Birla Institute of Technology and Science, Pilani

MID SEMESTER EXAMINATION, II SEMESTER 2016-17 PART ~~A~~ (Closed Book)

Course Number : ECON F354/ FIN F311
Course Title: Derivatives and Risk Management

Maximum Marks /Weight: 40 / 20%
Time: 60 minutes

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Use annual compounding only

1. If the current or spot market gold price is $ 400 per ounce, the forward market price with one year delivery is $450 per ounce and the one-year interest rate In US dollar is 4 percent, is there any possibility of arbitrage profit? Will the answer be different if forward market price $ 400 per ounce? If there exist an arbitrage opportunity, how will you exploit? Give all the calculations to justify your answer. (12 Marks)

We can buy the stock at ~~market~~ spot price of $400 per ounce, and then take a short position in a ~~future~~ forward with market ~~rate~~ value = $450 per ounce.

To buy we ~~borrow~~ borrow at the market at 4% interest.

So at t = 1 the cost of buying at t = 0 is = 400 × (1.04)
= $416 per ounce.

So there exists an arbitrage profit = $(450 − 416) per ounce
= $34 per ounce.

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If the forward market price = $400 per ounce there will be no arbitrage opportunity as $400 at t = 0 ≠ $400 at t = 1.

$400 at t = 0 = $416 at t = 1 which is > than $400 so we will incur loss.

A stock currently trades at a price of $100. The stock price can go 10% or go down 15%, The risk free interest rate is 6.5%, Use a one-period binomial model to calculate the price of a call option with an exercise price of $90. (12 Marks)

$t=0$ $t=1$

$100 \xrightarrow{p} 110$

$100 \xrightarrow{(1-p)} 85$

at $t=1$ Expected value of stock $= 100 \times (1.065) = 106.5$

$= 110 \times p + 85(1-p)$

$\Rightarrow 106.5 = 25p + 85$

$\Rightarrow p = \cancel{0.86}\ \frac{21.5}{25} = 0.86$

So the model is,

$t=0$ $t=1$

$100 \xrightarrow{0.86} 110$

$100 \xrightarrow{0.14} 85$

$t=0$ $t=1$

$C_{k=90}$ $100 \xrightarrow{0.86} 110$ IV → 20 $(110 - 90)$ TV → 0.

$100 \xrightarrow{0.14}$ IV → 0   TV → 0

At $t=1$ Time value = 0 and Intrinsic value = 20. $(S-K)$

for option payment

Lower as $K > S$ payment will not be exercised so it's value = 0.

stock price, strike price $(S-K)$

$E[t=1]$ of option $= 0.86 \times 20 = \$17.2$

to find the Present value we discount at rate of 6.5%.

So the price of call option $= \frac{17.2}{(1.065)} = \$16.15$ (Ans)

12

0.5
10.24

...e bond prices of zero coupon bonds are given as follows:

a. B(0,1) 94.34
b. B(0,2) 87.34
c. B(0,3) 79.38

Calculate the forward rates for the period of 1X2 and 2X3. If a person holds one bond of B(0,1) , two bonds of B(0,2) and three bonds B(0,3), what will be the portfolio duration? Give all the calculations. (16 Marks)

$B(0,1) = \frac{100}{(1+y_1)} = 94.34 \Rightarrow y_1 = 5.98\% \approx 6\%$

$B(0,2) = \frac{100}{(1+y_2)^2} = 87.34 \Rightarrow y_2 = 7\%$

$B(0,3) = \frac{100}{(1+y_3)^3} = 79.38 \Rightarrow y_3 = 8\%$

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Now for $f_{1\times2}$

$\cancel{100} \times (1+y_1)(1+f_{1\times2}) = \cancel{100}(1+y_2)^2$

$\Rightarrow (1.06)(1+f_{1\times2}) = (1.07)^2$

$\Rightarrow 1+f_{1\times2} = 1.08$

$\Rightarrow f_{1\times2} = 8\%$ (Ans)

Now for $f_{2\times3}$

$\cancel{100} \times (1+y_1)(1+f_{12})(1+f_{2\times3}) = \cancel{100} \times (1+y_3)^3$

$\Rightarrow 1+f_{2\times3} = \frac{(1.08)^{3}}{(1.08)\times(1.08)}$

$\Rightarrow 1+f_{2\times3} = 1.10$

$\Rightarrow f_{2\times3} = 10\%$ (Ans)

Term structure

Period	Zero Rates	~~Forward Rates~~ Period	Forward rates
0-1	6%	0-1	6%
0-2	7%	1-2	8%
0-3	8%	2-3	10%

Duration calculation

Price of Portfolio $= 1\times B(0,1) + 2\times B(0,2) + 3\times B(0,3)$
$= 94.34 + 2\times 87.34 + 3\times 79.38$
$= 507.16$

Weightage of $B_1 = \frac{94.34}{507.16} = 0.186$