03187/12(1 + 0.03187/12)^{12 \times 15}} \right) \left(\frac{1}{(1 + 0.03187/12)^{12 \times 3}} \right)$$

$$CF = 152.20$$

So the real value (in today's dollars) of each contribution is \$152.20. To find the NOMINAL value of the first contribution, we just factor in 3 years and 1 month of inflation:

$$FV = 152.20 \left(1 + \frac{0.048}{12}\right)^{12 \times 3 \frac{1}{12}} = 176.43$$

The first contribution will be \$176.43.

- c. In the future, our son (who is already showing signs of great intelligence... inherited from his mother, of course) ends up graduating from WSU in only 3 years. My wife and I decide to give him the remaining sum in his college fund as a graduation present. How much would my son receive at his graduation (which would be 21 years from today)? (12 pts)

The fund must have enough to cover the following real CFs:

Today	1	2	...	21	22
				8,600	8,600

Thus, the PV of the fund (21 years from today) must be:

$$PV = \frac{8,600}{(1.03234)^{21}} + \frac{8,600}{(1.03234)^{22}} = 8,957.72$$

The future nominal value in the account then must be:

$$FV = 8957.72 \left(1 + \frac{0.08}{12}\right)^{12 \times 21} = \$47,795.93$$

5. It is now September 2010. You are looking at investing some money into bonds. A friend of yours is selling a bond... she doesn't know the specific information about the bond, but knows that it has the following cash flows:

Today	Mar 2011	Sept 2011	Mar 2012	Sept 2012
	40	40	40	840

- a. What are the coupon rate, par value and maturity of this bond? (8 pts)

Par value: \$800

Maturity: 2 years

Coupon rate: 80/800 = 10%

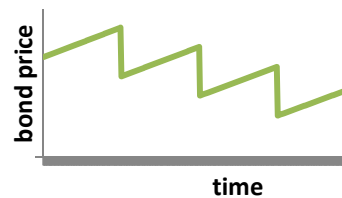
- b. Given the yield curve information below, how much would you pay to purchase this bond from your friend? Assume that the APRs are compounded *quarterly*. (10 pts)

$$PV = \frac{40}{\left(1 + \frac{0.079}{4}\right)^{4 \times 0.5}} + 40 \left(\frac{93 \frac{1}{32}}{100}\right) + 40 \left(\frac{90 \frac{8}{32}}{100}\right) + \frac{1040}{\left(1 + \frac{0.065}{4}\right)^{4 \times 2}}$$

$$PV = 850.15$$

	APR	T-strip
Dec 2010	8.1%	
Mar 2011	7.9%	
Jun 2011		94:19
Sept 2011		93:01
Dec 2011		91:19
Mar 2012		90:08
June 2012	6.7%	
Sept 2012	6.5%	

- c. Coupon bond prices follow a peculiar "saw-tooth" pattern. Below is a graph of the value of the bond above as a function of time, assuming that the YTM of the bond stays constant (in other words, to eliminate the effect of changes in discount rates.) Given what you know about finance, why do coupon bonds follow this saw-tooth pattern? Be specific. (6 pts)



The saw-tooth pattern is from the CFs and the time value of money. As a coupon is paid, the value of the bond drops by the amount of the coupon, as that coupon CF is no longer part of the future CFs of the bond. And as the bond moves closer to the next coupon payment, the value of the bond increases because of the time value of money (the bond has the same CFs but they will occur a little sooner). Thus, the bond price increases until the next coupon payment, when it falls again.