



INV3703 (489339)
MNK301S (463952)

May/June 2010

INVESTMENTS: DERIVATIVES

Duration 2 Hours

40 Marks

EXAMINERS .
FIRST
SECOND
EXTERNAL

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Use of a non-programmable pocket calculator is permissible

This paper consists of 23 pages, including the standard normal distribution table (p 13), formula sheet (pp14-16), seven sheets of paper for rough work (pp 17-23) and the instructions for completing a mark-reading sheet. Please answer all 40 questions on the mark-reading sheet

Indicate your student number and the correct unique number on the mark-reading sheet

Unique number: **INV3703 – 489339**
MNK301S – 463952 (supplementary students)

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NOTE: PLEASE COMPLETE THE ATTENDANCE REGISTER ON THE BACK PAGE, TEAR IT OFF AND HAND IT TO THE INVIGILATOR.

- 1 An individual, who enters into a forward contract to sell the ALSI index, will face the risk that _____
- 1 the market will fall
 - 2 the market will rise
 - 3 the market volatility will fall
 - 4 the market volatility will rise
- 2 Which of the following are classified as a contingent claim or a forward commitment?
- | <i>Contingent claim</i> | <i>Forward commitment</i> |
|-------------------------|---------------------------|
| 1 swaps | futures |
| 2 forwards | options |
| 3. futures | swaps |
| 4 options | swaps |
- 3 Calculate the price of a T-Bill with a face value of \$15,000, 175 days to maturity, and a discount yield of 1.67%
1. \$13,782.29
 - 2 \$14,484.69
 - 3 \$14,878.23
 - 4 \$15,000.00
- 4 What will happen to the discount yield if the price of the T-Bill is R14,500?
- 1 It will increase.
 2. It will decrease.
 - 3 It will remain unchanged
- 5 Jane Mollentze is a corporate treasurer who wishes to hedge against interest rate risk. She enters into a 6 X 12 FRA to hedge against an increase in future borrowing cost because of an increase in the short-term interest rate.

The current term structure of LIBOR is as follows:

Term	Interest rate
30 days	7.50%
90 days	7.65%
180 days	7.90%
360 days	8.05%

What rate will Jane receive on the 6 X 12 FRA?

- 1 7.89%
- 2 8.00%
- 3 15.36%

6 Identify the correct statement from the following alternatives

1. The value of a currency forward contract is the present value of the forward rate at expiration minus the spot rate discounted at the foreign interest rate over the life of the contract
2. Credit risk arises when the counterparty that owes the greater amount is unable to pay at expiration or declares bankruptcy prior to expiration
3. An off-market forward contract is established with a zero value and therefore has no payments at the start of the contract

7 A security is priced at \$2,500 today. The forward contract on this security is currently priced at \$2,775 and expires in two years. The annual interest rate is 7.50%.

Calculate the value of the off-market forward contract today?

1. -\$275.00
2. -\$81.40
3. \$98.70
4. \$611.67

8 The following information is available for a security

- Current price = R250
- Risk-free rate = 5.2%

A dealer offers you a forward contract for delivery in six months on the security at a price of R243. How would you earn an arbitrage profit?

1. Sell the forward contract, borrow money and buy the stock
2. Buy the forward contract, borrow money and buy the stock
3. Buy the forward contract, sell the stock and invest the proceeds
4. Sell the forward contract, sell the stock and invest the proceeds

Use the following information to answer questions 9 and 10 (Round to four decimals)

Blade Nkosi, an analyst at Jeppe Ltd, gathered the following information on the risk-free rates in the United States (domestic) and Australia (foreign)

	United States	Australia
Risk-free rates	7.20%	4.90%

The spot exchange rate between the United States and Australia is \$0.725

9. Calculate the continuous compounded risk-free rate for both the United States (US) and Australia (AUS)

	US	AUS
1.	6.95%	4.78%
2.	7.20%	4.90%
3.	6.95%	4.90%
4.	7.47%	5.02%

10. Calculate the price of the forward contract that expires in 120 days

1. \$0.7302
2. \$0.7305
3. \$0.7308

11. Calculate the price of a 200-day forward contract on an 8% US Treasury bond with a spot price of \$1,310. The bond has just paid a coupon and will make another coupon payment in 180 days. The annual risk-free rate is 5%

1. \$1,300.79
2. \$1,305.39
3. \$1,345.49

12. An 8-year \$1,000 par Treasury bond pays a 7% semi-annual coupon. The bond has a conversion factor of 1.025. The risk-free rate is 6% and the annual yield on the bond is 7%. The bond has just made a coupon payment. The price of a 15-month futures contract is closest to _____

1. \$979.00
2. \$983.32
3. \$1,049.32

13. Mathew Evans, a speculator, has purchased a March Eurodollar futures contract at a price of 91.64. Determine the annualised LIBOR rate priced into this contract and indicate what would happen to the futures price if the interest rate were to increase to 8.20% a month later

1. an 8.20% increase
2. an 8.20% decrease
3. an 8.36% decrease
4. an 8.36% increase

- 14 Indicate the correct statement from the following alternatives.
- 1 Eurodollar futures can be priced as easily as *Treasury bill futures*
 2. A condition in which the futures price is higher than the spot price is known as backwardation.
 - 3 The opportunity cost of funds tied up in the investment of the underlying asset affects the futures prices.
- 15 A gold futures contract requires the long trader to buy 100 troy ounces of gold. The initial margin requirement is \$3,550, and the maintenance margin requirement is %1,500. When could a long contract holder (June futures price \$425) and a short contract holder (August futures price \$397) receive a maintenance margin call respectively?
- 1 Price falls below \$404.50 Price falls below \$376.50
 2. Price falls below \$404.50 Price rises above \$417.50
 3. Price rises above \$445.50 Price falls below \$376.50
 4. Price rises above \$445.50 Price rises above \$417.50

Use the following information to answer questions 16 and 17

Catherine Tate is a trader for a large commodity company. She has been asked to look into the possibility of investing in gold futures. Catherine has gathered the following information. The current price of gold is \$1,139 and the risk-free interest rate is 7%. Assume the net cost of carry for gold is zero

- 16 Calculate the price of the gold futures contract that expires in 180 days?
- 1 \$1,158.16
 - 2 \$1,177.64
 - 3 \$1,218.73
17. If the futures contract were priced at \$1,185, what arbitrage transaction could be executed?
- 1 Take a long futures position and sell short the gold.
 - 2 Take a long futures position and buy the gold
 - 3 Take a short futures position and buy the gold
 - 4 Take a short futures position and sell short the gold
- 18 Calculate the payoff at expiration of a call and a put option on a bond in which the underlying is at \$1.25 per \$1 par at expiration, the contract is on \$100,000 face value bonds and the exercise price for the call and put option is \$1.17 and \$1.15 respectively
- 1 0 0.1
 2. 0.08 0
 3. 8,000 -10,000
 4. 8,000 0

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- 19 Consider a stock index option that expires in 75 days. The stock index is currently at 1240.89 and makes no cash payments during the life of the option. Assume that the stock index has a multiplier of 1. The risk-free rate is 3%. Calculate the lowest and highest possible prices for European-style put options on the above stock index with an exercise price of 1250.

1. 1222.55 1.51
2. 1242.43 1.54
3. 1252.37 1.51
4. 1247.43 1.54

Questions 20 and 21 Consider a two-period binomial model in which a stock currently trades at a price of \$65. The stock price can go up 22% or down 18% each period. The risk-free rate is 5% per period.

- 20 Calculate the price of a European put option expiring in two periods with an exercise price of \$70.

1. \$5.00
2. \$6.51
3. \$6.83
4. \$7.18

- 21 Calculate the price of a European call option expiring in two periods with an exercise price of \$60.

1. \$5.00
2. \$11.10
3. \$13.25
4. \$14.61

Questions 22 and 23 Jenna Adams, an analyst, provides you with the following information on put and call options on a stock.

Call price	\$7.75
Put price	\$2.25
Exercise price	\$34
Days to option expiration	214
Current stock price	\$36.22
Risk-free rate	4%

- 22 Calculate the current value of the fiduciary call.

1. \$33.23
2. \$35.48
3. \$38.73
4. \$40.98

23. Calculate the current value of the protective put
- 1 \$33 23
 - 2 \$35 48
 3. \$38 73
 - 4 \$40.98
- 24 An increase in the volatility of option prices will _____
1. increase call and put prices
 - 2 decrease call and put prices
 - 3 decrease put prices and increase call prices
 - 4 increase put prices and decrease call prices
- 25 Consider a two-period binomial model in which the stock currently trades at \$70 The stock price can go up 15% or down 15% each period. The risk-free rate is 5%. A put option on this stock expiring in two periods has an exercise price of \$75 Calculate the number of units of the underlying stock that would be needed at time 0 in the binomial tree in order to construct a risk-free hedge Use 10,000 puts
1. long position in 3,931 shares of the underlying stock
 2. short position in 3,931 shares of the underlying stock
 - 3 long position in 4,125 shares of the underlying stock
 4. short position in 4,125 shares of the underlying stock
26. Consider the following information on put and call options on a stock and identify the possible arbitrage transaction using a synthetic call
- | | |
|----------------------------|---------|
| Call price, c_0 | \$4 50 |
| Put price, p_0 | \$6 80 |
| Exercise price, X | \$70 |
| Days to expiration | 139 |
| Current stock price, S_0 | \$66 32 |
| Risk-free rate, r | 5% |
- 1 buy call; buy put; buy stock, issue bond
 2. sell call, buy put; buy stock, issue bond
 3. buy call, sell put, sell stock, buy bond
 4. sell call, buy put, buy stock; buy bond

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Questions 27 and 28: Consider an asset that trades at \$100 today. Call and put options on this asset are available at an exercise price of \$100. The options expire in 275 days, and the volatility is 0.45. The continuously compounded risk-free rate is 3%.

27 Calculate the $N(d_1)$ and $N(d_2)$ using the Black-Scholes-Merton model.

- | | | |
|----|--------|--------|
| 1. | 0.5871 | 0.4325 |
| 2. | 0.5987 | 0.4443 |
| 3. | 0.5871 | 0.5675 |
| 4. | 0.5987 | 0.5557 |

28 Calculate the values of European call and put options using the Black-Scholes-Merton model.

- | | | |
|----|---------|---------|
| 1. | \$0 | \$14.20 |
| 2. | \$5.54 | \$0 |
| 3. | \$5.54 | \$16.43 |
| 4. | \$16.43 | \$14.20 |

Questions 29 and 30: A forward contract is priced at 144. European options on the forward contract have an exercise price of 151 and expire in 70 days. The continuously compounded risk-free rate is 3.77%, and volatility is 0.33.

29 Calculate d_1 and d_2 , using the Black model.

- | | | |
|----|-------|-------|
| 1. | -0.26 | -0.40 |
| 2. | 0.26 | 0.40 |
| 3. | 0.43 | 0.29 |
| 4. | -0.43 | -0.29 |

30 Calculate the price of the put option on the forward contract using the Black model.

- | | |
|----|----------|
| 1. | \$0 |
| 2. | \$10.159 |
| 3. | \$10.977 |
| 4. | \$12.103 |

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31. A US company has entered into an interest rate swap with a dealer in which the notional principal is \$40 million. The company will pay a floating rate of LIBOR and receive a fixed rate of 6.12%. Interest is paid semiannually, and the current LIBOR is 5.95%. Calculate the first payment and indicate which party pays which. (Assume the floating rate payments are made on a basis of 180/360 and fixed rate payments on a basis of 180/365)

- | | | |
|---|-------------|---------------------|
| 1 | \$17,232.88 | Company pays dealer |
| 2 | \$17,232.88 | Dealer pays company |
| 3 | \$50,301.37 | Company pays dealer |
| 4 | \$50,301.37 | Dealer pays company |

Use the following information to answer questions 32 and 33

Consider a two-year interest rate swap with semi-annual payments. Assume a notional principal of \$25 million.

32. Calculate the semi-annual fixed payment and the annualized fixed rate on the swap if the current term structure of LIBOR interest rates is as follows:

$$\begin{aligned} L_0(180) &= 0.0715, & L_0(360) &= 0.0705 \\ L_0(540) &= 0.0695, & L_0(720) &= 0.0685 \end{aligned}$$

- | | | |
|---|-----------|-------|
| 1 | \$817,500 | 6.54% |
| 2 | \$780,100 | 6.54% |
| 3 | \$817,500 | 6.93% |
| 4 | \$780,100 | 6.93% |

33. Calculate the market value of the swap 120 days later from the point of view of the party paying the floating rate and receiving the fixed rate, and from the point of view of the party paying the fixed rate and receiving the floating rate, if the term structure 120 days later is as follows:

$$\begin{aligned} L_{120}(60) &= 0.0697, & L_{120}(240) &= 0.0653 \\ L_{120}(420) &= 0.0629, & L_{120}(600) &= 0.0613 \end{aligned}$$

- | | | |
|---|------------|------------|
| 1 | \$18,000 | -\$18,000 |
| 2 | -\$18,000 | \$18,000 |
| 3 | \$180,000 | -\$180,000 |
| 4 | -\$180,000 | \$180,000 |

- 34 An asset manager wishes to reduce his exposure to fixed-income securities and increases his exposure to large-cap stocks. He wishes to do so using an equity swap. He agrees to pay a dealer a fixed rate of 5.5%, and the dealer agrees to pay the manager the returns on a large-cap index. Calculate the overall payment six months later and indicate which party makes the payment, if the value of the large-cap index starts off at 577.60 and six months later is at 623.42. Assume that the payments are made semiannually and there are 365 days in a year. The notional principal is \$20 million.

- | | | |
|----|----------------|---------------------------|
| 1 | \$239,949.92 | Asset manager pays dealer |
| 2 | \$486,565.10 | Asset manager pays dealer |
| 3 | \$1,044,099.35 | Dealer pays asset manager |
| 4. | \$1,586,565.10 | Dealer pays asset manager |

- 35 Consider a one-year interest rate swap with quarterly payments. Calculate the quarterly fixed payment and the annualised fixed rate on the swap with a notional principal of \$10 million. The current term structure of the LIBOR interest rate is as follows:

$L_0(90)$	=	0.0781
$L_0(180)$	=	0.0763
$L_0(270)$	=	0.0733
$L_0(360)$	=	0.0710

- | | | |
|---|-----------|-------|
| 1 | \$173,000 | 1.73% |
| 2 | \$173,000 | 6.92% |
| 3 | \$692,000 | 1.73% |
| 4 | \$692,000 | 6.92% |

- 36 A company has most of its liabilities in the form of floating-rate notes with a maturity of two years and quarterly reset. The company is not concerned with interest rate movements over the next four quarters but is interested in the potential movement thereafter. Identify the most appropriate strategy that would allow the company to hedge the expected change in interest rates.

- 1 Go long a payer swaption with a one-year maturity.
- 2 Go long a receiver swaption with a one-year maturity.
- 3 Enter into a two-year, quarterly pay-floating, receive-fixed swap.
4. Enter into a two-year, quarterly pay-fixed, receive floating swap.

37 Indicate the correct statement from the following alternatives

- 1 The payoffs of an interest rate swaption are like those of an option on a zero-coupon bond
- 2 Swaptions are not based on specific underlying swaps but have a set exercise and expiration date
- 3 Swaption is the option to enter into a swap contract and gives the user more flexibility

38 Consider a European receiver swaption that expires in one year and is on a two-year swap that will make semiannual payments. The swaption has an exercise rate of 8.6% and the notional principal is \$34 million. At expiration, the term structure of interest rates is as follows

$L_0(180)$	= 0.0420
$L_0(360)$	= 0.0474
$L_0(540)$	= 0.0544
$L_0(720)$	= 0.0661

Indicate the correct statement with regard to exercising the swaption

- 1 Exercise the swaption with offsetting swap netted and receive a payment of \$1,060,800
- 2 Exercise the swaption, enter into receive-fixed (\$1,060,800) and pay-floating (\$714,000) swap
- 3 The holder can choose to receive an up-front cash payment of \$1,501,250 now
- 4 Exercise the swaption, enter into receive-fixed (\$1,060,800), pay-floating (\$714,000) swap and enter into pay-fixed (\$1,462,000), and receive floating (\$714,000) at market rate

Questions 39 and 40. A one-year swap with quarterly payments pays a fixed rate and receives a floating rate. The term structure at the beginning of swap is

$L_0(90)$	= 0.0252
$L_0(180)$	= 0.0310
$L_0(270)$	= 0.0368
$L_0(360)$	= 0.0402

In order to mitigate the credit risk of the parties engaged in the swap, the swap will be marked to market in 90 days. Suppose it is now 90 days later and the swap is being marked to market. The new term structure is:

$L_0(90)$	= 0.0539
$L_0(180)$	= 0.0610
$L_0(270)$	= 0.0649

39 Calculate the market value of the swap per \$1 notional principal and indicate who would make the payment

- 1 Fixed pays floating party \$0.0173
- 2 Floating pays fixed party \$0.0173
- 3 Fixed pays floating party \$0.9827
- 4 Floating pays fixed party \$0.9827

40 Calculate the new fixed rate on the swap at which the swap would proceed after the marked to market

- 1 1%
- 2 1.33%
- 3 1.59%
- 4 6.49%

[40]

Cumulative Probabilities for a Standard Normal Distribution

$$P(X \leq x) = N(x) \text{ for } x \geq 0 \text{ or } 1 - N(-x) \text{ for } x < 0$$

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0 5000	0 5040	0 5080	0 5120	0 5160	0 5199	0 5239	0 5279	0 5319	0 5359
0.10	0 5398	0 5438	0 5478	0 5517	0 5557	0 5596	0 5636	0 5675	0 5714	0 5753
0.20	0 5793	0 5832	0 5871	0 5910	0 5948	0 5987	0 6026	0 6064	0 6103	0 6141
0.30	0 6179	0 6217	0 6255	0 6293	0 6331	0 6368	0 6406	0 6443	0 6480	0 6517
0.40	0 6554	0 6591	0 6628	0 6664	0 6700	0 6736	0 6772	0 6808	0 6844	0 6879
0.50	0 6915	0 6950	0 6985	0 7019	0 7054	0 7088	0 7123	0 7157	0 7190	0 7224
0.60	0 7257	0 7291	0 7324	0 7357	0 7389	0 7422	0 7454	0 7486	0 7517	0 7549
0.70	0 7580	0 7611	0 7642	0 7673	0 7704	0 7734	0 7764	0 7794	0 7823	0 7852
0.80	0 7881	0 7910	0 7939	0 7967	0 7995	0 8023	0 8051	0 8078	0 8106	0 8133
0.90	0 8159	0 8186	0 8212	0 8238	0 8264	0 8289	0 8315	0 8340	0 8365	0 8389
1.00	0 8413	0 8438	0 8461	0 8485	0 8508	0 8531	0 8554	0 8577	0 8599	0 8621
1.10	0 8643	0 8665	0 8686	0 8708	0 8729	0 8749	0 8770	0 8790	0 8810	0 8830
1.20	0 8849	0 8869	0 8888	0 8907	0 8925	0 8944	0 8962	0 8980	0 8997	0 9015
1.30	0 9032	0 9049	0 9066	0 9082	0 9099	0 9115	0 9131	0 9147	0 9162	0 9177
1.40	0 9192	0 9207	0 9222	0 9236	0 9251	0 9265	0 9279	0 9292	0 9306	0 9319
1.50	0 9332	0 9345	0 9357	0 9370	0 9382	0 9394	0 9406	0 9418	0 9429	0 9441
1.60	0 9452	0 9463	0 9474	0 9484	0 9495	0 9505	0 9515	0 9525	0 9535	0 9545
1.70	0 9554	0 9564	0 9573	0 9582	0 9591	0 9599	0 9608	0 9616	0 9625	0 9633
1.80	0 9641	0 9649	0 9656	0 9664	0 9671	0 9678	0 9686	0 9693	0 9699	0 9706
1.90	0 9713	0 9719	0 9726	0 9732	0 9738	0 9744	0 9750	0 9756	0 9761	0 9767
2.00	0 9772	0 9778	0 9783	0 9788	0 9793	0 9798	0 9803	0 9808	0 9812	0 9817
2.10	0 9821	0 9826	0 9830	0 9834	0 9838	0 9842	0 9846	0 9850	0 9854	0 9857
2.20	0 9861	0 9864	0 9868	0 9871	0 9875	0 9878	0 9881	0 9884	0 9887	0 9890
2.30	0 9893	0 9896	0 9898	0 9901	0 9904	0 9906	0 9909	0 9911	0 9913	0 9916
2.40	0 9918	0 9920	0 9922	0 9925	0 9927	0 9929	0 9931	0 9932	0 9934	0 9936
2.50	0 9938	0 9940	0 9941	0 9943	0 9945	0 9946	0 9948	0 9949	0 9951	0 9952
2.60	0 9953	0 9955	0 9956	0 9957	0 9959	0 9960	0 9961	0 9962	0 9963	0 9964
2.70	0 9965	0 9966	0 9967	0 9968	0 9969	0 9970	0 9971	0 9972	0 9973	0 9974
2.80	0 9974	0 9975	0 9976	0 9977	0 9977	0 9978	0 9979	0 9979	0 9980	0 9981
2.90	0 9981	0 9982	0 9982	0 9983	0 9984	0 9984	0 9985	0 9985	0 9986	0 9986
3.00	0 9987	0 9987	0 9987	0 9988	0 9988	0 9989	0 9989	0 9989	0 9990	0 9990

PRICING AND VALUATION OF FORWARD CONTRACTS

Discrete interest (r)

$$(1+r)^T$$

Continuous interest (r^c)

$$e^{r^c T}$$

Conversion ($r \leftrightarrow r^c$)

$$r^c = \ln(1+r)$$

$$r = e^{r^c} - 1$$

Discount interest

$$\text{Amount} [1 - r(d/360)]$$

Add-on interest

$$\text{Amount} [1 + r(d/360)]$$

Forward rate agreement (FRA)*Price/rate*

$$FRA_{\text{rate}} = \left[\frac{1 + L_0 \left(\frac{h+m}{360} \right)}{1 + L_0 \left(\frac{h}{360} \right)} - 1 \right] \left(\frac{360}{m} \right)$$

Value

$$V_0 = \left[\frac{1}{1 + L_0 \left(\frac{h-g}{360} \right)} \right] - \left[\frac{1 + FRA_{\text{rate}} \left(\frac{m}{360} \right)}{1 + L_0 \left(\frac{h+m-g}{360} \right)} \right]$$

Payoff

$$FRA_{\text{payoff}} = NP \left[\frac{(U_{\text{rate}} - FRA_{\text{rate}}) \left(\frac{U_{\text{days}}}{360} \right)}{1 + U_{\text{rate}} \left(\frac{U_{\text{days}}}{360} \right)} \right]$$

Forward contract – no cash flows*Price*

$$F_T = S_0 (1+r)^T$$

Value

$$V_0 = S_0 - \frac{F_T}{(1+r)^T} \quad V_t = S_t - \frac{F_T}{(1+r)^{T-t}}$$

Forward contract – equity*Price and value – discrete compounding*

$$F_T = [S_0 - PV(D)] (1+r)^T$$

$$V_t = S_t - PV(D) - \left[\frac{F_T}{(1+r)^{T-t}} \right]$$

Price and value – continuous compounding

$$F_T = S_0 e^{(r^c - \delta^c)T}$$

$$V_t = S_t e^{-\delta(T-t)} - F_T e^{-r(T-t)}$$

Forward contract – fixed income*Price and value*

$$F_T = [B_0 - PV(C)] (1+r)^T$$

$$V_t = B_t - PV(C) - \left[\frac{F_T}{(1+r)^{T-t}} \right]$$

Forward contract – currency*Price and value – discrete compounding*

$$F_T = S_0 \left[\frac{(1+r_d)^{d/365}}{(1+r_f)^{d/365}} \right]$$

$$V_t = \left[\frac{S_t}{(1+r_f)^{T-t}} \right] - \left[\frac{F_T}{(1+r_d)^{T-t}} \right]$$

Price and value – continuous compounding

$$F_T = S_0 e^{(r_d^c - r_f^c)(d/365)}$$

$$V_t = S_t e^{-r_f(T-t)} - F_T e^{-r_d(T-t)}$$

Interest rate parity (IRP)

$$(1+r_d)^{d/365} = (1+r_f)^{d/365} \left(\frac{F}{S} \right)$$

PRICING OF FUTURES CONTRACTS**Futures price – no cost or benefit**

$$f_0(T) = S_0(1+r)^T$$

Futures price – net cost or benefit

$$f_0(T) = S_0(1+r)^T + FV(CB)$$

Futures price – stock

$$f_0(T) = S_0(1+r)^T - FV(D)$$

Futures price – stock index

$$f_0(T) = S_0 e^{(r^s - \delta^s)T}$$

Futures price – Treasury bill

$$f_0(T) = \frac{B_0(1+r)^T - FV(C)}{\text{Conversion Factor}}$$

Futures price – currency**Discrete compounding**

$$f_0(T) = S_0 \left[\frac{(1+r_d)^{d/365}}{(1+r_f)^{d/365}} \right]$$

Continuous compounding

$$f_0(T) = S_0 e^{(r_d - r_f)(d/365)}$$

PRICING AND VALUATION OF SWAPS**Net fixed payment**

$$NFP = (\text{swap rate} - \text{LIBOR}) \left(\frac{\text{days}}{360} \right) NP$$

Swap fixed rate

$$C = \left(\frac{1 - Z_4}{Z_1 + Z_2 + Z_3 + Z_4} \right)$$

Discount rate

$$Z_{\text{day}} = \frac{1}{1 + \left(R_{\text{day}} \times \frac{\text{days}}{360} \right)}$$

Market value of interest rate swap

$$MV_{\text{IRS}} = V_{\text{floating-rate bond}} - V_{\text{fixed-rate bond}}$$

Market value of currency swap

$$MV_{\text{CS}} = V_{\text{domestic bond}} - V_{\text{foreign bond}}$$

Return on equity

$$\text{Return} = \left(\frac{\text{Ending value}}{\text{Beginning value}} \right)$$

Yield on equity

$$\text{Yield} = \left(\frac{\text{Ending value}}{\text{Beginning value}} \right) - 1$$

Payment on equity position

$$PMT = \text{Yield} \times NP$$

Market value of equity swap

$$MV_{\text{ES}} = NP(\text{Return}_x - \text{Return}_y)$$

Swaption payoffs

$$\text{Payoff}_{\text{Swaption-payer}} = (\text{SFR} - X) \left(\frac{\text{days}}{360} \right) NP$$

$$\text{Payoff}_{\text{Swaption-receiver}} = (X - \text{SFR}) \left(\frac{\text{days}}{360} \right) NP$$

PRICING OF OPTION CONTRACTS**Intrinsic values**

$$c = \max[0; (S - X)]$$

$$p = \max[0; (X - S)]$$

Bounds – European options*No cash flows – upper and lower*

$$[S - X(1+r)^{-1}] \leq c \leq S$$

$$[X(1+r)^{-1} - S] \leq p \leq X(1+r)^{-1}$$

Cash flows – lower bounds

$$c \geq [S - PV(CF)] - PV(X)$$

$$p \geq PV(X) - [S - PV(X)]$$

Bounds – American options

$$[S - X(1+r)^{-1}] \leq C \leq S$$

$$(X - S) \leq P \leq X$$

Put-call parity – European options*No cash flows*

$$S + p = c + X(1+r)^{-1}$$

Cash flows

$$[S - PV(CF)] + p = c + PV(X)$$

Futures contracts

$$F_T(1+r)^{-1} + p = c + X(1+r)^{-1}$$

Put-call parity – American options

$$S - X \leq C - P \leq S - X(1+r)^{-1}$$

Binomial model

$$p = \frac{(1+r) - d}{u - d}$$

$$f = \frac{[(p)(f^+) + (1-p)(f^-)]}{(1+r)}$$

$$f = \frac{[(p)^2(f^{++}) + 2(p)(1-p)(f^{+-}) + (1-p)^2(f^{--})]}{(1+r)^2}$$

Black-Scholes Merton model**Black-Scholes model**

$$d_1 = \frac{\ln(S/X) + [r^c + (\sigma^2/2)]T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$$c = SN(d_1) - Xe^{-r^c T}N(d_2)$$

$$p = Xe^{-r^c T}N(-d_2) - SN(-d_1)$$

Merton's model

$$d_1 = \frac{\ln(S/X) + [(r^c - \delta) + (\sigma^2/2)]T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$$c = Se^{-\delta T}N(d_1) - Xe^{-r^c T}N(d_2)$$

$$p = Xe^{-r^c T}N(-d_2) - Se^{-\delta T}N(-d_1)$$

[$r^c = r_d^c$ and $\delta = r_f^c$ when pricing currency options]**Black's model**

$$d_1 = \frac{\ln(F/X) + (\sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$$c = e^{-r^c T} [FN(d_1) - XN(d_2)]$$

$$p = e^{-r^c T} [XN(-d_2) - FN(-d_1)]$$

Delta

$$\text{Delta} = \frac{f_1 - f_0}{S_1 - S_0} = N(d_1)$$

Interest rate options

$$IR_{\text{call}} = NP(U_{\text{rate}} - X_{\text{rate}}) \left(\frac{d}{360} \right)$$

$$IR_{\text{put}} = NP(X_{\text{rate}} - U_{\text{rate}}) \left(\frac{d}{360} \right)$$

PAGE FOR ROUGH WORK

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PART 1 (GENERAL/ALGEMEEN) DEEL 1

STUDY UNIT e.g. PSY100-X
 STUDIE-EENHEID by PSY100-X

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INITIALS AND SURNAME
 VOORLETTERS EN VAN

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 DATUM VAN EKSAMEN

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 VRAESTELNOMMER

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EXAMINATION CENTRE (E.G. PRETORIA)
 EKSAMENSENTRUM (BY PRETORIA)

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For use by examination invigilator
 Vir gebruik deur eksamenopsiener

◆

IMPORTANT

1. USE ONLY AN HB PENCIL TO COMPLETE THIS SHEET
2. MARK LIKE THIS
3. CHECK THAT YOUR INITIALS AND SURNAME HAS BEEN FILLED IN CORRECTLY
4. ENTER YOUR STUDENT NUMBER FROM LEFT TO RIGHT
5. CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY
6. CHECK THAT THE UNIQUE NUMBER HAS BEEN FILLED IN CORRECTLY
7. CHECK THAT ONLY ONE ANSWER PER QUESTION HAS BEEN MARKED
8. DO NOT FOLD

BELANGRIK

1. GEBUIK SLEGS 'N HB POTLOOD OM HIERDIE BLAD TE VOLTOOI
2. MERK AS VOLG
3. KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS
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PART 2 (ANSWERS/ANTWOORDE) DEEL 2

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Specimen only

MARK READING SHEET INSTRUCTIONS

Your mark reading sheet is marked by computer and should therefore be filled in thoroughly and correctly

USE ONLY AN HB PENCIL TO COMPLETE YOUR MARK READING SHEET

PLEASE DO NOT FOLD OR DAMAGE YOUR MARK READING SHEET

Consult the illustration of a mark reading sheet on the reverse of this page and follow the instructions step by step when working on your sheet

Instruction numbers ① to ⑩ refer to spaces on your mark reading sheet which you should fill in as follows

- ① Write your paper code in these eight squares, for instance

P	S	Y	1	0	0	-	X
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- ② The paper number pertains only to first-level courses consisting of two papers

WRITE

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 for the first paper and

0	2
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 for the second. If only one paper, then leave blank

- ③ Fill in your initials and surname.
- ④ Fill in the date of the examination
- ⑤ Fill in the name of the examination centre
- ⑥ WRITE the digits of your student number HORIZONTALLY (from left to right). Begin by filling in the first digit of your student number in the first square on the left, then fill in the other digits, each one in a separate square
- ⑦ In each vertical column mark the digit that corresponds to the digit in your student number as follows [-]
- ⑧ WRITE your unique paper number HORIZONTALLY
NB Your unique paper number appears at the top of your examination paper and consists only of digits (e.g. 403326)
- ⑨ In each vertical column mark the digit that corresponds to the digit number in your unique paper number as follows: [-]
- ⑩ Question numbers 1 to 140 indicate corresponding question numbers in your examination paper. The five spaces with digits 1 to 5 next to each question number indicate an alternative answer to each question. The spaces of which the number correspond to the answer you have chosen for each question and should be marked as follows: [-]
- ◆ For official use by the invigilator. Do not fill in any information here.