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Review

Normal Quantile Plot (QQ Plot)

Plot the transformation that makes your data (old variable) and ~~normal~~ standard normal (new variable)

If plot is a line your original data was normal. Otherwise it wasn't

Won't be a perfect line because the data are random.

Homework gives you the idea and intuition

Generating pseudorandom numbers with computer

Want perfectly normal data to test QQ plot; so we use a computer program.

Random numbers are unpredictable
Psedorandom numbers look for essentially all purposes like random numbers but they are predictable if you know algorithm and seed

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Each seed gives a different stream of random numbers

Any integer that the computer can represent can be used as a different seed

. A dynamic seed in StatCrunch sets the seed according to the system clock and picks a different seed each time.

Chapter 4. We call a phenomenon <u>random</u> if individual outcomes are uncertain but there is nonetheless a regular distribution of outcomes in a large number of repetitions

The probability of any outcome of a random phenomenon is the proportion of times the outcome would occur in a very long series of repetitions

Coin toss $P(\text{Heads}) = .5$
$P(\text{Tails}) = .5$

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New

§4.2 Probability Models

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

A probability model has two parts

book uses list

* A "list" of possible outcomes of the phenomenon
* The probability of each outcome

A "list" is not quite the right word here. The right word is set.

What is a set? How does ~~it~~ differ from a list?

A set is a collection of objects
A list is a less precise concept but list ~~of~~ often means an enumeration (item 1) (item 2) etc has an order, set doesn't.

Examples of sets:
people in this room
numbers between 1 and 50

Sets are written as

{people in this room}

A set comes with the concept

"is an element of" written $\in$

True or False?

Sean Carver $\in$ {people in this room}

Sean Carver is an element of the set of people in this room

True or False

False $\Rightarrow$ Barak Obama $\in$ {people in this room}

B. O. is an element of the set of people...

BO $\notin$ { } true.

A set comes with the concept

"is a subset of" $\subset$

$A \subset B$ means every element of A is also an element of B

T or F {Women in this room} $\subset$ {people in the room}

{Women at AU} $\subset$ {peopl in this room}

False $\not\subset$

The concept of set comes with the concept of empty set $\emptyset$

$\{\text{giraffes in this room}\} = \emptyset$

(there are no giraffes in this room!

$\emptyset \subset A$ for Every set A

The empty set is a subset of every set (every element of $\emptyset$ is also an element of A)

$A \subset A$ for every set A
(every element of A is also an element of A).

Back to probability

The <u>sample space</u> S of a random phenomenon is the set of all possible outcomes of the phenomenon

Example $\{H, T\}$ for a coin toss

Warning: There is a certain amount of arbitraryness in assigning a sample space.

Lets say the coin lands on a table.

You could record just heads and tails in which case the sample space would be

$$\{H, T\}$$

OR you could record both heads and tails and the (x, y) coordinates of where the coin comes to rest on the table.

(H, x, y) and (T, x, y) would be different outcomes for each possible value of x, and y.

The ~~experiment~~ phenomenon would be the same what you record would be different

The sample space depends on what you record.

An event is a subset of the sample space.

Book's definition An event is an outcome or set of outcomes.

Outcomes of coin toss recording only heads and tails are

$$H, ~~and~~ T$$

The events are

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

However the book doesn't distinguish between

$$H \text{ and } \{H\}$$

Makes a mathematician cringe

Both OK in terms of exam, homework

With subsets there is the notion of union and intersection

A = {men in this room}

B = {people in this room wearing a blue shirt}

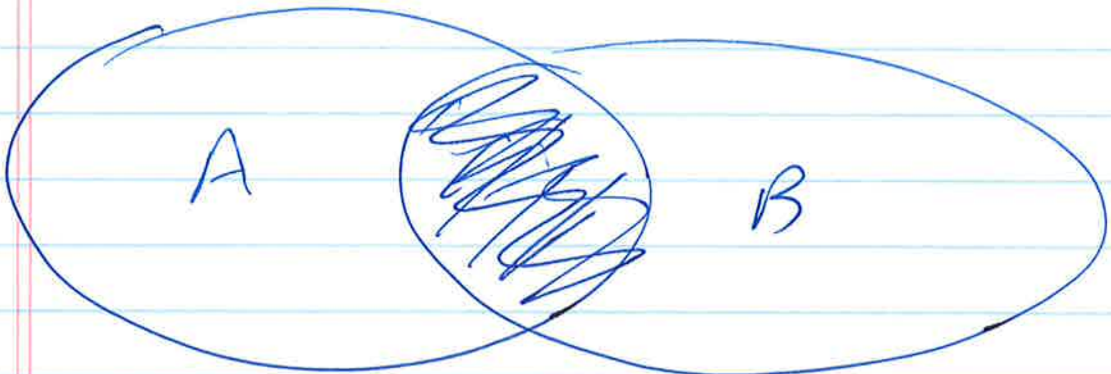
$\boxed{A \cup B}$ A Union B

Would be

$A \cup B$ = {every person in this room who is either a man or ~~woman~~ wearing a blue shirt}

thus the women wearing blue shirts would be ~~them~~ elements of $A \cup B$

$\boxed{A \cap B}$ <u>A intersection B</u>



would be

$A \cap B$ {every person in this room who is <u>both</u> a man <u>and</u> wearing a blue shirt}

Finally there is the concept of complement

If A is an event

A^c is the set of every outcome that is not in A.

$\{H\}^c = \{T\}$ $\quad$ $\{T\}^c = \{H\}$

$\{H,T\}^c = \emptyset$ $\quad$ $\emptyset^c = \{H,T\}$

There is the notion of disjoint set

A and B are disjoint if they have no elements in common (intersection is empty set)

Now we are ready for probability

The probability is a number assigned to all events.

To be a legitimate probability assignment it must obey certain Rules.

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

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

Rule 2 All possible outcomes together must 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 occurs is the sum of their individual probabilities

A or B
+

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 occur.

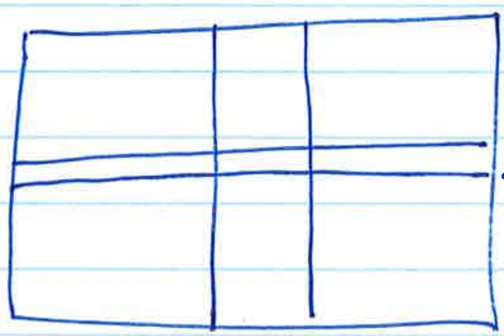
Complement Rule

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

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.

The picture that goes with this is



rectangular sample space

$\leftarrow B$

$A \uparrow$

A is a vertical Bar and B is a horizontal bar. The areas of each region is the probability

Rule 5. If A and B are independent

$$P(A \text{ and } B) = P(A \cap B) = P(A)P(B)$$

IF all outcomes are equally likely then Probability(each outcome)

$$= \frac{1}{\text{total number of outcomes}}$$

If all outcomes are equally likely ~~and~~ and A is an event

$$P(A) = \frac{\text{total number of outcomes in A}}{\text{total number of outcomes in entire sample space.}}$$