Professional Level – Options Module

Advanced Financial Management

Tuesday 12 June 2012

Paper P4

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

This paper is divided into two sections:

Section A – BOTH questions are 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.

ACCA

The Association of Chartered Certified Accountants

Section A – BOTH questions are compulsory and MUST be attempted

1 Nente Co, an unlisted company, designs and develops tools and parts for specialist machinery. The company was formed four years ago by three friends, who own 20% of the equity capital in total, and a consortium of five business angel organisations, who own the remaining 80%, in roughly equal proportions. Nente Co also has a large amount of debt finance in the form of variable rate loans. Initially the amount of annual interest payable on these loans was low and allowed Nente Co to invest internally generated funds to expand its business. Recently though, due to a rapid increase in interest rates, there has been limited scope for future expansion and no new product development.

The Board of Directors, consisting of the three friends and a representative from each business angel organisation, met recently to discuss how to secure the company's future prospects. Two proposals were put forward, as follows:

Proposal 1
To accept a takeover offer from Mije Co, a listed company, which develops and manufactures specialist machinery tools and parts. The takeover offer is for $2·95 cash per share or a share-for-share exchange where two Mije Co shares would be offered for three Nente Co shares. Mije Co would need to get the final approval from its shareholders if either offer is accepted;

Proposal 2
To pursue an opportunity to develop a small prototype product that just breaks even financially, but gives the company exclusive rights to produce a follow-on product within two years.

The meeting concluded without agreement on which proposal to pursue.

After the meeting, Mije Co was consulted about the exclusive rights. Mije Co's directors indicated that they had not considered the rights in their computations and were willing to continue with the takeover offer on the same terms without them.

Currently, Mije Co has 10 million shares in issue and these are trading for $4·80 each. Mije Co's price to earnings (P/E) ratio is 15. It has sufficient cash to pay for Nente Co's equity and a substantial proportion of its debt, and believes that this will enable Nente Co to operate on a P/E level of 15 as well. In addition to this, Mije Co believes that it can find cost-based synergies of $150,000 after tax per year for the foreseeable future. Mije Co's current profit after tax is $3,200,000.

The following financial information relates to Nente Co and to the development of the new product.

Nente Co financial information

Extract from the most recent income statement

	$'000
Sales revenue	8,780
Profit before interest and tax	1,230
Interest	(455)
Tax	(155)
Profit after tax	620
Dividends	Nil

Extract from the most recent statement of financial position

	$'000
Net non-current assets	10,060
Current assets	690
Total Assets	10,750
Share capital (40c per share par value)	960
Reserves	1,400
Non-current liabilities: Variable rate loans	6,500
Current liabilities	1,890
Total liabilities and capital	10,750

In arriving at the profit after tax amount, Nente Co deducted tax allowable depreciation and other non-cash expenses totalling $1,206,000. It requires an annual cash investment of $1,010,000 in non-current assets and working capital to continue its operations.

Nente Co's profits before interest and tax in its first year of operation were $970,000 and have been growing steadily in each of the following three years, to their current level. Nente Co's cash flows grew at the same rate as well, but it is likely that this growth rate will reduce to 25% of the original rate for the foreseeable future.

Nente Co currently pays interest of 7% per year on its loans, which is 380 basis points over the government base rate, and corporation tax of 20% on profits after interest. It is estimated that an overall cost of capital of 11% is reasonable compensation for the risk undertaken on an investment of this nature.

New product development (Proposal 2)

Developing the new follow-on product will require an investment of $2,500,000 initially. The total expected cash flows and present values of the product over its five-year life, with a volatility of 42% standard deviation, are as follows:

Year(s)	Now	1	2	3 to 7 (in total)
Cash flows ($'000)	–	–	(2,500)	3,950
Present values ($'000)	–	–	(2,029)	2,434

Required:

Prepare a report for the Board of Directors of Nente Co that:

(i) Estimates the current value of a Nente Co share, using the free cash flow to firm methodology; (7 marks)

(ii) Estimates the percentage gain in value to a Nente Co share and a Mije Co share under each payment offer; (8 marks)

(iii) Estimates the percentage gain in the value of the follow-on product to a Nente Co share, based on its cash flows and on the assumption that the production can be delayed following acquisition of the exclusive rights of production; (8 marks)

(iv) Discusses the likely reaction of Nente Co and Mije Co shareholders to the takeover offer, including the assumptions made in the estimates above and how the follow-on product's value can be utilised by Nente Co. (8 marks)

Professional marks will be awarded in question 1 for the presentation, structure and clarity of the answer. (4 marks)

(35 marks)

2 Three proposals were put forward for further consideration after a meeting of the executive directors of Ennea Co to discuss the future investment and financing strategy of the business. Ennea Co is a listed company operating in the haulage and shipping industry.

Proposal 1
To increase the company's level of debt by borrowing a further $20 million and use the funds raised to buy back share capital.

Proposal 2
To increase the company's level of debt by borrowing a further $20 million and use these funds to invest in additional non-current assets in the haulage strategic business unit.

Proposal 3
To sell excess non-current haulage assets with a net book value of $25 million for $27 million and focus on offering more services to the shipping strategic business unit. This business unit will require no additional investment in non-current assets. All the funds raised from the sale of the non-current assets will be used to reduce the company's debt.

Ennea Co financial information

Extracts from the forecast financial position for the coming year

	$m
Non-current assets	282
Current assets	66
Total assets	348
Equity and liabilities	
Share capital (40c per share par value)	48
Retained earnings	123
Total equity	171
Non-current liabilities	140
Current liabilities	37
Total liabilities	177
Total liabilities and capital	348

Ennea Co's forecast after tax profit for the coming year is expected to be $26 million and its current share price is $3·20 per share. The non-current liabilities consist solely of a 6% medium term loan redeemable within seven years. The terms of the loan contract stipulates that an increase in borrowing will result in an increase in the coupon payable of 25 basis points on the total amount borrowed, while a reduction in borrowing will lower the coupon payable by 15 basis points on the total amount borrowed.

Ennea Co's effective tax rate is 20%. The company's estimated after tax rate of return on investment is expected to be 15% on any new investment. It is expected that any reduction in investment would suffer the same rate of return.

Required:

(a) Estimate and discuss the impact of each of the three proposals on the forecast statement of financial position, the earnings and earnings per share, and gearing of Ennea Co. (20 marks)

(b) An alternative suggestion to proposal three was made where the non-current assets could be leased to other companies instead of being sold. The lease receipts would then be converted into an asset through securitisation. The proceeds from the sale of the securitised lease receipts asset would be used to reduce the outstanding loan borrowings.

Required:

Explain what the securitisation process would involve and what would be the key barriers to Ennea Co undertaking the process. (5 marks)

(25 marks)

Section B – TWO questions ONLY to be attempted

3 Sembilan Co, a listed company, recently issued debt finance to acquire assets in order to increase its activity levels. This debt finance is in the form of a floating rate bond, with a face value of $320 million, redeemable in four years. The bond interest, payable annually, is based on the spot yield curve plus 60 basis points. The next annual payment is due at the end of year one.

Sembilan Co is concerned that the expected rise in interest rates over the coming few years would make it increasingly difficult to pay the interest due. It is therefore proposing to either swap the floating rate interest payment to a fixed rate payment, or to raise new equity capital and use that to pay off the floating rate bond. The new equity capital would either be issued as rights to the existing shareholders or as shares to new shareholders.

Ratus Bank has offered Sembilan Co an interest rate swap, whereby Sembilan Co would pay Ratus Bank interest based on an equivalent fixed annual rate of 3·76¼% in exchange for receiving a variable amount based on the current yield curve rate. Payments and receipts will be made at the end of each year, for the next four years. Ratus Bank will charge an annual fee of 20 basis points if the swap is agreed.

The current annual spot yield curve rates are as follows:

Year	One	Two	Three	Four
Rate	2·5%	3·1%	3·5%	3·8%

The current annual forward rates for years two, three and four are as follows:

Year	Two	Three	Four
Rate	3·7%	4·3%	4·7%

Required:

(a) Based on the above information, calculate the amounts Sembilan Co expects to pay or receive every year on the swap (excluding the fee of 20 basis points). Explain why the fixed annual rate of interest of 3·76¼% is less than the four-year yield curve rate of 3·8%. (6 marks)

(b) Demonstrate that Sembilan Co's interest payment liability does not change, after it has undertaken the swap, whether the interest rates increase or decrease. (5 marks)

(c) Discuss the factors that Sembilan Co should consider when deciding whether it should raise equity capital to pay off the floating rate debt. (9 marks)

(20 marks)

4 Tisa Co is considering an opportunity to produce an innovative component which, when fitted into motor vehicle engines, will enable them to utilise fuel more efficiently. The component can be manufactured using either process Omega or process Zeta. Although this is an entirely new line of business for Tisa Co, it is of the opinion that developing either process over a period of four years and then selling the productions rights at the end of four years to another company may prove lucrative.

The annual after-tax cash flows for each process are as follows:

Process Omega					
Year	0	1	2	3	4
After-tax cash flows ($000)	(3,800)	1,220	1,153	1,386	3,829

Process Zeta					
Year	0	1	2	3	4
After-tax cash flows ($000)	(3,800)	643	546	1,055	5,990

Tisa Co has 10 million 50c shares trading at 180c each. Its loans have a current value of $3·6 million and an average after-tax cost of debt of 4·50%. Tisa Co's capital structure is unlikely to change significantly following the investment in either process.

Elfu Co manufactures electronic parts for cars including the production of a component similar to the one being considered by Tisa Co. Elfu Co's equity beta is 1·40, and it is estimated that the equivalent equity beta for its other activities, excluding the component production, is 1·25. Elfu Co has 400 million 25c shares in issue trading at 120c each. Its debt finance consists of variable rate loans redeemable in seven years. The loans paying interest at base rate plus 120 basis points have a current value of $96 million. It can be assumed that 80% of Elfu Co's debt finance and 75% of Elfu Co's equity finance can be attributed to other activities excluding the component production.

Both companies pay annual corporation tax at a rate of 25%. The current base rate is 3·5% and the market risk premium is estimated at 5·8%.

Required:

(a) Provide a reasoned estimate of the cost of capital that Tisa Co should use to calculate the net present value of the two processes. Include all relevant calculations. (8 marks)

(b) Calculate the internal rate of return (IRR) and the modified internal rate of return (MIRR) for Process Omega. Given that the IRR and MIRR of Process Zeta are 26·6% and 23·3% respectively, recommend which process, if any, Tisa Co should proceed with and explain your recommendation. (8 marks)

(c) Elfu Co has estimated an annual standard deviation of $800,000 on one of its other projects, based on a normal distribution of returns. The average annual return on this project is $2,200,000.

Required:

Estimate the project's Value at Risk (VAR) at a 99% confidence level for one year and over the project's life of five years. Explain what is meant by the answers obtained. (4 marks)

(20 marks)

5 Kilenc Co, a large listed company based in the UK, produces pharmaceutical products which are exported around the world. It is reviewing a proposal to set up a subsidiary company to manufacture a range of body and facial creams in Lanosia. These products will be sold to local retailers and to retailers in nearby countries.

Lanosia has a small but growing manufacturing industry in pharmaceutical products, although it remains largely reliant on imports. The Lanosian government has been keen to promote the pharmaceutical manufacturing industry through purchasing local pharmaceutical products, providing government grants and reducing the industry's corporate tax rate. It also imposes large duties on imported pharmaceutical products which compete with the ones produced locally.

Although politically stable, the recent worldwide financial crisis has had a significant negative impact on Lanosia. The country's national debt has grown substantially following a bailout of its banks and it has had to introduce economic measures which are hampering the country's ability to recover from a deep recession. Growth in real wages has been negative over the past three years, the economy has shrunk in the past year and inflation has remained higher than normal during this time.

On the other hand, corporate investment in capital assets, research and development, and education and training, has grown recently and interest rates remain low. This has led some economists to suggest that the economy should start to recover soon. Employment levels remain high in spite of low nominal wage growth.

Lanosian corporate governance regulations stipulate that at least 40% of equity share capital must be held by the local population. In addition at least 50% of members on the Board of Directors, including the Chairman, must be from Lanosia. Kilenc Co wants to finance the subsidiary company using a mixture of debt and equity. It wants to raise additional equity and debt finance in Lanosia in order to minimise exchange rate exposure. The small size of the subsidiary will have minimal impact on Kilenc Co's capital structure. Kilenc Co intends to raise the 40% equity through an initial public offering (IPO) in Lanosia and provide the remaining 60% of the equity funds from its own cash funds.

Required:

(a) Discuss the key risks and issues that Kilenc Co should consider when setting up a subsidiary company in Lanosia, and suggest how these may be mitigated. (15 marks)

(b) The directors of Kilenc Co have learnt that a sizeable number of equity trades in Lanosia are conducted using dark pool trading systems.

Required:

Explain what dark pool trading systems are and how Kilenc Co's proposed Initial Public Offering (IPO) may be affected by these. (5 marks)

(20 marks)

Formulae

Modigliani and Miller Proposition 2 (with tax)

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

Two asset portfolio

$$s_p = \sqrt{w_a^2 s_a^2 + w_b^2 s_b^2 + 2 w_a w_b r_{ab} s_a s_b}$$

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