Professional Level – Options Module

Advanced Financial Management

Tuesday 4 December 2012

Paper P4

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

This paper is divided into two sections:

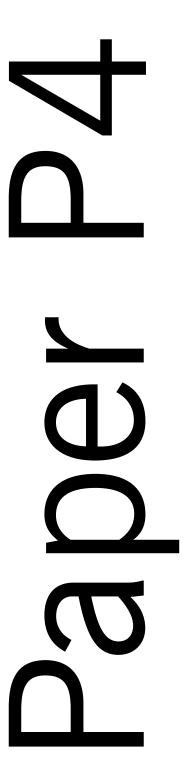Section A – BOTH questions are compulsory and MUST be attempted

Section B – TWO questions ONLY to be attempted
Formulae and tables are on pages 11–15.

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.

The Association of Chartered Certified Accountants

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Section A – BOTH questions are compulsory and MUST be attempted

1   Coeden Co is a listed company operating in the hospitality and leisure industry. Coeden Co's board of directors met recently to discuss a new strategy for the business. The proposal put forward was to sell all the hotel properties that Coeden Co owns and rent them back on a long-term rental agreement. Coeden Co would then focus solely on the provision of hotel services at these properties under its popular brand name. The proposal stated that the funds raised from the sale of the hotel properties would be used to pay off 70% of the outstanding non-current liabilities and the remaining funds would be retained for future investments.

The board of directors are of the opinion that reducing the level of debt in Coeden Co will reduce the company's risk and therefore its cost of capital. If the proposal is undertaken and Coeden Co focuses exclusively on the provision of hotel services, it can be assumed that the current market value of equity will remain unchanged after implementing the proposal.

Coeden Co Financial Information

Extract from the most recent Statement of Financial Position

	$'000
Non-current assets (re-valued recently)	42,560
Current assets	26,840
Total assets	69,400
Share capital (25c per share par value)	3,250
Reserves	21,780
Non-current liabilities (5·2% redeemable bonds)	42,000
Current liabilities	2,370
Total capital and liabilities	69,400

Coeden Co's latest free cash flow to equity of $2,600,000 was estimated after taking into account taxation, interest and reinvestment in assets to continue with the current level of business. It can be assumed that the annual reinvestment in assets required to continue with the current level of business is equivalent to the annual amount of depreciation. Over the past few years, Coeden Co has consistently used 40% of its free cash flow to equity on new investments while distributing the remaining 60%. The market value of equity calculated on the basis of the free cash flow to equity model provides a reasonable estimate of the current market value of Coeden Co.

The bonds are redeemable at par in three years and pay the coupon on an annual basis. Although the bonds are not traded, it is estimated that Coeden Co's current debt credit rating is BBB but would improve to A+ if the non-current liabilities are reduced by 70%.

Other Information

Coeden Co's current equity beta is 1·1 and it can be assumed that debt beta is 0. The risk free rate is estimated to be 4% and the market risk premium is estimated to be 6%.

There is no beta available for companies offering just hotel services, since most companies own their own buildings. The average asset beta for property companies has been estimated at 0·4. It has been estimated that the hotel services business accounts for approximately 60% of the current value of Coeden Co and the property company business accounts for the remaining 40%.

Coeden Co's corporation tax rate is 20%. The three-year borrowing credit spread on A+ rated bonds is 60 basis points and 90 basis points on BBB rated bonds, over the risk free rate of interest.

Required:

(a) Calculate, and comment on, Coeden Co's cost of equity and weighted average cost of capital before and after implementing the proposal. Briefly explain any assumptions made. (20 marks)

(b) Discuss the validity of the assumption that the market value of equity will remain unchanged after the implementation of the proposal. (5 marks)

(c) As an alternative to selling the hotel properties, the board of directors is considering a demerger of the hotel services and a separate property company which would own the hotel properties. The property company would take over 70% of Coeden Co's long-term debt and pay Coeden Co cash for the balance of the property value.

Required:

Explain what a demerger is, and the possible benefits and drawbacks of pursuing the demerger option as opposed to selling the hotel properties. (8 marks)

(33 marks)

2 Lignum Co, a large listed company, manufactures agricultural machines and equipment for different markets around the world. Although its main manufacturing base is in France and it uses the Euro (€) as its base currency, it also has a few subsidiary companies around the world. Lignum Co's treasury division is considering how to approach the following three cases of foreign exchange exposure that it faces.

Case One

Lignum Co regularly trades with companies based in Zuhait, a small country in South America whose currency is the Zupesos (ZP). It recently sold machinery for ZP140 million, which it is about to deliver to a company based there. It is expecting full payment for the machinery in four months. Although there are no exchange traded derivative products available for the Zupesos, Medes Bank has offered Lignum Co a choice of two over-the-counter derivative products.

The first derivative product is an over-the-counter forward rate determined on the basis of the Zuhait base rate of 8·5% plus 25 basis points and the French base rate of 2·2% less 30 basis points.

Alternatively, with the second derivative product Lignum Co can purchase either Euro call or put options from Medes Bank at an exercise price equivalent to the current spot exchange rate of ZP142 per €1. The option premiums offered are: ZP7 per €1 for the call option or ZP5 per €1 for the put option.

The premium cost is payable in full at the commencement of the option contract. Lignum Co can borrow money at the base rate plus 150 basis points and invest money at the base rate minus 100 basis points in France.

Case Two

Namel Co is Lignum Co's subsidiary company based in Maram, a small country in Asia, whose currency is the Maram Ringit (MR). The current pegged exchange rate between the Maram Ringit and the Euro is MR35 per €1. Due to economic difficulties in Maram over the last couple of years, it is very likely that the Maram Ringit will devalue by 20% imminently. Namel Co is concerned about the impact of the devaluation on its Statement of Financial Position.

Given below is an extract from the current Statement of Financial Position of Namel Co.

	MR '000
Non-current assets	179,574
Current assets	146,622
Total assets	326,196
Share capital and reserves	102,788
Non-current liabilities	132,237
Current liabilities	91,171
Total capital and liabilities	326,196

The current assets consist of inventories, receivables and cash. Receivables account for 40% of the current assets. All the receivables relate to sales made to Lignum Co in Euro. About 70% of the current liabilities consist of payables relating to raw material inventory purchased from Lignum Co and payable in Euro. 80% of the non-current liabilities consist of a Euro loan and the balance are borrowings sourced from financial institutions in Maram.

Case Three

Lignum Co manufactures a range of farming vehicles in France which it sells within the European Union to countries which use the Euro. Over the previous few years, it has found that its sales revenue from these products has been declining and the sales director is of the opinion that this is entirely due to the strength of the Euro. Lignum Co's biggest competitor in these products is based in the USA and US$ rate has changed from almost parity with the Euro three years ago, to the current value of US$1·47 for €1. The agreed opinion is that the US$ will probably continue to depreciate against the Euro, but possibly at a slower rate, for the foreseeable future.

Required:

Prepare a report for Lignum Co's treasury division that:

(i) Briefly explains the type of currency exposure Lignum Co faces for each of the above cases; (3 marks)

(ii) Recommends which of the two derivative products Lignum Co should use to manage its exposure in case one and advises on alternative hedging strategies that could be used. Show all relevant calculations; (9 marks)

(iii) Computes the gain or loss on Namel Co's Statement of Financial Position, due to the devaluation of the Maram Ringit in case two, and discusses whether and how this exposure should be managed; (8 marks)

(iv) Discusses how the exposure in case three can be managed. (3 marks)

Professional marks will be awarded in question 2 for the structure and presentation of the report. (4 marks)

(27 marks)

3 Sigra Co is a listed company producing confectionary products which it sells around the world. It wants to acquire Dentro Co, an unlisted company producing high quality, luxury chocolates. Sigra Co proposes to pay for the acquisition using one of the following three methods:

Method 1
A cash offer of $5·00 per Dentro Co share; or

Method 2
An offer of three of its shares for two of Dentro Co's shares; or

Method 3
An offer of a 2% coupon bond in exchange for 16 Dentro Co's shares. The bond will be redeemed in three years at its par value of $100.

Extracts from the latest financial statements of both companies are as follows:

	Sigra Co $'000	Dentro Co $'000
Sales revenue	44,210	4,680
Profit before tax	6,190	780
Taxation	(1,240)	(155)
Profit after tax	4,950	625
Dividends	(2,700)	(275)
Retained earnings for the year	2,250	350
Non-current assets	22,450	3,350
Current assets	3,450	247
Non-current liabilities	9,700	873
Current liabilities	3,600	436
Share capital (40c per share)	4,400	500
Reserves	8,200	1,788

Sigra Co's current share price is $3·60 per share and it has estimated that Dentro Co's price to earnings ratio is 12·5% higher than Sigra Co's current price to earnings ratio. Sigra Co's non-current liabilities include a 6% bond redeemable in three years at par which is currently trading at $104 per $100 par value.

Sigra Co estimates that it could achieve synergy savings of 30% of Dentro Co's estimated equity value by eliminating duplicated administrative functions, selling excess non-current assets and through reducing the workforce numbers, if the acquisition were successful.

Required:

(a) Estimate the percentage gain on a Dentro Co share under each of the above three payment methods. Comment on the answers obtained. (16 marks)

(b) In relation to the acquisition, the board of directors of Sigra Co are considering the following two proposals:

Proposal 1
Once Sigra Co has obtained agreement from a significant majority of the shareholders, it will enforce the remaining minority shareholders to sell their shares; and

Proposal 2
Sigra Co will offer an extra 3 cents per share, in addition to the bid price, to 30% of the shareholders of Dentro Co on a first-come, first-serve basis, as an added incentive to make the acquisition proceed more quickly.

Required:

With reference to the key aspects of the global regulatory framework for mergers and acquisitions, briefly discuss the above proposals. (4 marks)

(20 marks)

4 Arbore Co is a large listed company with many autonomous departments operating as investment centres. It sets investment limits for each department based on a three-year cycle. Projects selected by departments would have to fall within the investment limits set for each of the three years. All departments would be required to maintain a capital investment monitoring system, and report on their findings annually to Arbore Co's board of directors.

The Durvo department is considering the following five investment projects with three years of initial investment expenditure, followed by several years of positive cash inflows. The department's initial investment expenditure limits are $9,000,000, $6,000,000 and $5,000,000 for years one, two and three respectively. None of the projects can be deferred and all projects can be scaled down but not scaled up.

Investment required at start of year				
Project	Year one (Immediately)	Year two	Year three	Project net present value
PDur01	$4,000,000	$1,100,000	$2,400,000	$464,000
PDur02	$800,000	$2,800,000	$3,200,000	$244,000
PDur03	$3,200,000	$3,562,000	$0	$352,000
PDur04	$3,900,000	$0	$200,000	$320,000
PDur05	$2,500,000	$1,200,000	$1,400,000	Not provided

PDur05 project's annual operating cash flows commence at the end of year four and last for a period of 15 years. The project generates annual sales of 300,000 units at a selling price of $14 per unit and incurs total annual relevant costs of $3,230,000. Although the costs and units sold of the project can be predicted with a fair degree of certainty, there is considerable uncertainty about the unit selling price. The department uses a required rate of return of 11% for its projects, and inflation can be ignored.

The Durvo department's managing director is of the opinion that all projects which return a positive net present value should be accepted and does not understand the reason(s) why Arbore Co imposes capital rationing on its departments. Furthermore, she is not sure why maintaining a capital investment monitoring system would be beneficial to the company.

Required:

(a) **Calculate the net present value of project PDur05. Calculate and comment on what percentage fall in the selling price would need to occur before the net present value falls to zero.** (6 marks)

(b) **Formulate an appropriate capital rationing model, based on the above investment limits, that maximises the net present value for department Durvo. Finding a solution for the model is not required.** (3 marks)

(c) Assume the following output is produced when the capital rationing model in part (b) above is solved:

Category 1: Total Final Value
$1,184,409

Category 2: Adjustable Final Values
Project PDur01: 0·958
Project PDur02: 0·407
Project PDur03: 0·732
Project PDur04: 0·000
Project PDur05: 1·000

Category 3:

Constraints Utilised	Slack
Year one: $9,000,000	Year one: $0
Year two: $6,000,000	Year two: $0
Year three: $5,000,000	Year three: $0

Required:

Explain the figures produced in each of the three output categories. (5 marks)

(d) **Provide a brief response to the managing director's opinions by:**

    (i) **Explaining why Arbore Co may want to impose capital rationing on its departments;** (2 marks)

    (ii) **Explaining the features of a capital investment monitoring system and discussing the benefits of maintaining such a system.** (4 marks)

(20 marks)

5 Strom Co is a clothing retailer, with stores selling mid-price clothes and clothing accessories throughout Europe. It sells its own-brand items, which are produced by small manufacturers located in Africa, who work solely for Strom Co. The recent European sovereign debt crisis has affected a number of countries in the European Union (EU). Consequently, Strom Co has found trading conditions to be extremely difficult, putting pressure on profits and sales revenue.

The sovereign debt crisis in Europe resulted in countries finding it increasingly difficult and expensive to issue government bonds to raise funds. Two main reasons have been put forward to explain why the crisis took place: firstly, a number of countries continued to borrow excessive funds, because their expenditure exceeded taxation revenues; and secondly, a number of countries allocated significant sums of money to support their banks following the 'credit crunch' and the banking crisis.

In order to prevent countries defaulting on their debt obligations and being downgraded, the countries in the EU and the International Monetary Fund (IMF) established a fund to provide financial support to member states threatened by the risk of default, credit downgrades and excessive borrowing yields. Strict economic conditions known as austerity measures were imposed on these countries in exchange for receiving financial support.

The austerity measures have affected Strom Co negatively, and the years 2011 and 2012 have been particularly bad, with sales revenue declining by 15% and profits by 25% in 2011, and remaining at 2011 levels in 2012. On investigation, Strom Co noted that clothing retailers selling clothes at low prices and at high prices were not affected as badly as Strom Co or other mid-price retailers. Indeed, the retailers selling low-priced clothes had increased their profits, and retailers selling luxury, expensive clothes had maintained their profits over the last two to three years.

In order to improve profitability, Strom Co's board of directors expects to cut costs where possible. A significant fixed cost relates to quality control, which includes monitoring the working conditions of employees of Strom Co's clothing manufacturers, as part of its ethical commitment.

Required:

(a) Explain the role and aims of the International Monetary Fund (IMF) and discuss possible reasons why the austerity measures imposed on European Union (EU) countries might have affected Strom Co negatively.

(10 marks)

(b) Suggest, giving reasons, why the austerity measures might not have affected clothing retailers at the high and low price range, as much as the mid-price range retailers like Strom Co. (4 marks)

(c) Discuss the risks to Strom Co of reducing the costs relating to quality control and how the detrimental impact of such reductions in costs could be decreased. (6 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

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

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

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

[P.T.O.

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:

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

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

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

[P.T.O.

Annuity Table

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

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