Stat 202 - 2015S ~~D~~ - W~~1~~2 - ~~Fri~~ Wed (Pg 1)

Review

A ~~probability model~~ is a description of a random phenomenon in the language of mathematics

A probability model consists of

1) the set of possible outcomes of the phenomenon (sample space)

2) the probability of each outcome, ~~more~~ precisely each event (subset of sample space) (we'll see today why probabilities are assigned to events not outcomes)

Set Theory

A set is a collection of objects

Eg {Head, Tails}

{People in this room}

{Numbers between 1 and 6 (e.g. die faces}

~~III A~~

Notions

e.g.

Is an element of $\in$
Is not an element of $\notin$
Is a subset of $\subset$
Is not a subset of $\not\subset$

give examples

If A and B are sets

A is a subset of B, $A \subset B$, if every element of A is also an element of B

Empty set $\emptyset$, set of no elements.

$\emptyset \subset A$ for every set A
$A \subset A$ for every set A

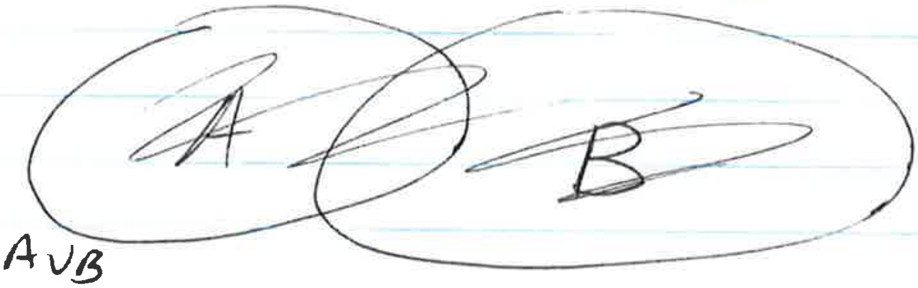
The sample space S of a random phenonomenon is the set of all possible outcomes of the phenomenon

$\{$Heads, Tails$\}$ Coin
$\{1, 2, 3, 4, 5, 6\}$ Die

An event is a subset of sample space

$\{H\}, \{T\}, \{H, T\}, \emptyset$

$\boxed{A \cup B}$ (A or B) Venn Diagrams



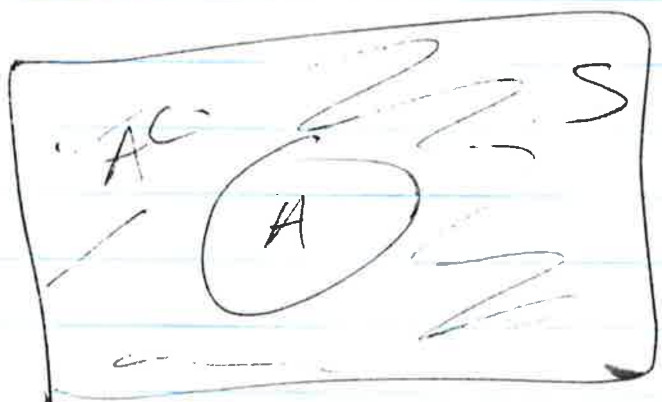
elements of $A \cup B$ are in A or in B or Both

$\boxed{A \cap B}$ (A and B)

$A \cap B$

elements of $A \cap B$ are in both A and B

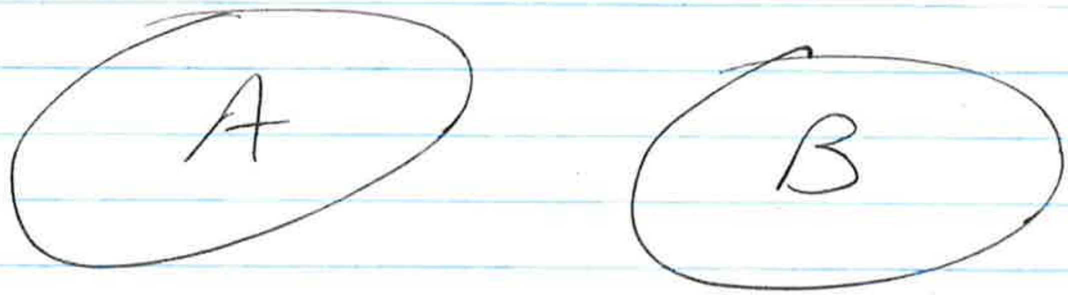
$\boxed{A^c}$



elements of A^c are in the sample space S but not in A.

Disjoint sets

HAVE no elements in common



A Probability is a number assigned to an event.

When probabilities are assigned to all events, they must obey certain rules

Rule 1: Each probability must be a number between 0 and 1

For all events A, $0 \leq P(A) \leq 1$

Rule 2: All possible outcomes together have probability 1

$$P(S) = 1$$

← sample space

Rule 3: If two events have no outcomes in common, the probability that either one occurs or the other is the sum of the individual probabilities

If A and B are disjoint events
$$P(A \cup B) = P(A) + P(B)$$

Rule 4: The probability that an event does not occur is one minus the probability that it does ~~[illegible]~~ occur:

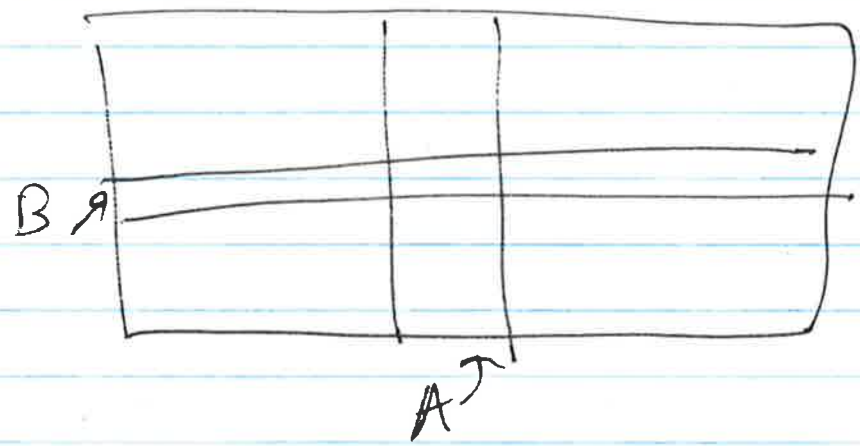
For all events A, $P(A^c) = 1 - P(A)$

Rule 5: For Rule 5 we must define independent events

Two events A and B are <u>independent</u> if knowing that one occurs does not change the probability that the other occurs (sucessive coin tosses, sex of children)

first Heads cant predict if second Heads or tails (First born a boy doesn't tell you if second is a boy or girl.

The picture that goes with this definition is



rectangular Sample Space

S

Areas of sets are there probabilities

A is a vertical bar B is a horizontal bar

$$P(A \cap B) = P(A)P(B)$$

area of intersection

base x height

Rule 5: If A and B are independent

$$P(A \cap B) = P(A)P(B)$$

If all outcomes are equally likely then

$$\text{Probability(each outcome)} = \frac{1}{\text{total number of outcomes}}$$

And if A is an event in a probability model where all outcomes are equally likely

Then

$$P(A) = \frac{\text{total number of outcomes in } A}{\text{total number of outcomes in } S}$$

Entire sample space.

§4.3 Random Variables

A random variable is a function that assigns a number to each outcome of a random phenomenon

EG: Flip a coin three times in a row.

Sample space

TTT → 0
HTT → 1
THT → 1
TTH → 1
HHT → 2
HTH → 2
THH → 2
HHH → 3

outcomes ← these are numbers assigned to ~~ou~~tomes

In this case the number assigned happens to be the number of heads seen. in 3 flips

However any assignment of numbers to outcomes is a random variable.

Not all of these assignments (RVs) would be useful.