

Professional Level – Options Module

Advanced Financial Management

March/June 2016 – Sample Questions



Time allowed

Reading and planning: 15 minutes

Writing: 3 hours

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 9–13.

Do NOT open this question 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.

P4 Paper

Think Ahead

ACCA

The Association of
Chartered Certified
Accountants

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

- 1 Lirio Co is an engineering company which is involved in projects around the world. It has been growing steadily for several years and has maintained a stable dividend growth policy for a number of years now. The board of directors (BoD) is considering bidding for a large project which requires a substantial investment of \$40 million. It can be assumed that the date today is 1 March 2016.

The BoD is proposing that Lirio Co should not raise the finance for the project through additional debt or equity. Instead, it proposes that the required finance is obtained from a combination of funds received from the sale of its equity investment in a European company and from cash flows generated from its normal business activity in the coming two years. As a result, Lirio Co's current capital structure of 80 million \$1 equity shares and \$70 million 5% bonds is not expected to change in the foreseeable future.

The BoD has asked the company's treasury department to prepare a discussion paper on the implications of this proposal. The following information on Lirio Co has been provided to assist in the preparation of the discussion paper.

Expected income and cash flow commitments prior to undertaking the large project for the year to the end of February 2017

Lirio Co's sales revenue is forecast to grow by 8% next year from its current level of \$300 million, and the operating profit margin on this is expected to be 15%. It is expected that Lirio Co will have the following capital investment requirements for the coming year, before the impact of the large project is considered:

1. A \$0.10 investment in working capital for every \$1 increase in sales revenue;
2. An investment equivalent to the amount of depreciation to keep its non-current asset base at the present productive capacity. The current depreciation charge already included in the operating profit margin is 25% of the non-current assets of \$50 million;
3. A \$0.20 investment in additional non-current assets for every \$1 increase in sales revenue;
4. \$8 million additional investment in other small projects.

In addition to the above sales revenue and profits, Lirio Co has one overseas subsidiary – Pontac Co, from which it receives dividends of 80% on profits. Pontac Co produces a specialist tool which it sells locally for \$60 each. It is expected that it will produce and sell 400,000 units of this specialist tool next year. Each tool will incur variable costs of \$36 per unit and total annual fixed costs of \$4 million to produce and sell.

Lirio Co pays corporation tax at 25% and Pontac Co pays corporation tax at 20%. In addition to this, a withholding tax of 8% is deducted from any dividends remitted from Pontac Co. A bi-lateral tax treaty exists between the countries where Lirio Co is based and where Pontac Co is based. Therefore corporation tax is payable on profits made by subsidiary companies, but full credit is given for corporation tax already paid.

It can be assumed that receipts from Pontac Co are in \$ equivalent amounts and exchange rate fluctuations on these can be ignored.

Sale of equity investment in the European country

It is expected that Lirio Co will receive Euro (€) 20 million in three months' time from the sale of its investment. The € has continued to remain weak, while the \$ has continued to remain strong through 2015 and the start of 2016. The financial press has also reported that there may be a permanent shift in the €/ \$ exchange rate, with firms facing economic exposure. Lirio Co has decided to hedge the € receipt using one of currency forward contracts, currency futures contracts or currency options contracts.

The following exchange contracts and rates are available to Lirio Co.

	Per €1
Spot rates	\$1.1585–\$1.1618
Three-month forward rates	\$1.1559–\$1.1601

Currency futures (contract size \$125,000, quotation: € per \$1)

March futures	€0.8638
June futures	€0.8656

Currency options (contract size \$125,000, exercise price quotation € per \$1, premium € per \$1)

Exercise price	Calls		Puts	
	March	June	March	June
0·8600	0·0255	0·0290	0·0267	0·0319

It can be assumed that futures and options contracts expire at the end of their respective months.

Dividend history, expected dividends and cost of capital, Lirio Co

Year to end of February	2013	2014	2015	2016
Number of \$1 equity shares in issue (000)	60,000	60,000	80,000	80,000
Total dividends paid (\$ 000)	12,832	13,602	19,224	20,377

It is expected that dividends will grow at the historic rate, if the large project is not undertaken.

Expected dividends and dividend growth rates if the large project is undertaken

Year to end of February 2017	Remaining cash flows after the investment in the \$40 million project will be paid as dividends.
Year to end of February 2018	The dividends paid will be the same amount as the previous year.
Year to end of February 2019	Dividends paid will be \$0·31 per share.
In future years from February 2019	Dividends will grow at an annual rate of 7%.

Lirio Co's cost of equity capital is estimated to be 12%.

Required:

- (a) **With reference to purchasing power parity, explain how exchange rate fluctuations may lead to economic exposure.** (6 marks)
- (b) **Prepare a discussion paper, including all relevant calculations, for the board of directors (BoD) of Lirio Co which:**
 - (i) **Estimates Lirio Co's dividend capacity as at 28 February 2017, prior to investing in the large project;** (9 marks)
 - (ii) **Advises Lirio Co on, and recommends, an appropriate hedging strategy for the Euro (€) receipt it is due to receive in three months' time from the sale of the equity investment;** (14 marks)
 - (iii) **Using the information on dividends provided in the question, and from (b) (i) and (b) (ii) above, assesses whether or not the project would add value to Lirio Co;** (8 marks)
 - (iv) **Discusses the issues of proposed methods of financing the project which need to be considered further.** (9 marks)

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

(50 marks)

Section B – TWO questions ONLY to be attempted

2 Louieed Co

Louieed Co, a listed company, is a major supplier of educational material, selling its products in many countries. It supplies schools and colleges and also produces learning material for business and professional exams. Louieed Co has exclusive contracts to produce material for some examining bodies. Louieed Co has a well-defined management structure with formal processes for making major decisions.

Although Louieed Co produces online learning material, most of its profits are still derived from sales of traditional textbooks. Louieed Co's growth in profits over the last few years has been slow and its directors are currently reviewing its long-term strategy. One area in which they feel that Louieed Co must become much more involved is the production of online testing materials for exams and to validate course and textbook learning.

Bid for Tidded Co

Louieed Co has recently made a bid for Tidded Co, a smaller listed company. Tidded Co also supplies a range of educational material, but has been one of the leaders in the development of online testing and has shown strong profit growth over recent years. All of Tidded Co's initial five founders remain on its board and still hold 45% of its issued share capital between them. From the start, Tidded Co's directors have been used to making quick decisions in their areas of responsibility. Although listing has imposed some formalities, Tidded Co has remained focused on acting quickly to gain competitive advantage, with the five founders continuing to give strong leadership.

Louieed Co's initial bid of five shares in Louieed Co for three shares in Tidded Co was rejected by Tidded Co's board. There has been further discussion between the two boards since the initial offer was rejected and Louieed Co's board is now considering a proposal to offer Tidded Co's shareholders two shares in Louieed Co for one share in Tidded Co or a cash alternative of \$22.75 per Tidded Co share. It is expected that Tidded Co's shareholders will choose one of the following options:

- (i) To accept the two-shares-for-one-share offer for all the Tidded Co shares; or,
- (ii) To accept the cash offer for all the Tidded Co shares; or,
- (iii) 60% of the shareholders will take up the two-shares-for-one-share offer and the remaining 40% will take the cash offer.

In case of the third option being accepted, it is thought that three of the company's founders, holding 20% of the share capital in total, will take the cash offer and not join the combined company. The remaining two founders will probably continue to be involved in the business and be members of the combined company's board.

Louieed Co's finance director has estimated that the merger will produce annual post-tax synergies of \$20 million. He expects Louieed Co's current price-earnings (P/E) ratio to remain unchanged after the acquisition.

Extracts from the two companies' most recent accounts are shown below:

	Louieed \$m	Tidded \$m
Profit before finance cost and tax	446	182
Finance costs	(74)	(24)
Profit before tax	372	158
Tax	(76)	(30)
Profit after tax	296	128
Issued \$1 nominal shares	340 million	90 million
P/E ratios, based on most recent accounts	14	15.9
Long-term liabilities (market value) (\$m)	540	193
Cash and cash equivalents (\$m)	220	64

The tax rate applicable to both companies is 20%.

Assume that Louieed Co can obtain further debt funding at a pre-tax cost of 7.5% and that the return on cash surpluses is 5% pre-tax.

Assume also that any debt funding needed to complete the acquisition will be reduced instantly by the balances of cash and cash equivalents held by Louieed Co and Tidded Co.

Required:

- (a) Discuss the advantages and disadvantages of the acquisition of Tidded Co from the viewpoint of Louieed Co. (6 marks)
- (b) Calculate the P/E ratios of Tidded Co implied by the terms of Louieed Co's initial and proposed offers, for all three of the above options. (5 marks)
- (c) Calculate, and comment on, the funding required for the acquisition of Tidded Co and the impact on Louieed Co's earnings per share and gearing, for each of the three options given above.

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

(14 marks)

(25 marks)

3 Staple Group is one of Barland's biggest media groups. It consists of four divisions, organised as follows:

- **Staple National** – the national newspaper, the *Daily Staple*. This division's revenues and operating profits have decreased for the last two years.
- **Staple Local** – a portfolio of 18 local and regional newspapers. This division's operating profits have fallen for the last five years and operating profits and cash flows are forecast to be negative in the next financial year. Other newspaper groups with local titles have also reported significant falls in profitability recently.
- **Staple View** – a package of digital channels showing sporting events and programmes for a family audience. Staple Group's board has been pleased with this division's recent performance, but it believes that the division will only be able to sustain a growth rate of 4% in operating profits and cash flows unless it can buy the rights to show more major sporting events. Over the last year, Staple View's biggest competitor in this sector has acquired two smaller digital broadcasters.
- **Staple Investor** – established from a business which was acquired three years ago, this division offers services for investors including research, publications, training events and conferences. The division gained a number of new clients over the last year and has thus shown good growth in revenues and operating profits.

Some of Staple Group's institutional investors have expressed concern about the fall in profitability of the two newspaper divisions.

The following summarised data relates to the group's last accounting year. The % changes in pre-tax profits and revenues are changes in the most recent figures compared with the previous year.

	Division				
	Total	National	Local	View	Investor
Revenues (\$m)	1,371·7	602·4	151·7	496·5	121·1
Increase/(decrease) in revenues (%)		(5·1)	(14·7)	8·2	16·5
Pre-tax profits (\$m)	177·3	75·6	4·5	73·3	23·9
Increase/(decrease) in pre-tax profits (%)		(4·1)	(12·6)	7·4	19·1
Post-tax cash flows (\$m)	120·2	50·7	0·3	53·5	15·7
Share of group net assets (\$m)	635·8	267·0	66·6	251·2	51·0
Share of group long-term liabilities (\$m)	230·9	104·4	23·1	93·4	10·0

Staple Group's board regards the *Daily Staple* as a central element of the group's future. The directors are currently considering a number of investment plans, including the development of digital platforms for the *Daily Staple*. The finance director has costed the investment programme at \$150 million. The board would prefer to fund the investment programme by disposing parts or all of one of the other divisions. The following information is available to help assess the value of each division:

- One of Staple Group's competitors, Postway Co, has contacted Staple Group's directors asking if they would be interested in selling 15 of the local and regional newspapers for \$60 million. Staple Group's finance director believes this offer is low and wishes to use the net assets valuation method to evaluate a minimum price for the Staple Local division.
- Staple Group's finance director believes that a valuation using free cash flows would provide a fair estimate of the value of the Staple View division. Over the last year, investment in additional non-current assets for the Staple View division has been \$12·5 million and the incremental working capital investment has been \$6·2 million. These investment levels will have to increase at 4% annually in order to support the expected sustainable increases in operating profit and cash flow.
- Staple Group's finance director believes that the valuation of the Staple Investor division needs to reflect the potential it derives from the expertise and experience of its staff. The finance director has calculated a value of \$118·5 million for this division, based on the earnings made last year but also allowing for the additional earnings which he believes that the expert staff in the division will be able to generate in future years.

Assume a risk-adjusted, all-equity financed, cost of capital of 12% and a tax rate of 30%. Goodwill should be ignored in any calculations.

Staple Group's finance and human resources directors are looking at the staffing of the two newspaper divisions. The finance director proposes dismissing most staff who have worked for the group for less than two years, two years' employment being when staff would be entitled to enhanced statutory employment protection. The finance director

also proposes a redundancy programme for longer-serving staff, selecting for redundancy employees who have complained particularly strongly about recent changes in working conditions. There is a commitment in Staple Group's annual report to treat employees fairly, communicate with them regularly and enhance employees' performance by structured development.

Required:

- (a) Evaluate the options for disposing of parts of Staple Group, using the financial information to assess possible disposal prices. The evaluation should include a discussion of the benefits and drawbacks to Staple Group from disposing of parts of the Staple Group.** (19 marks)
- (b) Discuss the significance of the finance director's proposals for reduction in staff costs for Staple Group's relationships with its shareholders and employees and discuss the ethical implications of the proposals.** (6 marks)

(25 marks)

- 4 Furlion Co manufactures heavy agricultural equipment and machinery which can be used in difficult farming conditions. Furlion Co's chief executive has been investigating a significant opportunity in the country of Naswa, where Furlion Co has not previously sold any products. The government of Naswa has been undertaking a major land reclamation programme and Furlion Co's equipment is particularly suitable for use on the reclaimed land. Because of the costs and other problems involved in transporting its products, Furlion Co's chief executive proposes that Furlion Co should establish a plant for manufacturing machinery in Naswa. He knows that the Naswan government is keen to encourage the development of sustainable businesses within the country.

Initial calculations suggest that the proposed investment in Naswa would have a negative net present value of \$1.01 million. However, Furlion Co's chief executive believes that there may be opportunities for greater cash flows in future if the Naswan government expands its land reclamation programme. The government at present is struggling to fund expansion of the programme out of its own resources and is looking for other funding. If the Naswan government obtains this funding, the chief executive has forecast that the increased demand for Furlion Co's products would justify \$15 million additional expenditure at the site of the factory in three years' time. The expected net present value for this expansion is currently estimated to be \$0.

It can be assumed that all costs and revenues include inflation. The relevant cost of capital is 12% and the risk free rate is 4%. The chief executive has estimated the likely volatility of cash flows at a standard deviation of 30%.

One of Furlion Co's non-executive directors has read about possible changes in interest rates and wonders how these might affect the investment appraisal.

Required:

- (a) **Assess, showing all relevant calculations, whether Furlion Co should proceed with the significant opportunity. Discuss the assumptions made and other factors which will affect the decision of whether to establish a plant in Naswa. The Black Scholes pricing model may be used, where appropriate.** (16 marks)
- (b) **Explain what is meant by an option's rho and discuss the impact of changes in interest rates on the appraisal of the investment.** (5 marks)
- (c) **Discuss the possibility of the Naswan government obtaining funding for further land reclamation from the World Bank, referring specifically to the International Development Association.** (4 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

$$P_0 = \frac{D_0(1 + g)}{(r_e - g)}$$

Gordon's growth approximation

$$g = b r_e$$

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

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

Modified Internal Rate of Return

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

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

<i>Discount rate (r)</i>											
<i>Periods</i> (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

<i>Discount rate (r)</i>											
<i>Periods</i> (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