Probability, Mean, Median & Mode[1]
In-Class Problem[2]

As the manager of a consumer products retail chain, you keep track of statistics for each store. You've been asked to come up with some numbers to help your investors understand the impact of individual customers on a particular store's monthly performance. Please use the following customer data to answer the questions. Be sure to round your answers to at least two decimal places (four when you're calculating a ratio and turning it into a percentage outcome).

Customer	Monthly store visits	Average purchase amount per visit	Items purchased per visit
John	1	300	10
Gina	4	150	5
Sheri	2	500	15
Steve	6	50	3
Julie	4	35	6
Mark	2	50	2
Beth	5	100	1
Jon	1	150	2
Steven	1	50	4
Lynn	3	75	2
Jessica	6	100	1
Brandon	2	150	2
Kendall	1	35	5
Becca	2	75	3
Justin	1	25	4
Sam	1	15	10
Gus	1	10	5
Ike	1	5	1
Richard	2	75	25
Lauren	4	65	30
Rob	1	150	50

1. What is the mean (average) number of visits your customers make to your store each month?

Sum of customer visits each month = 51; Number of customers = 21

Mean (average) number of customer visits = $\frac{\text{Sum of customer visits each month}}{\text{Number of customers}} = \frac{51}{21} = 2.43$

[1] This problem and solution set is intended to present an abbreviated discussion of the included finance concepts and is not intended to be a full or complete representation of them or the underlying foundations from which they are built.

[2] This problem set was developed by Richard Haskell, PhD (rhaskell@westminstercollege.edu), Associate Professor of Finance, Gore School of Business, Westminster College, Salt Lake City, Utah (2017).

2. What is the median purchase amount per visit?

Order the average purchase amount per visit as follows (either *high to low* or *low to high*):

	Average purchase amount per visit
1	5
2	10
3	15
4	25
5	35
6	35
7	50
8	50
9	50
10	65
11	75
12	75
13	75
14	100
15	100
16	150
17	150
18	150
19	150
20	300
21	500

The middle value in the ordered series of value is at #11

3. What is the mode value of customer monthly purchase amounts?

The customer monthly purchase amount will be the *Monthly Store Visits* x *Average Purchase per Visit* as follows – it's helpful to order amounts so you can see the number of times each amount occurs

Monthly store visits	Average purchase amount per visit	Customer monthly purchase value	Number of times each monthly purchase value occurs
1	5	5	1
1	10	10	1
1	15	15	1
1	25	25	1
1	35	35	1
1	50	50	1
2	50	100	1
4	35	140	1
2	75	150	
2	75	150	4
1	150	150	
1	150	150	
3	75	225	1
4	65	260	1
6	50	300	
2	150	300	3
1	300	300	
5	100	500	1
6	100	600	2
4	150	600	
2	500	1000	1

The most often observed value is $150 with 4 observations

4. **What is the probability Julie will visit your store on any given day of a month with the mode value of days per month?**

   So… this is a little tricky. First you have to determine the mode value of days per month. There is one month with 28 or 29 days (February), 4 months with 30 days (Sept, Apr, June, November), and 7 months with 31 days (Jan, Mar, May, July, Aug, Oct, Dec). So the mode days per month is 31 as it occurs most often.

   Julie comes 4 times a month, so the equation is

$$\boldsymbol{\rho} = \frac{Number\ of\ ways\ an\ outcome\ can\ occur}{Total\ number\ of\ possible\ outcomes} = \frac{4}{31} = 0.129\ or\ 12.9\%$$

5. **You've realized this store's cash flow is running really light and the firm's owners are expecting customers to come in and spend big! What is the probability any one of your customers will spend $300 or more over the coming month?**

   This isn't as difficult as it might appear. There are 21 customers who each visit your store each month. Among them there are 7 who spend $300 or more. So the equation is

$$\boldsymbol{\rho} = \frac{Number\ of\ ways\ an\ outcome\ can\ occur}{Total\ number\ of\ possible\ outcomes} = \frac{7}{21} = 0.3333\ or\ 33.33\%$$

	Customer monthly purchase value	Customer monthly purchase quantity
1	5	1
2	10	5
3	15	10
4	25	4
5	35	5
6	50	4
7	100	4
8	140	24
9	150	6
10	150	50
11	150	2
12	150	50
13	225	6
14	260	120
15	300	18
16	300	4
17	300	10
18	500	5
19	600	6
20	600	20
21	1000	30

6. What is the probability of any one of the store's customers purchasing the median number of items?

To do this we need to calculate the number of items purchased each month by multiplying the Monthly Store Visits by the Items Purchased per Visit – this results in the Customer Monthly Purchase Quantity. We then need to order the Customer Monthly Purchase Quantity and observe the median purchase quantity (the purchase quantity in the middle of the ordered list). Which, in this case, is 6 items.

	Monthly store visits	Items purchased per visit	Customer monthly purchase quantity
1	1	1	1
2	1	2	2
3	1	4	4
4	1	4	4
5	2	2	4
6	2	2	4
7	1	5	5
8	1	5	5
9	5	1	5
10	2	3	6
11	3	2	6
12	6	1	6
13	1	10	10
14	1	10	10
15	6	3	18
16	4	5	20
17	4	6	24
18	2	15	30
19	2	25	50
20	1	50	50
21	4	30	120

The middle value in the ordered series of value is at #11

Now that we know the median quantity is 6, we can identify the probability. There are 3 customers out of 21 who purchase 6 items each month. So the equation is

$$\boldsymbol{\rho} = \frac{Number\ of\ ways\ an\ outcome\ can\ occur}{Total\ number\ of\ possible\ outcomes} = \frac{3}{21} = 0.142\ or\ 14.29\%\%$$