C37

Cumulative frequency

CHAPTER ASSIGNMENT · 14 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Show your working. Use graph paper for the cumulative frequency diagrams and plot each point at the upper boundary of its class.

Practice questions from *Cambridge IGCSE Mathematics Core and Extended* (4th edition), Chapter 37 (Cumulative frequency), for classroom use. Where a question uses a graph in the book, the graph's readings are given here as a table (marked as approximate). The Check yourself and Chapter quiz questions are Guru Jazzy's own.

Exercise 37.1 · Cumulative frequency

37.1.1 Sixty athletes enter a long-distance run. Their finishing times are recorded and are shown in the table below:

Finishing time (h)	0–	0.5–	1.0–	1.5–	2.0–	2.5–	3.0–3.5
Frequency	0	0	6	34	16	3	1
Cumulative freq.							

(a) Copy the table and calculate the values for the cumulative frequency.

(b) Draw a cumulative frequency diagram of the results.

(c) Show how your graph could be used to find the approximate median finishing time.

(d) What does the median value tell us?

37.1.2 Three mathematics classes take the same test in preparation for their final exam. Their raw scores are shown below:

Class A: 12, 21, 24, 30, 33, 36, 42, 45, 53, 53, 57, 59, 61, 62, 74, 88, 92, 93

Class B: 48, 53, 54, 59, 61, 62, 67, 78, 85, 96, 98, 99

Class C: 10, 22, 36, 42, 44, 68, 72, 74, 75, 83, 86, 89, 93, 96, 97, 99, 99

(a) Using the class intervals $0 \leq x < 20$, $20 \leq x < 40$ etc., draw up a grouped frequency and cumulative frequency table for each class.

(b) Draw a cumulative frequency diagram for each class.

(c) Show how your graph could be used to find the median score for each class.

(d) What does the median value tell us?

37.1.3 The table below shows the heights of students in a class over a three-year period.

Height (cm)	Frequency 2007	Frequency 2008	Frequency 2009
150–	6	2	2
155–	8	9	6
160–	11	10	9
165–	4	4	8
170–	1	3	2
175–	0	2	2
180–185	0	0	1

(a) Construct a cumulative frequency table for each year.

(b) Draw the cumulative frequency diagram for each year.

(c) Show how your graph could be used to find the median height for each year.

(d) What does the median value tell us?

Exercise 37.2 · Quartiles, interquartile range and box-and-whisker plots

37.2.1 Using the results obtained from Question 2 in Exercise 37.1:

(a) find the interquartile range of each of the classes taking the mathematics test,

(b) analyse your results and write a brief summary comparing the three classes.

37.2.2 Using the results obtained from Question 3 in Exercise 37.1:

(a) find the interquartile range of the students' heights each year,

(b) analyse your results and write a brief summary comparing the three years.

37.2.3 Forty boys enter a school javelin competition. The distances thrown are recorded below:

Distance thrown (m)	0–	20–	40–	60–	80–100
Frequency	4	9	15	10	2

(a) Construct a cumulative frequency table for the above results.

(b) Draw a cumulative frequency diagram.

(c) If the top 20% of boys are considered for the final, estimate (using the graph) the qualifying distance.

(d) Calculate the interquartile range of the throws.

(e) Calculate the median distance thrown.

37.2.4 The masses of two different types of orange are compared. Eighty oranges are randomly selected from each type and weighed. The results are shown in the table:

Mass (g)	Type A frequency	Type B frequency
75–	4	0
100–	7	16
125–	15	43
150–	32	10
175–	14	7
200–	6	4
225–250	2	0

(a) Construct a cumulative frequency table for each type of orange.

(b) Draw a cumulative frequency diagram for each type of orange.

(c) Calculate the median mass for each type of orange.

(d) Using your graphs, estimate for each type of orange: (i) the lower quartile, (ii) the upper quartile, (iii) the interquartile range.

(e) On the same scale, draw a box-and-whisker plot for each type of orange.

(f) Write a brief report, with reference to the box-and-whisker plots, comparing the two types of orange.

37.2.5 Two competing brands of battery are compared. One hundred batteries of each brand are tested and the duration of each is recorded. The results of the tests are shown in the cumulative frequency diagrams in the book. The points marked on the two diagrams (read from the book's figure, approximate) are:

Duration (h)	10	20	30	40
Brand X cumulative frequency	0	20	60	100
Brand Y cumulative frequency	5	60	95	100

(a) The manufacturers of brand X claim that on average their batteries will last at least 40% longer than those of brand Y. Showing your method clearly, decide whether this claim is true.

(b) The manufacturers of brand X also claim that their batteries are more reliable than those of brand Y. Is this claim true? Show your working clearly.

Student assessment 1

SA1.1 Thirty students sit a maths exam. Their marks are given as percentages and are shown in the table below.

Mark	20–	30–	40–	50–	60–	70–	80–	90–100
Frequency	2	3	5	7	6	4	2	1

(a) Construct a cumulative frequency table of the above results.

(b) Draw a cumulative frequency diagram of the results.

(c) Using the graph, estimate a value for: (i) the median, (ii) the upper and lower quartiles, (iii) the interquartile range.

(d) On the same graph as your cumulative frequency diagram, construct a box-and-whisker plot of the data.

SA1.2 Four hundred students sit an IGCSE exam. Their marks (as percentages) are shown in the table below.

Mark (%)	31–40	41–50	51–60	61–70	71–80	81–90	91–100
Frequency	21	55	125	74	52	45	28
Cumulative frequency							

(a) Copy and complete the above table by calculating the cumulative frequency.

(b) Draw a cumulative frequency diagram of the results.

(c) Using the graph, estimate a value for: (i) the median result, (ii) the upper and lower quartiles, (iii) the interquartile range.

SA1.3 Eight hundred students sit an exam. Their marks (as percentages) are shown in the table below.

Mark (%)	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
Frequency	10	30	40	50	70	100	240	160	70	30
Cumulative frequency										

(a) Copy and complete the above table by calculating the cumulative frequency.

(b) Draw a cumulative frequency diagram of the results.

(c) An A grade is awarded to a student at or above the 80th percentile. What mark is the minimum requirement for an A grade?

(d) A C grade is awarded to any student between and including the 55th and the 70th percentile. What marks form the lower and upper boundaries of a C grade?

(e) Calculate the interquartile range for this exam.

SA1.4 Four cumulative frequency graphs, A, B, C and D, are plotted on the same axes (the book's figure, with x from 0 to 100 and f from 0 to 100). Approximate points read from the figure are:

x	0	20	40	60	80	100
A	0	30	70	85	95	100
B	0	5	15	65	90	100
C	0	0	0	70	90	100
D	0	0	0	10	80	100

Four box-and-whisker plots are also plotted on the same x axis (the book's figure). Approximate readings are:

Plot	Minimum	Lower quartile	Median	Upper quartile	Maximum
1	0	17	30	45	100
2	40	65	72	80	100
3	40	50	55	60	100
4	0	45	53	65	100

Decide which box-and-whisker plot goes with which cumulative frequency graph. Give reasons for your choices.

Check yourself

1. A cumulative frequency graph for 80 values is drawn. At what heights on the vertical axis do you read the lower quartile, the median and the upper quartile? [3]

2. The frequencies for the classes $0 \le t < 10$, $10 \le t < 20$, $20 \le t < 30$ and $30 \le t < 40$ are 5, 15, 20 and 10. Write the cumulative frequency for each class and state the median class. [3]

3. A set has lower quartile 32 and upper quartile 47. Find the interquartile range. [1]

4. Set P has median 50 and interquartile range 8. Set Q has median 50 and interquartile range 20. Which set is more consistent? Give a reason. [2]

5 Why is the first point of a cumulative frequency graph plotted at the lower bound of the first class with a cumulative frequency of 0? [2]

6 Sketch a box-and-whisker plot for minimum 10, lower quartile 25, median 40, upper quartile 50 and maximum 80, and label the five values. [3]

Chapter quiz

Q1 Class frequencies are 4, 7, 9, 5 in order. What is the last cumulative frequency?

A	B	C	D
9	16	25	21

Q2 For the class $10 \leq t < 15$, where is its point plotted on a cumulative frequency graph?

A	B	C	D
At t = 10	At t = 12.5	At t = 15	At t = 5

Q3 A cumulative frequency curve ends at 80. At what height do you read the median?

A	B	C	D
20	40	60	80

Q4 For 60 values, at what cumulative frequency do you read the lower quartile?

A	B	C	D
15	20	30	45

Q5 For 200 values, at what cumulative frequency do you read the upper quartile?

A	B	C	D
50	100	150	175

Q6 The lower quartile is 13 h and the upper quartile is 25 h. What is the interquartile range?

A	B	C	D
6 h	12 h	19 h	38 h

Q7 Two data sets have the same median. Set P has IQR 6 and set Q has IQR 12. Which is more consistent?

A	B	C	D
Set P	Set Q	They are equal	It cannot be told

Q8 Which five values are needed to draw a box-and-whisker plot?

A	B	C	D
Mean, mode, median, range, IQR	Minimum, lower quartile, median, upper quartile, maximum	Minimum, mean, median, mode, maximum	Lower quartile, median, upper quartile, mean, range

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Q9 In a box-and-whisker plot, what does the length of the box show?

A	B	C	D
The range	The median	The interquartile range	The mean

Q10 A top 20% of students go to the final. Which percentile gives the qualifying mark?

A	B	C	D
20th	25th	75th	80th

Q11 Frequency table: first class is $0 \le t < 5$. What minimum value do we use on the box plot?

A	B	C	D
0	2.5	5	The first frequency

Q12 Why is the interquartile range often better than the range?

A	B	C	D
It uses every value	It is always larger	Extreme values do not change it	It equals the median

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End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/o-level-mathematics/chapter-37-cumulative-frequency/