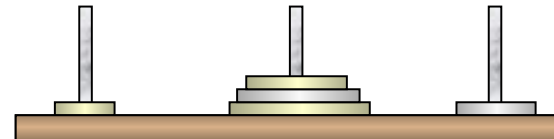
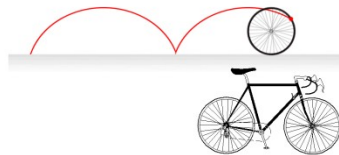
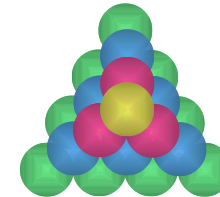
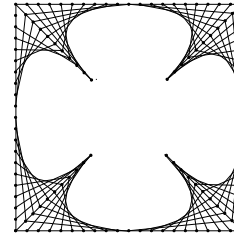
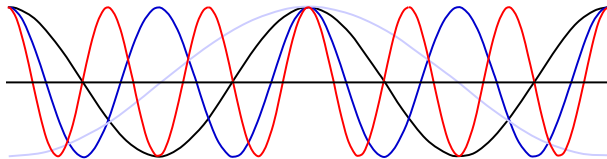
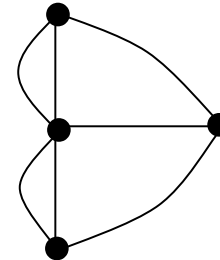
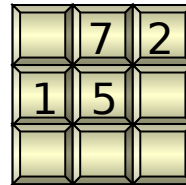
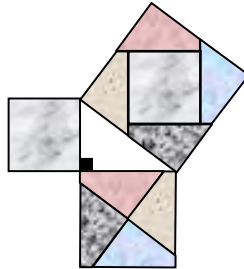
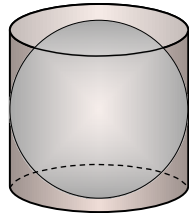




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Cumulative Frequency Curves

Remember:

- When data is **grouped** we don't know the actual value of either the **mean**, **median**, **mode** or **range**.
- We can get an **estimate** for the mean by using **mid-points** from the frequency table.

We can also use the grouped data to obtain an **estimate** of the **median** and a **measure of spread** called the **inter-quartile range**. We do this by plotting a **cumulative frequency curve** (Ogive).

minutes late	frequency	midpoint(x)	mp x f
0 - 10	27		
10 - 20	10		
20 - 30	7		
30 - 40	5		
40 - 50	4		
50 - 60	2		



The measure of spread used with the median is the **inter-quartile range**. This is a **better** measure of spread as it only uses the **middle half** of the data that is grouped around the **median**. This means that unlike the range it is **not** subject to **extreme values**.

Cumulative Frequency Curves

Remember:

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20 - 30	7		
30 - 40	5		
40 - 50	4		
50 - 60	2		



Discuss the calculations below

Battery Life:

The life of 12 batteries recorded in hours is:

2, 5, 6, 6, 7, 8, 8, 8, 9, 9, 10, 15

Mean = $93/12 = 7.75$ hours and the range = $15 - 2 = 13$ hours.



2, 5, 6, 6, 7, 8, 8, 8, 9, 9, 10, 15

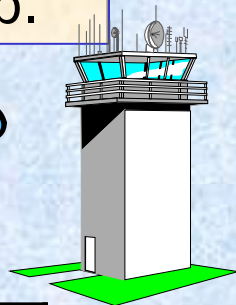
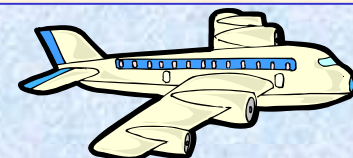
Median = 8 hours and the inter-quartile range = $9 - 6 = 3$ hours.

Cumulative Frequency Curves

Cumulative frequency diagrams are used to obtain an **estimate** of the **median, and quartiles**. from a set of grouped data. Constructing a **cumulative frequency table** is first step.

Example 1.

During a 4 hour period at a busy airport the number of late-arriving aircraft was recorded.

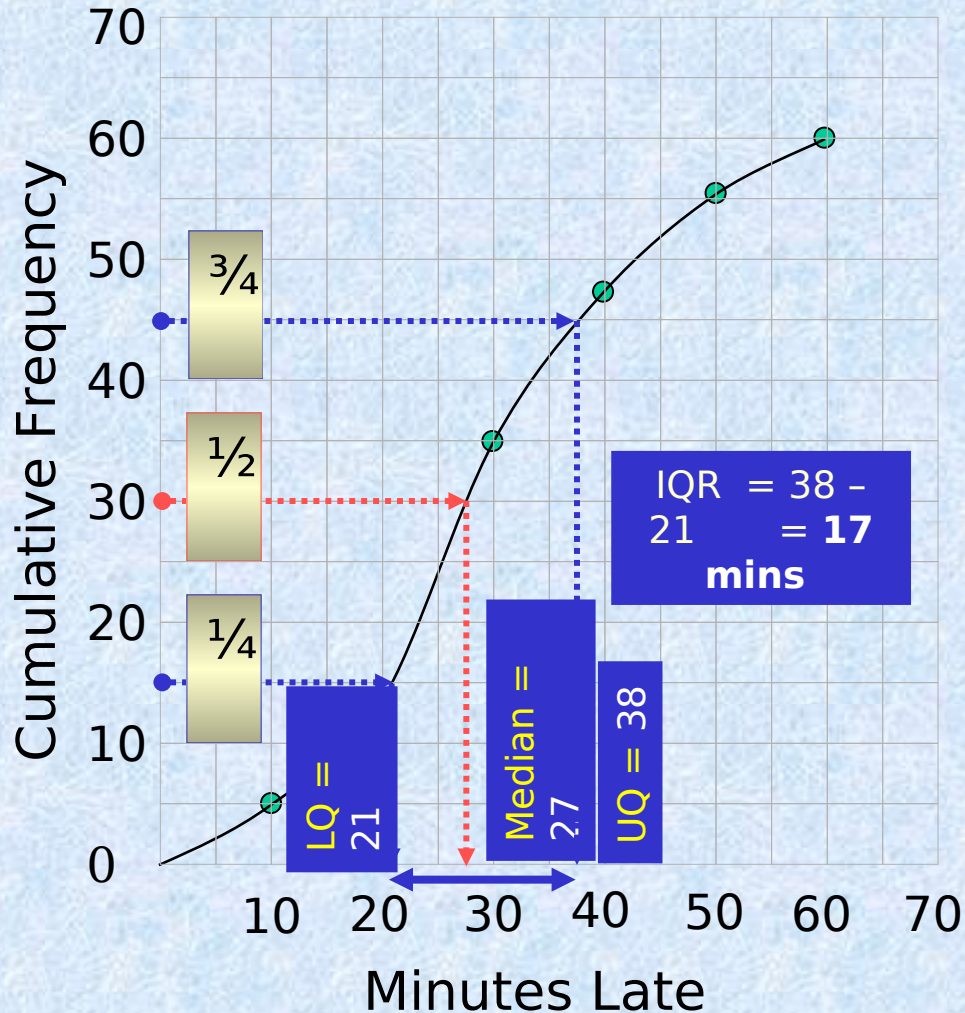


Cumulative frequency table

Minutes Late	Frequency	Upper Limit	Cumulative Frequency
0 - 10	5	< 10	5
10 - 20	8	< 20	13
20 - 30	22	< 30	35
30 - 40	12	< 40	47
40 - 50	8	< 50	55
50 - 60	5	< 60	60

Cumulative frequency just means **running total**.

Plotting the curve



Cumulative frequency table

Mins Late	f	Upper Limit	CF
0 - 10	5	< 10	5
10 - 20	8	< 20	13
20 - 30	22	< 30	35
30 - 40	12	< 40	47
40 - 50	8	< 50	55
50 - 60	5	< 60	60

Plot the **end point** of each interval against **cumulative frequency**, then join the points to make the curve.

Get an estimate for the **median**.

Find the **Upper Quartile**.

Find the **lower quartile**.

Find the **Inter Quartile Range**. (IQR = UQ - LQ)

Cumulative Frequency Curves

Cumulative frequency diagrams are used to obtain an **estimate** of the **median** and quartiles from a set of grouped data. Constructing a **cumulative frequency table** is first step.

Example 2.

A P.E teacher records the distance jumped by each of 70 pupils.

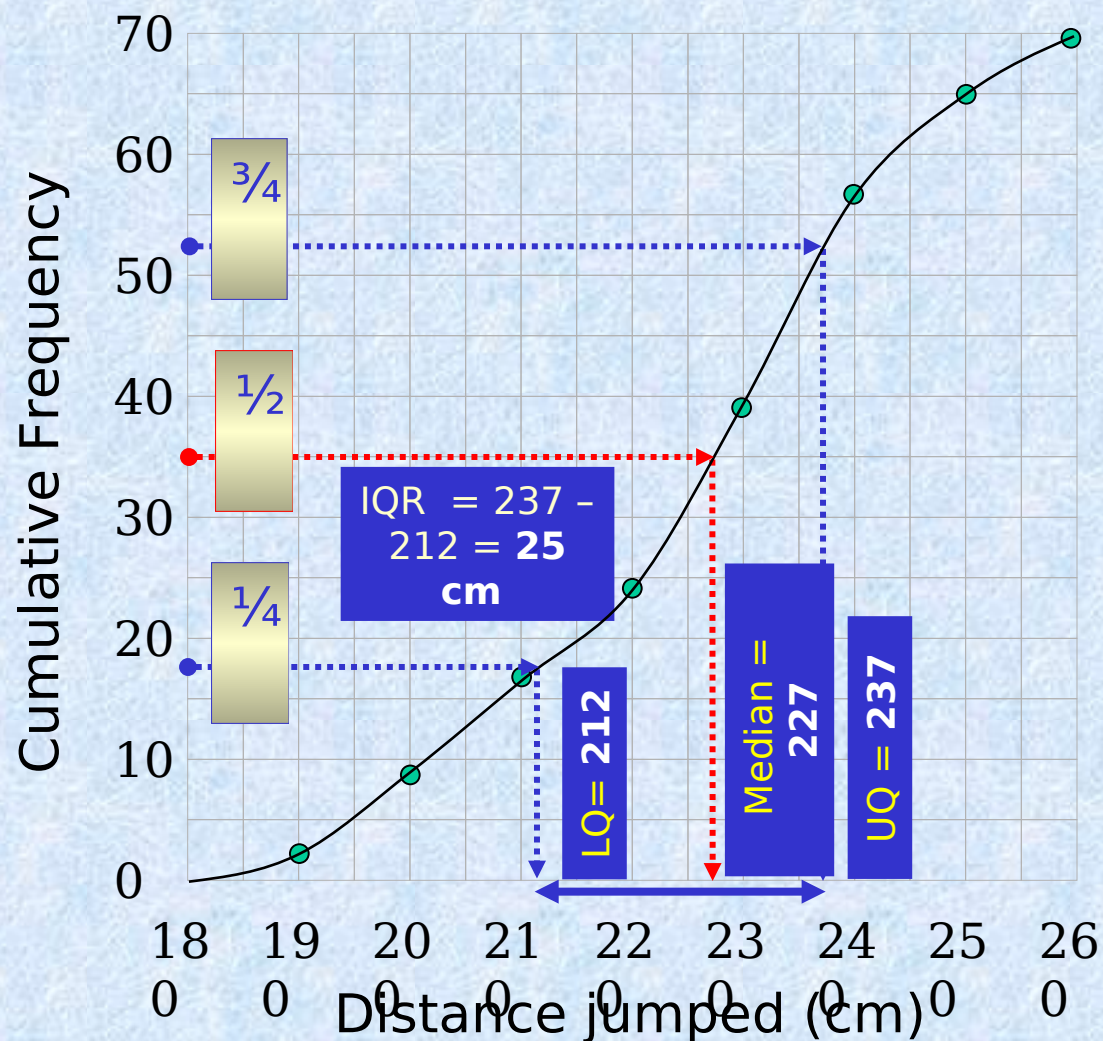


Cumulative frequency table

Distance (cm)	No. of pupil	Upper Limit	Cumulative Frequency
$180 \leq d < 190$	^S 2	$d < 190$	2
$190 \leq d < 200$	6	$d < 200$	8
$200 \leq d < 210$	9	$d < 210$	17
$210 \leq d < 220$	7	$d < 220$	24
$220 \leq d < 230$	15	$d < 230$	39
$230 \leq d < 240$	18	$d < 240$	57
$240 \leq d < 250$	8	$d < 250$	65
$250 \leq d < 260$	5	$d < 260$	70

Cumulative frequency just means **running total**

Plotting The Curve



Cumulative Frequency Table

Distance jumped (cm)	Number of pupils	Cumulative Frequency
$180 \leq d < 190$	2	2
$190 \leq d < 200$	6	8
$200 \leq d < 210$	9	17
$210 \leq d < 220$	7	24
$220 \leq d < 230$	15	39
$230 \leq d < 240$	18	57
$240 \leq d < 250$	8	65
$250 \leq d < 260$	5	70

Plot the **end point** of each interval against **cumulative frequency**, then join the points to make the curve.

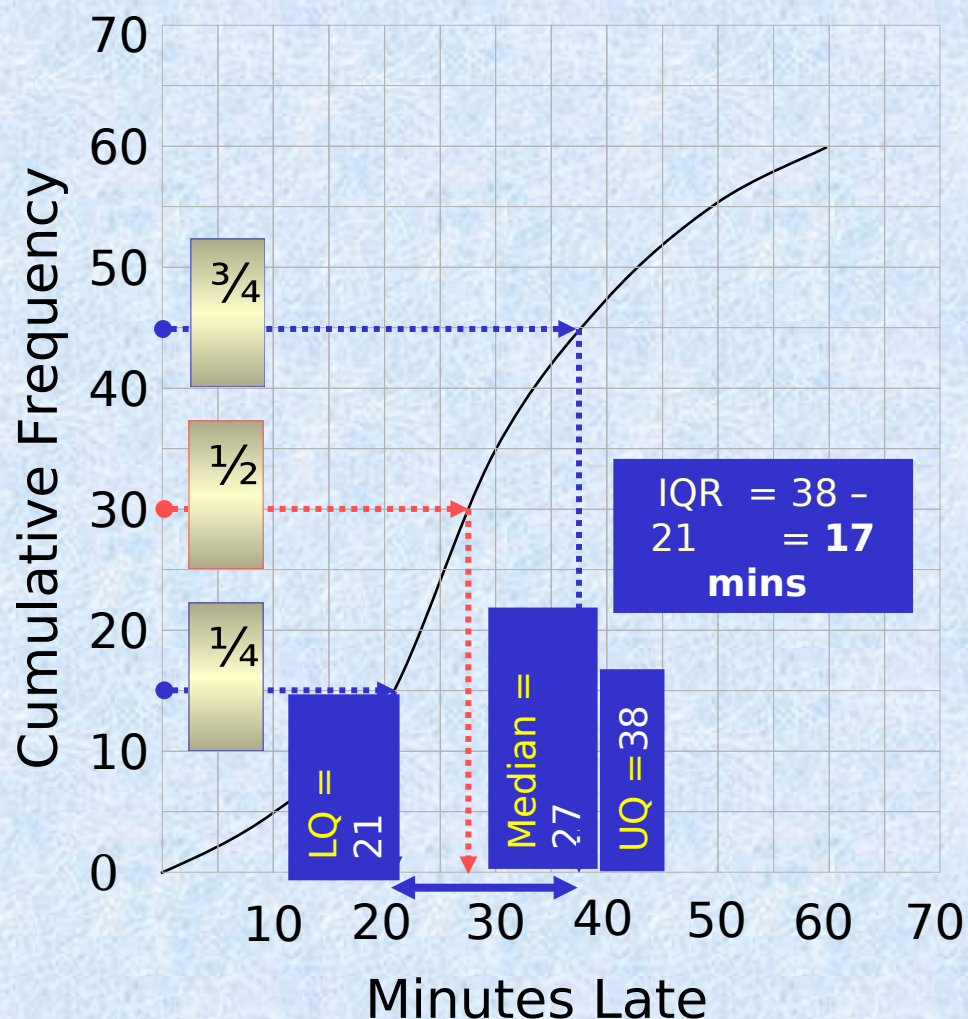
Get an estimate for the **median**

Find the **Upper Quartile**.

Find the **Lower Quartile**.

Find the **Inter Quartile Range**. ($IQR = UQ - LQ$)

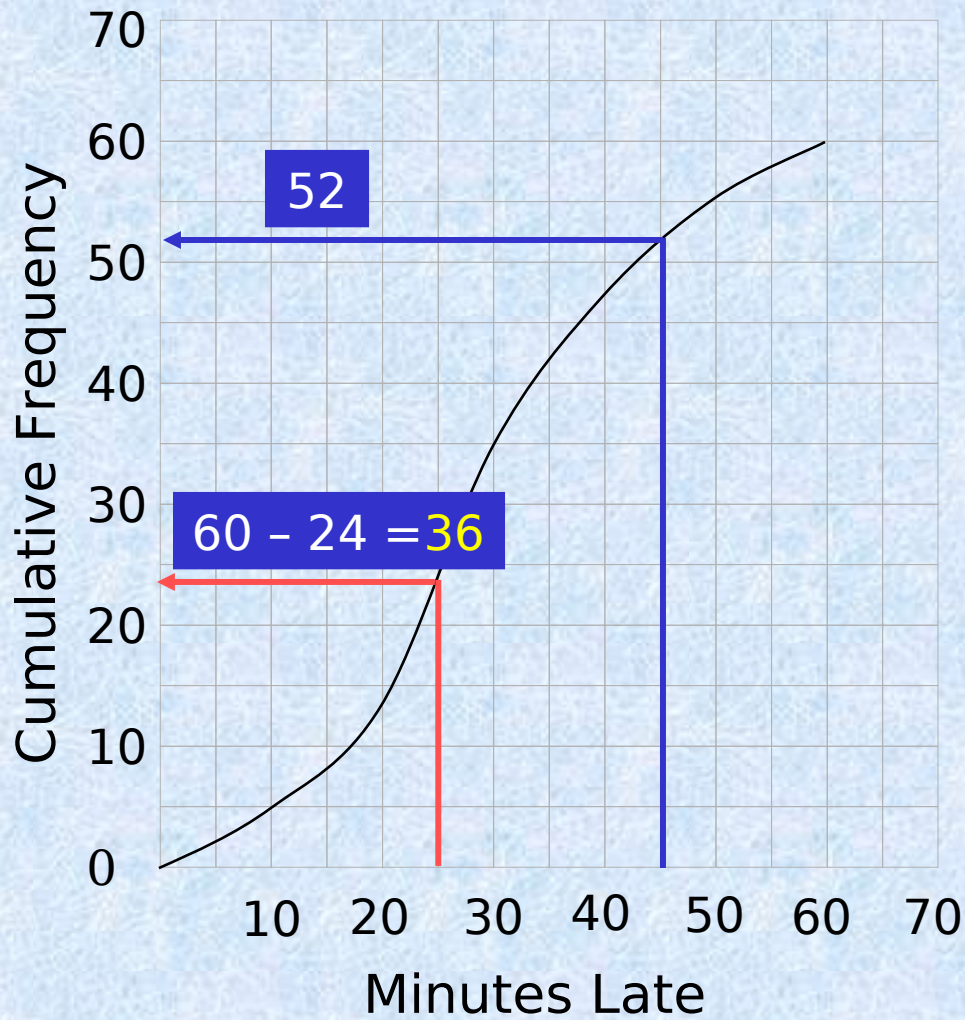
Interpreting Cumulative Frequency Curves



The cumulative frequency curve gives information on aircraft arriving late at an airport. Use the curve to find estimates to

- (a) The median
- (b) The inter-quartile range
- (c) The number of aircraft arriving less than 45 minutes late.
- (d) The number of aircraft arriving more than 25 minutes late.

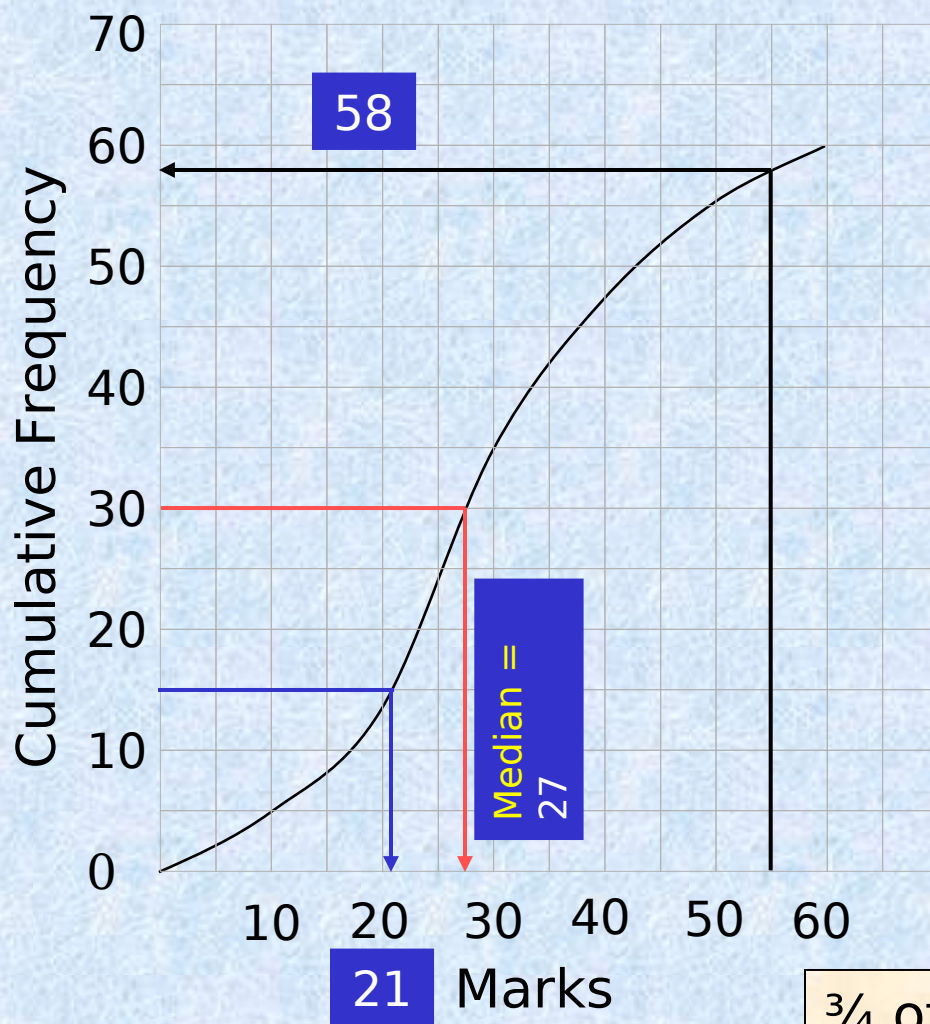
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Interpreting Cumulative Frequency Curves

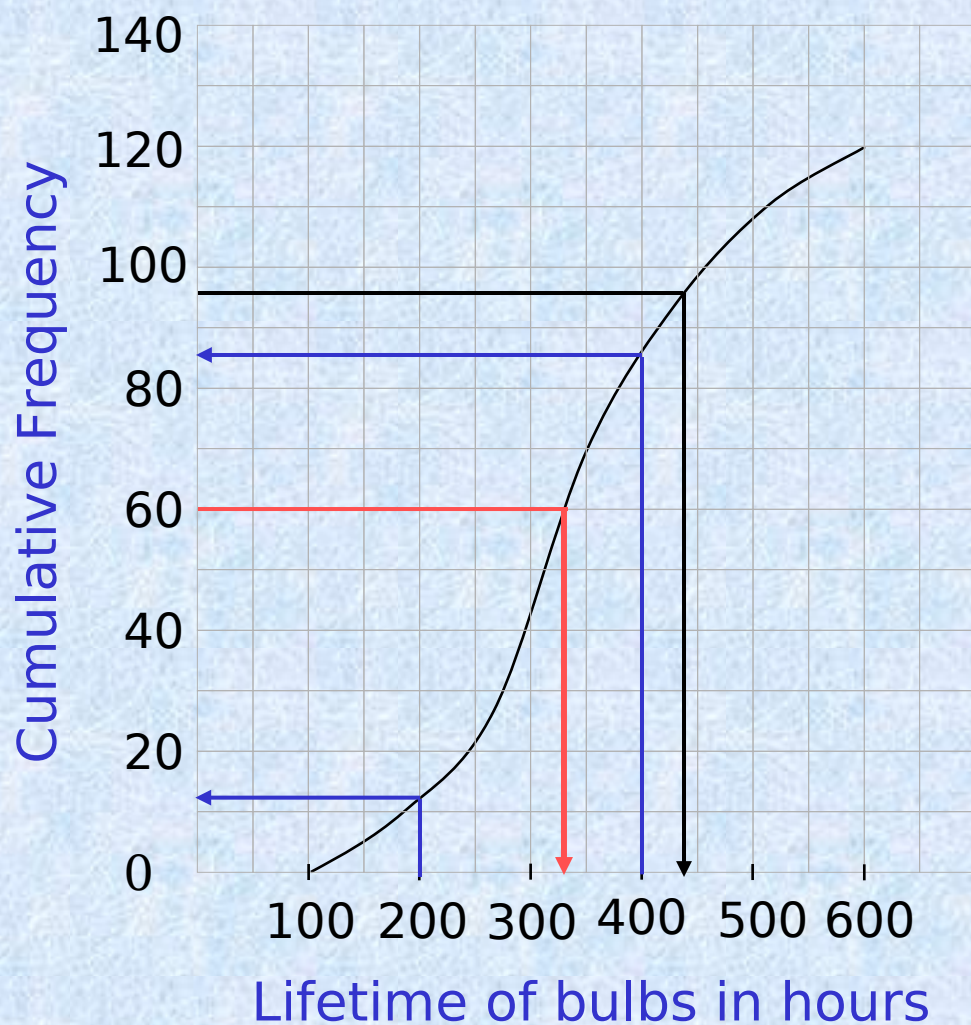


The graph shows the cumulative frequency curve of the marks for students in an examination. Use the graph to find:

- (a) The median mark.
- (b) The number of students who got less than 55 marks.
- (c) The pass mark if $\frac{3}{4}$ of the students passed the test.

$\frac{3}{4}$ of the students passing the test implies that $\frac{1}{4}$ failed. (15 students)

Interpreting Cumulative Frequency Curves



The lifetime of 120 projector bulbs was measured in a laboratory. The graph shows the cumulative frequency curve for the results. Use the graph to find:

- (a) The median lifetime of a bulb.
- (b) The number of bulbs that had a lifetime of between 200 and 400 hours?
- (c) After how many hours were 80% of the bulbs dead?.
- (d) What was the shortest lifetime of a bulb?

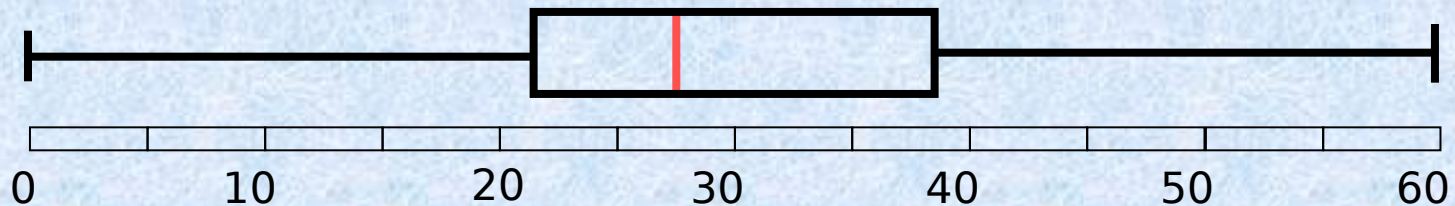
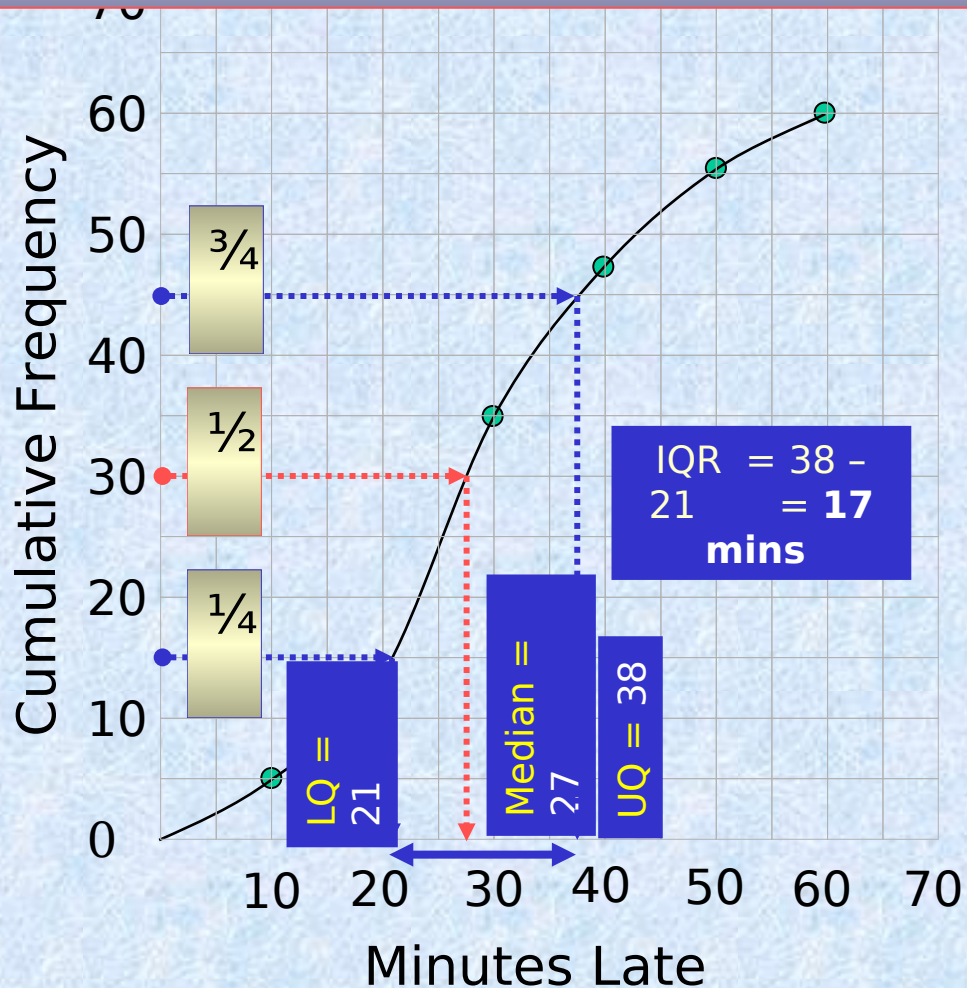
(a) 330 hours

(b) $86 - 12 = 74$

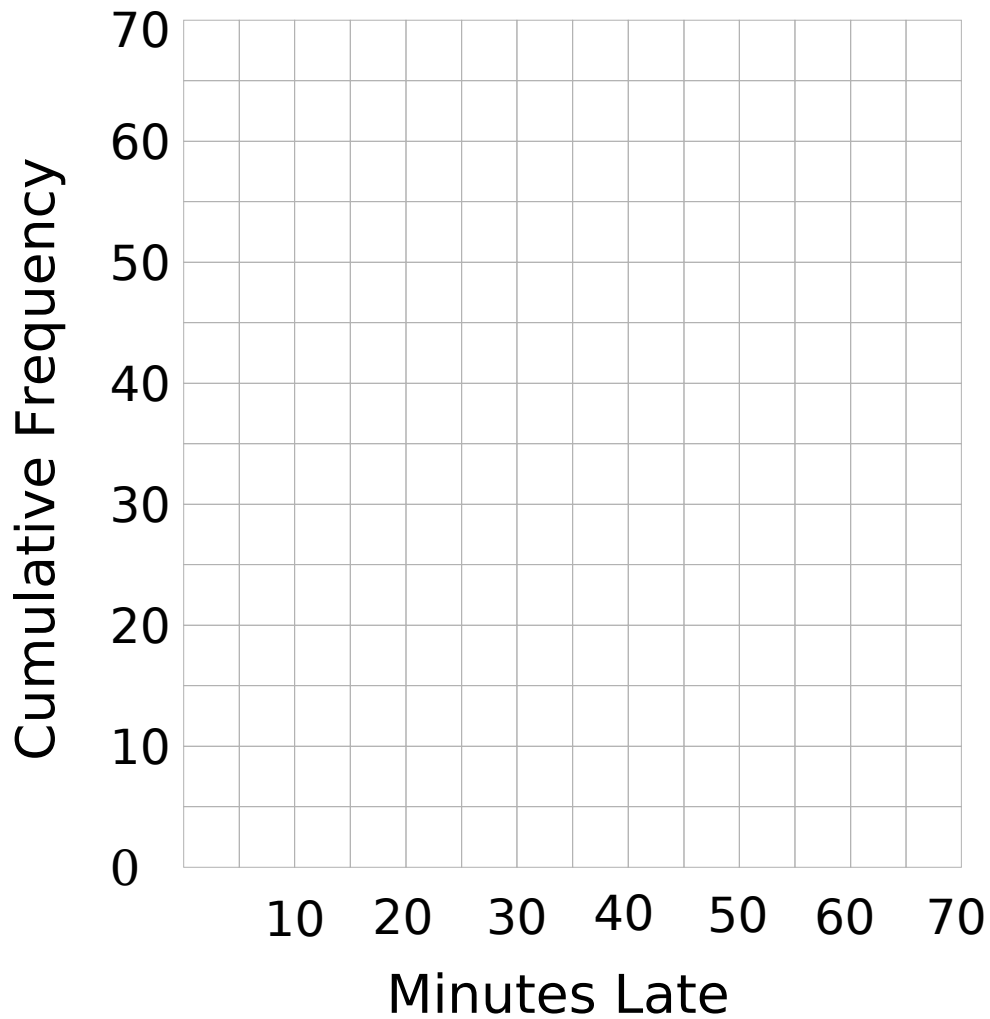
(c) 440 hours

(d) 100 hours

Box Plot from Cumulative Frequency Curve

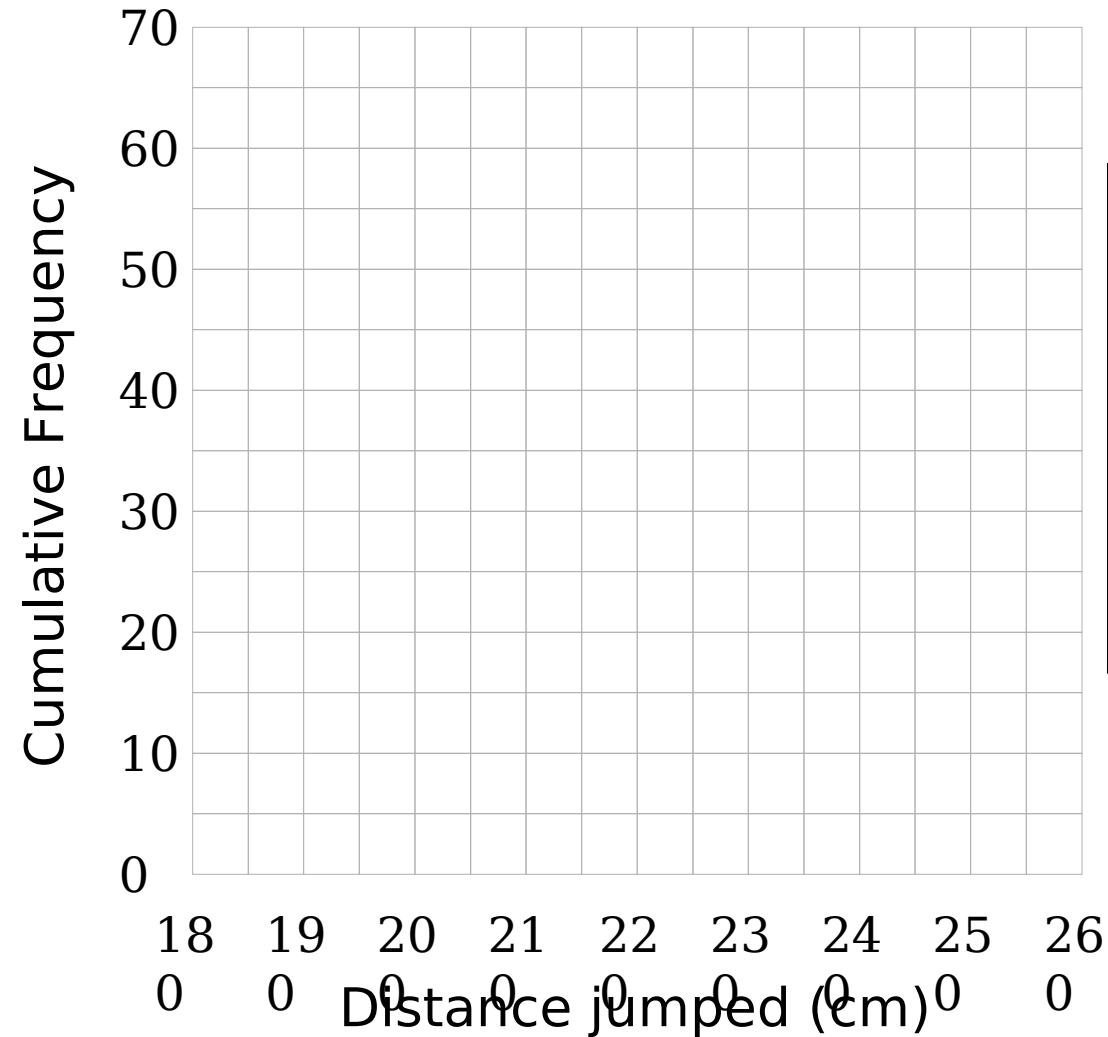


Example 1



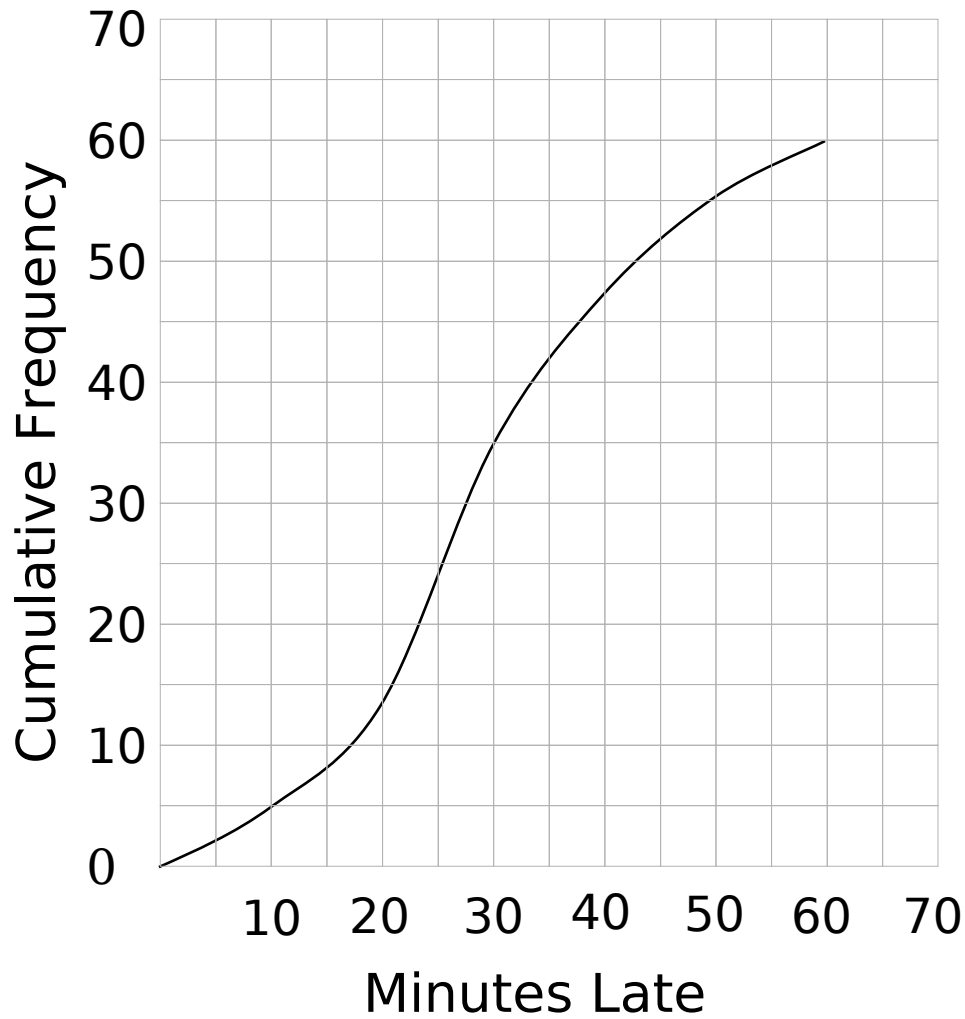
Mins Late	f	Upper Limit	CF
0 - 10	5	< 10	
10 - 20	8	< 20	
20 - 30	22	< 30	
30 - 40	12	< 40	
40 - 50	8	< 50	
50 - 60	5	< 60	

Example 2



Distance jumped (cm)	Number of pupils	Cumulative Frequency
$180 \leq d < 190$	2	
$190 \leq d < 200$	6	
$200 \leq d < 210$	9	
$210 \leq d < 220$	7	
$220 \leq d < 230$	15	
$230 \leq d < 240$	18	
$240 \leq d < 250$	8	
$250 \leq d < 260$	5	

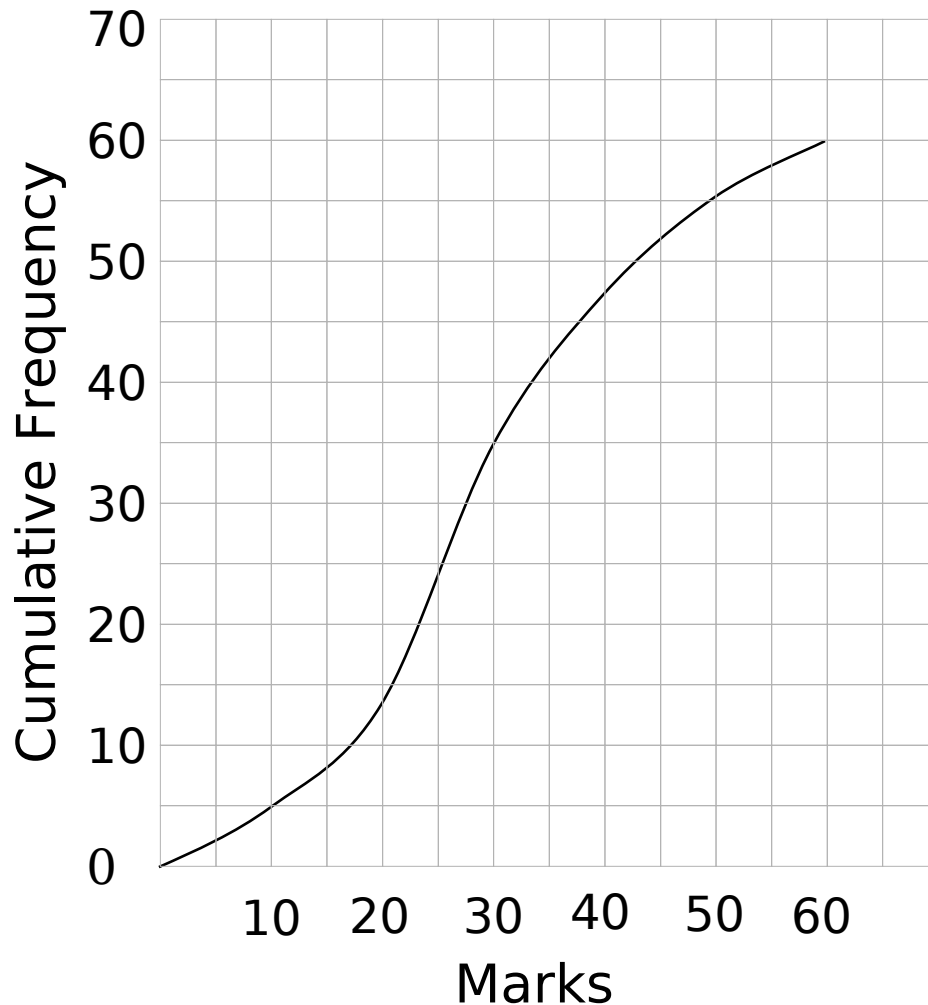
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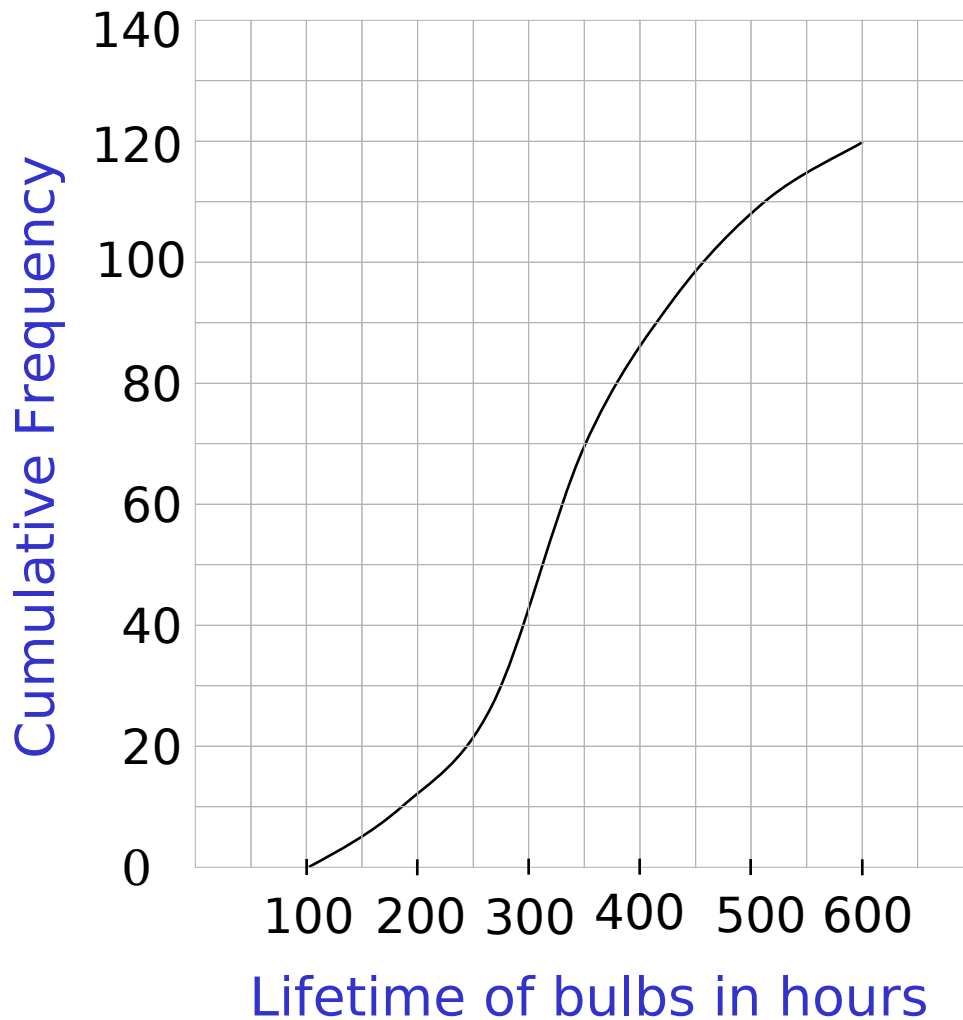
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Cumulative Frequency Curves

- Cumulative Frequency = a running total of the data
- Median = Half way up the Cumulative Frequency
- Lower Quartile (LQ) = $\frac{1}{4}$ way up Cum Freq
- Upper Quartile (UQ) = $\frac{3}{4}$ way up Cum Freq
- Inter Quartile Range = UQ - LQ

Big Worked Example

The table below shows the number of minutes students were late for their fun algebra lesson.

(a) Draw a **Cumulative Frequency Diagram** of the data

(b) Use it to find the **Median**, **Lower Quartile**, **Upper Quartile**, and **Inter Quartile Range**

(c) Draw a **Box Plot** assuming a minimum time of 0 minutes and a maximum of 25 minutes

Time t (mins)	Number of Students	Cumulative Frequency
$0 < t \leq 10$	16	
$10 < t \leq 15$	30	
$15 < t \leq 20$	22	
$20 < t \leq 25$	2	

