1/10/15

Math 263 Lecture 6

Today: 4.1-4.2 basic Probability

Thurs: Probability, cont'd

Next week: Probability, cont'd

WebAssign for 4.1-4.2 & 4.5 due Fri 2/13

What is a "random" event?

- An event that we don't know the outcome of.

Examples

1) What will the weather be tomorrow?

$Pr(\text{Rain}) = \frac{?}{}$

$Pr(\text{sun}) = \frac{?}{}$

$Pr(\text{snow}) = \frac{?}{}$.

- When tomorrow comes, the weather will do something. We're not sure what, but the possible events follow a distribution!

2) What number will the die show on its next roll?

$Pr(1) = 1/6$
$Pr(2) = 1/6$
...

} if the die is fair!

How do we determine probabilities without prior knowledge of the distribution?

- We do "experiments" & record outcomes
- The "frequentist" def^{n}:

"The probability that an event occurs is the proportion of times the event occurs in *many* repeated trials" (* many ≡ "infinitely" many)

I.E. Roll a die 10,000 times:

Roll	1	2	3	4	5	6
# times	1661	1672	1660	1659	1683	1665

$$Pr(\text{Die shows } 1) \overset{\uparrow}{\simeq} \frac{1661}{10000} = 0.1661$$

Need a "larger" sample for =

Alternate def^{n}s exist, in particular the Bayesian approach, which doesn't rely on a "law of large #'s" In other words, it ~~works~~ can work "better" on small sample sizes

Idea behind frequentist def^{n}: If the process follows some "true" distribution, "random" fluctuations will average out over a large # of samples
e.g. lots of 6's will eventually be balanced by lots of other rolls.

Independence

Suppose we ask two people what their favorite color is. Does the first person's answer affect the second's?

"Conditional" probability: probability that an event occurs <u>given</u> that another has occured.

i.e. $Pr(2^{nd}\text{ person says blue} \mid \text{first person says red})$

"given"

"A" & "B" are <u>independent</u> if

$$Pr(A|B) = Pr(A)$$

Sample Spaces & events

A <u>Sample space</u> is a <u>set</u>

e.g. 1 coin flip

$S = \{H, T\}$

2 coin flip

$S = \{HT, TH, HH, TT\}$

An event is some subset of the Sample space

I.E. "The event that Coin 1 is Heads"

$A = \{HT, HH\}$

* Sample spaces can contain either Quantitative or Categorical Variable's!

Ex Throw a dart at a dart board.

$S = \{Red, Black\}$

$S = \{$distance from center$\}$ (in cm)

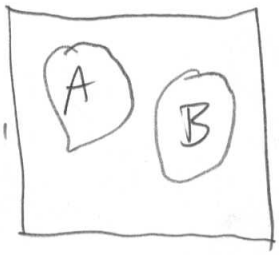
$= \{$all reall #'s between 0 & 20$\}$

Eg. "2.75239" or "π cm from center".

$S = \{\#\ Hit\} = \{1, 2, 3, \ldots, 20\}$

Venn diagrams and disjoint/mutualy exclusive events:

"Mutually Exclusive"



I.E.

$A = \{HT, HH\}$

$B = \{TT\}$

Probabilities

A Probability is a number between 0 & 1 Assigned to each event.

IE. $Pr(\{HTHH, HHTT\})$

Event

Probability "Rules" / Axioms:

1) $0 \leq Pr(A) \leq 1$ For all events A.

2) $Pr(S) = 1$ IE The Probability of Something Happening is 1

3) If A & B are Mutually exclusive,

$Pr(A \text{ or } B) = Pr(A) + Pr(B)$

4) $Pr(A \text{ Does NOT occur})$

$= 1 - Pr(A \text{ does occur})$

"A does not occur" = "A^c"

Ex Flip a coin 3 times. Find the →

Probability that the first flip is NOT Heads.

Ex What is wrong w/ the following?

A person is selected @ random. We collect their gender & whether they are left or right handed. Sample space?

Pr(female left) = 0.13

Pr(female right) = 0.87

Pr(male left) = 0.13

Pr(male right) = 0.87

{male left, male right, female left, female right}

Doesn't make sense because Pr(S) = 2!!

Ex

Suppose we draw from females only.

The prob