11-13

Warm-up Poker Hands

4 suits, spades, hearts, clubs, diamonds. A, 2, 3, ..., 10, J, Q, K

13 cards in each suite

a.) In 5-card Poker, how many possible hands are there?

b.) How many Full Houses with 3 10's and 2 queens?

c.) How many Full Houses?

b.) How many different ways to get 3 10's and 2 queens?

- $C(4,3) = \frac{4!}{(4-3)!\,3!} = 4$ ways to choose 3 10's
- $C(4,2) = \frac{4!}{(4-2)!\,2!} = \frac{4\cdot 3\cdot 2\cdot 1}{2\cdot 1\cdot 2\cdot 1} = \frac{2\cdot 3}{1} = 6$ ways to choose 2 queens

$\Rightarrow 4\cdot 6 = 24$ ways to get a full house with 3 10's & 2 Q's

a.) 2,598,960 hands possible in 5-card poker. $C(52,5)$

c.) Step 1: Pick a denomination: $C(13,1) = 13$ options

Step 2: Choose 3 of 4 cards: $C(4,3) = 4$ options

Step 3: Choose our next denomination: $C(12,1) = 12$ options

Step 4: Choose 2 of 4 cards: $C(4,2) = 6$ options

$13\cdot 4\cdot 12\cdot 6 = 3,744$ possible full houses.

Chapter 7: Probability

7.1 Sample Spaces & Events

A sample space is the set of all possible outcomes of an expirement.

ex/ Expirement: Flipping a coin and seeing which side faces up

Sample space: $S = \{H, T\}$

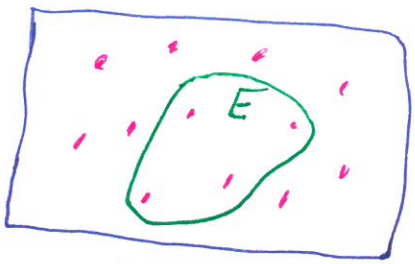
Outcomes are possible results of an expirement

ex/ Expirement: Rolling die and observing top number.

Outcomes: 1, 2, 3, 4, 5, 6

Sample Space: $S = \{1, 2, 3, 4, 5, 6\}$

An Event is a subset of our sample space.



S
set of all outcomes

E: subset of S outcomes we are interested in.

ex/ Roll a die

$S = \{1, 2, 3, 4, 5, 6\}$

Interested in event where resulting # is odd

$E = \{1, 3, 5\}$

ex/ Experiment: Select a city that starts with the letter "J"

Sample Space: $S = \{ x \mid x \text{ is a city starting with the letter "J"} \}$

Event: The city is Johannesburg

$E = \{ \text{Johannesburg} \}$

- Events are subsets of our sample space

ex/ Experiment: Roll two distinguishable dice.

$S = \{ (1,1), (1,2), \ldots, (6,6) \}$

Event: when the numbers rolled add up to 1

$E = \{ \} = \emptyset$

Mutually Exclusive Events

events are mutually exclusive when their intersection is empty. Two things that cannot happen at the same time.

ex/ Experiment: Roll two distinguishable dice

$S = \{ (1,1), \ldots, (6,6) \}$

Event E: The numbers rolled are the same

Event F: The sum of the numbers rolled is odd

Mutually exclusive

- Rember that events are sets
  - we can take unions — either/or
  - we can take intersections — and
  - We can take complements. — not

7.2 Relative Frequency

Motivation: want to test if a coin is fair.

How to check: Flip it a lot of times.

ex/ flip a coin 100 times

53 heads & 47 tails.

$\frac{53}{100} = .53$ is our relative frequency or estimated probability

Had an expirement - flipping a coin repeated N times and we observe the outcome from

100 " $S = \{H, T\}$ looking for Event $E = \{H\}$

Number of times that E occurs is called the frequency $fr(E) = 53$

The relative frequency is the frequency of our event divided by the number times we did the expirement.

$$\frac{fr(E)}{N} = \frac{53}{100} = .53$$

ex/ Auctions on eBay

We take a survey of 50 paintings on eBay and observe the Bid Price

Bid Price	\$0 - 9.99	\$10 - 49.99	\$50 - 99.99	≥ \$100
Frequency	6	23	15	6

Say our expirement pick a painting and observe the price.

what is the <u>relative frequency distribution</u>?

- The relative frequency for each individual out come.

Bid Price	\$0 - 9.99	\$10 - 49.99	\$50 - 99.99	≥ \$100
Relative frequency	$\frac{6}{50} = .12$	$\frac{23}{50} = .46$	$\frac{15}{50} = .30$	$\frac{6}{50} = .12$

note: $.12 + .46 + .30 + .12 = 1$

Question: what is the relative frequency that a painting in this survey has a bid price of less than \$50

Solution: # of paintings less than \$50 is $6 + 23 = 29$

and $\frac{29}{50} = .58 = \frac{\text{\# of painting} < \$50}{\text{\# of paintings in survey}}$

Also we could just add the relative frequencies from our distribution $.12 + .46 = .58$

ex Table of 200 authors surveyed by a publishing company.

	New Authors	Established Authors	Total
Sussesfull	12	44	56
Unsucsesfull	38	106	144
Total	50	150	200

Find the relative frequency that

a.) Established and succesful

$\frac{44}{200} = .22$

b.) Unsuccesful and new

$\frac{38}{200} = .19$

c.) Succesful

$\frac{56}{200} = .28$

d.) A succesful author is established.

Previously sample space was authors surveyed

Now it is succesful authors surveyed.

$\frac{44}{56} =$