

Strategic Professional – Options

# Advanced Financial Management (AFM)

Friday 6 March 2020



**Time allowed:** 3 hours 15 minutes

This question paper is divided into two sections:

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

Section B – BOTH questions are compulsory and MUST be attempted

**Formulae and tables are on pages 10–14.**

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

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

AFM

Think Ahead

**ACCA**

The Association of  
Chartered Certified  
Accountants

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The question paper begins on page 3.**

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

### 1 Introduction

Westparley Co is a listed retailer, mainly selling food and small household goods. It has outperformed its competitors over the last few years as a result of providing high quality products at reasonable prices, and also having a stronger presence online. It has kept a control on costs, partly by avoiding operating large stores on expensive city centre sites. Instead, it has had smaller stores on the edge of cities and towns, and a limited number of larger stores on convenient out-of-town sites, aiming at customers who want their journeys to shops to be quick. One of its advertising slogans has been: 'We are where you want us to be.'

Westparley Co's share price has recently performed better than most companies in the retail sector generally. Share prices in the retail sector have been relatively low as a result of poor results due to high competition, large fixed cost base and high interest rates. The exception has been shares in retailers specialising in computer and high-technology goods. These shares appear to have benefited from a boom generally in share prices of high-technology companies. Some analysts believe share prices of many companies in the high-technology sector are significantly higher than a rational analysis of their future prospects would indicate.

#### Matravers Co

Westparley Co has identified the listed retailer Matravers Co as an acquisition target, because it believes that Matravers Co's shares are currently undervalued and part of Matravers Co's operations would be a good strategic fit for Westparley Co.

Matravers Co operates two types of store:

**Matravers Home** mainly sells larger household items and home furnishings. These types of retailer have performed particularly badly recently and one major competitor of Matravers Home has just gone out of business. Matravers Home operates a number of city centre sites but has a much higher proportion of out-of-town sites than its competitors.

**Matravers Tech** sells computers and mobile phones in much smaller outlets than those of Matravers Home.

Extracts from Matravers Co's latest annual report are given below:

	\$m
Pre-tax profit	1,950
Long-term loan	6,500
Share capital (\$1 shares)	5,000

The share of pre-tax profit between Matravers Home and Matravers Tech was 80:20.

The current market value of Matravers Co's shares is \$12,500m and its debt is currently trading at its book value. Westparley Co believes that it will have to pay a premium of 15% to Matravers Co's shareholders to buy the company.

Westparley Co intends to take advantage of the current values attributed to businesses such as Matravers Tech by selling this part of Matravers Co at the relevant sector price earnings ratio of 18, rather than a forecast estimate of Matravers Tech's present value of future free cash flows of \$4,500m.

The company tax rate for both companies is 28% per year.

#### Post-acquisition cost of capital

The post-acquisition cost of capital of the combined company will be based on its cost of equity and cost of debt. The asset beta post-acquisition can be assumed to be both companies' asset betas weighted in proportion to their current market value of equity.

Westparley Co has 4,000 million \$1 shares in issue, currently trading at \$8.50. It has \$26,000m debt in issue, currently trading at \$105 per \$100 nominal value. Its equity beta is 1.02.

Matravers Co's asset beta is 0.75. The current market value of Matravers Co's shares is \$12,500m and its long-term loan is currently trading at its book value of \$6,500m.

The risk-free rate of return is estimated to be 3.5% and the market risk premium is estimated to be 8%.

The pre-tax cost of debt of the combined company is expected to be 9.8%. It can be assumed that the debt:equity ratio of the combined company will be the same as Westparley Co's current debt:equity ratio in market values.

The company tax rate for both companies is 28% per year.

### Plans for Matravers Co

The offer for Matravers Co will be a cash offer. Any funding required for this offer will be a mixture of debt and equity. Although for the purposes of the calculation it has been assumed that the overall mix of debt and equity will remain the same, the directors are considering various plans for funding the purchase which could result in a change in Westparley Co's gearing.

As soon as it acquires all of Matravers Co's share capital, Westparley Co would sell Matravers Tech as it does not fit in with Westparley Co's strategic plans and Westparley Co wishes to take advantage of the large values currently attributed to high-technology businesses. Westparley Co would then close Matravers Home's worst-performing city centre stores. It anticipates the loss of returns from these stores would be partly compensated by higher online sales by Matravers Co, generated by increased investment in its online operations. The remaining city centre stores and all out-of-town stores would start selling the food and household items currently sold in Westparley Co's stores, and Westparley Co believes that this would increase profits from those stores.

Westparley Co also feels that reorganising Matravers Co's administrative functions and using increased power as a larger retailer can lead to synergies after the acquisition.

### Post-acquisition details

Once Matravers Tech has been sold, Westparley Co estimates that sales revenue from the Matravers Home stores which remain open, together with the online sales from its home business, will be \$43,260m in the first year post-acquisition, and this figure is expected to grow by 3% per year in years 2 to 4.

The profit margin before interest and tax is expected to be 6% of sales revenue in years 1 to 4.

Tax allowable depreciation is assumed to be equivalent to the amount of investment needed to maintain existing operations. However, an investment in assets (including working capital) will be required of \$630m in year 1. In years 2 to 4, investment in assets each year will be \$0.50 of every \$1 increase in sales revenue.

After four years, the annual growth rate of free cash flows is expected to be 2% for the foreseeable future.

As well as the free cash flows from Matravers Co, Westparley Co expects that post-tax synergies will arise from its planned reorganisation of Matravers Co as follows in the next three years:

Year	1	2	3
	\$m	\$m	\$m
Free cash flows	700	750	780

The current market value of Matravers Co's shares is \$12,500m and its debt is currently trading at its book value of \$6,500m.

**Required:**

(a) **Discuss the behavioural factors which may have led to businesses such as Matravers Tech being valued highly.** (6 marks)

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

(i) **compares the additional value which Westparley Co believes can be generated from the sale of Matravers Tech based on the P/E ratio, with that of the projected present value of its future free cash flows;** (4 marks)

(ii) **calculates the weighted average cost of capital for the combined company;** (6 marks)

(iii) **estimates the total value which Westparley Co's shareholders will gain from the acquisition of Matravers Co; and** (10 marks)

(iv) **assesses the strategic and financial value to Westparley Co of the acquisition, including a discussion of the estimations and assumptions made.** (12 marks)

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

(4 marks)

(c) **Discuss the factors which may determine how the offer for Matravers Co will be financed and hence the level of gearing which Westparley Co will have.** (8 marks)

**(50 marks)**

**Section B – BOTH questions are compulsory and MUST be attempted**

2 Boullain Co is based in the Eurozone and manufactures components for agricultural machinery. The company is financed by a combination of debt and equity, having obtained a listing five years ago. In addition to the founder's equity stake, the shareholders consist of pension funds and other institutional investors. Until recently, sales have been generated exclusively within the Eurozone area but the directors are keen to expand and have identified North America as a key export market. The company recently completed its first sale to a customer based in the United States, although payment will not be received for another six months.

**Hedging policy and key stakeholders**

At a recent board meeting, Boullain Co's finance director argued that the expansion into foreign markets creates the need for a formal hedging policy and that shareholder value would be enhanced if this policy was communicated to the company's other stakeholders. However, Boullain Co's chief executive officer disagreed with the finance director on the following grounds. First, existing shareholders are already well diversified and would therefore not benefit from additional risk reduction hedging strategies. Second, there is no obvious benefit to shareholder value by communicating the hedging policy to other stakeholders such as debt providers, employees, customers and suppliers. You have been asked to provide a rationale for the finance director's comments in advance of the next board meeting.

**Hedging products**

Assume today's date is 1 March 20X0. Boullain Co is due to receive \$18,600,000 from the American customer on 31 August 20X0. The finance director is keen to minimise the company's exposure to foreign exchange risk and has identified forward contracts, exchange traded futures and options as a way of achieving this objective.

The following quotations have been obtained.

**Exchange rates (quoted as €/US\$1)**

Spot	0.8707–0.8711
Six months forward	0.8729–0.8744

**Currency futures (contract size €200,000; exercise price quoted as US\$ per €1)**

	Exercise price
March	1.1476
June	1.1449
September	1.1422

**Currency options (contract size €200,000; exercise price quoted as US\$ per €1, premium: US cents per €1)**

Exercise price	Calls			Puts		
	March	June	September	March	June	September
1.1420	0.43	0.59	0.77	0.62	0.78	0.89

Assume futures and options contracts mature at the month end and that there is no basis risk. The number of contracts to be used should be rounded down to the nearest whole number in calculations. If the full amount cannot be hedged using an exact number of futures or options contracts, the balance is hedged using the forward market.

**Margin information**

Once the position is open, the euro futures contract outlined above will be marked-to-market on a daily basis. The terms of the contract require Boullain Co to deposit an initial margin of \$3,500 per contract with the clearing house. Assume the maintenance margin is equivalent to the initial margin. The tick size on the contract is \$0.0001.

Your manager is concerned about the impact of an open futures position on Boullain Co's cash flow and has asked you to calculate and explain the impact of the following hypothetical changes in the closing settlement price in the first three days of the contract.

Closing settlement prices (US\$ per €1)

Date	Settlement price
1 March	1.1410
2 March	1.1418
3 March	1.1433

**Required:**

- (a) Explain the rationale for the policy of hedging Boullain Co's foreign exchange risk and the potential benefits to shareholder value if that policy is effectively communicated to the company's key stakeholders. (7 marks)
- (b) Recommend a hedging strategy for Boullain Co's foreign currency receipt in six months' time based on the hedging choices the finance director is considering. Support your recommendation with appropriate discussion and relevant calculations. (11 marks)
- (c) Calculate and explain the impact of the open futures position on Boullain Co's US\$ cash flow, based on the settlement prices provided. (7 marks)

**(25 marks)**

- 3** Hathaway Co operates in the aviation industry, manufacturing safety equipment for commercial aircraft. The company has a policy of carefully appraising new investment opportunities, including the detailed analysis of all cost and revenue assumptions prior to their approval.

#### **Project chi**

Hathaway Co's board is reviewing a potential investment, project chi. The company's engineers have developed a new technology which can detect the potential for mechanical failure with a greater degree of accuracy than has previously been the case. Early test results have been extremely encouraging.

If the board accepts the engineers' proposal, Hathaway Co would need to submit an application to the relevant regulatory authority. It is expected regulatory approval would be granted in one year's time. Manufacturing and sales would commence immediately after being granted regulatory approval. Hathaway Co's chief engineer presented an investment case for project chi to the board, including a summary of the following cost and revenue forecasts and assumptions.

Hathaway Co is expected to sell 3,000 units in the first year of production with demand increasing by 5% in each subsequent year of its four-year life. These sales forecasts are based on a contribution of \$5,000 per unit in the first year of production and increasing at 2% per year in subsequent years. Annual fixed costs of \$8.7m are expected in the first year of production, increasing at 3% per year throughout the life of the project.

An investment in plant and machinery of \$12m will be required as soon as regulatory approval has been granted. Tax allowable depreciation is available on the plant and machinery at an annual rate of 20% on a straight-line basis. A balancing adjustment is expected at the end of the project when the plant and machinery will be scrapped.

Tax is payable at 20% in the year in which profits are made. The relevant cost of capital to be used in the appraisal is 12%.

#### **Project chi extra information**

The finance director, however, raised the following objections and consequences to the chief engineer's presentation.

The chief engineer's cost and revenue assumptions ignore the possibility of a recession, which has a 20% probability of occurring. In a recession, the total present values for the four years of production are likely to be 40% lower. The finance director also believes there is an alternative, mutually exclusive, development opportunity based on the new technology although this would still depend on it being granted regulatory approval. This alternative option would incur an identical investment cost of \$12m but generate annual, inflation adjusted, post-tax cash flows of \$3.43m over its seven-year life from year two onwards.

The investment case assumes regulatory approval is certain whereas historically only 70% of Hathaway Co's applications have been approved. In one year's time, if the regulatory application is not approved, it is assumed that the concept can be sold to Gepe Co for \$1.0m at that time. If the board rejects the proposal now, assume the concept can be sold for \$4.3m immediately.

#### **Projects lambda and kappa**

A recent board meeting discussed two recent investments, projects lambda and kappa, both involving the construction of new manufacturing plants for safety equipment. Both projects are now operational although project lambda experienced significant time delays and cost overruns while project kappa was under budget and within schedule.

On closer examination, the directors noticed that project lambda's revenue far exceeded initial expectations, whereas project kappa's revenue was much less than originally expected. On balance, Hathaway Co's chief executive officer suggested that each project's successes compensated for their respective failings and that this was to be expected when making predictions about the future in an investment plan. However, one of the directors suggested the company could benefit from the introduction of a capital investment monitoring system and post-completion audit. The directors agreed to discuss this in greater depth at the next board meeting.



**Required:**

- (a) (i) Evaluate the financial acceptability of the project chi investment proposal based on the chief engineer's forecasts, assuming regulatory approval is granted in one year's time. (6 marks)
- (ii) Calculate the expected net present value of the proposal based on the finance director's assumptions about the likelihood of a recession and the potential impact on project chi's cash flows. (2 marks)
- (iii) Calculate the net present value of the finance director's alternative option for the technology and advise the board whether this is worth pursuing. (3 marks)
- (iv) Recommend whether the board should proceed with the application for regulatory approval after taking into consideration Hathaway Co's 70% approval rate with its regulatory applications or to sell the concept now to Gepe Co. Include in your analysis any comments on your findings. (6 marks)
- (b) Explain the rationale for implementing capital investment monitoring systems and post-completion audits. Suggest ways in which Hathaway Co may have benefited if these procedures had been applied to projects lambda and kappa. (8 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

$$g = br_e$$

### 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

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

### 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

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