Math 2311

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Office Hours: MW 11am to 12:45pm in 639 PGH

Online Thursdays 4-5:30pm

And by appointment

Class webpage: http://www.math.uh.edu/~bekki/Math2311.html

Math 2311
Class Notes for Section 1.5 – 2.2

Last week:

- Population - everyone
- Sample - subset of pop.
- Mean
- Median
- Mode

measures of center

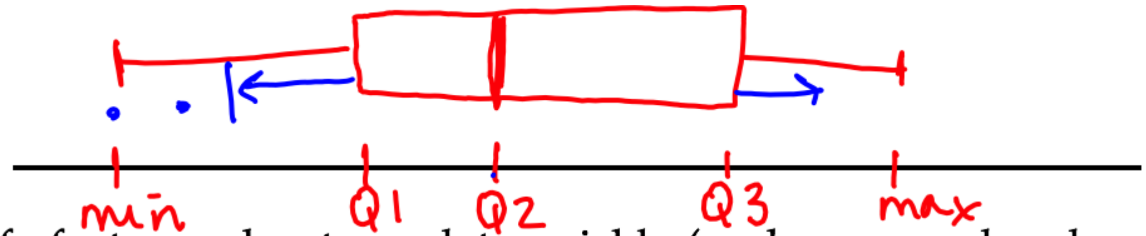
- Five number summary - min, Q1, Q2, Q3, max
- IQR
- Variance
- Standard Deviation

spread

We also talked about some graphs:

- Bar plot - categorical
- Histogram - quantitative
- Stem and leaf plot
- Dot plot -

1.5 continued:



Boxplots not only help identify features about our data quickly (such as spread and location of center) but can be very helpful when comparing data sets.

How to make a box plot:

1. Order the values in the data set in ascending order (least to greatest).
2. Find and label the median.
3. Of the lower half (less than the median – do not include), find and label Q1.
4. Of the upper half (greater than the median – do not include), find and label Q3.
5. Label the minimum and maximum.
6. Draw and label the scale on an axis.
7. Plot the five number summary.
8. Sketch a box starting at Q1 to Q3.
9. Sketch a segment within the box to represent the median.
10. Connect the min and max to the box with line segments.

Note: If data contains outliers, a **box and whiskers plot** can be used instead to display the data. In a box and whiskers plot, the outliers are displayed with dots above the value and the segments begin (or end) at the next data value within the outlier interval.

>boxplot(heights)

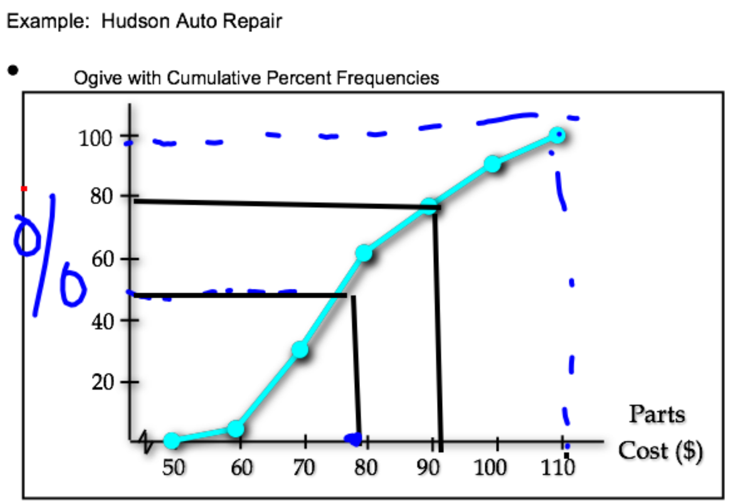
outliers: 1.5(IQR)

A **pie chart** is a circular chart, divided into sectors, indicating the proportion of each data value compared to the entire set of values. Pie charts are good for categorical data.

```
>pie(numcols, labels=colors)
```

A **cumulative frequency plot** of the percentages (also called an **ogive**) can be used to view the total number of events that occurred up to a certain value.

Example: Here is an ogive for Hudson Auto Repair's cost of parts sold:



80% are less than 90

50% are less than 78

data	freq	cumul. freq
5	2	2
6	4	6
7	2	8
9	1	9
11	3	12

Where is the median of this data?

50% → 78

Some Questions to think about:

1. Which of the following would be best to use for categorical data:
   a. Pie chart
   b. Dot plot
   c. Stem and leaf plot

Use this stem plot to answer the next 2:
This data represents the number of cans of soda sold from a particular vending machine.

Stems = 10s digit, Leaves = ones digit

3 | 01238
4 | 05
5 | 1236789
6 | 2

2. What is the median of the data?
   a. 45
   b. 51
   c. 51.5
   d. 5.1
   e. 4.5

15

7 $\boxed{}$ 7

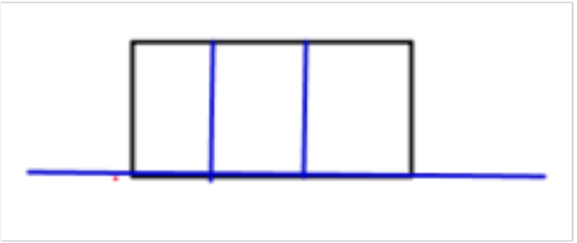
↑ 8th in list

3. What is the range of the data?
   a. 3.2
   b. 32
   c. 3.1
   d. 31

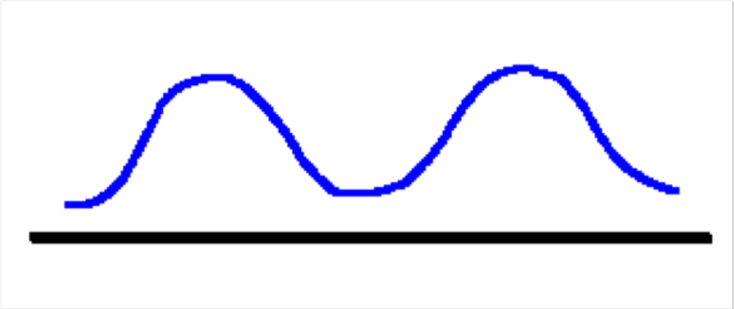
$62 - 30 = 32$

Patterns and shapes:

Uniform graphs

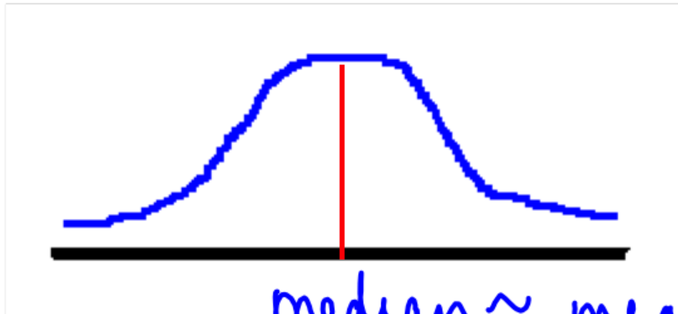


Symmetric graphs



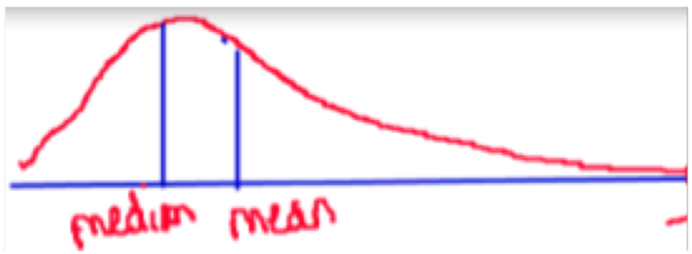
Some other features

Bell Shaped



median $\simeq$ mean

Skewed right



median < mean

Skewed left

median > mean

2.1 - Counting Techniques

Combinatorics is the study of the number of ways a set of objects can be arranged, combined, or chosen; or the number of ways a succession of events can occur. Each result is called an **outcome**. An **event** is a subset of outcomes. When several events occur together, we have a **compound event**.

The **Fundamental Counting Principle** states that the total number of a ways a compound event may occur is $n_1 \cdot n_2 \cdot n_3 \cdot \ldots \cdot n_i$ where n_1 represents the number of ways the first event may occur, n_2 represents the number of ways the second event may occur, and so on.

Example:
How many ways can you create a pizza choosing a meat and two veggies if you have 3 choices of meats and 4 choices for veggies?

$3 \cdot 4 \cdot 3 = 36$

veggies

veggies -1
(used one)

A **permutation** of a set of n objects is an ordered arrangement of the objects.

$${}_nP_n = n(n-1)(n-2)....3\cdot 2\cdot 1 = n!$$

$${}_nP_r = \frac{n!}{(n-r)!}$$

Examples:

In how many ways can 6 people be seated in a row?

$6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1 = 720$

$6!$

In how many ways can 3 of the six symbols, &^%$#@ be arranged?

$\underline{6}\cdot \underline{5}\cdot \underline{4} = 120$

$\frac{6!}{(6-3)!}$

6 (nPr) 3 = 120

When we allow repeated values, The number of orderings of n objects taken r at a time, with repetition is n^r.

Example:

In how many ways can you write 4 letters on a tag using each of the letters C O U G A R with repetition?

$6 \cdot 6 \cdot 6 \cdot 6 = 6^4$

The number of permutations, P, of n objects taken n at a time with r objects alike, s of another kind alike, and t of another kind alike is

$$P = \frac{n!}{r!s!t!}$$

Example:

How many different words (they do not have to be real words) can be formed from the letters in the word MISSISSIPPI?

```
> factorial(11)/(factorial(4)*factorial(4)*factorial(2))
[1] 34650
```

$$\frac{11!}{(4!\,4!\,2!)}$$

I's S's P's

The number of circular permutations of n objects is $(n-1)!$

Example:

In how many ways can 12 people be seated around a circular table?

$11!$

order doesn't matter

A **combination** gives the number of ways of picking r unordered outcomes from n possibilities. The number of combinations of a set of n objects taken r at a time is

$$ {}_nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!} $$

$$ {}_{10}C_4 = \frac{10!}{4!\,6!} $$

choose(n,r)

${}_nC_r$

Example:

In how many ways can a committee of 5 be chosen from a group of 12 people?

$$ {}_{12}C_5 = 792 $$

22. $\underbrace{\underline{6}\ \underline{5}\ \underline{4}\ \underline{3}\ \underline{2}\ \underline{1}}_{6!}\ \underline{}\ \underbrace{\underline{4}\ \underline{3}\ \underline{2}\ \underline{1}}_{4!}$

Section 2.2 – Sets and Venn Diagrams

A set is a collection of objects. Two sets are equal if they contain the same elements. Set *A* is a subset of set *B* if every element that is in set *A* is also in set *B*. The notation for this is $A \subseteq B$.

Set *A* is a proper subset of set *B* if every element that is in set *A* is also in set *B* *and* there is at least one element in set *B* that is not in set *A*. The notation for this is $A \subset B$.

The union of *A* and *B*, which is written as $A \cup B$, is the set of all elements that belong either to set *A* or to set *B* (or that belong to both *A* and *B*).

The intersection of *A* and *B*, which is written as $A \cap B$, is the set of all elements that belong to both to set *A* and set *B*. If the intersection of two sets is empty (the empty set is denoted by $\varnothing$, then the sets are disjoint or mutually exclusive and we write

$$A \cap B = \varnothing$$

The complement of set *A*, which is written as A^c, is the set of all elements that are in the universal set but are not in set *A*.

Examples:

Use the following information to answer the questions:

$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ ← union of everthing — Universal set

$A = \{1, 2, 5, 6, 9, 10\}$

$B = \{3, 4, 7, 8\}$

$C = \{2, 3, 8, 9, 10\}$

Find:

$A^c = \{3,4,7,8\}$

$A \cup C = \{1,2,3,5,6,8,9,10\}$

$A \cap B = \{\ \} = \emptyset$

$A^c \cap C = \{3,8\}$

$(B \cup C)^c = \{1,5,6\}$

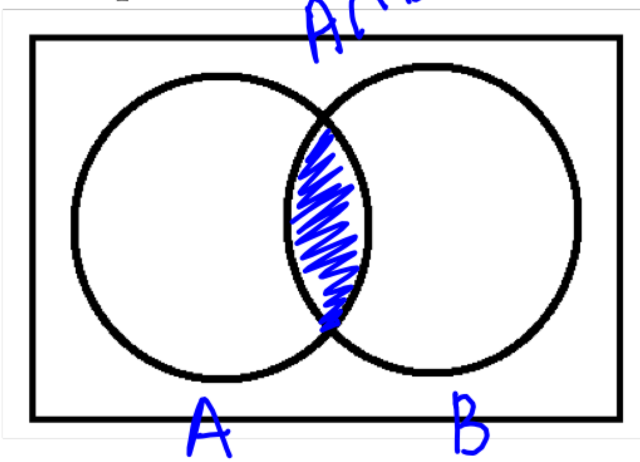
$A \cap B \cap C = \emptyset$

$B \cup C = \{2,3,4,7,8,9,10\}$

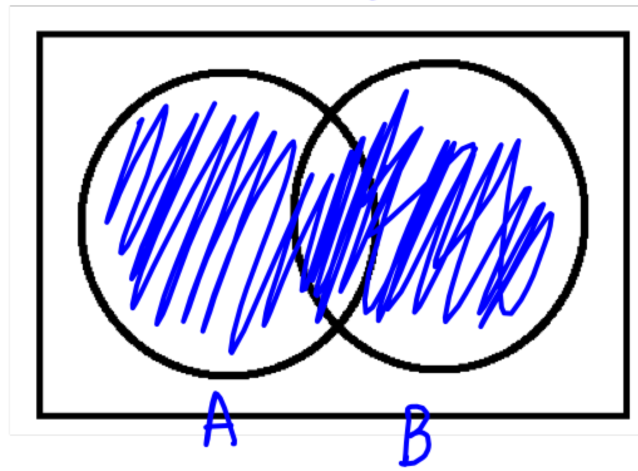
Venn diagrams can be used to represent sets.

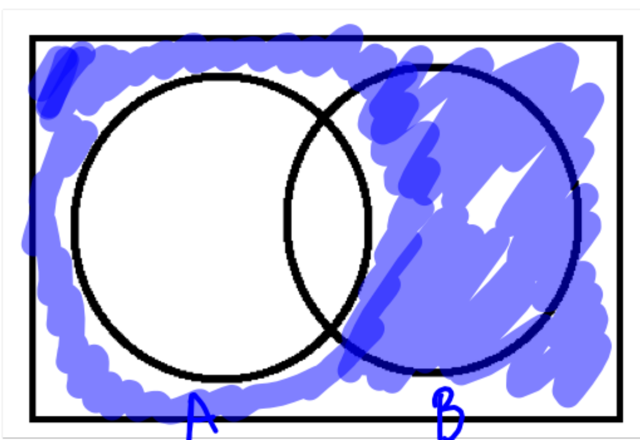
Examples:

$A \cap B$

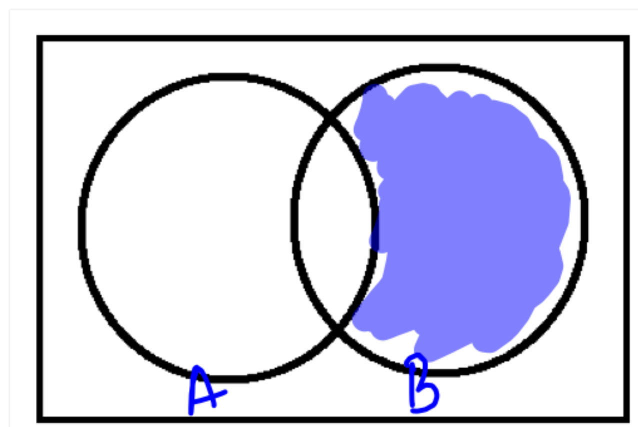


$A \cup B$

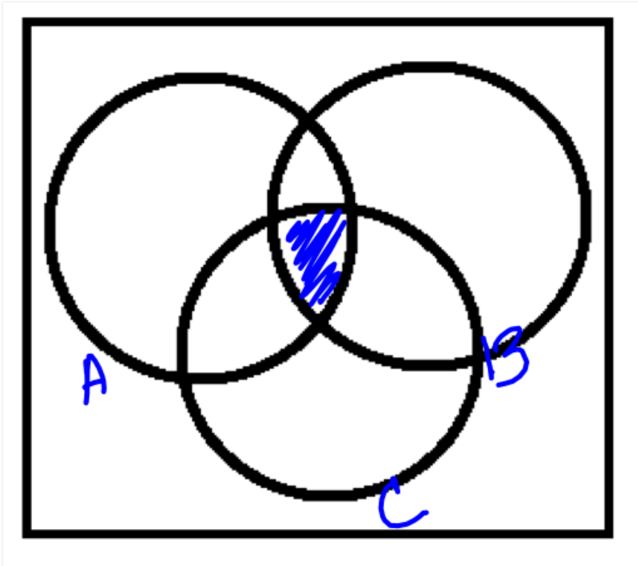




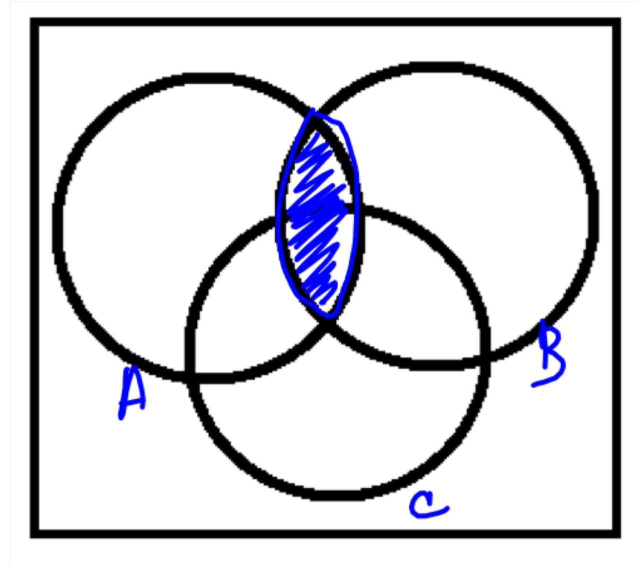
A^c



$A^c \cap B$



$A \cap B \cap C$



$A \cap B$

$(A \cap B) \cup C$

Draw a Venn Diagram for the following situation: A group of 100 people are asked about their preference for soft drinks. The results are as follows:

55 Like Coke

25 Like Diet Coke

45 Like Pepsi

15 like Coke and Diet Coke

5 Like all 3 soft drinks

25 Like Coke and Pepsi

5 Only like Diet Coke

try to fill in