

Write a program that will read an unknown number of marks (loops), continuing to ask for marks until a sentinel value of -1 is read. Assume the marks are whole (integer) numbers between 0 and 10. Output an error message for marks outside of this range.

For each valid mark entered, you will keep a count of how many times that mark occurred. For example, if the user enters 5, 7, and 5, then there have been 2 occurrences of the mark 5, and 1 occurrence of the mark 7. This type of data is commonly called *frequency data*, as we are tracking the frequency of each mark.

You will need an array to store this data:

- i. What kind of data will the array store?
- ii. How many elements are required for the array?
- iii. What is a good, meaningful name for the array?

Once mark entry is completed (using the sentinel value of -1), your program should:

- (a) Display a summary of the frequency data. List each possible mark (from 0 to 10) and beside it, display the number of occurrences of that mark.

Sample Input	Sample Output	
0	Mark	Frequency
0	0	2
1	1	3
1	2	1
1	3	2
2	4	0
3	5	0
3	6	0
	7	0
	8	0
	9	0
	10	0

- (b) Calculate and display the arithmetic mean of the marks. The mean is the sum of the marks divided by the total number of marks. If possible, your final answer should be rounded to one decimal place (research output in Java for this).

Given: 3, 4, 5, 6, 7

Sum is 25

Mean is  $25 / 5 = 5$

- (c) Determine and display the mode of the marks. The mode of a group of values is the value that occurs most often in the group. A group may have more than one mode if more than one value occurs with the maximum frequency. Such a group is said to be multi-modal.

Given: 3, 4, 5, 6, 7

All numbers occur once.

The mode is 3, 4, 5, 6, and 7

Given: 3, 3, 4, **5, 5, 5**, 6, 7, 7

The maximum frequency, or number of occurrences, is 3 times for the number 5.

The mode is 5

- (d) Determine and display the median of the marks. The median is the middle value from an ordered list of all the values. If there are an odd number of values, the median will be the middle value. If there are an even number of values, the median is the average of the two values adjacent to the middle.

Given: 3, 4, **5**, 6, 7

There are 5 terms (odd), so the median is the middle term.

The median is 5

Given: 3, 3, **3, 4**, 4, 4

There are 6 terms (even), so the median is the mean of the two middle terms.

The middle terms are 3 and 4.

The mean is  $(3 + 4) / 2 = 3.5$

Given: 3, 3, **3, 3**, 4, 4

There are 6 terms (even), so the median is the mean of the two middle terms.

The middle terms are 3 and 3.

The mean is  $(3 + 3) / 2 = 3$

**Practice Arrays**

To do this assignment, it is critical to understand the array with the frequency data. Complete the following questions without using a Java program.

1. Given the following data, fill in the frequency table.

Input: 0 0 2 4 4 5 5 6 6 6 6 6 7 7 7 7 7 7 7 8 8 8 9 9 10

Mark	0	1	2	3	4	5	6	7	8	9	10
Frequency											

What are the mean, median, and mode for the data?

2. Given the following frequency table, determine the mean, median, and mode. Do not rewrite the data as a giant list of numbers! Try to develop an *algorithm* using the frequency data.

Mark	0	1	2	3	4	5	6	7	8	9	10
Frequency	5	3	0	1	4	7	14	14	9	5	1

3. Given the following frequency table, determine the mean, median, and mode.

Mark	0	1	2	3	4	5	6	7	8	9	10
Frequency	500	100	0	0	300	1000	200	600	300	200	100