Professional Level – Options Module

Advanced Financial Management

Tuesday 2 December 2014

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 8–12.

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.

Paper P4

ACCA

The Association of Chartered Certified Accountants

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

1 Nahara Co and Fugae Co

Nahara Co is a private holding company owned by the government of a wealthy oil-rich country to invest its sovereign funds. Nahara Co has followed a strategy of risk diversification for a number of years by acquiring companies from around the world in many different sectors.

One of Nahara Co's acquisition strategies is to identify and purchase undervalued companies in the airline industry in Europe. A recent acquisition was Fugae Co, a company based in a country which is part of the European Union (EU). Fugae Co repairs and maintains aircraft engines.

A few weeks ago, Nahara Co stated its intention to pursue the acquisition of an airline company based in the same country as Fugae Co. The EU, concerned about this, asked Nahara Co to sell Fugae Co before pursuing any further acquisitions in the airline industry.

Avem Co's acquisition interest in Fugae Co

Avem Co, a UK-based company specialising in producing and servicing business jets, has approached Nahara Co with a proposal to acquire Fugae Co for $1,200 million. Nahara Co expects to receive a premium of at least 30% on the estimated equity value of Fugae Co, if it is sold.

Given below are extracts from the most recent statements of financial position of both Avem Co and Fugae Co.

	Avem Co $ million	Fugae Co $ million
Share capital (50c/share)	800	100
Reserves	3,550	160
Non-current liabilities	2,200	380
Current liabilities	130	30
Total capital and liabilities	6,680	670

Each Avem Co share is currently trading at $7·50, which is a multiple of 7·2 of its free cash flow to equity. Avem Co expects that the total free cash flows to equity of the combined company will increase by $40 million due to synergy benefits. After adding the synergy benefits of $40 million, Avem Co then expects the multiple of the total free cash flow of the combined company to increase to 7·5.

Fugae Co's free cash flow to equity is currently estimated at $76·5 million and it is expected to generate a return on equity of 11%. Over the past few years, Fugae Co has returned 77·3% of its annual free cash flow to equity back to Nahara Co, while retaining the balance for new investments.

Fugae Co's non-current liabilities consist entirely of $100 nominal value bonds which are redeemable in four years at the nominal value, on which the company pays a coupon of 5·4%. The debt is rated at B+ and the credit spread on B+ rated debt is 80 basis points above the risk-free rate of return.

Proposed luxury transport investment project by Fugae Co

In recent years, the country in which Fugae Co is based has been expanding its tourism industry and hopes that this industry will grow significantly in the near future. At present tourists normally travel using public transport and taxis, but there is a growing market for luxury travel. If the tourist industry does expand, then the demand for luxury travel is expected to grow rapidly. Fugae Co is considering entering this market through a four-year project. The project will cease after four years because of increasing competition.

The initial cost of the project is expected to be $42,000,000 and it is expected to generate the following after-tax cash flows over its four-year life:

Year	1	2	3	4
Cash flows ($000s)	3,277.6	16,134.3	36,504.7	35,683.6

The above figures are based on the tourism industry expanding as expected. However, it is estimated that there is a 25% probability that the tourism industry will not grow as expected in the first year. If this happens, then the present value of the project's cash flows will be 50% of the original estimates over its four-year life.

It is also estimated that if the tourism industry grows as expected in the first year, there is still a 20% probability that the expected growth will slow down in the second and subsequent years, and the present value of the project's cash flows would then be 40% of the original estimates in each of these years.

Lumi Co, a leisure travel company, has offered $50 million to buy the project from Fugae Co at the start of the second year. Fugae Co is considering whether having this choice would add to the value of the project.

If Fugae Co is bought by Avem Co after the project has begun, it is thought that the project will not result in any additional synergy benefits and will not generate any additional value for the combined company, above any value the project has already generated for Fugae Co.

Although there is no beta for companies offering luxury forms of travel in the tourist industry, Reka Co, a listed company, offers passenger transportation services on coaches, trains and luxury vehicles. About 15% of its business is in the luxury transport market and Reka Co's equity beta is 1·6. It is estimated that the asset beta of the non-luxury transport industry is 0·80. Reka Co's shares are currently trading at $4·50 per share and its debt is currently trading at $105 per $100. It has 80 million shares in issue and the book value of its debt is $340 million. The debt beta is estimated to be zero.

General information
The corporation tax rate applicable to all companies is 20%. The risk-free rate is estimated to be 4% and the market risk premium is estimated to be 6%.

Required:

(a) Discuss whether or not Nahara Co's acquisition strategies, of pursuing risk diversification and of purchasing undervalued companies, can be valid. (7 marks)

(b) Discuss why the European Union (EU) may be concerned about Nahara Co's stated intention and how selling Fugae Co could reduce this concern. (4 marks)

(c) Prepare a report for the Board of Directors of Avem Co, which:

(i) Estimates the additional value created for Avem Co, if it acquires Fugae Co without considering the luxury transport project; (10 marks)

(ii) Estimates the additional value of the luxury transport project to Fugae Co, both with and without the offer from Lumi Co; (18 marks)

(iii) Evaluates the benefit attributable to Avem Co and Fugae Co from combining the two companies with and without the project, and concludes whether or not the acquisition is beneficial. The evaluation should include any assumptions made. (7 marks)

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

(50 marks)

Section B – TWO questions ONLY to be attempted

2 Keshi Co is a large multinational company with a number of international subsidiary companies. A centralised treasury department manages Keshi Co and its subsidiaries' borrowing requirements, cash surplus investment and financial risk management. Financial risk is normally managed using conventional derivative products such as forwards, futures, options and swaps.

Assume it is 1 December 2014 today and Keshi Co is expecting to borrow $18,000,000 on 1 February 2015 for a period of seven months. It can either borrow the funds at a variable rate of LIBOR plus 40 basis points or a fixed rate of 5·5%. LIBOR is currently 3·8% but Keshi Co feels that this could increase or decrease by 0·5% over the coming months due to increasing uncertainty in the markets.

The treasury department is considering whether or not to hedge the $18,000,000, using either exchange-traded March options or over-the-counter swaps offered by Rozu Bank.

The following information and quotes for $ March options are provided from an appropriate exchange. The options are based on three-month $ futures, $1,000,000 contract size and option premiums are in annual %.

March calls	Strike price	March puts
0·882	95·50	0·662
0·648	96·00	0·902

Option prices are quoted in basis points at 100 minus the annual % yield and settlement of the options contracts is at the end of March 2015. The current basis on the March futures price is 44 points; and it is expected to be 33 points on 1 January 2015, 22 points on 1 February 2015 and 11 points on 1 March 2015.

Rozu Bank has offered Keshi Co a swap on a counterparty variable rate of LIBOR plus 30 basis points or a fixed rate of 4·6%, where Keshi Co receives 70% of any benefits accruing from undertaking the swap, prior to any bank charges. Rozu Bank will charge Keshi Co 10 basis points for the swap.

Keshi Co's chief executive officer believes that a centralised treasury department is necessary in order to increase shareholder value, but Keshi Co's new chief financial officer (CFO) thinks that having decentralised treasury departments operating across the subsidiary companies could be more beneficial. The CFO thinks that this is particularly relevant to the situation which Suisen Co, a company owned by Keshi Co, is facing.

Suisen Co operates in a country where most companies conduct business activities based on Islamic finance principles. It produces confectionery products including chocolates. It wants to use Salam contracts instead of commodity futures contracts to hedge its exposure to price fluctuations of cocoa. Salam contracts involve a commodity which is sold based on currently agreed prices, quantity and quality. Full payment is received by the seller immediately, for an agreed delivery to be made in the future.

Required:

(a) Based on the two hedging choices Keshi Co is considering, recommend a hedging strategy for the $18,000,000 borrowing. Support your answer with appropriate calculations and discussion. (15 marks)

(b) Discuss how a centralised treasury department may increase value for Keshi Co and the possible reasons for decentralising the treasury department. (6 marks)

(c) Discuss the key differences between a Salam contract, under Islamic finance principles, and futures contracts. (4 marks)

(25 marks)

3 Riviere Co is a small company based in the European Union (EU). It produces high quality frozen food which it exports to a small number of supermarket chains located within the EU as well. The EU is a free trade area for trade between its member countries.

Riviere Co finds it difficult to obtain bank finance and relies on a long-term strategy of using internally generated funds for new investment projects. This constraint means that it cannot accept every profitable project and often has to choose between them.

Riviere Co is currently considering investment in one of two mutually exclusive food production projects: Privi and Drugi. Privi will produce and sell a new range of frozen desserts exclusively within the EU. Drugi will produce and sell a new range of frozen desserts and savoury foods to supermarket chains based in countries outside the EU. Each project will last for five years and the following financial information refers to both projects.

Project Drugi, annual after-tax cash flows expected at the end of each year (€000s)

Year	**Current**	**1**	**2**	**3**	**4**	**5**
Cash flows (€000s)	(11,840)	1,230	1,680	4,350	10,240	2,200

	Privi	**Drugi**
Net present value	€2,054,000	€2,293,000
Internal rate of return	17·6%	Not provided
Modified internal rate of return	13·4%	Not provided
Value at risk (over the project's life)		
95% confidence level	€1,103,500	Not provided
90% confidence level	€860,000	Not provided

Both projects' net present value has been calculated based on Riviere Co's nominal cost of capital of 10%. It can be assumed that both projects' cash flow returns are normally distributed and the annual standard deviation of project Drugi's present value of after-tax cash flows is estimated to be €400,000. It can also be assumed that all sales are made in € (Euro) and therefore the company is not exposed to any foreign exchange exposure.

Notwithstanding how profitable project Drugi may appear to be, Riviere Co's board of directors is concerned about the possible legal risks if it invests in the project because they have never dealt with companies outside the EU before.

Required:

(a) Discuss the aims of a free trade area, such as the European Union (EU), and the possible benefits to Riviere Co of operating within the EU. (5 marks)

(b) Calculate the figures which have not been provided for project Drugi and recommend which project should be accepted. Provide a justification for the recommendation and explain what the value at risk measures. (13 marks)

(c) Discuss the possible legal risks of investing in project Drugi which Riviere Co may be concerned about and how these may be mitigated. (7 marks)

(25 marks)

4 Kamala Co, a listed company, manufactures parts and machinery for the construction industry. About five years ago, Kamala Co started to manufacture parts and machinery for hospitals and companies engaged in biomedical research using largely the same manufacturing and processing systems it already had in place. In 2011, a young and ambitious chief executive officer (CEO) took over the running of the company.

With the publication of the latest financial statements for the year to 30 November 2014, the CEO made a brief statement and it includes the following two points:

– The CEO was very pleased with growth in the financial ratios provided and sales revenue from 2012 to 2014. More pleasing was growth in the share price, which increased even faster than the growth in the market index, suggesting that Kamala Co has been a successful company.

– The CEO expressed a desire to make Kamala Co the leading manufacturer of parts and machinery for the construction industry by acquiring a major rival manufacturer in 2015, and financing the acquisition through an issue of a new bond and a small rights issue.

An analyst, after examining the recent financial statements and the two points above, was less positive about Kamala Co's future prospects.

Given below are extracts from the recent financial statements, some ratios, and other financial information for Kamala Co.

Kamala Co
Year ending 30 November (all amounts in $m)

	2012	2013	2014
Sales revenue	3,760	4,054	5,230
Operating profit	714	819	1,098
Finance costs	97	168	269
Profit before tax	617	651	829
Taxation	154	163	207
Profit for the year	463	488	622
Dividends	139	137	152

Kamala Co
Year ending 30 November (all amounts in $m)

	2012	2013	2014
Total non-current assets	3,962	5,507	7,669
Total current assets	980	1,410	1,880
Total non-current and current assets	4,942	6,917	9,549
Equity			
Ordinary shares ($0·25)	750	750	750
Reserves	1,476	1,827	2,297
Total equity	2,226	2,577	3,047
Non-current liabilities			
Bank loans	476	1,176	1,316
Bonds	1,008	1,008	2,218
Total non-current liabilities	1,484	2,184	3,534
Current liabilities			
Trade and other payables	1,232	1,540	2,016
Bank overdraft	–	616	952
Total current liabilities	1,232	2,156	2,968
Total non-current and current liabilities	2,716	4,340	6,502

Kamala Co: By activity
Year ending 30 November (all amounts in $m)

	2012	2013	2014
Sales revenue			
Construction	2,420	2,644	3,660
Hospitals and biomedical	1,340	1,410	1,570
Operating profit			
Construction	460	489	693
Hospitals and biomedical	254	330	405

Ratios: Kamala Co

	2012	2013	2014
Operating profit margin	19·0%	20·2%	21·0%
Dividend cover	3·3	3·6	4·1
Earnings per share	15·4c	16·3c	20·7c
Gearing [(debt/debt + equity)]	40%	46%	54%

Other financial information

	30 November 2012	30 November 2013	30 November 2014
Kamala Co share price ($)	1·69	2·01	2·69
Market index	4,539	5,447	6,550
Industry index	840	1,092	1,422
Industry average PE ratio	9·2:1	12·1:1	15·3:1

	2013 ($m)	2014 ($m)
Depreciation deducted to arrive at the operating profit (equivalent to tax allowable depreciation)	826	1,150
Economic depreciation	990	1,380
Non-cash expenses (excluding depreciation)	150	170

Kamala Co's cost of capital is estimated to be 10%. The company's corporation tax rate is 25%.

Required:

(a) Discuss the advantages and drawbacks of using the economic value added (EVA™) technique to assess a company's performance. (6 marks)

(b) Estimate Kamala Co's EVA™ for the years ending 30 November 2013 and 30 November 2014. (5 marks)

(c) Evaluate Kamala Co's performance and conclude whether the analyst's opinion or the chief executive officer's opinion has the greater validity. Include any additional ratio and activity trends, and share price analysis, which are deemed to be relevant to the evaluation. (14 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

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

The Fisher formula

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

Purchasing power parity and interest rate parity

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

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