



The Association of Business Executives

NQF

**Introduction to Quantitative
Methods**

Mark Scheme

Unit Title: Introduction to Quantitative Methods

Unit Code: IQM

Session: June 2015

Question 1

(a) Without the use of a calculator, find the value of the following showing all steps in your calculations. (Express each answer as a fraction in its simplest form.)

(i) $\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4}$

(ii) $\frac{(-2) \times (-1)}{(-2) \times (14 - (-18))}$

(iii) $\sqrt{\frac{36}{144} \times \left(\frac{1}{2} \div \frac{8}{2}\right)}$

(i) $\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{4 \times 4 \times 4} = \frac{1}{64}$ **(2 marks; MM up to 1 marks)**

(ii) $\frac{(-2) \times (-1)}{(-2) \times (14 - (-18))} = \frac{2}{(-2) \times 32} = \frac{2}{(-64)}$ **(3 marks; MM up to 2 marks)**

$= -\frac{1}{32}$ **(1 mark)**

(iii) $\sqrt{\frac{36}{144} \times \left(\frac{1}{2} \div \frac{8}{2}\right)} = \sqrt{\frac{36}{144} \times \left(\frac{1}{2} \times \frac{2}{8}\right)} = \sqrt{\frac{36}{144} \times \frac{2}{16}}$ **(3 marks; MM up to 2 marks)**

$= \sqrt{\frac{72}{2304}}$ **(1 mark)**

Maximum Marks for (a) 10 marks

(b) A firm has estimated that the probability of a parcel being delivered on time is 0.85. Express this probability as a:

- (i) fraction in its simplest form
- (ii) percentage
- (iii) correct to 1 decimal place

Award 2 marks for each correct answer and 1 mark for each answer where the final answer is incorrect but there is evidence that the correct method has been used. Award a maximum of 1 mark if the fraction in part (ii) is not expressed in its simplest form. Award 1 mark for part (iii) where the decimal is rounded up correct to 1 decimal place.

(i) $\frac{85}{100} = \frac{17}{20}$ **(2 marks; MM up to 1 mark)**

(ii) $\frac{17}{20} \times \frac{100}{1} = 85\%$ **(2 marks; MM up to 1 mark)**

(iii) 0.9 **(2 marks)**

Maximum Marks for (b) 6 marks

(c) A food manufacturing company generated an operating profit of £524,622.90 in the 2014/15 financial year.

- (i) Express this operating profit correct to 3 significant figures.
- (ii) If the company's operating profit was taxed at 20%, calculate the amount of tax the company would have to pay. (Give your answer to the nearest £.)

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Award **2 marks** for each correct answer and **1 mark** where the final answer is incorrect but there is evidence that the correct method has been used. For part (ii), award an **additional 1 mark** where the answer is given rounded up to the nearest £.

(i) £525,000 **(2 marks; MM up to 1 mark)**

(ii) $£524,622.90 \times \frac{20}{100} = £104,924.58$ **(2 marks; MM up to 1 mark)**

$= £104,925$ **(1 mark)**

Maximum Marks for (c) 5 marks

(d) Convert the following numbers from standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer, to the normal decimal form:

(i) 25.8×10^{-2}

(ii) 4.26×10^3

Award **2 marks** for each correct answer and **1 mark** where the final answer is incorrect but there is evidence that the correct method has been used.

(i) 0.258 **(2 marks; MM up to 1 mark)**

(ii) 4260 **(2 marks; MM up to 1 mark)**

Maximum Marks for (d) 4 marks
Total Maximum Marks for Q1 25 marks

Question 2

(a) A University is considering placing an advertisement in a student magazine to advertise the new Business Studies qualifications that it is offering students from September 2015. The cost of placing an advertisement in this magazine is £300 and the magazine is distributed to 5,000 students. Given this information:

(i) Calculate the cost of the advertisement per copy of the magazine distributed.

(ii) Assuming that the advertisement results in 50 students applying to study at the University, calculate the advertising cost per student application.

(iii) Calculate the expected number of student applications for every £120 spent on advertising in this particular magazine.

Award **4 marks** for part (i) and **3 marks** for part (ii) and (iii) for a correct answer and up to **2 marks** where the final answer is incorrect but there is evidence that the correct method has been used.

(i) $\frac{300}{5,000} = £0.06$ per copy **(4 marks; MM up to 2 marks)**

(ii) $\frac{300}{50} = £6$ per student application **(3 marks; MM up to 2 marks)**

(iii) $\frac{120}{6} = 20$ student applications **(3 marks; MM up to 2 marks)**

Maximum Marks for (a) 10 marks

(b) An employee is contracted to work 8 hours per day between Monday and Friday. She is paid a basic rate of £7.20 per hour worked. Any additional hours worked between Monday and Friday are paid at a higher rate of £10.80 per hour. Her basic hourly rate is doubled for every hour worked at weekends.

(i) Calculate the employee's basic weekly wage (i.e. assuming that she does not work any additional hours to those contracted).

(ii) In a particular week, the employee worked four additional hours between Monday and Friday, and six hours on Saturday. Calculate her total weekly wage for that week.

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- (iii) Calculate how many hours she would need to work at a weekend to receive the same increase in her basic wage as if during the week she were to work six additional hours to those contracted.

Award 3 marks for each correct answer and up to 2 marks where the final answer is incorrect but there is evidence that the correct method has been used.

- (i) $8 \text{ hours} \times 5 \text{ days} \times \text{£}7.20 = \text{£}288.00$ (3 marks; MM up to 2 marks)
(ii) $288.00 + (4 \text{ hours} \times \text{£}10.80) + (6 \text{ hours} \times (2 \times \text{£}7.20)) = \text{£}417.60$ (3 marks; MM up to 2 marks)
(iii) $\frac{6 \text{ hours} \times \text{£}10.80}{\text{£}14.40} = 4.5 \text{ hours}$ (3 marks; MM up to 2 marks)

Maximum Marks for (b) 9 marks

(c) An American investor has purchased a Chinese company for CNY 1 million, plus a 3% sales tax. The current Chinese Yuan (CNY) to US Dollar (USD) exchange rate is:
 $0.16259 \text{ CNY} = 1.00 \text{ USD}$

Calculate the total purchase cost of this investment, including the sales tax, in US Dollars. (Give your answer to the nearest Dollar.)

Award 6 marks for a correct answer and up to 3 marks where the final answer is incorrect but there is evidence that the correct method has been used. To attain full marks, the final answer should be rounded up to the nearest Dollar.

Purchase price of Chinese company = CNY 1,000,000
Sales tax at 3% = CNY 1,000,000 \times 0.03 = CNY 30,000
Total purchase cost of Chinese company in CNY = CNY 1,030,000
Total purchase cost of Chinese company in USD = CNY 1,030,000 \div 0.16259 = USD 6,334,952.90
(5 marks; MM up to 3 marks)
Total purchase cost of Chinese company to the nearest USD = USD 6,334,953 (1 mark)

Maximum Marks for (c) 6 marks
Total Maximum Marks for Q2 25 marks

Question 3

(a) In January 2015, a steel manufacturing company purchased new equipment costing £375,000. Calculate the value of the equipment in January 2020 if it is depreciated by:

- (i) £25,000 per year using the straight line method
(ii) 10% per year using the reducing balance method

Award 5 marks for each correct answer to parts (i) and (ii) and up to 3 marks each where the final answer is incorrect but there is evidence that the correct method has been used. To attain full marks, the final answer should be expressed to the nearest £.

(i) Initial cost: = £375,000
Depreciation: £25,000 \times 5 years = £125,000
Value of equipment after five years: £375,000 – £125,000 = **£250,000**
(5 marks; MM up to 3 marks)

(ii) The value at the end of each year is 90% of the value at the beginning of the year:

Value at the end of year 1: £375,000 \times 90% = £337,500
Value at the end of year 2: £337,500 \times 90% = £303,750
Value at the end of year 3: £303,750 \times 90% = £273,375
Value at the end of year 4: £273,375 \times 90% = £246,038
Value at the end of year 5: £246,038 \times 90% = **£221,434**

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Or by formula, the value of the machine after five years:

$$375,000 \times (1-0.10)^5 = 375,000 \times 0.90^5 = \text{£}221,434$$

(5 marks; MM up to 3 marks)

Maximum Marks for (a) 10 marks

(b) An investor deposits £80,000 in a bank. The bank pays interest, compounded annually, at a rate of 2.9% per year.

- (i) Calculate the total interest received by the investor after five years. (Give your answer to the nearest £.)
- (ii) Suppose the bank pays interest compounded half yearly instead of annually, at a rate of 1.45% per half year. Calculate how much the investment would be worth after five years. (Give your answer to the nearest £.)

Award **5 marks** for each correct answer to parts (i) and (ii) and **up to 3 marks** each where the final answer is incorrect but there is evidence that the correct method has been used. To attain full marks, the final answer should be expressed to the nearest £.

$$(i) \quad 80,000 \times \left(1 + \frac{2.9}{100}\right)^5 - 80,000 = \text{£}12,292.60$$

$$= \text{£}12,293$$

(5 marks; MM up to 3 marks)

$$(ii) \quad 80,000 \times \left(1 + \frac{1.45}{100}\right)^{5 \times 2} = \text{£}92,386.92$$

$$= \text{£}92,387$$

(5 marks; MM up to 3 marks)

Maximum Marks for (b) 10 marks

(c) Calculate the annual rate of compound interest that would be necessary for £80,000 to grow to £125,000 by the end of 5 years. (Give your answer correct to 1 decimal place.)

Award **5 marks** for a correct answer and **up to 3 marks** where the final answer is incorrect but there is evidence that the correct method has been used. To attain full marks, the final answer should be expressed to 1 decimal place.

$$80,000 \times \left(1 + \frac{i}{100}\right)^5 = 125,000$$

$$\therefore \left(1 + \frac{i}{100}\right)^5 = \frac{125,000}{80,000}$$

$$\therefore \left(1 + \frac{i}{100}\right)^5 = 1.5625$$

$$\therefore 1 + \frac{i}{100} = 1.5625^{\frac{1}{5}}$$

$$\therefore 1 + \frac{i}{100} = 1.0934$$

$$\therefore i = (1.0934 - 1) \times 100$$

$$\therefore i = 9.3\% \quad (5 \text{ marks; MM up to 3 marks})$$

Maximum Marks for (c) 5 marks
Total Maximum Marks for Q3 25 marks

Question 4

(a) If a paint manufacturing company's annual production costs are represented by the equation $y = 0.42x + 75$, where y is the company's total cost of production (in £'000) and x is the number of tins of paint produced (in '000), determine the:

- (i) Company's total production cost if the number of tins of paint produced is 120,000.
- (ii) Number of tins of paint produced if total production costs are £142,200.

Award 3 marks for each correct answer expressed in the correct units and up to 1 mark where the final answer is incorrect but there is evidence that the correct method has been used.

(i) If $x = 120$ ('000)	$y = (0.42 \times 120) + 75$	
$y = 50.4 + 75$	$y = 125.4$	(2 marks; MM up to 1 mark)
$y = \text{£}125,400$		(1 mark)

(ii) If $y = 142.2$ ('000)	$142.2 = 0.42x + 75$	
$x = \frac{142.2 - 75}{0.42}$	$x = 160$	(2 marks; MM up to 1 mark)
$x = \text{160,000}$		(1 mark)

Maximum Marks for (a) 6 marks

(b) Solve the following equations:

- (i) $8x - 24 = 3x + 16$
- (ii) $\frac{x}{2} + \frac{x}{4} = \frac{3}{5}$
- (iii) $x^2 - 8x + 15 = 0$, using factorisation
- (iv) $x^2 - 5x + 4.56 = 0$, using the quadratic formula

Award 3 marks for a correct answer to part (i) and up to 2 marks where the final answer is incorrect but there is evidence that the correct method has been used.

Award 4 marks for a correct answer to parts (ii, iii and iv) and up to 2 marks where the final answer is incorrect but there is evidence that the correct method. If for part (iii) the equation has been solved using the quadratic formula rather than factorisation, and vice versa for part (iv), then award up to 2 marks for the correct answer.

(i) $8x - 24 = 3x + 16$	$8x - 3x = 16 + 24$	
$5x = 40$	$x = 8$	(3 marks; MM up to 2 marks)

(ii) $\frac{x}{2} + \frac{x}{4} = \frac{3}{5}$	$\frac{2x}{4} + \frac{x}{4} = \frac{3}{5}$	$\frac{3x}{4} = \frac{3}{5}$
$x = \frac{3}{5} \times \frac{4}{3}$	$x = \frac{12}{15}$	$x = \frac{4}{5}$ or 0.8
		(4 marks; MM up to 2 marks)

(iii) Using the factorisation	$(x - 3)(x - 5) = 0$	
either: $x - 3 = 0$ or	$x - 5 = 0$	
so: $x = 3$ or	$x = 5$	(4 marks; MM up to 2 marks)

(iv) Using the quadratic formula	$x = \frac{-5 \pm \sqrt{-5^2 - (4 \times 1 \times 4.56)}}{2 \times 1}$
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$x = \frac{-(-5) \pm \sqrt{25 - 18.24}}{2}$	$x = \frac{5 \pm \sqrt{6.76}}{2}$	$x = \frac{5 \pm 2.6}{2}$
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So	$x = \frac{2.4}{2}$ or $x = \frac{7.6}{2}$	
	$x = 1.2$ or $x = 3.8$	(4 marks; MM up to 2 marks)

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Maximum Marks for (b) 15 marks

(c) Simplify the following logarithm expression to a single log term: $\log (x - 7) + \log (x)$

Award 4 marks for a correct answer and up to 2 marks where the final answer is incorrect but there is evidence that the correct method has been used. Award 3 marks where the final answer is given without the brackets - i.e. $\log x^2 - 7x$

Using the rule:	$\log (p \times q)$	= $\log p + \log q$:	
	$\log (x - 7) + \log (x)$	= $\log (x(x - 7))$	
		= $\log (x^2 - 7x)$	(4 marks; MM up to 2 marks)

Maximum Marks for (c) 4 marks
Total Maximum Marks for Q4 25 marks

Question 5

(a) Explain the difference between ‘quantitative data’ and ‘qualitative data’, using examples.

Award 1 mark for each valid point made in differentiating between the two types of data, up to a maximum of 2 marks. Award 1 mark for each example of ‘quantitative data’ and ‘qualitative data’ given, up to a maximum of 2 marks.

Quantitative data is generally referred to as information about ‘quantities’, for which observations are measurable and numerical in nature. Such data is easy to analyse statistically. In contrast, qualitative data is generally referred to as information about ‘qualities’, for which observations can’t actually be measured and are non-numeric in nature. **(up to 2 marks for explanation)**

An example of quantitative data could include the number of cars produced by a car manufacturing plant each day. An example of qualitative data could include the different colours of cars produced by a car manufacturing plant each day. **(up to 2 marks for examples)**

Maximum Marks for (a) 4 marks

(b) Classify the following operational data, used by a delivery company to monitor performance, as either continuous or discrete:

- (i) Average number of parcels delivered per hour
- (ii) Time taken to deliver ten parcels
- (iii) Total weight of parcels delivered each day
- (iv) Distance travelled during the day by each delivery driver

Award 1 mark for each correct answer.

- (i) Discrete
- (ii) Continuous
- (iii) Continuous
- (iv) Continuous

Maximum Marks for (b) 4 marks

(c) Given the quadratic equation $y = x^2 - 8x + 12$:

- (i) Construct a table and calculate the value of y for the following values of x : -1, 0, 1, 2, 3, 4, 5, 6, 7, 8.
- (ii) Using your tabulated data in (i), plot a graph of $y = x^2 - 8x + 12$ for the values of x from $x = -1$ to $x = 8$. (Use the graph paper at the front of your answer book.)

In part (i) award 5 marks for a correctly constructed table and up to 3 marks if the contingency table is not totally correct but there is evidence of some correct workings.

In part (ii), award 6 marks for an accurate fully labelled plot. Award 1 mark for the inclusion of a title and 1 mark for axes labels. Award up to 4 marks for an accurate, scaled and well-drawn plot of the quadratic equation.

FINAL VERSION: TO BE USED FOR MARKING

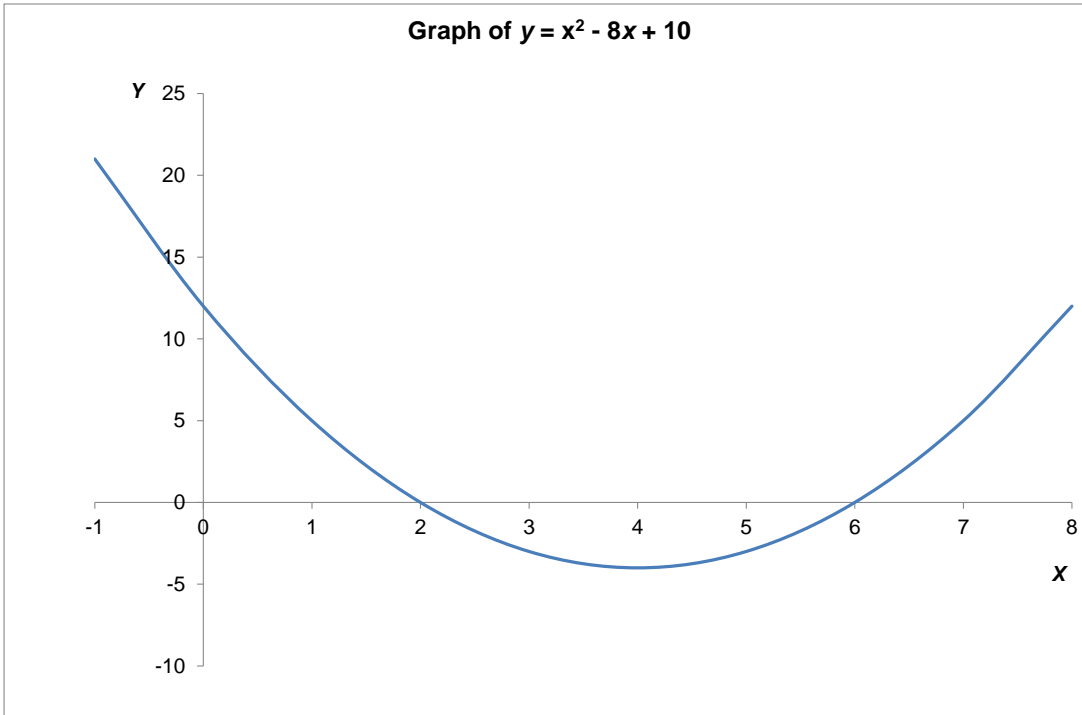
(Accept OF marks for part (ii) where a student has not attained full marks in part (i) for incorrectly calculated y -values, but where these have been correctly plotted in part (ii)).

(i)

x	-1	0	1	2	3	4	5	6	7	8
x^2	1	0	1	4	9	16	25	36	49	64
$-8x$	8	0	-8	-16	-24	-32	-40	-48	-56	-64
12	12	12	12	12	12	12	12	12	12	12
y	21	12	5	0	-3	-4	-3	0	5	12

(5 marks; MM up to 3 marks)

(ii)



(6 marks; OF = 6, MM as specified above)

Maximum Marks for (c) 11 marks

(d) Using the graph of $y = x^2 - 8x + 12$ plotted in (c), find the:

- (i) values of x when $y = 0$
- (ii) values of x and y when $y = x^2 - 8x + 12$ is at its minimum
- (iii) co-ordinates at which the function $y = x^2 - 8x + 12$ intersects the y -axis

- (i) $x = 2$ and 6 (2 marks, OF=2, MM up to 1 mark)
- (ii) $x = 4$ and $y = -4$ (2 marks, OF=2, MM up to 1 mark)
- (iii) $(0, 2)$ (2 marks, OF=2, MM up to 1 mark)

Maximum Marks for (d) 6 marks
Total Maximum Marks for Q5 25 marks

Question 6

The following table shows the grouped frequency distribution of the height (cm) of a sample of students studying business management subjects.

Class interval of student heights (cm)	Number of students
120 to less than 130	1
130 to less than 140	3
140 to less than 150	5
150 to less than 160	16
160 to less than 170	21
170 to less than 180	28
180 to less than 190	5
190 to less than 200	1

(a) Using the grouped frequency distribution table:

- (i) Determine the modal class interval of the students' heights.
- (ii) Calculate the mean height of the students.

*Award **up to 2 marks** for the correct modal class interval in part (i); if the units (cm) are not included then award up to 1 mark. For part (ii), award 4 marks for the correct answer, and up to 2 marks where the final answer is incorrect but there is evidence that the correct method has been used*

- (i) Modal class interval of student heights is '170 cm to less than 180 cm' **(up to 2 marks)**
- (ii)

Class interval of heights (grams)	Mid-value (X)	Frequency (f)	fx
120 to less than 130	125	1	125
130 to less than 140	135	3	405
140 to less than 150	145	5	725
150 to less than 160	155	16	2480
160 to less than 170	165	21	3465
170 to less than 180	175	28	4900
180 to less than 190	185	5	925
190 to less than 200	195	1	195
		$\sum f = 80$	$\sum fx = 13,220$

$$\bar{x} = \frac{\sum fx}{\sum f} = \frac{13,220}{80} = 165.25cm \quad \text{(4 marks; MM up to 2 marks)}$$

Maximum Marks for (a) 6 marks

(b) Using the frequency distribution data presented in the table above, construct a cumulative frequency distribution table of student heights using class intervals of 'less than 130', 'less than 140', 'less than 150', 'less than 160', 'less than 170', 'less than 180', 'less than 190' and 'less than 200'.

Award a total of 4 marks for an accurate cumulative frequency distribution table.

Award up to 2 marks correctly calculating the cumulative frequencies.

Award up to 2 marks for using the correct class interval labels.

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Class interval of weights (grams)	Frequency (<i>f</i>)	Cumulative frequency (<i>cf</i>)
less than 130	1	1
less than 140	3	4
less than 150	5	9
less than 160	16	25
less than 170	21	46
less than 180	28	74
less than 190	5	79
less than 200	1	80

(4 marks; MM as specified above)

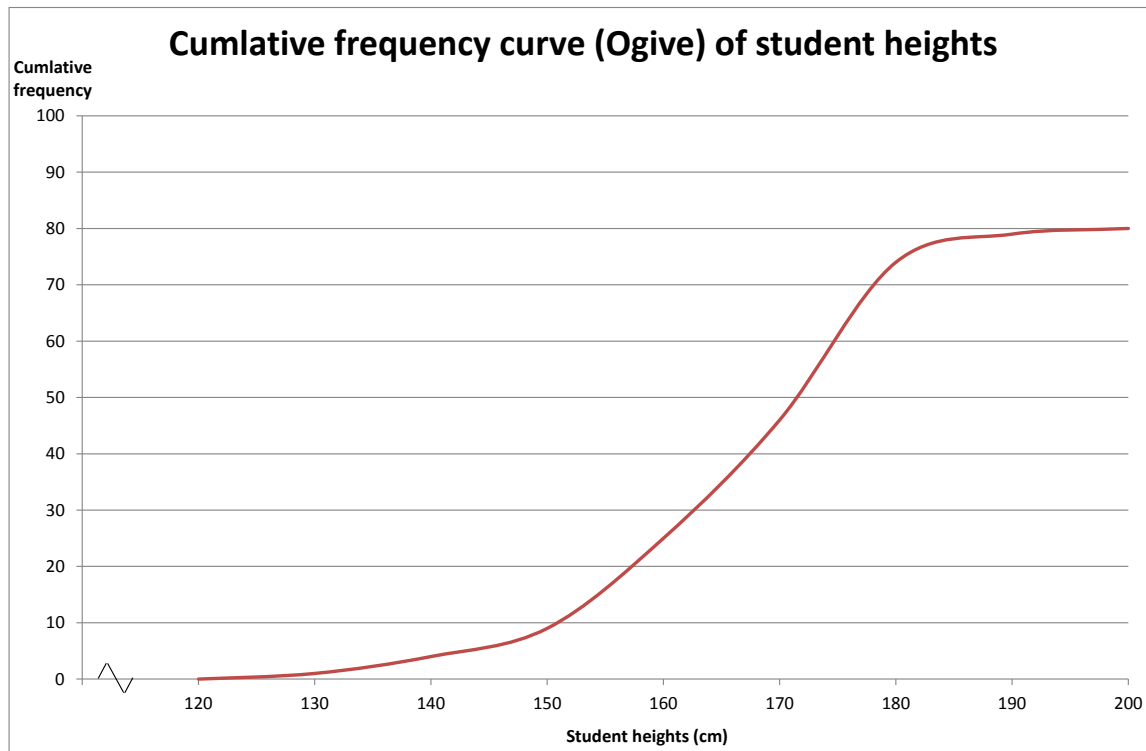
Maximum Marks for (b) 4 marks

(c) Using the cumulative frequency distribution data constructed in (b), draw a fully-labelled cumulative frequency curve (ogive) showing the height distribution of the sample of students studying business management subjects. (Use the graph paper provided at the front of your answer book.)

*Award a total of **6 marks** for an accurate fully labelled ogive:*

*Award **up to 2 marks** for the inclusion of a title, and axes labels and units*

*Award **up to 4 marks** for an accurate, scaled and well-drawn ogive*



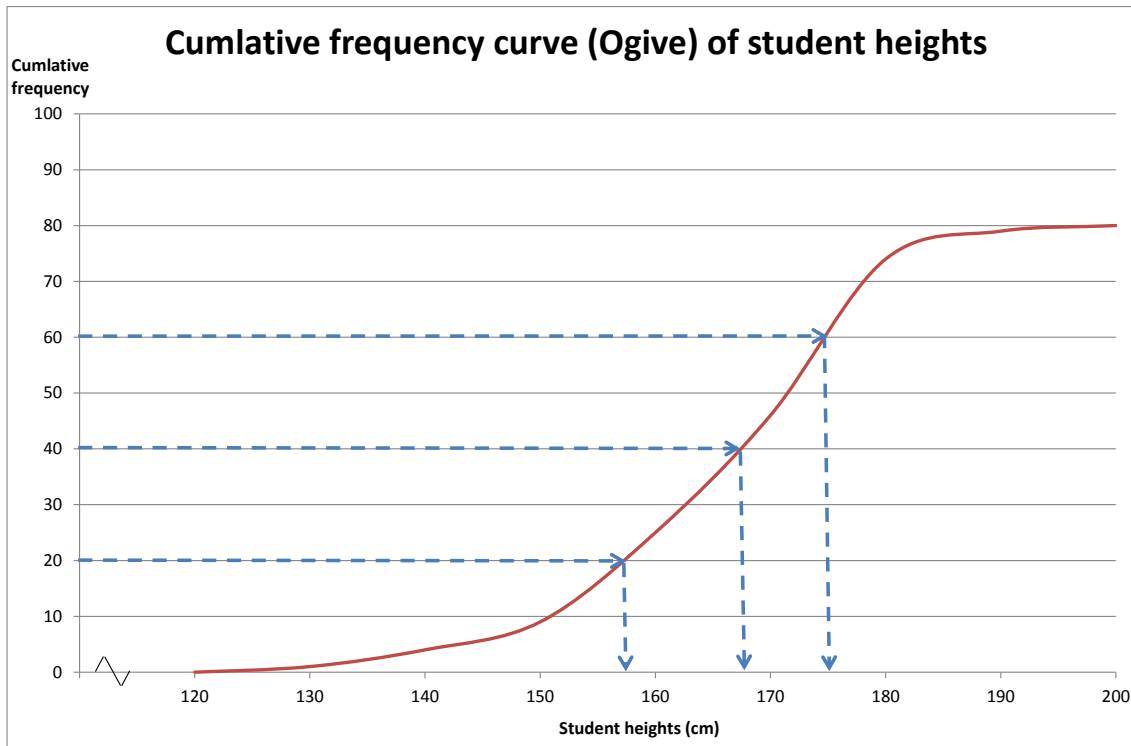
(6 marks; MM as specified above)

Maximum Marks for (c) 6 marks

(d) Using your cumulative frequency curve drawn in (c), determine the:

- (i) Median height of students
- (ii) The upper and lower quartile values of the student heights, and use these values to calculate the interquartile range

*Award **3 marks** for **each** correct answer and **up to 2 marks** where the final answer is incorrect but there is evidence that the correct method has been used. If the cumulative frequency has not been used to determine the median and interquartile range, award a **maximum of 1 mark** for each correct answer.*



(i) Most likely value of the median is approximately 168 cm (3 marks; OF=3, MM up to 2 marks)

(ii) $Q_1 = 157$

$Q_3 = 175$

Interquartile range = $Q_3 - Q_1 = 175 - 157 = 18$ cm (3 marks; OF=3, MM up to 2 marks)

Maximum Marks for (d) 6 marks

(e) Explain why the 'interquartile range' is a more reliable measure of dispersion than the 'range'.

Award up to 4 marks for an accurate explanation and relevant points made.

The range is the difference between the lowest and highest values in a dataset. It is a useful measure for showing the spread within a dataset and for comparing the spread between similar datasets. However, since the range is based solely on the two most extreme values within the dataset, if one of these is either exceptionally high or low (i.e. an outlier), it will result in a range that is not typical of the variability within the dataset.

In contrast, the inter-quartile range is a measure that indicates the extent to which the central 50% of values within the dataset are dispersed. The inter-quartile range is therefore a more reliable measure of dispersion of an overall dataset as it removes/ignores the outlying values which the range fails to do.

Thus, the interquartile range is a more reliable measure of dispersion than the range because it is not affected by extreme values in the same way as the range is.

Maximum Marks for (e) 3 marks
Total Maximum Marks for Q6 25 marks

Question 7

(a) Explain, using examples, what is meant by the term ‘subjective probability’.

For the explanation of subjective probability award 1 mark for each valid point made, up to a maximum of 5 marks. For the use of examples, award up to a maximum of 4 marks.

Subjective probability describes an individual’s personal judgement about how likely a particular event is to occur. It is not based on any precise theoretical or empirical foundation, but is often a reasonable assessment by a knowledgeable person. Thus, a person’s subjective probability of an event describes his/her degree of belief in the outcome of that event. **(up to 5 marks)**

In business, managers will often make strategic decisions based on the subjective probability of the outcome of an event – i.e. on their instinct given their knowledge of the business environment in which they operate. For example, investors on the stock market may base many of their decisions to buy and sell shares on their instinct. **(up to 4 marks)**

Maximum Marks for (a) 9 marks

(b) A retailer sells 50 chocolate products, 20 of which are produced from South American cocoa with the remainder produced from African cocoa. Of the 20 chocolate products produced from South American cocoa, 15 contain less than 99% cocoa. Only 10 of the 50 chocolate products are made from 99% or more cocoa.

Use this information to construct a two-way contingency table and use it to calculate the probability that a chocolate product picked at random:

- (i) Is produced from African cocoa
- (ii) Contains less than 99% cocoa
- (iii) Is produced from African cocoa **and** contains less than 99% cocoa
- (iv) Is produced from African cocoa **or** contains less than 99% cocoa

*Award 4 marks for a correctly completed contingency table (with row and column totals) and up to 2 marks if the contingency table is not totally correct but there is evidence of some correct workings. Award 3 marks each for correctly calculating the probabilities for parts (i) to (iv) or up to 2 marks where the final answer is incorrect but there is evidence that the correct method has been used. Any student that incorrectly answered part (a) should **not be penalised** a subsequent time in answering parts (i) and (iv).*

	Produced from African cocoa	Produced from South American cocoa	Total
Contains less than 99% cocoa	25	15	40
Contains 99% or more cocoa	5	5	10
Total	30	20	50

(4 marks; MM up to 2 marks)

(i) P(produced from African cocoa)
 $= \frac{30}{50} = \frac{3}{5}$ or 0.60 or 60% **(3 marks; OF=3, MM up to 2 marks)**

(ii) P(contains less than 99% cocoa)
 $= \frac{40}{50} = \frac{4}{5}$ or 0.80 or 80% **(3 marks; OF=3, MM up to 2 marks)**

(iii) P(produced from African cocoa **and** contains less than 99% cocoa)
 $= \frac{25}{50} = \frac{1}{2}$ or 0.50 or 50% **(3 marks; OF=3, MM up to 2 marks)**

(iv) P(produced from African cocoa **or** contains less than 99% cocoa)
 $= \frac{30+15}{50} = \frac{9}{10}$ or 0.90 or 90% **(3 marks; OF=3, MM up to 2 marks)**

Maximum Marks for (b) 16 marks
Total Maximum Marks for Q7 25 marks

Question 8

(a) A game at a casino involves rolling two 6-sided dice. To win, a score of less than 4 in total from both dice added together must be rolled. Calculate the:

- (i) Probability of winning a game
- (ii) Expected profit for the casino if 200 people each pay £1 per game to play and the prize for scoring less than 4 in total from both dice is £5. (Give your answer to the nearest £.)

Maximum Marks for (a) 8 marks

Award 4 marks for a correct answer and up to 2 marks where the final answer is incorrect but there is evidence that the correct method has been used.

$$(i) \quad P(\text{scoring} < 4) = \frac{3}{6 \times 6} = \frac{3}{36} = \frac{1}{12} \quad \text{or} \quad 8.3\%$$

(4 marks; MM up to 2 marks)

$$(ii) \quad \text{Expected profit} = (200 \times £1) - (200 \times \frac{1}{12} \times £5) = £117$$

(4 marks; OF 2 marks, MM up to 2 marks)

(b) The weight of a bag of rice is found to be normally distributed with a mean of 1,000 grams and a standard deviation of 10 grams.

- (i) Find the probability that a randomly selected bag of rice weighs more than 1,030 grams.
- (ii) Sketch a standard normal distribution curve and represent the probability calculated in (i) as an area under your normal distribution curve.
- (iii) Find the probability that a randomly selected bag of rice weighs between 995 grams and 1030 grams.
- (iv) If 2,500 bags of rice were selected at random, calculate how many bags would weigh more than 1,030 grams. (Give your answer rounded up to the nearest bag of rice.)

Maximum Marks for (b) 17 marks

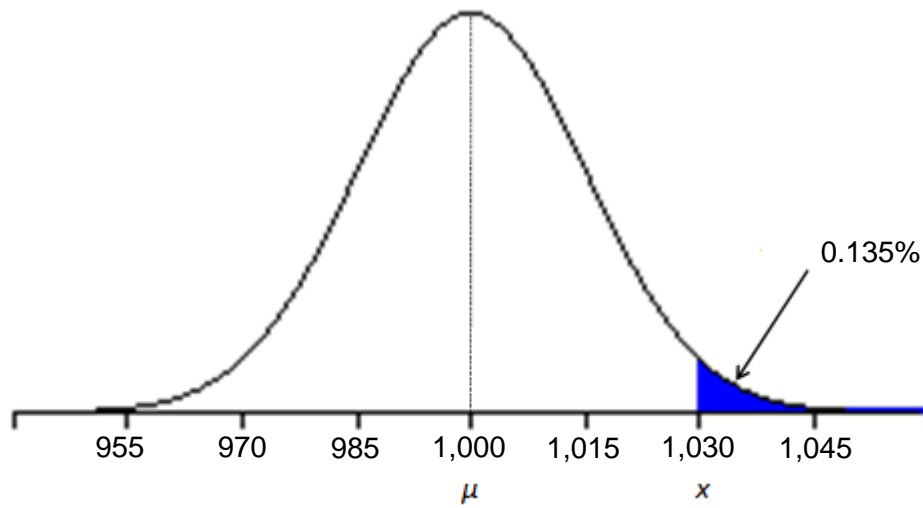
Award 5 marks each for correctly calculating the probabilities for parts (i) and (iii), and up to 3 marks where the final answer is incorrect but there is evidence that the correct method has been used. For part (ii), award up to 4 marks for a correct sketch of the standard normal distribution curve, with the probability clearly shown as an area under the right hand tail of the curve. For part (iv), award 3 marks for the correct answer, rounded up to the nearest bag of rice. Award a maximum of 2 marks if the answer has not been rounded up and 1 mark where the final answer is incorrect but there is evidence that the correct method has been applied.

$$(i) \quad P(X > 1030) = P(Z < \frac{1030-1000}{10}) = P(Z < 3) = 0.00135 \text{ or } 0.135\%$$

(5 marks; MM up to 3 marks)

(ii)

FINAL VERSION: TO BE USED FOR MARKING



(up to 4 marks)

$$\begin{aligned}
 \text{(iii) } P(995 < X < 1030) &= P\left(\frac{995-1000}{10} < X < \frac{1030-1000}{10}\right) = P(-0.5 < X < 3) \\
 = 1 - (0.3085 + 0.00135) &= 1 - (0.30985) = 0.69015 \text{ or } 69.015\%
 \end{aligned}$$

(5 marks; MM up to 3 marks)

$$\text{(iv) } 2500 \times 0.135\% = 2500 \times 0.00135 = 3.375$$

(2 marks; MM up to 1 mark)

= 4 bags of rice

(1 mark)

Total Maximum Marks for Q8 25 marks