Professional Level – Options Module

Advanced Financial Management

Tuesday 2 June 2015

Paper P4

Time allowed
Reading and planning: 15 minutes
Writing: 3 hours

This paper is divided into two sections:

Section A – This ONE question is compulsory and MUST be attempted

Section B – TWO questions ONLY to be attempted

Formulae and tables are on pages 9–13.

Do NOT open this paper until instructed by the supervisor.
During reading and planning time only the question paper may be annotated. You must NOT write in your answer booklet until instructed by the supervisor.
This question paper must not be removed from the examination hall.

ACCA

The Association of Chartered Certified Accountants

Section A – This ONE question is compulsory and MUST be attempted

1 Yilandwe

Yilandwe, whose currency is the Yilandwe Rand (YR), has faced extremely difficult economic challenges in the past 25 years because of some questionable economic policies and political decisions made by its previous governments. Although Yilandwe's population is generally poor, its people are nevertheless well-educated and ambitious. Just over three years ago, a new government took office and since then it has imposed a number of strict monetary and fiscal controls, including an annual corporation tax rate of 40%, in an attempt to bring Yilandwe out of its difficulties. As a result, the annual rate of inflation has fallen rapidly from a high of 65% to its current level of 33%. These strict monetary and fiscal controls have made Yilandwe's government popular in the larger cities and towns, but less popular in the rural areas which seem to have suffered disproportionately from the strict monetary and fiscal controls.

It is expected that Yilandwe's annual inflation rate will continue to fall in the coming few years as follows:

Year	Inflation rate
1	22·0%
2	14·7%
3 onwards	9·8%

Yilandwe's government has decided to continue the progress made so far, by encouraging foreign direct investment into the country. Recently, government representatives held trade shows internationally and offered businesses a number of concessions, including:

(i) zero corporation tax payable in the first two years of operation; and
(ii) an opportunity to carry forward tax losses and write them off against future profits made after the first two years.

The government representatives also promised international companies investing in Yilandwe prime locations in towns and cities with good transport links.

Imoni Co

Imoni Co, a large listed company based in the USA with the US dollar ($) as its currency, manufactures high tech diagnostic components for machinery, which it exports worldwide. After attending one of the trade shows, Imoni Co is considering setting up an assembly plant in Yilandwe where parts would be sent and assembled into a specific type of component, which is currently being assembled in the USA. Once assembled, the component will be exported directly to companies based in the European Union (EU). These exports will be invoiced in Euro (€).

Assembly plant in Yilandwe: financial and other data projections

It is initially assumed that the project will last for four years. The four-year project will require investments of YR21,000 million for land and buildings, YR18,000 million for machinery and YR9,600 million for working capital to be made immediately. The working capital will need to be increased annually at the start of each of the next three years by Yilandwe's inflation rate and it is assumed that this will be released at the end of the project's life.

It can be assumed that the assembly plant can be built very quickly and production started almost immediately. This is because the basic facilities and infrastructure are already in place as the plant will be built on the premises and grounds of a school. The school is ideally located, near the main highway and railway lines. As a result, the school will close and the children currently studying there will be relocated to other schools in the city. The government has kindly agreed to provide free buses to take the children to these schools for a period of six months to give parents time to arrange appropriate transport in the future for their children.

The current selling price of each component is €700 and this price is likely to increase by the average EU rate of inflation from year 1 onwards.

The number of components expected to be sold every year are as follows:

Year	1	2	3	4
Sales component units (000s)	150	480	730	360

The parts needed to assemble into the components in Yilandwe will be sent from the USA by Imoni Co at a cost of $200 per component unit, from which Imoni Co would currently earn a pre-tax contribution of $40 for each component unit. However, Imoni Co feels that it can negotiate with Yilandwe's government and increase the transfer price to $280 per component unit. The variable costs related to assembling the components in Yilandwe are currently

YR15,960 per component unit. The current annual fixed costs of the assembly plant are YR4,600 million. All these costs, wherever incurred, are expected to increase by that country's annual inflation every year from year 1 onwards.

Imoni Co pays corporation tax on profits at an annual rate of 20% in the USA. The tax in both the USA and Yilandwe is payable in the year that the tax liability arises. A bilateral tax treaty exists between Yilandwe and the USA. Tax allowable depreciation is available at 25% per year on the machinery on a straight-line basis.

Imoni Co will expect annual royalties from the assembly plant to be made every year. The normal annual royalty fee is currently $20 million, but Imoni Co feels that it can negotiate this with Yilandwe's government and increase the royalty fee by 80%. Once agreed, this fee will not be subject to any inflationary increase in the project's four-year period.

If Imoni Co does decide to invest in an assembly plant in Yilandwe, its exports from the USA to the EU will fall and it will incur redundancy costs. As a result, Imoni Co's after-tax cash flows will reduce by the following amounts:

Year	1	2	3	4
Redundancy and lost contribution	20,000	55,697	57,368	59,089

Imoni Co normally uses its cost of capital of 9% to assess new projects. However, the finance director suggests that Imoni Co should use a project specific discount rate of 12% instead.

Other financial information

Current spot rates

Euro per Dollar	€0·714/$1
YR per Euro	YR142/€1
YR per Dollar	YR101·4/$1

Forecast future rates based on expected inflation rate differentials

Year	1	2	3	4
YR/$1	120·1	133·7	142·5	151·9

Year	1	2	3	4
YR/€1	165·0	180·2	190·2	200·8

Expected inflation rates

EU expected inflation rate: Next two years	5%
EU expected inflation rate: Year 3 onwards	4%
USA expected inflation rate: Year 1 onwards	3%

Required:

(a) Discuss the possible benefits and drawbacks to Imoni Co of setting up its own assembly plant in Yilandwe, compared to licensing a company based in Yilandwe to undertake the assembly on its behalf. (5 marks)

(b) Prepare a report which:

(i) Evaluates the financial acceptability of the investment in the assembly plant in Yilandwe; (21 marks)

(ii) Discusses the assumptions made in producing the estimates, and the other risks and issues which Imoni Co should consider before making the final decision; (17 marks)

(iii) Provides a reasoned recommendation on whether or not Imoni Co should invest in the assembly plant in Yilandwe. (3 marks)

Professional marks will be awarded in part (b) for the format, structure and presentation of the report. (4 marks)

(50 marks)

Section B – TWO questions ONLY to be attempted

2 The treasury department of Chawan Co, a listed company, aims to maintain a portfolio of around $360 million consisting of equity shares, corporate bonds and government bonds, which it can turn into cash quickly for investment projects. Chawan Co is considering disposing 27 million shares, valued at $2·15 each, which it has invested in Oden Co. The head of Chawan Co's treasury department is of the opinion that, should the decision be made to dispose of its equity stake in Oden Co, this should be sold through a dark pool network and not sold on the stock exchange where Oden Co's shares are listed. In the last few weeks, there have also been rumours that Oden Co may become subject to a takeover bid.

Oden Co operates in the travel and leisure (T&L) sector, and the poor weather conditions in recent years, coupled with a continuing recession, has meant that the T&L sector is under-performing. Over the past three years, sales revenue fell by an average of 8% per year in the T&L sector. However, there are signs that the economy is starting to recover, but this is by no means certain.

Given below are extracts from the recent financial statements and other financial information for Oden Co and the T&L sector.

Oden Co
Year ending 31 May (all amounts in $m)

	2013	2014	2015
Total non-current assets	972	990	980
Total current assets	128	142	126
Total assets	1,100	1,132	1,106
Equity			
Ordinary shares ($0·50)	300	300	300
Reserves	305	329	311
Total equity	605	629	611
Non-current liabilities			
Bank loans	115	118	100
Bonds	250	250	260
Total non-current liabilities	365	368	360
Current liabilities			
Trade and other payables	42	45	37
Bank overdraft	88	90	98
Total current liabilities	130	135	135
Total equity and liabilities	1,100	1,132	1,106

Oden Co
Year ending 31 May (all amounts in $m)

	2013	2014	2015
Sales revenue	1,342	1,335	1,185
Operating profit	218	203	123
Finance costs	(23)	(27)	(35)
Profit before tax	195	176	88
Taxation	(35)	(32)	(16)
Profit for the year	160	144	72

Other financial information (Based on annual figures till 31 May of each year)

	2012	2013	2014	2015
Oden Co average share price ($)	2·10	2·50	2·40	2·20
Oden Co dividend per share ($)	0·15	0·18	0·20	0·15
T&L sector average share price ($)	3·80	4·40	4·30	4·82
T&L sector average earnings per share ($)	0·32	0·36	0·33	0·35
T&L sector average dividend per share ($)	0·25	0·29	0·29	0·31
Oden Co's equity beta	1·5	1·5	1·6	2·0
T&L sector average equity beta	1·5	1·4	1·5	1·6

The risk-free rate and the market return have remained fairly constant over the last ten years at 4% and 10% respectively.

Required:

(a) Explain what a dark pool network is and why Chawan Co may want to dispose of its equity stake in Oden Co through one, instead of through the stock exchange where Oden Co's shares are listed. (5 marks)

(b) Discuss whether or not Chawan Co should dispose of its equity stake in Oden Co. Provide relevant calculations to support the discussion.

Note: Up to 10 marks are available for the calculations. (20 marks)

(25 marks)

3 In order to raise funds for future projects, the management of Bento Co, a large manufacturing company, is considering disposing of one of its subsidiary companies, Okazu Co, which is involved in manufacturing rubber tubing. They are considering undertaking the disposal through a management buy-out (MBO) or a management buy-in (MBI). Bento Co wants $60 million from the sale of Okazu Co.

Given below are extracts from the most recent financial statements for Okazu Co:

Year ending 30 April (all amounts in $000)

	2015
Total non-current assets	40,800
Total current assets	12,300
Total assets	53,100
Equity	24,600
Non-current liabilities	16,600
Current liabilities	
Trade and other payables	7,900
Bank overdraft	4,000
Total current liabilities	11,900
Total equity and liabilities	53,100

Year ending 30 April (all amounts in $000)

	2015
Sales revenue	54,900
Operating profit	12,200
Finance costs	1,600
Profit before tax	10,600
Taxation	2,120
Profit for the year	8,480

Notes relating to the financial statements above:

(i) Current assets, non-current assets and the trade and other payables will be transferred to the new company when Okazu Co is sold. The bank overdraft will be repaid by Bento Co prior to the sale of Okazu Co.

(ii) With the exception of the bank overdraft, Bento Co has provided all the financing to Okazu Co. No liabilities, except the trade and other payables specified above, will be transferred to the new company when Okazu Co is sold.

(iii) It is estimated that the market value of the non-current assets is 30% higher than the book value and the market value of the current assets is equivalent to the book value.

(iv) The group finance costs and taxation are allocated by Bento Co to all its subsidiaries in pre-agreed proportions.

Okazu Co's senior management team has approached Dofu Co, a venture capital company, about the proposed MBO. Dofu Co has agreed to provide leveraged finance for a 50% equity stake in the new company on the following basis:

(i) $30 million loan in the form of an 8% bond on which interest is payable annually, based on the loan amount outstanding at the start of each year. The bond will be repaid on the basis of fixed equal annual payments (constituting of interest and principal) over the next four years;

(ii) $20 million loan in the form of a 6% convertible bond on which interest is payable annually. Conversion may be undertaken on the basis of 50 equity shares for every $100 from the beginning of year five onwards;

(iii) 5,000,000 $1 equity shares for $5,000,000.

Okazu Co's senior management will contribute $5,000,000 for 5,000,000 $1 equity shares and own the remaining 50% of the equity stake.

As a condition for providing the finance, Dofu Co will impose a restrictive covenant that the new company's gearing ratio will be no higher than 75% at the end of its first year of operations, and then fall to no higher than 60%, 50% and 40% at the end of year two to year four respectively. The gearing ratio is determined by the book value of debt divided by the combined book values of debt and equity.

After the MBO, it is expected that earnings before interest and tax will increase by 11% per year and annual dividends of 25% on the available earnings will be paid for the next four years. It is expected that the annual growth rate of dividends will reduce by 60% from year five onwards following the MBO. The new company will pay tax at a rate of 20% per year. The new company's cost of equity has been estimated at 12%.

Required:

(a) Distinguish between a management buy-out (MBO) and a management buy-in (MBI). Discuss the relative benefits and drawbacks to Okazu Co if it is disposed through a MBO instead of a MBI. (5 marks)

(b) Estimate, showing all relevant calculations, whether the restrictive covenant imposed by Dofu Co is likely to be met. (12 marks)

(c) Discuss, with supporting calculations, whether or not an MBO would be beneficial for Dofu Co and Okazu Co's senior management team. (8 marks)

(25 marks)

4 For a number of years Daikon Co has been using forward rate agreements to manage its exposure to interest rate fluctuations. Recently its chief executive officer (CEO) attended a talk on using exchange-traded derivative products to manage risks. She wants to find out by how much the extra cost of the borrowing detailed below can be reduced, when using interest rate futures, options on interest rate futures, and a collar on the options, to manage the interest rate risk. She asks that detailed calculations for each of the three derivative products be provided and a reasoned recommendation to be made.

Daikon Co is expecting to borrow $34,000,000 in five months' time. It expects to make a full repayment of the borrowed amount in 11 months' time. Assume it is 1 June 2015 today. Daikon Co can borrow funds at LIBOR plus 70 basis points. LIBOR is currently 3·6%, but Daikon Co expects that interest rates may increase by as much as 80 basis points in five months' time.

The following information and quotes from an appropriate exchange are provided on LIBOR-based $ futures and options.

Three-month $ December futures are currently quoted at 95·84. The contract size is $1,000,000, the tick size is 0·01% and the tick value is $25.

Options on three-month $ futures, $1,000,000 contract, tick size 0·01% and tick value $25. Option premiums are in annual %.

December calls	Strike price	December puts
0·541	95·50	0·304
0·223	96·00	0·508

Initial assumptions

It can be assumed that settlement for both the futures and options contracts is at the end of the month; that basis diminishes to zero at a constant rate until the contract matures and time intervals can be counted in months; that margin requirements may be ignored; and that if the options are in-the-money, they will exercised at the end of the hedge instead of being sold.

Further issues

In the talk, the CEO was informed of the following issues:

(i) Futures contracts will be marked-to-market daily. The CEO wondered what the impact of this would be if 50 futures contracts were bought at 95·84 on 1 June and 30 futures contracts were sold at 95·61 on 3 June, based on the $ December futures contract given above. The closing settlement prices are given below for four days:

Date	Settlement price
1 June	95·84
2 June	95·76
3 June	95·66
4 June	95·74

(ii) Daikon Co will need to deposit funds into a margin account with a broker for each contract they have opened, and this margin will need to be adjusted when the contracts are marked-to-market daily.

(iii) It is unlikely that option contracts will be exercised at the end of the hedge period unless they have reached expiry. Instead, they more likely to be sold and the positions closed.

Required:

(a) Based on the three hedging choices available to Daikon Co and the initial assumptions given above, draft a response to the chief executive officer's (CEO) request made in the first paragraph of the question.

(15 marks)

(b) Discuss the impact on Daikon Co of each of the three further issues given above. As part of the discussion, include the calculations of the daily impact of the mark-to-market closing prices on the transactions specified by the CEO.

(10 marks)

(25 marks)

Formulae

Modigliani and Miller Proposition 2 (with tax)

$$k_e = k_e^i + (1 - T)(k_e^i - k_d)\frac{V_d}{V_e}$$

The Capital Asset Pricing Model

$$E(r_i) = R_f + \beta_i(E(r_m) - R_f)$$

The asset beta formula

$$\beta_a = \left[\frac{V_e}{(V_e + V_d(1 - T))}\beta_e\right] + \left[\frac{V_d(1 - T)}{(V_e + V_d(1 - T))}\beta_d\right]$$

The Growth Model

$$P_o = \frac{D_o(1 + g)}{(r_e - g)}$$

Gordon's growth approximation

$$g = br_e$$

The weighted average cost of capital

$$WACC = \left[\frac{V_e}{V_e + V_d}\right]k_e + \left[\frac{V_d}{V_e + V_d}\right]k_d(1 - T)$$

The Fisher formula

$$(1 + i) = (1 + r)(1 + h)$$

Purchasing power parity and interest rate parity

$$S_1 = S_0 x \frac{(1 + h_c)}{(1 + h_b)} \qquad F_0 = S_0 x \frac{(1 + i_c)}{(1 + i_b)}$$

Modified Internal Rate of Return

$$MIRR = \left[\frac{PV_R}{PV_I}\right]^{\frac{1}{n}} \left(1 + r_e\right) - 1$$

The Black-Scholes option pricing model

$$c = P_a N(d_1) - P_e N(d_2) e^{-rt}$$

Where:

$$d_1 = \frac{\ln(P_a / P_e) + (r + 0.5s^2)t}{s\sqrt{t}}$$

$$d_2 = d_1 - s\sqrt{t}$$

The Put Call Parity relationship

$$p = c - P_a + P_e e^{-rt}$$

Present Value Table

Present value of 1 i.e. $(1 + r)^{-n}$

Where r = discount rate
n = number of periods until payment

Discount rate (r)

Periods (n)	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	
1	0·990	0·980	0·971	0·962	0·952	0·943	0·935	0·926	0·917	0·909	1
2	0·980	0·961	0·943	0·925	0·907	0·890	0·873	0·857	0·842	0·826	2
3	0·971	0·942	0·915	0·889	0·864	0·840	0·816	0·794	0·772	0·751	3
4	0·961	0·924	0·888	0·855	0·823	0·792	0·763	0·735	0·708	0·683	4
5	0·951	0·906	0·863	0·822	0·784	0·747	0·713	0·681	0·650	0·621	5
6	0·942	0·888	0·837	0·790	0·746	0·705	0·666	0·630	0·596	0·564	6
7	0·933	0·871	0·813	0·760	0·711	0·665	0·623	0·583	0·547	0·513	7
8	0·923	0·853	0·789	0·731	0·677	0·627	0·582	0·540	0·502	0·467	8
9	0·914	0·837	0·766	0·703	0·645	0·592	0·544	0·500	0·460	0·424	9
10	0·905	0·820	0·744	0·676	0·614	0·558	0·508	0·463	0·422	0·386	10
11	0·896	0·804	0·722	0·650	0·585	0·527	0·475	0·429	0·388	0·350	11
12	0·887	0·788	0·701	0·625	0·557	0·497	0·444	0·397	0·356	0·319	12
13	0·879	0·773	0·681	0·601	0·530	0·469	0·415	0·368	0·326	0·290	13
14	0·870	0·758	0·661	0·577	0·505	0·442	0·388	0·340	0·299	0·263	14
15	0·861	0·743	0·642	0·555	0·481	0·417	0·362	0·315	0·275	0·239	15

(n)	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	
1	0·901	0·893	0·885	0·877	0·870	0·862	0·855	0·847	0·840	0·833	1
2	0·812	0·797	0·783	0·769	0·756	0·743	0·731	0·718	0·706	0·694	2
3	0·731	0·712	0·693	0·675	0·658	0·641	0·624	0·609	0·593	0·579	3
4	0·659	0·636	0·613	0·592	0·572	0·552	0·534	0·516	0·499	0·482	4
5	0·593	0·567	0·543	0·519	0·497	0·476	0·456	0·437	0·419	0·402	5
6	0·535	0·507	0·480	0·456	0·432	0·410	0·390	0·370	0·352	0·335	6
7	0·482	0·452	0·425	0·400	0·376	0·354	0·333	0·314	0·296	0·279	7
8	0·434	0·404	0·376	0·351	0·327	0·305	0·285	0·266	0·249	0·233	8
9	0·391	0·361	0·333	0·308	0·284	0·263	0·243	0·225	0·209	0·194	9
10	0·352	0·322	0·295	0·270	0·247	0·227	0·208	0·191	0·176	0·162	10
11	0·317	0·287	0·261	0·237	0·215	0·195	0·178	0·162	0·148	0·135	11
12	0·286	0·257	0·231	0·208	0·187	0·168	0·152	0·137	0·124	0·112	12
13	0·258	0·229	0·204	0·182	0·163	0·145	0·130	0·116	0·104	0·093	13
14	0·232	0·205	0·181	0·160	0·141	0·125	0·111	0·099	0·088	0·078	14
15	0·209	0·183	0·160	0·140	0·123	0·108	0·095	0·084	0·074	0·065	15

Annuity Table

Present value of an annuity of 1 i.e. $\frac{1-(1+r)^{-n}}{r}$

Where r = discount rate
n = number of periods

Discount rate (r)

Periods (n)	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	
1	0·990	0·980	0·971	0·962	0·952	0·943	0·935	0·926	0·917	0·909	1
2	1·970	1·942	1·913	1·886	1·859	1·833	1·808	1·783	1·759	1·736	2
3	2·941	2·884	2·829	2·775	2·723	2·673	2·624	2·577	2·531	2·487	3
4	3·902	3·808	3·717	3·630	3·546	3·465	3·387	3·312	3·240	3·170	4
5	4·853	4·713	4·580	4·452	4·329	4·212	4·100	3·993	3·890	3·791	5
6	5·795	5·601	5·417	5·242	5·076	4·917	4·767	4·623	4·486	4·355	6
7	6·728	6·472	6·230	6·002	5·786	5·582	5·389	5·206	5·033	4·868	7
8	7·652	7·325	7·020	6·733	6·463	6·210	5·971	5·747	5·535	5·335	8
9	8·566	8·162	7·786	7·435	7·108	6·802	6·515	6·247	5·995	5·759	9
10	9·471	8·983	8·530	8·111	7·722	7·360	7·024	6·710	6·418	6·145	10
11	10·368	9·787	9·253	8·760	8·306	7·887	7·499	7·139	6·805	6·495	11
12	11·255	10·575	9·954	9·385	8·863	8·384	7·943	7·536	7·161	6·814	12
13	12·134	11·348	10·635	9·986	9·394	8·853	8·358	7·904	7·487	7·103	13
14	13·004	12·106	11·296	10·563	9·899	9·295	8·745	8·244	7·786	7·367	14
15	13·865	12·849	11·938	11·118	10·380	9·712	9·108	8·559	8·061	7·606	15

(n)	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	
1	0·901	0·893	0·885	0·877	0·870	0·862	0·855	0·847	0·840	0·833	1
2	1·713	1·690	1·668	1·647	1·626	1·605	1·585	1·566	1·547	1·528	2
3	2·444	2·402	2·361	2·322	2·283	2·246	2·210	2·174	2·140	2·106	3
4	3·102	3·037	2·974	2·914	2·855	2·798	2·743	2·690	2·639	2·589	4
5	3·696	3·605	3·517	3·433	3·352	3·274	3·199	3·127	3·058	2·991	5
6	4·231	4·111	3·998	3·889	3·784	3·685	3·589	3·498	3·410	3·326	6
7	4·712	4·564	4·423	4·288	4·160	4·039	3·922	3·812	3·706	3·605	7
8	5·146	4·968	4·799	4·639	4·487	4·344	4·207	4·078	3·954	3·837	8
9	5·537	5·328	5·132	4·946	4·772	4·607	4·451	4·303	4·163	4·031	9
10	5·889	5·650	5·426	5·216	5·019	4·833	4·659	4·494	4·339	4·192	10
11	6·207	5·938	5·687	5·453	5·234	5·029	4·836	4·656	4·486	4·327	11
12	6·492	6·194	5·918	5·660	5·421	5·197	4·988	4·793	4·611	4·439	12
13	6·750	6·424	6·122	5·842	5·583	5·342	5·118	4·910	4·715	4·533	13
14	6·982	6·628	6·302	6·002	5·724	5·468	5·229	5·008	4·802	4·611	14
15	7·191	6·811	6·462	6·142	5·847	5·575	5·324	5·092	4·876	4·675	15

Standard normal distribution table

	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
0·0	0·0000	0·0040	0·0080	0·0120	0·0160	0·0199	0·0239	0·0279	0·0319	0·0359
0·1	0·0398	0·0438	0·0478	0·0517	0·0557	0·0596	0·0636	0·0675	0·0714	0·0753
0·2	0·0793	0·0832	0·0871	0·0910	0·0948	0·0987	0·1026	0·1064	0·1103	0·1141
0·3	0·1179	0·1217	0·1255	0·1293	0·1331	0·1368	0·1406	0·1443	0·1480	0·1517
0·4	0·1554	0·1591	0·1628	0·1664	0·1700	0·1736	0·1772	0·1808	0·1844	0·1879
0·5	0·1915	0·1950	0·1985	0·2019	0·2054	0·2088	0·2123	0·2157	0·2190	0·2224
0·6	0·2257	0·2291	0·2324	0·2357	0·2389	0·2422	0·2454	0·2486	0·2517	0·2549
0·7	0·2580	0·2611	0·2642	0·2673	0·2704	0·2734	0·2764	0·2794	0·2823	0·2852
0·8	0·2881	0·2910	0·2939	0·2967	0·2995	0·3023	0·3051	0·3078	0·3106	0·3133
0·9	0·3159	0·3186	0·3212	0·3238	0·3264	0·3289	0·3315	0·3340	0·3365	0·3389
1·0	0·3413	0·3438	0·3461	0·3485	0·3508	0·3531	0·3554	0·3577	0·3599	0·3621
1·1	0·3643	0·3665	0·3686	0·3708	0·3729	0·3749	0·3770	0·3790	0·3810	0·3830
1·2	0·3849	0·3869	0·3888	0·3907	0·3925	0·3944	0·3962	0·3980	0·3997	0·4015
1·3	0·4032	0·4049	0·4066	0·4082	0·4099	0·4115	0·4131	0·4147	0·4162	0·4177
1·4	0·4192	0·4207	0·4222	0·4236	0·4251	0·4265	0·4279	0·4292	0·4306	0·4319
1·5	0·4332	0·4345	0·4357	0·4370	0·4382	0·4394	0·4406	0·4418	0·4429	0·4441
1·6	0·4452	0·4463	0·4474	0·4484	0·4495	0·4505	0·4515	0·4525	0·4535	0·4545
1·7	0·4554	0·4564	0·4573	0·4582	0·4591	0·4599	0·4608	0·4616	0·4625	0·4633
1·8	0·4641	0·4649	0·4656	0·4664	0·4671	0·4678	0·4686	0·4693	0·4699	0·4706
1·9	0·4713	0·4719	0·4726	0·4732	0·4738	0·4744	0·4750	0·4756	0·4761	0·4767
2·0	0·4772	0·4778	0·4783	0·4788	0·4793	0·4798	0·4803	0·4808	0·4812	0·4817
2·1	0·4821	0·4826	0·4830	0·4834	0·4838	0·4842	0·4846	0·4850	0·4854	0·4857
2·2	0·4861	0·4864	0·4868	0·4871	0·4875	0·4878	0·4881	0·4884	0·4887	0·4890
2·3	0·4893	0·4896	0·4898	0·4901	0·4904	0·4906	0·4909	0·4911	0·4913	0·4916
2·4	0·4918	0·4920	0·4922	0·4925	0·4927	0·4929	0·4931	0·4932	0·4934	0·4936
2·5	0·4938	0·4940	0·4941	0·4943	0·4945	0·4946	0·4948	0·4949	0·4951	0·4952
2·6	0·4953	0·4955	0·4956	0·4957	0·4959	0·4960	0·4961	0·4962	0·4963	0·4964
2·7	0·4965	0·4966	0·4967	0·4968	0·4969	0·4970	0·4971	0·4972	0·4973	0·4974
2·8	0·4974	0·4975	0·4976	0·4977	0·4977	0·4978	0·4979	0·4979	0·4980	0·4981
2·9	0·4981	0·4982	0·4982	0·4983	0·4984	0·4984	0·4985	0·4985	0·4986	0·4986
3·0	0·4987	0·4987	0·4987	0·4988	0·4988	0·4989	0·4989	0·4989	0·4990	0·4990

This table can be used to calculate $N(d)$, the cumulative normal distribution functions needed for the Black-Scholes model of option pricing. If $d_i > 0$, add 0·5 to the relevant number above. If $d_i < 0$, subtract the relevant number above from 0·5.

End of Question Paper