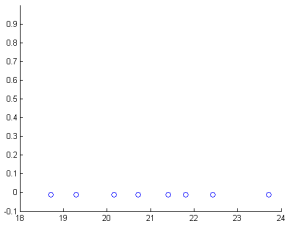
Assignment #1

1. According to the journal Chemical Engineering, an important property of a fiber is its water absorbency. A random sample of 8 pieces of cotton fiber was taken and the absorbency on each piece was measured. The following are the absorbency values: 18.71 21.41 20.72 21.81 19.29 22.43 20.17 23.71

   (a) Calculate the sample mean and median for the above sample values.

   mean = 21.0313
   median = 20.0650

   (b) Do a dot plot of the absorbency data.



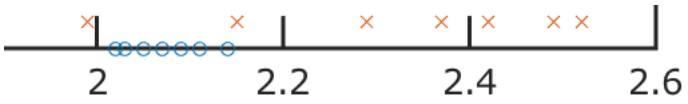
   (c) Using only the values of the mean, and median, do you have evidence of outliers in the data?

   No. They are all close together.

2. The tensile strength of silicone rubber is thought to be a function of curing temperature. A study was carried out in which samples of 7 specimens of the rubber were prepared using curing temperatures of 20 °C and 45 °C. The data below show the tensile strength values in megapascals.

   20 °C: 2.07 2.14 2.03 2.05 2.09 2.11 2.02
   45 °C: 2.52 2.15 2.49 2.37 1.99 2.42 2.29

   (a) Show a dot plot of the data with both low and high temperature tensile strength values.



   (b) Compute sample mean tensile strength for both samples.

   $\bar{x}_{20°C}$ = 2.0729 $\bar{x}_{45°C}$ = 2.3186

   (c) Does it appear as if curing temperature has an influence on tensile strength, based on the plot? Comment further.

Based on the plot, it seems that high temperature yields more high values of tensile strength, along with a few low values of tensile strength. Overall, the temperature does have an influence on the tensile strength.

(d) Does anything else appear to be influenced by an increase in curing temperature? Explain.

It also seems that the variation of the tensile strength gets larger when the cure temperature is increased.

3. For problem 2, compute the sample standard deviation in tensile strength for the samples separately for the two temperatures. Does it appear as if an increase in temperature influences the variability in tensile strength? Explain.

$s_{20°C} = 0.0435$
$s_{45°C} = 0.1915$
Note these are sample standard deviation, with $N - 1$.

4. The following data represent the length of life, in seconds, of 30 fruit flies subject to a new spray in a controlled laboratory experiment: 17 20 10 9 23 13 12 19 18 24 12 14 6 9 13 6 7 10 13 7 16 18 8 13 3 32 9 7 10 11

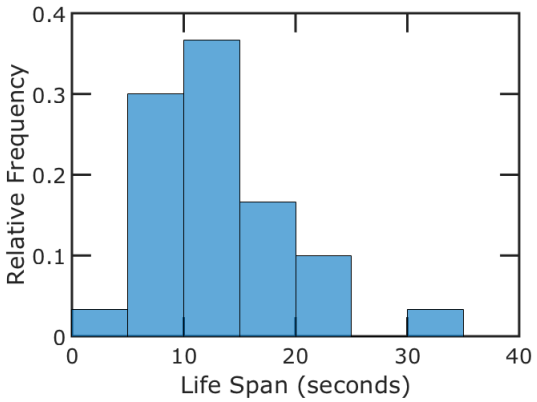
(a) Construct a double-stem-and-leaf plot for the life span of the fruit flies using the stems 0⋆, 0·, 1⋆, 1·, 2⋆, 2·, and 3⋆ such that stems coded by the symbols ⋆ and · are associated, respectively, with leaves 0 through 4 and 5 through 9.

Stem	Leaf	Frequency
0⋆	3	1
0·	6 6 7 7 7 8 9 9 9	9
1⋆	0 0 0 1 2 2 3 3 3 3 4	11
1·	6 7 8 8 9	5
2⋆	0 3 4	3
2·		0
3⋆	2	1

(b) Set up a relative frequency distribution.

Class Interval	Frequency	Relative Frequency
0-4	1	0.0333
5-9	9	0.3
10-14	11	0.3667
15-19	5	0.1667
20-24	3	0.1
24-29	0	0
30-34	1	0.0333

(c) Construct a relative frequency histogram.



(d) Find the median.

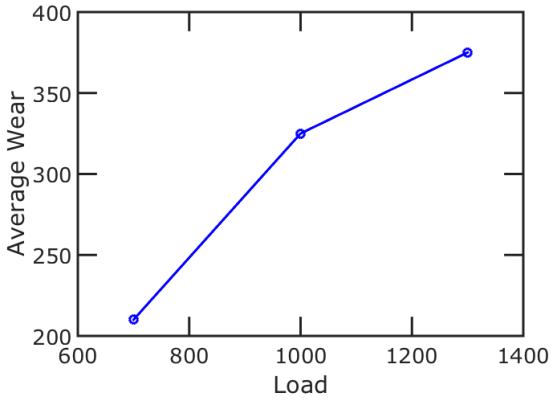
$\tilde{x} = 12.$
mean $= 12.9667$

5. Below are the lifetimes, in hours, of a fifty 40-watt, 110-volt internally frosted incandescent lamps, taken from forced life tests:

   Construct a double-stem-and-leaf plot for the life tests:
   919 1196 785 1126 936 918 1156 920 948 1067 1092 1162 1170 929 950 905 972 1035

6. A study is done to determine the influence of the wear, y, of a bearing as a function of the load, x, on the bearing. A designed experiment is used for this study. Three levels of load were used, 700 lb, 1000 lb, and 1300 lb. Four specimens were used at each level, and the sample means were, respectively, 210, 325, and 375.

   (a) Plot average wear against load.

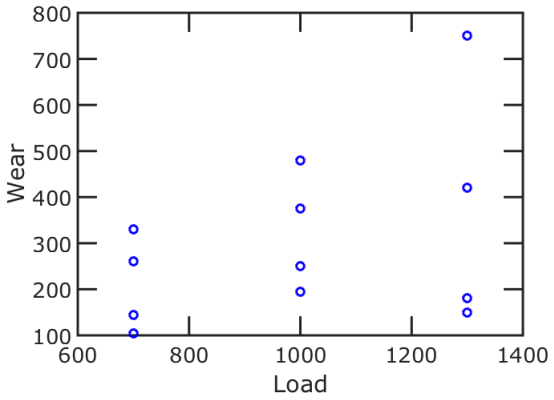


(b) From the plot in (a), does it appear as if a relationship exists between wear and load?

When the load value increases, the wear value also increases. It does show certain relationship.

(c) Suppose we look at the individual wear values for each of the four specimens at each load level (see the data that follow). Plot the wear results for all specimens against the three load values.

Load (lb)	Wear Measurements			
700	145	105	260	330
1000	250	195	375	480
1300	150	180	420	750



(d) From your plot in (c), does it appear as if a clear relationship exists? If your answer is different from that in (b), explain why.

The relationship between load and wear in (c) is not as strong as the case in (a), especially for the load at 1300. One reason is that there is an extreme value (750) which influences the mean value at the load 1300.

7. An engineering firm is hired to determine if certain waterways in Virginia are

safe for fishing. Samples are taken from three rivers.

(a) List the elements of a sample space S, using the letters F for safe to fish and N for not safe to fish.

$S = \{FFF, FFN, FNF, NFF, FNN, NFN, NNF, NNN\}$

(b) List the elements of S corresponding to event E that at least two of the rivers are safe for fishing.

$E = \{FFF, FFN, FNF, NFF\}$

(c) Define an event that has as its elements the points FFF,NFF,FFN,NFN.

The second river was safe for fishing.

8. If $S = \{0,1,2,3,4,5,6,7,8,9\}$ and $A = \{0,2,4,6,8\}$, $B = \{1,3,5,7,9\}$, $C = \{2,3,4,5\}$, and $D = \{1,6,7\}$, list the elements of the sets corresponding to the following events:

(a) $A \cup C$

$A \cup C = \{0,2,3,4,5,6,8\}$

(b) $A \cap B$

$A \cap B = \phi$

(c) C'

$C' = \{0,1,6,7,8,9\}$

(d) $(C' \cap D) \cup B$

$C' \cap D = \{1,6,7\}$
$(C' \cap D) \cap B = \{1,3,5,6,7,9\}$

(e) $(S \cap C)'$

$(S \cap C)' = C' = \{0,1,6,7,8,9\}$

(f) $A \cap C \cap D'$

$A \cap C = \{2,4\}$, so $A \cap C \cap D' = \{2,4\}$

9. Suppose that a family is leaving on a summer vacation in their camper and that M is the event that they will experience mechanical problems, T is the event that they will receive a ticket for committing a traffic violation, and V is the event that they will arrive at a campsite with no vacancies.

Referring to the following Venn diagram, list the numbers of the regions that represent the following events:
(a) The family will experience no mechanical problems and will not receive a ticket for a traffic violation but will arrive at a campsite with no vacancies.

6

(b) The family will experience both mechanical problems and trouble in locating a campsite with a vacancy but will not receive a ticket for a traffic violation.

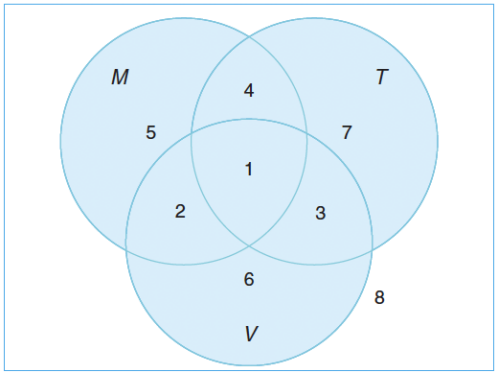
2

(c) The family will either have mechanical trouble or arrive at a campsite with no vacancies but will not receive a ticket for a traffic violation.

2, 5, 6

(d) The family will not arrive at a campsite with no vacancies.

4, 5, 7, 8



10. A California study concluded that following 7 simple health rules can extend a man's life by 11 years on the average and a woman's life by 7 years. These 7 rules are as follows: no smoking, get regular exercise, use alcohol only in moderation, get 7 to 8 hours of sleep, maintain proper weight, eat breakfast, and do not eat between meals. In how many ways can a person adopt 5 of these rules to follow (a) if the person presently violates all 7 rules? (b) if the person never drinks and always eats breakfast?

7 rules total. (a). Choose 5 rules from among 7. $\binom{7}{5} = 21$ (b). Choose 3 rules (since already follows 2) from the remaining 5. $\binom{5}{3} = 10$