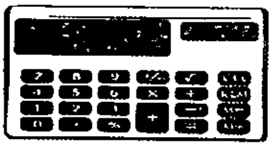
UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA university of south africa

INV3703 (473681) October/November 2014

INVESTMENTS: DERIVATIVES

Duration 2 Hours | 70 Marks

EXAMINERS

FIRST	MR CF ERASMUS
SECOND	MR G MAROZVA
EXTERNAL	MS M REYERS

Use of a non-programmable pocket calculator is permissible

Closed book examination

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A non-programmable financial and/or a scientific calculator is permissible.

This paper consists of 27 pages, including three pages for rough work (pp 21–23), the standard normal distribution table (p 24), a formula sheet (pp 25–27), and instructions for completing a mark-reading sheet

INSTRUCTIONS

Complete section A on the mark-reading sheet provided Write your student number and the unique number on the mark-reading sheet

UNIQUE NUMBER: 473681

Complete sections B, C, D and E on the examination paper
Assume all risk-free rates as discrete unless stated otherwise
Round all answers to at least 4 decimals and your final answer to 2 decimals

Mark allocation for the paper

Section A	10 multiple-choice questions	**[20 marks]**
Section B	Forwards and Futures	**[20 marks]**
Section C	Options	**[15 marks]**
Section D	Swaps	**[10 marks]**
Section E	Theory and application	**[5 marks]**
Total		**[70 marks]**

SECTION A: MULTIPLE-CHOICE QUESTIONS [10 x 2 marks = 20 marks]

1 For all parties involved, which of the following financial instruments is an example of a contingent claim?

1 Swaps
✓2 Put options
3 Futures contracts
4 Forward contracts

2 Renault entered into a forward contract with a platinum supplier, which one of the following statements is *least accurate* regarding a forward contract?

1 Futures contracts are easier to offset than forward contracts
2 Forward contracts are generally less liquid than futures contracts
3 Forward contracts are easier to tailor to specific needs than futures contracts
✓4 Forward contracts are characterised by having a clearinghouse as an intermediary Futures contracts have a clearinghouse.

3 A 90-day T-bill is selling at a discount of 8%, the price per $1 par for the T-bill would be closest to

1 $0 92
✓2 $0 98
3 $1 02
4 $1 08

Discount yield= 0.08=(1-Price/1)(360/90)=
1*0.08*90/360= 0.02 1-0.02= 0.98
Similiar to page 67 Q1 a.

4 A five-year Treasury bond with a par value of $1000, 7% annual yield and a 10% semi-annual coupon is priced at $1214 75 A futures contract calling for delivery of the bond expires one year from now The one-year risk-free rate is 6% Assume that coupons are reinvested at the 7% annual yield of the Treasury bond The futures price would be closest to

1 $1 000 00
2 $1 090 48
3 $1 101 75
✓4 $1 185 89

1000*0.05= $50 (10%/2=5%)
50(1+0.035)+50=101.75 (7% reinvestment/2= 0.035)
1214.75(1.06)-101.75= $1185.89

[TURN OVER]

5 Ngomandi, the head of treasury at Eskom, wishes to hedge against an increase in borrowing costs due to a possible downgrade in Eskom's credit rating Ngomandi proposes to the management of Eskom to hedge the risk by entering into a long 3 × 6 FRA The current structure for LIBOR is as follows

Term	Interest rate
90 day	6 15%
180 day	6 30%
270 day	6 60%

The rate that Ngomandi would receive on a 6 × 12 FRA is closest to

ERROR

1 3 18%
2 4 88%
3 6 65%
4 6 72%

6 Suppose Retha, a trader, went long in a 6 × 12 FRA and the FRA rate is 0 0606 Suppose it is now 55 days after the initiation of the contract and the interest rates have risen with the LIBOR term structure is as follows

Term	Interest rate
125 day	6 65%
305 day	7 24%

The market value of this FRA based on a notional principal of R50 000 000 would be closest to

1 R95 000
2 R335 000 ✓
3 R370 000
4 R2 616 000

h=180
m= 180
g=55
h-g= 125 6.65%
h+m-g= 180+180-55= 305 7.24%

=1/1+0.0665(125/360) - (1 +0.0606(180/360)/(1+0.0724(305/360)
=0.00668 * 50 000 000
=R334 000

7 A share index option that expires in 75 days is currently at 1240 89 and makes no cash payments during the life of the option Assume a share multiplier of 1 and a risk-free rate of 3% The lowest possible price for a European-style call option on this index with a exercise price of 1225 would be closest to

Similiar to Q6 a P245. Also example of Put option.

1 0
2 15 89
3 23 31 ✓
4 1240 89

1240.89-1225/(1.03)^75/365
= 23.31$

[TURN OVER]

8 A two-period binomial model with a share that currently trades at $50 in the spot market can either increase in value by 18 per cent or decrease by 15 per cent in the highly volatile market The annual risk-free rate is 9 per cent and each period of the binomial model is equal to one year The risk-neutral probability for the binomial model would be closest to

1 0 27
2 0 30
3 0 70
4 0 73 ✓

(1+r)-d / u-d
(1+0.09) -(1-0.15) / (1+0.18)-0.85
=0.727
=0.73

9 An asset manager wishes to enter into a two-year equity swap in which he will receive the rate of return on the FTSE 100 equity index in exchange for paying a fixed interest rate The FTSE 100 equity index is at 1510 89 at the beginning of the swap The swap has a notional principal of £100 million and calls for semi-annual payments The current term structure of interest rates is
$L_0(540) = 0\ 0642$
$L_0(720) = 0\ 0656$
The present value discount factor for $L_0(540)$ would be closest to

1 0 8702
2 0 9122
3 0 9358
4 1 0642

10 An asset manager wishes to reduce his exposure to large-cap stocks and increase his exposure to small cap stocks He seeks to do so using an equity swap He agrees to pay a dealer the return on a large-cap index, and the dealer agrees to pay the manager the return on a small-cap index The value of the small-cap index starts off at 712 70, and the large-cap index starts at 1230 10 In six months, the small-cap index is at 653 30 and the large-cap index is at 1270 92 Assume that payments are made semi-annually and the notional principal is $5 000 000 The first overall payment and the party that makes the payment is most likely to be

1 R166 000 by the dealer to the asset manager
2 R166 000 by the asset manager to the dealer
3 R582 500 by the asset manager to the dealer ✓
4 R582 500 by the dealer to the asset manager

(20)

Small caps: (653.3/712.70 -1)(5000000)= -$416725
Asset manager owes the dealer. If it was positive then dealer owed asset manager.
Large caps: (1270.92/1230.10 -1)(5000000)= 165921
Asset manager owes the dealer. If amount was negative the dealer owed Asset Manager.
Total $416725+165921= 582646. The asset manager owes the dealer.

[TURN OVER]

SECTION B: FORWARDS AND FUTURES (20 marks)

1 Adele, a treasury manager, wants to enter into a FRA that expires in 42 days and is based on the 162-day LIBOR The dealer quotes a rate of 5 25% on this FRA Assume that at expiration the 162-day LIBOR is 4 75% and the notional principal $5 000 000

1 1 What term is used to describe nonstandard FRAs? (1)

Off the run FRA

1 2 Calculate the payoff of the FRA for the long position and indicate whether the long party makes a profit or a loss (2)

(0.0475-0.0525)(162/360)/(1+0.0475(162/360))* 5 000 000
=-$11014.56
Because the party is long, the amount represents a loss.

2 A barrel of oil is currently priced at $115 and the risk-free rate is 6% Suppose a dealer was to offer you a contract in which the forward price of the barrel of oil with delivery in three months is $109

2 1 How would you take advantage of the situation to make an arbitrage profit? (3)

2 2 How much would your arbitrage profit be? (1)

3 Edmund currently owns a share that pays regular dividends and trades at $40 Edmund plans to sell the share in 320 days In order to hedge against any possible price declines, Edmund takes a short position in a forward contract that expires in 320 days The current risk-free rate is 6 5% Over the next 320 days, the share will pay the following dividends

Days to next dividend	Dividends per share
90	$2 40
180	$2 40
270	$2 40

3 1 The initial price of the forward contract is $34 89 Suppose it is 150 days after Edmund entered into the forward contract and the share price declined to $32 What would the value of the contract be at this point and would the short position make a gain or loss? (6)

SIMILIAR QUESTION PAGE 68 Q11 B

St= $32 - share price declined to.
F= 34.89 (given) Initial price
t= 150/365
T= 320/365
T-t= 170/365
r= 0.065
We are 150 days later so it is only 30 days to the next dividend and (270-150) 120 the next.
2.40/(1.065)^30/365 +2.40/(1.065)^120/365
= 4.74
PV(D)=$32-4.74= -(34.89/(1.065)^170/365)
= -$6.62
Negative value is a gain for the short.

4 Copper is currently priced at $90 per unit A futures contract on the copper expires in 75 days and the risk-free rate is 7 per cent Calculate the futures price of the copper if the storage cost at the futures expiration is equal to $3 (2)

PAGE 114 QB

$90(1.07)^75/365+3= $94.26

5 The IMM index price was quoted yesterday at 94 23 for a March Eurodollar futures contract Eurodollar futures contracts are each based on a $1 000 000 notional principal and have 90-days to expiry

5 1 Based on the rate of 94 23, what is the actual price of this futures contract? (2)

PAGE 144 Question 6 A &B

100-94.23= 5.77%
$1 000 000(1-0.0577(90/360))
=$985575

5 2 The IMM index price changed since yesterday, today the index is priced at 94 28 How much is the actual change in the futures price of the contract? (1)

100-94.28= 5.72%
1 000 000(1-0.0572(90/360))= $985700

Actual change: 985 700-985 575= $125
OR
It changed 8 basis points
8*$25(always 25)= 125

6 The current spot exchange rate for the British pound is $1 3819/£1 The US interest rate is 3 6% and the UK interest rate is 2 8% A futures contract on the exchange rate for the British pound expires in 340 days Calculate the appropriate futures price of the forward contract (2)

P146. Q18 A

(So/(1+r^f)^T) (1+r)^T
(1.3819/(1.028^340/365))(1+0.036)^340/365
= 1.3919

(20)

SECTION C: OPTIONS (15 marks)

1 A call option on an interest rate is based on a 180-day LIBOR rate of 7% and has a notional principal of $1 000 000

1 1 Calculate the payoff at expiration for the call option if the exercise rate is 5% (2)

Similiar to Page 244 Q3A

St=0.07
(0.07-0.05)*(180/360)* 1 000 000
= $10 000

1 2 Calculate the payoff at expiration for the call option if the exercise rate is 8% (1)

St=0.07
(0.07-0.08)*(180/360)*1 000 000
=$0 Can not be negative.

2 Christie, an analyst at Brooklyn Investments collects the following information on call and put prices of a share

Call price	$ 6 60
Put price	$ 7 60
Share price	$88 00
Exercise price	$92 00
Risk-free rate	5 per cent
Days to expiration	329

Assume a 365 day year

2 1 Use put-call parity to calculate the price of the synthetic put option (2)

PAGE 251 Q9 a

Bond price: 92/(1+0.05)^329/365= 88.04

6.60+88.04-88= $6.64

2 2 Use put-call parity to calculate the price of the synthetic call option (2)

7.60+88-88.04=$7.56

3 Call and put options are available on a Netcare share (JSE NTC), the share is currently trading at R34 00 and the options have an exercise price of R35 00 The options expire in 310 days and the volatility is 0 40 The current continuously compounded risk-free rate is 5% and there are no dividends paid on this share The exact call and put prices for this specific share according to the Black-Scholes option pricing model are as priced below

Share price	Call price	Put price
R34 00	R1 19	R0 73

3 1 Calculate d_1 for the above share (Assume a 365 day year) (3)

PAGE 237 Problem 12.

0.22 ONLINE CALCULATER
EXCERICISE PRICE IS SPOT PRICE

[TURN OVER]

3 2 Suppose the approximate delta value of the call option is 0 5871, what would the new price of the call option be if the Netcare share price changed with R3 00? (2)

Question 16 B page248

0.5871(3)=1.7613

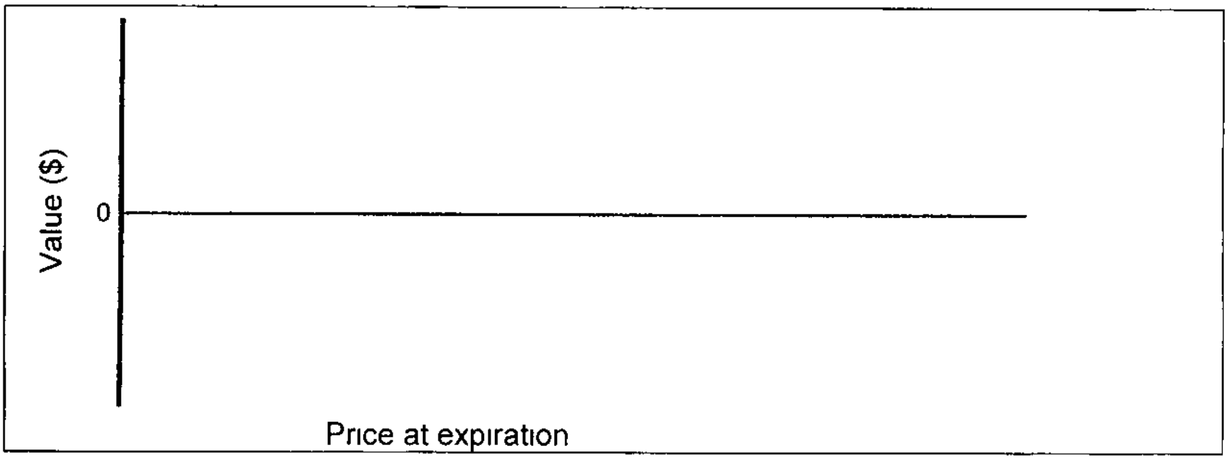
1.19+1.7613= 2.9513

4 Consider an asset that trades at $30 today Call and put options on this asset are available with an exercise price of $34 The options expire in 300 days, and the volatility is 0 55 The continuously compounded risk-free rate is 4% The asset has a dividend yield of 1% Assume N(d_1) = 0 5199 and N(d_2) = 0 3264 and a 365-day year

4 1 Use the Merton model to calculate the value of the European call option (2)

30(0.5199)-34e^(-0.04(300/365)) (0.3264) = $4.86

5 Draw the option diagram of a short call on the following axis (1)



(15)

SECTION D: SWAPS (10 marks)

1 Le Vu, a French company, issued a floating-rate bond and anticipates that interest rates will rise in the short term Pierre, the treasurer, enters into a swap for a fixed payment with a dealer in order to hedge against the interest rate risk The swap is on a notional principal of €5 000 000 and the company will pay a fixed rate of 6 per cent while receiving Euribor The current Euribor rate is 5 per cent

1 1 Calculate the first fixed and floating payments of the swap Assume that the floating rate payments will be based on 90/360 days and the fixed rate at 90/365 days (4)

Question4 page 319

Fixed payments: 5 000 000(0.06)(90/365)= €73972.60
Floating payments: 5 000 000(0.05)(90/360)= €62500

Net payment is €11472.6 made by the company paying the fixed

2 An asset manager wishes to enter into a two-year equity swap in which he will receive the rate of return on the NYSE index (NYA IND) in exchange for paying a fixed interest rate The NYSE index is at 10610 89 at the beginning of the swap The swap has a notional principal of $10 million and calls for semi-annual payments The current term structure of interest rates is

$L_0(180) = 0\ 0501$
$L_0(360) = 0\ 0556$
$L_0(540) = 0\ 0602$
$L_0(720) = 0\ 0656$

The present value discount factors for 180, 360, 540 and 720 days are

$$B_0(180) = \frac{1}{1 + 0\ 0501\left(^{180}/_{360}\right)} = 0\ 9756$$

$B_0(360) = 0\ 9473$
$B_0(540) = 0\ 9172$
$B_0(720) = 0\ 8840$

2 1 Calculate the annualised fixed rate on the swap per $1 notional principal (2)

and Question 13 page 232

1-0.8840 / 0.9756+0.9473+0.9172+0.8840
=0.0311
0.0311(360/180)
=0.0622

Ninety days later the NYSE index is at 10908 16 and the present value factors of the term structure of interest are

$B_{90}(180) = 0\ 9902$
$B_{90}(360) = 0\ 9615$
$B_{90}(540) = 0\ 9298$
$B_{90}(720) = 0\ 9024$

2 2 Calculate the present value of the remaining fixed payment (1)

0.0311(0.9902+0.9615+0.9298+0.9024)+1(0.9024)= 1.02 - answer

2 3 Calculate the value of the equity payment (1)

(10908.16/10610.89)=1.028

2 4 Calculate the market value of the swap and state whether the fixed rate payer pays or receives the market value (2)

(1.028-1.02) 10 000 000= R80 000

(10)

SECTION E: THEORY AND APPLICATION (5 marks)

1 Options are sensitive to a number of variables namely the spot price, strike price, volatility, time to maturity and interest rates

1 1 If the strike price of an option increases, would the value of the put option increase or decrease? (1)

Decrease

1 2 If the volatility of an option increases, would the value of the call option increase or decrease? (1)

Increase

2 Which type of derivative instrument can be considered as a variation of a forward contract as it is essentially equivalent to a series of forward contracts? (1)

SWAPS

3 Suppose an investor has a long position on gold futures that will expire in 6 months

3 1 If the investor wishes to close out the position before the expiry of the contacts, which transactions should the investor make? (1)

Enter into an opposite transaction. Go short. Offsetting

3 2 What is this method called of closing out a futures position before expiry? (1)

Offset

(5)

TOTAL **[70 MARKS]**

ROUGH WORK (WILL NOT BE MARKED)

ROUGH WORK (WILL NOT BE MARKED)

ROUGH WORK (WILL NOT BE MARKED)

Cumulative probabilities for a standard normal distribution

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

[TURN OVER]

PRICING AND VALUATION OF FORWARD

Discrete interest (r)

$(1+r)^T$

Continuous interest (r^c)

e^{r^cT}

Conversion ($r \leftrightarrow r^c$)

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

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

Discount interest

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

Add-on interest

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

Forward rate agreement (FRA)

Price/rate

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

Value

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

Payoff

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

Forward contract – no cash flows

Price

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

Value

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

Forward contract – equity

Price and value – discrete compounding

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

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

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

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

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

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

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

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

Interest rate parity (IRP)

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

PRICING OF FUTURES

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

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

Futures price – Treasury bill

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

Futures price – currency

Discrete compounding

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

Continuous compounding

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

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

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

Market value of interest rate swap

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

Market value of currency swap

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

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

$$MV_{ES} = NP(\text{Return}_X - \text{Return}_Y)$$

Swaption payoffs

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

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

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

$$\left[S - X(1+r)^{-t}\right] \le c \le S$$

$$\left[X(1+r)^{-t} - S\right] \le p \le X(1+r)^{-t}$$

Cash flows – lower bounds

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

Bounds – American options

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

Put-call parity – European options

No cash flows

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

Cash flows

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

Futures contracts

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

Put-call parity – American options

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

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

$$d_1 = \frac{\ln(S/X) + [r^c + (\sigma^2/2)]T}{\sigma\sqrt{T}}$$
$$d_2 = d_1 - \sigma\sqrt{T}$$

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

Merton's model

$$d_1 = \frac{\ln(S/X) + [(r^c - \delta) + (\sigma^2/2)]T}{\sigma\sqrt{T}}$$
$$d_2 = d_1 - \sigma\sqrt{T}$$

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

[$r^c = r_d^c$ and $\delta = r_f^c$ when pricing currency options]

Black's model

$$d_1 = \frac{\ln(F/X) + (\sigma^2/2)T}{\sigma\sqrt{T}}$$
$$d_2 = d_1 - \sigma\sqrt{T}$$

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

Delta

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

Interest rate options

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

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EXAMINATION MARK READING SHEET — EKSAMEN-MERKLEESBLAD

PART 1 (GENERAL/ALGEMEEN) DEEL 1

STUDY UNIT e.g. PSY100-X / STUDIE-EENHEID bv PSY100-X (1)

INITIALS AND SURNAME / VOORLETTERS EN VAN (3) ____________________

DATE OF EXAMINATION / DATUM VAN EKSAMEN (4) ____________________

PAPER NUMBER / VRAESTELNOMMER (2)

EXAMINATION CENTRE (E G PRETORIA) / EKSAMENSENTRUM (BV PRETORIA) (5) ____________________

STUDENT NUMBER / STUDENTENOMMER (6)	UNIQUE PAPER NO / UNIEKE VRAESTEL NR (8)
[0] [0] [0] [0] [0] [0] [0] [0]	[0] [0] [0] [0] [0] [0]
[1] [1] [1] [1] [1] [1] [1] [1]	[1] [1] [1] [1] [1] [1]
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[9] [9] [9] [9] [9] [9] [9] [9]	[9] [9] [9] [9] [9] [9]

For use by examination invigilator

Vir gebruik deur eksamenopsiener

◆

IMPORTANT	BELANGRIK
1 USE ONLY AN HB PENCIL TO COMPLETE THIS SHEET	1 GEBRUIK SLEGS 'N HB POTLOOD OM HIERDIE BLAD TE VOLTOOI
2 MARK LIKE THIS	2 MERK AS VOLG
3 CHECK THAT YOUR INITIALS AND SURNAME HAS BEEN FILLED IN CORRECTLY	3 KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS
4 ENTER YOUR STUDENT NUMBER FROM LEFT TO RIGHT	4 VUL U STUDENTENOMMER VAN LINKS NA REGS IN
5 CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY	5 KONTROLEER DAT U DIE KORREKTE STUDENTENOMMER VERSTREK HET
6 CHECK THAT THE UNIQUE NUMBER HAS BEEN FILLED IN CORRECTLY	6 KONTROLEER DAT DIE UNIEKE NOMMER REG INGEVUL IS
7 CHECK THAT ONLY ONE ANSWER PER QUESTION HAS BEEN MARKED	7 MAAK SEKER DAT NET EEN ALTERNATIEF PER VRAAG GEMERK IS
8 DO NOT FOLD	8 MOENIE VOU NIE

PART 2 (ANSWERS/ANTWOORDE) DEEL 2

(10)

1	[1] [2] [3] [4] [5]	36	[1] [2] [3] [4] [5]	71	[1] [2] [3] [4] [5]	106	[1] [2] [3] [4] [5]
2	[1] [2] [3] [4] [5]	37	[1] [2] [3] [4] [5]	72	[1] [2] [3] [4] [5]	107	[1] [2] [3] [4] [5]
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6	[1] [2] [3] [4] [5]	41	[1] [2] [3] [4] [5]	76	[1] [2] [3] [4] [5]	111	[1] [2] [3] [4] [5]
7	[1] [2] [3] [4] [5]	42	[1] [2] [3] [4] [5]	77	[1] [2] [3] [4] [5]	112	[1] [2] [3] [4] [5]
8	[1] [2] [3] [4] [5]	43	[1] [2] [3] [4] [5]	78	[1] [2] [3] [4] [5]	113	[1] [2] [3] [4] [5]
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12	[1] [2] [3] [4] [5]	47	[1] [2] [3] [4] [5]	82	[1] [2] [3] [4] [5]	117	[1] [2] [3] [4] [5]
13	[1] [2] [3] [4] [5]	48	[1] [2] [3] [4] [5]	83	[1] [2] [3] [4] [5]	118	[1] [2] [3] [4] [5]
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