GESTÃO FINANCEIRA II

PROBLEM SET 3: Solutions

Chapters 8 and 9
Bond Valuation (Revision)
Forward Interest Rates
Stock Valuation (Revision)

(FROM BERK AND DEMARZO'S "CORPORATE FINANCE")

LICENCIATURA – UNDERGRADUATE COURSE

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Chapter 8
Valuing Bonds

8-3. The following table summarizes prices of various default-free, zero-coupon bonds (expressed as a percentage of face value):

Maturity (years)	1	2	3	4	5
Price (per $100 face value)	$95.51	$91.05	$86.38	$81.65	$76.51

a. Compute the yield to maturity for each bond.

Use the following equation.

$$1 + YTM_n = \left(\frac{FV_n}{P}\right)^{1/n}$$

$$1 + YTM_1 = \left(\frac{100}{95.51}\right)^{1/1} \Rightarrow YTM_1 = 4.70\%$$

$$1 + YTM_1 = \left(\frac{100}{91.05}\right)^{1/2} \Rightarrow YTM_1 = 4.80\%$$

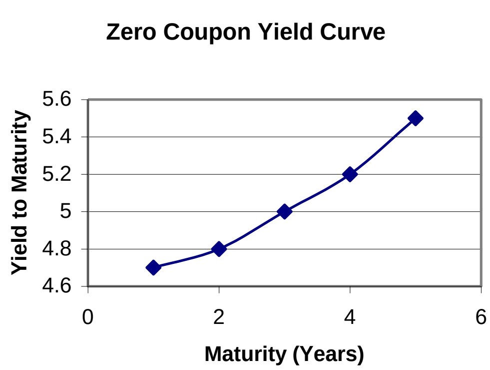
$$1 + YTM_3 = \left(\frac{100}{86.38}\right)^{1/3} \Rightarrow YTM_3 = 5.00\%$$

$$1 + YTM_4 = \left(\frac{100}{81.65}\right)^{1/4} \Rightarrow YTM_4 = 5.20\%$$

$$1 + YTM_5 = \left(\frac{100}{76.51}\right)^{1/5} \Rightarrow YTM_5 = 5.50\%$$

b. Plot the zero-coupon yield curve (for the first five years).

The yield curve is as shown below.



c. Is the yield curve upward sloping, downward sloping, or flat?

The yield curve is upward sloping.

8-23. Prices of zero-coupon, default-free securities with face values of $1000 are summarized in the following table:

Maturity (years)	1	2	3
Price (per $1000 face value)	$970.87	$938.95	$904.56

Suppose you observe that a three-year, default-free security with an annual coupon rate of 10% and a face value of $1000 has a price today of $1183.50. Is there an arbitrage opportunity? If so, show specifically how you would take advantage of this opportunity. If not, why not?

First, figure out if the price of the coupon bond is consistent with the zero coupon yields implied by the other securities.

$$970.87 = \frac{1000}{(1+YTM_1)} \quad \rightarrow \quad YTM_1 = 3.0\%$$

$$938.95 = \frac{1000}{(1+YTM_2)^2} \quad \rightarrow \quad YTM_2 = 3.2\%$$

$$904.56 = \frac{1000}{(1+YTM_3)^3} \quad \rightarrow \quad YTM_3 = 3.4\%$$

According to these zero coupon yields, the price of the coupon bond should be:

$$\frac{100}{(1+.03)} + \frac{100}{(1+.032)^2} + \frac{100+1000}{(1+.034)^3} = \$1186.00.$$

The price of the coupon bond is too low, so there is an arbitrage opportunity. To take advantage of it:

	Today	1 Year	2 Years	3 Years
Buy 10 Coupon Bonds	-11835.00	+1000	+1000	+11,000
Short Sell 1 One-Year Zero	+970.87	-1000		
Short Sell 1 Two-Year Zero	+938.95		-1000	
Short Sell 11 Three-Year Zeros	+9950.16			-11,000
Net Cash Flow	24.98	0	0	0

8-25. Suppose you are given the following information about the default-free, coupon-paying yield curve:

Maturity (years)	1	2	3	4
Coupon rate (annual payments)	0.00%	10.00%	6.00%	12.00%
YTM	2.000%	3.908%	5.840%	5.783%

a. **Use arbitrage to determine the yield to maturity of a two-year, zero-coupon bond.**

We can construct a two-year zero coupon bond using the one and two-year coupon bonds as follows.

	CashFlow in Year: 1	2	3
Two-year coupon bond ($1000 FV)	100	1,100	
One-year bond ($100 Face Value)	(100)		
Two-year zero ($1100 Face Value)	-	1,100	

Now, Price(2-year coupon bond) = $\frac{100}{1.03908}+\frac{1100}{1.03908^2}=\$1115.05$

Price(1-year bond) = $\frac{100}{1.02}=\$98.04.$

By the Law of One Price:

Price(2 year zero) = Price(2 year coupon bond) – Price(One-year bond)

= 1115.05 – 98.04 = $1017.01

Given this price per $1100 face value, the YTM for the 2-year zero is

$$YTM(2)=\left(\frac{1100}{1017.01}\right)^{1/2}-1=4.000\%.$$

b. What is the zero-coupon yield curve for years 1 through 4?

We already know YTM(1) = 2%, YTM(2) = 4%. We can construct a 3-year zero as follows:

	Cash Flow in Year:		
	1	2	3
Three-year coupon bond ($1000 face value)	60	60	1,060
one-year zero ($60 face value)	(60)		
two-year zero ($60 face value)	-	(60)	
Three -year zero ($1060 face value)	-	-	1,060

Now, Price(3-year coupon bond) = $\frac{60}{1.0584}+\frac{60}{1.0584^2}+\frac{1060}{1.0584^3}=\$1004.29.$

By the Law of One Price:

Price(3-year zero) = Price(3-year coupon bond) – Price(One-year zero) – Price(Two-year zero)

= Price(3-year coupon bond) – PV(coupons in years 1 and 2)

= 1004.29 – 60 / 1.02 – 60 / 1.04^2 = $889.99.

Solving for the YTM:

$$YTM(3)=\left(\frac{1060}{889.99}\right)^{1/3}-1=6.000\%.$$

Finally, we can do the same for the 4-year zero:

	Cash Flow in Year:			
	1	2	3	4
Four-year coupon bond ($1000 face value)	120	120	120	1,120
one-year zero ($120 face value)	(120)			
two-year zero ($120 face value)	—	(120)		
three-year zero ($120 face value)	—	—	(120)	
Four-year zero ($1120 face value)	—	—	—	1,120

Now, Price(4-year coupon bond) = $\frac{120}{1.05783}+\frac{120}{1.05783^2}+\frac{120}{1.05783^3}+\frac{1120}{1.05783^4}=\$1216.50.$

By the Law of One Price:

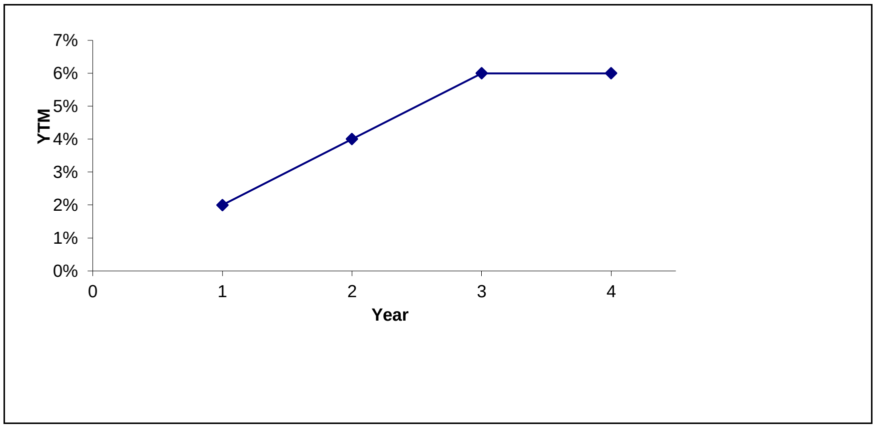
Price(4-year zero) = Price(4-year coupon bond) – PV(coupons in years 1–3)

= 1216.50 – 120 / 1.02 – 120 / 1.04^2 – 120 / 1.06^3 = \$887.15.

Solving for the YTM:

$$YTM(4)=\left(\frac{1120}{887.15}\right)^{1/4}-1=6.000\%.$$

Thus, we have computed the zero coupon yield curve as shown.



8-30. HMK Enterprises would like to raise \$10 million to invest in capital expenditures. The company plans to issue five-year bonds with a face value of \$1000 and a coupon rate of 6.5% (annual payments). The following table summarizes the yield to maturity for five-year (annualpay) coupon corporate bonds of various ratings:

Rating	AAA	AA	A	BBB	BB
YTM	6.20%	6.30%	6.50%	6.90%	7.50%

a. Assuming the bonds will be rated AA, what will the price of the bonds be?

The price will be

$$P=\frac{65}{(1+.063)}+\ldots+\frac{65+1000}{(1+.063)^5}=\$1008.36.$$

b. How much total principal amount of these bonds must HMK issue to raise \$10 million today, assuming the bonds are AA rated? (Because HMK cannot issue a fraction of a bond, assume that all fractions are rounded to the nearest whole number.)

Each bond will raise \$1008.36, so the firm must issue: $\frac{\$10,000,000}{\$1008.36}=9917.13\Rightarrow 9918$ bonds.

This will correspond to a principal amount of $9918\times\$1000=\$9,918,000.$

c. **What must the rating of the bonds be for them to sell at par?**

For the bonds to sell at par, the coupon must equal the yield. Since the coupon is 6.5%, the yield must also be 6.5%, or A-rated.

d. **Suppose that when the bonds are issued, the price of each bond is $959.54. What is the likely rating of the bonds? Are they junk bonds?**

First, compute the yield on these bonds:

$$959.54 = \frac{65}{(1+YTM)} + \ldots + \frac{65+1000}{(1+YTM)^5} \Rightarrow YTM = 7.5\%.$$

Given a yield of 7.5%, it is likely these bonds are BB rated. Yes, BB-rated bonds are junk bonds.

Chapter 8 - Appendix
Forward Interest Rates

Problems A.1–A.4 refer to the following table:

Maturity (years)	1	2	3	4	5
Zero-coupon YTM	4.0%	5.5%	5.5%	5.0%	4.5%

A.1. What is the forward rate for year 2 (the forward rate quoted today for an investment that begins in one year and matures in two years)?

$$f_2 = \frac{(1+YTM_2)^2}{(1+YTM_1)} - 1 = \frac{1.055^2}{1.04} - 1 = 7.02\%$$

A.2. What is the forward rate for year 3 (the forward rate quoted today for an investment that begins in two years and matures in three years)? What can you conclude about forward rates when the yield curve is flat?

$$f_3 = \frac{(1+YTM_3)^3}{(1+YTM_2)^2} - 1 = \frac{1.055^3}{1.055^2} - 1 = 5.50\%$$

When the yield curve is flat (spot rates are equal), the forward rate is equal to the spot rate.

A.3. What is the forward rate for year 5 (the forward rate quoted today for an investment that begins in four years and matures in five years)?

$$f_5 = \frac{(1+YTM_5)^5}{(1+YTM_4)^4} - 1 = \frac{1.045^5}{1.050^4} - 1 = 2.52\%$$

When the yield curve is flat (spot rates are equal), the forward rate is equal to the spot rate.

A.4. Suppose you wanted to lock in an interest rate for an investment that begins in one year and matures in five years. What rate would you obtain if there are no arbitrage opportunities?

Call this rate $f_{1,5}$. If we invest for one-year at YTM1, and then for the 4 years from year 1 to 5 at rate $f_{1,5}$, after five years we would earn

$$(1+YTM_1)(1+f_{1,5})^4$$

with no risk. No arbitrage means this must equal that amount we would earn investing at the current five year spot rate:

$(1 + YTM_1)(1 + f_{1,5})^4 = (1 + YTM_5)^5$.

Therefore, $$(1+f_{1,5})^4 = \frac{(1+YTM_5)^5}{1+YTM_1} = \frac{1.045^5}{1.04} = 1.19825$$

and so: $f_{1,5} = 1.19825^{1/4} - 1 = 4.625\%$.

A.5. Suppose the yield on a one-year, zero-coupon bond is 5%. The forward rate for year 2 is 4%, and the forward rate for year 3 is 3%. What is the yield to maturity of a zero-coupon bond that matures in three years?

We can invest for three years with risk by investing for one year at 5%, and then locking in a rate of 4% for the second year and 3% for the third year. The return from this strategy must equal the return from investing in a 3-year, zero-coupon bond:

$(1 + YTM_3)^3 = (1.05)(1.04)(1.03) = 1.12476$

Therefore: $YTM_3 = 1.12476^{1/3} - 1 = 3.997\%$.

Chapter 9
Valuing Stocks

9-1. Assume Evco, Inc. has a current price of $50 and will pay a $2 dividend in one year, and its equity cost of capital is 15%. What price must you expect it to sell for right after paying the dividend in one year in order to justify its current price?

We can solve for the price of the stock in one year given the current price of $50.00, the $2 dividend, and the 15% cost of capital.

$$50 = \frac{2+X}{1.15}$$

$$X = 55.50$$

At a current price of $50, we can expect Evco stock to sell for $55.50 immediately after the firm pays the dividend in one year.

9-2. Anle Corporation has a current price of $20, is expected to pay a dividend of $1 in one year, and its expected price right after paying that dividend is $22.

a. **What is Anle's expected dividend yield?**

Div yld = 1/20 = 5%

b. **What is Anle's expected capital gain rate?**

Cap gain rate = (22-20)/20 = 10%

c. **What is Anle's equity cost of capital?**

Equity cost of capital = 5% + 10% = 15%

9-6. Summit Systems will pay a dividend of $1.50 this year. If you expect Summit's dividend to grow by 6% per year, what is its price per share if its equity cost of capital is 11%?

P = 1.50 / (11% – 6%) = $30

9-12. Colgate-Palmolive Company has just paid an annual dividend of $0.96. Analysts are predicting an 11% per year growth rate in earnings over the next five years. After then, Colgate's earnings are expected to grow at the current industry average of 5.2% per year. If Colgate's equity cost of capital is 8.5% per year and its dividend payout ratio remains constant, what price does the dividend-discount model predict Colgate stock should sell for?

PV of the first 5 dividends:

$$PV_{first\ 5} = \frac{0.96\ 1.11}{0.085-0.11}\left(1-\left(\frac{1.11}{1.085}\right)^{5}\right) = 5.14217.$$

PV of the remaining dividends in year 5:

$$PV_{\text{remaining in year 5}} = \frac{0.96\ 1.11^{5}\ 1.052}{0.085-0.052} = 51.5689.$$

Discounting back to the present

$$PV_{remaining} = \frac{51.5689}{1.085^{5}} = 34.2957.$$

Thus the price of Colgate is

$$P = PV_{first\ 5} + PV_{remaining} = 39.4378.$$

9-15. Suppose Cisco Systems pays no dividends but spent $5 billion on share repurchases last year. If Cisco's equity cost of capital is 12%, and if the amount spent on repurchases is expected to grow by 8% per year, estimate Cisco's market capitalization. If Cisco has 6 billion shares outstanding, what stock price does this correspond to?

Total payout next year = 5 billion × 1.08 = $5.4 billion
Equity Value = 5.4 / (12% – 8%) = $135 billion
Share price = 135 / 6 = $22.50

9-22. You notice that PepsiCo has a stock price of $52.66 and EPS of $3.20. Its competitor, the Coca-Cola Company, has EPS of $2.49. Estimate the value of a share of Coca-Cola stock using only this data.

PepsiCo P/E = 52.66/3.20 = 16.46x. Apply to Coca-Cola: $2.49 ×16.46 = $40.98.

9-24. Suppose that in January 2006, Kenneth Cole Productions had sales of $518 million, EBITDA of $55.6 million, excess cash of $100 million, $3 million of debt, and 21 million shares outstanding.

TABLE 9.1: Stock Prices and Multiples for the Footwear Industry, January 2006

Ticker	Name	Stock Price ($)	Market Capitalization ($ millions)	Enterprise Value ($ millions)	P/E	Price/ Book	Enterprise Value/ Sales	Enterprise Value/ EBITDA
KCP	Kenneth Cole Productions	26.75	562	465	16.21	2.22	0.90	8.36
NKE	NIKE, Inc.	84.20	21,830	20,518	16.64	3.59	1.43	8.75
PMMAY	Puma AG	312.05	5,088	4,593	14.99	5.02	2.19	9.02
RBK	Reebok International	58.72	3,514	3,451	14.91	2.41	0.90	8.58
WWW	Wolverine World Wide	22.10	1,257	1,253	17.42	2.71	1.20	9.53
BWS	Brown Shoe Company	43.36	800	1,019	22.62	1.91	0.47	9.09
SKX	Skechers U.S.A.	17.09	683	614	17.63	2.02	0.62	6.88
SRR	Stride Rite Corp.	13.70	497	524	20.72	1.87	0.89	9.28
DECK	Deckers Outdoor Corp.	30.05	373	367	13.32	2.29	1.48	7.44
WEYS	Weyco Group	19.90	230	226	11.97	1.75	1.06	6.66
RCKY	Rocky Shoes & Boots	19.96	106	232	8.66	1.12	0.92	7.55
DFZ	R.G. Barry Corp.	6.83	68	92	9.20	8.11	0.87	10.75
BOOT	LaCrosse Footwear	10.40	62	75	12.09	1.28	0.76	8.30
			Average (excl. KCP)		**15.01**	**2.84**	**1.06**	**8.49**
				Maximum	+51%	+186%	+106%	+27%
				Minimum	–42%	–61%	–56%	–22%

a. Using the average enterprise value to sales multiple in Table 9.1, estimate KCP's share price.

Estimated enterprise value for KCP = Average EV/Sales × KCP Sales = 1.06 × $518 million = $549 million. Equity Value = EV – Debt + Cash = $549 – 3 + 100 = $646 million. Share price = Equity Value / Shares = $646/ 21 = $30.77

b. What range of share prices do you estimate based on the highest and lowest enterprise value to sales multiples in Table 9.1?

$16.21 – $58.64

c. Using the average enterprise value to EBITDA multiple in Table 9.1, estimate KCP's share price.

Est. enterprise value for KCP = Average EV/EBITDA × KCP EBITDA = 8.49 × $55.6 million = $472 million. Share Price = ($472 – 3 + 100)/21 = $27.10

d. What range of share prices do you estimate based on the highest and lowest enterprise value to EBITDA multiples in Table 9.1?

$22.25 – $33.08