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FE 620 Homework 1

I pledge my honor that I have abide by the Stevens Honor System

1. Problem 1.1

a.

1.1

Spot price: $5,050

Forward price: $5,200

$r = 3.5\%$

$F^* = 5050e^{.035} = \$5{,}229.88$

$F_0 = \$5{,}200$

$F^* > F_0$

$\text{Profit} = F^* - F_0 = \$29.88$

Spot price: $5,050

Forward price: $5,300

$r = 3.5\%$

$F^* = 5050e^{.035} = \$5{,}229.88$

$F_0 = \$5{,}300$

$F^* < F_0$

b. Yes, there is an arbitrage opportunity when the forward price is $5200. Since the market forward is too low, we can do a reverse cash and carry. At time 0, we have to short-sell gold at $5050 and invest the cash received from it at the risk free rate of 3.5% for 1 year. Enter the long term forward contract at $5200. At 1 year, the investment has grown to $5229.88 and we use $5200 to buy 1 oz of gold with the forward contract. Return the gold received from the forward contract. The expected profit from this is $5229.88-$5200=$29.88.

c. No, there is no arbitrage opportunity when the forward price is \$5300. The no-arbitrage forward price is \$5229.88, which is less than \$5300. Therefore, no arbitrage opportunity exists.

2. Problem 1.2

a.

1.2

3.25% w/ Semi-annual compounding

$R_2 = 0.0325$

$G = \left(1 + \frac{R_2}{2}\right)^2 = \left(1 + \frac{.0325}{2}\right)^2 = 1.0328$

Annual: $1 + R_1 = G \rightarrow 1 + R_1 = 1.0328 \quad R_1 = 0.0328$

Quarterly: $\left(1 + \frac{R_4}{4}\right)^4 = G \rightarrow G^{\frac{1}{4}} = 1 + \frac{R_4}{4} \rightarrow R_4 = 4(G^{\frac{1}{4}} - 1) = 0.0324$

Continuous: $e^{R_c} = G \quad R_c = \ln(G) = 0.0323$

b. Annual compounding: 3.28%

c. Quarterly compounding: 3.24%

d. Continuous compounding: 3.23%

3. Problem 1.3

1.3

Excellent credit: 17.15%

daily for 365 days a year

balance : \$10,000

Total balance after 30 days

Daily rate = $\frac{0.1715}{365} = 0.00047$

Balance after 30 days = $10{,}000(1 + \text{Daily Rate})^{30}$

$= 10{,}141.92$

$\boxed{\$10{,}141.92}$

a.

b. If a customer with excellent credit has a balance of \$10,000 on his credit card, the total balance including interest after 30 days would be \$10,141.92.

4. Problem 1.4

a.

				Coupon	5.00%
	Zero rates				
	Maturity	R(T)			
	1Y	3.00%			
	2Y	3.50%			
	5Y	4.25%			
	10Y	4.50%			
	Coupon index				
	n	Time	Zero Rate R(T)	DiscFactor(T)	Cash Flows
	0	0	3.00%	1	
	1	0.5	3.00%	0.98511194	2.5
	2	1	3.00%	0.97044553	2.5
	3	1.5	3.50%	0.94885432	2.5
	4	2	3.50%	0.93239382	102.5
				Bond price	102.831

b. The price of Bond B1 would be $102.83

c.

Pricing a 10-year bond				
			Coupon	6.00%
Zero rates				
Maturity	R(T)			
1Y	3.00%			
2Y	3.50%			
5Y	4.25%			
10Y	4.50%			
Coupon index				
n	Time	Zero Rate R(T)	DiscFactor(T)	Cash Flows
0	0	3.00%	1	
1	0.5	3.00%	0.98511194	3
2	1	3.00%	0.97044553	3
3	1.5	3.50%	0.94885432	3
4	2	3.50%	0.93239382	3
5	2.5	4.25%	0.89919982	3
6	3	4.25%	0.88029342	3
7	3.5	4.25%	0.86178453	3
8	4	4.25%	0.84366482	3
9	4.5	4.25%	0.82592608	3
10	5	4.25%	0.80856032	3
11	5.5	4.50%	0.78075022	3
12	6	4.50%	0.76337949	3
13	6.5	4.50%	0.74639525	3
14	7	4.50%	0.72978887	3
15	7.5	4.50%	0.71355197	3
16	8	4.50%	0.69767633	3
17	8.5	4.50%	0.68215389	3
18	9	4.50%	0.66697681	3
19	9.5	4.50%	0.6521374	3
20	10	4.50%	0.63762815	103
			Bond price	111.843

d. The price of Bond B2 would be $111.84.

1.4 YTM = (Annual coupon + (FV - Current price) ÷ maturity) ÷ ((FV + current price) ÷ 2)

a) $(5 + (100 - 102.831) \div 2) \div ((100 + 102.831) \div 2) = 0.03534$

$y = 3.534\%$

b) $(6 + (100 - 111.843) \div 10) \div ((100 + 111.843) \div 2)$

$y = 4.546\%$

e.

f. I computed the yield to maturities using the formula written above and got 3.534% for B1 and 4.546% for B2.

5. Problem 1.5

a.

Problem 1.5

Payment due in 6 months: €1,000,000

Forward contract 1.0m euros, maturity 6 months, rate = 1.150

Current rate $X_0 = 1.100$

rate at maturity $X(6M) = 1.175$

Without hedge: €1,000,000 at 1.175, 1,175,000 USD

With hedge: €1,000,000 at 1.150, 1,150,000 USD

Gain of $25,000

$$\text{forward rate} = \text{current rate}\; e^{(r_{USD} - r_{eur})T}$$

$$1.15 = 1.1\, e^{(r_{USD} - r_{eur})T}$$

$$r_{USD} - r_{eur} = \frac{1}{0.5} \ln\left(\frac{1.15}{1.1}\right)$$

$$r_{USD} - r_{eur} = 2\ln(1.0\overline{45})$$

$$r_{USD} - r_{eur} = .0889$$

$$8.89\%$$

b. There is a gain of $25,000 at maturity.

c. The interest rate differential is 8.89%.