Professional Level – Options Module

Advanced Financial Management

September/December 2016 – Sample Questions

Paper P4

Time allowed: 3 hours 15 minutes

This question 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 8–12.

Do NOT open this question paper until instructed by the supervisor.

This question paper must not be removed from the examination hall.

Think Ahead

ACCA

The Association of Chartered Certified Accountants

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

1 Morada Co is involved in offering bespoke travel services and maintenance services. In addition to owning a few hotels, it has built strong relationships with companies in the hospitality industry all over the world. It has a good reputation of offering unique, high quality holiday packages at reasonable costs for its clients. The strong relationships have also enabled it to offer repair and maintenance services to a number of hotel chains and cruise ship companies.

Following a long discussion at a meeting of the board of directors (BoD) about the future strategic direction which Morada Co should follow, three directors continued to discuss one particular issue over dinner. In the meeting, the BoD had expressed concern that Morada Co was exposed to excessive risk and therefore its cost of capital was too high. The BoD feared that several good projects had been rejected over the previous two years, because they did not meet Morada Co's high cost of capital threshold. Each director put forward a proposal, which they then discussed in turn. At the conclusion of the dinner, the directors decided to ask for a written report on the proposals put forward by the first director and the second director, before taking all three proposals to the BoD for further discussion.

First director's proposal

The first director is of the opinion that Morada Co should reduce its debt in order to mitigate its risk and therefore reduce its cost of capital. He proposes that the company should sell its repair and maintenance services business unit and focus just on offering bespoke travel services and hotel accommodation. In the sale, the book value of non-current assets will reduce by 30% and the book value of current liabilities will reduce by 10%. It is thought that the non-current assets can be sold for an after-tax profit of 15%.

The first director suggests that the funds arising from the sale of the repair and maintenance services business unit and cash resources should be used to pay off 80% of the long-term debt. It is estimated that as a result of this, Morada Co's credit rating will improve from Baa2 to A2.

Second director's proposal

The second director is of the opinion that risk diversification is the best way to reduce Morada Co's risk and therefore reduce its cost of capital. He proposes that the company raise additional funds using debt finance and then create a new strategic business unit. This business unit will focus on construction of new commercial properties.

The second director suggests that $70 million should be borrowed and used to invest in purchasing non-current assets for the construction business unit. The new debt will be issued in the form of four-year redeemable bonds paying an annual coupon of 6·2%. It is estimated that if this amount of debt is raised, then Morada Co's credit rating will worsen to Ca3 from Baa2. Current liabilities are estimated to increase to $28 million.

Third director's proposal

The third director is of the opinion that Morada Co does not need to undertake the proposals suggested by the first director and the second director just to reduce the company's risk profile. She feels that the above proposals require a fundamental change in corporate strategy and should be considered in terms of more than just tools to manage risk. Instead, she proposes that a risk management system should be set up to appraise Morada Co's current risk profile, considering each type of business risk and financial risk within the company, and taking appropriate action to manage the risk where it is deemed necessary.

Morada Co, extracts from the forecast financial position for the coming year

	$000
Non-current assets	280,000
Current assets	48,000
Total assets	328,000
Equity and liabilities	
Share capital (40c/share)	50,000
Retained earnings	137,000
Total equity	187,000
Non-current liabilities (6·2% redeemable bonds)	120,000
Current liabilities	21,000
Total liabilities	141,000
Total liabilities and equity capital	328,000

Other financial information

Morada Co's forecast after-tax earnings for the coming year are expected to be $28 million. It is estimated that the company will make a 9% return after-tax on any new investment in non-current assets, and will suffer a 9% decrease in after-tax earnings on any reduction in investment in non-current assets.

Morada Co's current share price is $2·88 per share. According to the company's finance division, it is very difficult to predict how the share price will react to either the proposal made by the first director or the proposal made by the second director. Therefore it has been assumed that the share price will not change following either proposal.

The finance division has further assumed that the proportion of the book value of non-current assets invested in each business unit gives a fair representation of the size of each business unit within Morada Co.

Morada Co's equity beta is estimated at 1·2, while the asset beta of the repairs and maintenance services business unit is estimated to be 0·65. The relevant equity beta for the new, larger company including the construction unit relevant to the second director's proposals has been estimated as 1·21.

The bonds are redeemable in four years' time at face value. For the purposes of estimating the cost of capital, it can be assumed that debt beta is zero. However, the four-year credit spread over the risk free rate of return is 60 basis points for A2 rated bonds, 90 basis points for Baa2 rated bonds and 240 basis points for Ca3 rated bonds.

A tax rate of 20% is applicable to all companies. The current risk free rate of return is estimated to be 3·8% and the market risk premium is estimated to be 7%.

Required:

(a) Explain how business risk and financial risk are related; and how risk mitigation and risk diversification can form part of a company's risk management strategy. (6 marks)

(b) Prepare a report for the board of directors of Morada Co which:

(i) Estimates Morada Co's cost of equity and cost of capital, based on market value of equity and debt, before any changes and then after implementing the proposals put forward by the first and by the second directors; (17 marks)

(ii) Estimates the impact of the first and second directors' proposals on Morada Co's forecast after-tax earnings and forecast financial position for the coming year; and (7 marks)

(iii) Discusses the impact on Morada Co of the changes proposed by the first and second directors and recommends whether or not either proposal should be accepted. The discussion should include an explanation of any assumptions made in the estimates in (b)(i) and (b)(ii) above. (9 marks)

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

(c) Discuss the possible reasons for the third director's proposal that a risk management system should consider each risk, before taking appropriate action. (7 marks)

(50 marks)

Section B – TWO questions ONLY to be attempted

2 Fernhurst Co is a manufacturer of mobile communications technology. It is about to launch a new communications device, the Milland, which its directors believe is both more technologically advanced and easier to use than devices currently offered by its rivals.

Investment in the Milland

The Milland will require a major investment in facilities. Fernhurst Co's directors believe that this can take place very quickly and production be started almost immediately.

Fernhurst Co expects to sell 132,500 units of the Milland in its first year. Sales volume is expected to increase by 20% in Year 2 and 30% in Year 3, and then be the same in Year 4 as Year 3, as the product reaches the end of its useful life. The initial selling price in Year 1 is expected to be $100 per unit, before increasing with the rate of inflation annually.

The variable cost of each unit is expected to be $43·68 in year 1, rising by the rate of inflation in subsequent years annually. Fixed costs are expected to be $900,000 in Year 1, rising by the rate of inflation in subsequent years annually.

The initial investment in non-current assets is expected to be $16,000,000. Fernhurst Co will also need to make an immediate investment of $1,025,000 in working capital. The working capital will be increased annually at the start of each of Years 2 to 4 by the inflation rate and is fully recoverable at the end of the project's life. Fernhurst Co will also incur one-off marketing expenditure of $1,500,000 post inflation after the launch of the Milland. The marketing expenditure can be assumed to be made at the end of Year 1 and be a tax allowable expense.

Fernhurst Co pays company tax on profits at an annual rate of 25%. Tax is payable in the year that the tax liability arises. Tax allowable depreciation is available at 20% on the investment in non-current assets on a reducing balance basis. A balancing adjustment will be available in Year 4. The realisable value of the investment at the end of Year 4 is expected to be zero.

The expected annual rate of inflation in the country in which Fernhurst Co is located is 4% in Year 1 and 5% in Years 2 to 4.

The applicable cost of capital for this investment appraisal is 11%.

Other calculations

Fernhurst Co's finance director has indicated that besides needing a net present value calculation based on this data for the next board meeting, he also needs to know the figure for the project's duration, to indicate to the board how returns from the project will be spread over time.

Failure of launch of the Milland

The finance director would also like some simple analysis based on the possibility that the marketing expenditure is not effective and the launch fails, as he feels that the product's price may be too high. He has suggested that there is a 15% chance that the Milland will have negative net cash flows for Year 1 of $1,000,000 or more. He would like to know by what percentage the selling price could be reduced or increased to result in the investment having a zero net present value, assuming demand remained the same.

Assessment of new products

Fernhurst Co's last board meeting discussed another possible new product, the Racton, and the finance director presented a range of financial data relating to this product, including the results of net present value and payback evaluations. One of the non-executive directors, who is not a qualified accountant, stated that he found it difficult to see the significance of the different items of financial data. His understanding was that Fernhurst Co merely had to ensure that the investment had a positive net present value and shareholders were bound to be satisfied with it, as it would maximise their wealth in the long term. The finance director commented that, in reality, some shareholders looked at the performance of the investments which Fernhurst Co made over the short term, whereas some were more concerned with the longer term. The financial data he presented to board meetings included both short and long-term measures.

Required:

(a) Evaluate the financial acceptability of the investment in the Milland and, calculate and comment on the investment's duration. (15 marks)

(b) Calculate the % change in the selling price required for the investment to have a zero net present value, and discuss the significance of your results. (5 marks)

(c) Discuss the non-executive director's understanding of net present value and explain the importance of other measures in providing data about an investment's short and long-term performance. (5 marks)

(25 marks)

3 Chithurst Co gained a stock exchange listing five years ago. At the time of the listing, members of the family who founded the company owned 75% of the shares, but now they only hold just over 50%. The number of shares in issue has remained unchanged since Chithurst Co was listed. Chithurst Co's directors have continued the policy of paying a constant dividend per share each year which the company had before it was listed. However, investors who are not family members have become increasingly critical of this policy, saying that there is no clear rationale for it. They would prefer to see steady dividend growth, reflecting the increase in profitability of Chithurst Co since its listing.

The finance director of Chithurst Co has provided its board with details of Chithurst Co's dividends and investment expenditure, compared with two other similar-sized companies in the same sector, Eartham Co and Iping Co. Each company has a 31 December year end.

	Chithurst Co			Eartham Co			Iping Co		
	Profit for year after interest and tax	Dividend paid	New investment expenditure	Profit for year after interest and tax	Dividend paid	New investment expenditure	Profit for year after interest and tax	Dividend paid	New investment expenditure
	$m	$m	$m	$m	$m	$m	$m	$m	$m
2012	77	33	18	95	38	30	75	35	37
2013	80	33	29	(10)	15	15	88	17	64
2014	94	33	23	110	44	42	118	39	75
2015	97	33	21	120	48	29	132	42	84

Other financial information relating to the three companies is as follows:

	Chithurst Co	Eartham Co	Iping Co
Cost of equity	11%	14%	12%
Market capitalisation $m	608	1,042	1,164
Increase in share price in last 12 months	1%	5%	10%

Chithurst Co's finance director has estimated the costs of equity for all three companies.

None of the three companies has taken out significant new debt finance since 2011.

Required:

(a) Discuss the benefits and drawbacks of the dividend policies which the three companies appear to have adopted. Provide relevant calculations to support your discussion.

Note: Up to 5 marks are available for the calculations. (15 marks)

(b) Discuss how the market capitalisation of the three companies compares with your valuations calculated using the dividend valuation model. Use the data provided to calculate valuations based on growth rates for the most recent year and for the last three years.

Note: Up to 5 marks are available for the calculations. (10 marks)

(25 marks)

4 Pault Co is currently undertaking a major programme of product development. Pault Co has made a significant investment in plant and machinery for this programme. Over the next couple of years, Pault Co has also budgeted for significant development and launch costs for a number of new products, although its finance director believes there is some uncertainty with these budgeted figures, as they will depend upon competitor activity amongst other matters.

Pault Co issued floating rate loan notes, with a face value of $400 million, to fund the investment in plant and machinery. The loan notes are redeemable in ten years' time. The interest on the loan notes is payable annually and is based on the spot yield curve, plus 50 basis points.

Pault Co's finance director has recently completed a review of the company's overall financing strategy. His review has highlighted expectations that interest rates will increase over the next few years, although the predictions of financial experts in the media differ significantly.

The finance director is concerned about the exposure Pault Co has to increases in interest rates through the loan notes. He has therefore discussed with Millbridge Bank the possibility of taking out a four-year interest rate swap. The proposed terms are that Pault Co would pay Millbridge Bank interest based on an equivalent fixed annual rate of 4·847%. In return, Pault Co would receive from Millbridge Bank a variable amount based on the forward rates calculated from the annual spot yield curve rate at the time of payment minus 20 basis points. Payments and receipts would be made annually, with the first one in a year's time. Millbridge Bank would charge an annual fee of 25 basis points if Pault Co enters the swap.

The current annual spot yield curve rates are as follows:

Year	One	Two	Three	Four
Rate	3·70%	4·25%	4·70%	5·10%

A number of concerns were raised at the recent board meeting when the swap arrangement was discussed.

– Pault Co's chairman wondered what the value of the swap arrangement to Pault Co was, and whether the value would change over time.

– One of Pault Co's non-executive directors objected to the arrangement, saying that in his opinion the interest rate which Pault Co would pay and the bank charges were too high. Pault Co ought to stick with its floating rate commitment. Investors would be critical if, at the end of four years, Pault Co had paid higher costs under the swap than it would have done had it left the loan unhedged.

Required:

(a) (i) Using the current annual spot yield curve rates as the basis for estimating forward rates, calculate the amounts Pault Co expects to pay or receive each year under the swap (excluding the fee of 25 basis points). (6 marks)

(ii) Calculate Pault Co's interest payment liability for Year 1 if the yield curve rate is 4·5% or 2·9%, and comment on your results. (6 marks)

(b) Advise the chairman on the current value of the swap to Pault Co and the factors which would change the value of the swap. (4 marks)

(c) Discuss the disadvantages and advantages to Pault Co of not undertaking a swap and being liable to pay interest at floating rates. (9 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

[P.T.O.

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