

Median and mode from frequency tables

Starter

- (Review of last lesson)** The numbers 3, 5, 7, 8, N are arranged in ascending order. If the mean of the numbers is equal to the median, find N .

Notes

Calculating the averages from a **frequency table** is more complicated than from a list of values.

A frequency table tells us how many of each value there are. Consider the table below.

| | | | | | |
|-------------------------|---|---|---|---|---|
| Number of mobile phones | 0 | 1 | 2 | 3 | 4 |
| Frequency | 3 | 8 | 5 | 3 | 1 |

There are 3 people who do not have a mobile phone, 8 people who have 1 mobile phone etc.

Finding the mode

It is easy to see that the mode of the data is the one with the **highest frequency**.

From the table above the mode will be 1 mobile phone since its frequency is the highest.

N.B. If the table is a **grouped** frequency table (i.e. 0 – 2, 3 – 5 etc.) we call the mode the **modal interval**.

Finding the median

The median is the middle value when the data is put in increasing (or decreasing) order. Tables usually have the data already in increasing order.

We could write out all the data value. So for the data on mobile phones, we could write:

0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 4.

We could then cross off from either end and find the middle value. This method is time-consuming though – imagine if the frequencies were 15, 38 or even 152.

There are two quicker methods and you can decide which one you choose.

Method 1: median = $\frac{1}{2}(n + 1)$ **term**

where n is the sum of the frequencies.

- Sum the frequency.

E.g. $3 + 8 + 5 + 3 + 1 = 20$ – this is n

- Calculate $\frac{1}{2}(n + 1)$ – this is the value we are looking for

E.g. $\frac{1}{2}(20 + 1) = 10.5$ th term

- Find the $\frac{1}{2}(n + 1)$ th term

E.g. We need to find the 10.5–th term (i.e. the mean of the 10th and 11th terms)
From the table the frequencies are:

| | | | | | |
|-----------------------|----------|----------|----------|----------|----------|
| Mobile phones: | 0 | 1 | 2 | 3 | 4 |
| Frequency: | 3 | 8 | 5 | 3 | 1 |
| Running total: | 3 | 11 | 16 | 19 | 20 |

(3+8) (11+5) etc.

Either the 10th and 11th terms are both in the category that has 8 as the frequency (i.e. 1 mobile phone)
or 10.5 is between 3 and 11 so it is the category that has 8 as the frequency.
 So the median is 1 mobile phone.

Method 2 – crossing off from each end

1. Write the frequencies out.

E.g. 3 8 5 3 1

2. Cross the smallest number from the ends and subtract this value from the other end value.

E.g. 1 is smallest so cross out and subtract 1 from the the other number at the end (3)
~~3~~ 2 8 5 3 ~~1~~

3. Repeat step 2 until there is only one number left in the middle

E.g. 2 is smallest so cross out and subtract 2 from the the other number at the end (3)
~~3~~ 2 8 5 ~~3~~ 1 ~~1~~
 1 is smallest so cross out and subtract 1 from the the other number at the end (8)
~~3~~ 2 ~~8~~ 7 5 ~~3~~ ~~1~~ ~~1~~
 5 is smallest so cross out and subtract 5 from the the other number at the end (7)
~~3~~ 2 ~~8~~ ~~7~~ 2 ~~5~~ ~~3~~ ~~1~~ ~~1~~

4. The number that is left is **not** the median. Look back at the table to see which value its original frequency was from.

E.g. ~~3~~ 2 ~~8~~ ~~7~~ 2 ~~5~~ ~~3~~ ~~1~~ ~~1~~
 The 2 is left...which started out as an 8 and comes from the group of 1 mobile phone.
 So the median is 1 mobile phone.

E.g. 1 Find the mode and median for the following data:

(a)

| | | | | | |
|------------------|---|---|---|----|---|
| Number of people | 1 | 2 | 3 | 4 | 5 |
| Frequency | 4 | 5 | 8 | 10 | 3 |

(b)

| | | | | | | |
|-----------------|---|---|---|---|---|---|
| Number of goals | 0 | 1 | 2 | 3 | 4 | 5 |
| Frequency | 1 | 3 | 4 | 5 | 3 | 2 |

Video:

[Median from a frequency table](#)

[Solutions to Starter and E.g.s](#)

Exercise

- 9-1 class textbook: p471 M14.2 Qu 1-5
- A*-G class textbook: p425 M14.2 Qu 1-6
- 9-1 homework book: p161 M14.2 Qu 1-4
- A*-G homework book: p118 M14.2 Qu 1-4

Summary

The mode of the data is the one with the *highest frequency*.

Finding the median from a table:

Method 1: median = $\frac{1}{2}(n + 1)$ term where n is the sum of the frequencies.

1. Sum the frequency.
2. Calculate $\frac{1}{2}(n + 1)$ – this is the value we are looking for
3. Find the $\frac{1}{2}(n + 1)$ th term.

Method 2: crossing off from each end

1. Write the frequencies out.
2. Cross the smallest number from the ends and subtract this value from the other end value.
3. Repeat step 2 until there is only one number left in the middle
4. The number that is left is *not* the median. Look back at the table to see which value its original frequency was from.