Mosaic
mean (~weight, data = BabyWeight)
sd ( )
var( )

Section 2.3
Basic Probability Models

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.

The **sample space** of a random phenomenon is the set of all possible outcomes.

An **event** is a subset of the sample space. A **simple event** is an event consisting of exactly one outcome.

To compute the probability of some event E occurring, divide the number of ways that E can occur by the number of possible outcomes the sample space, S, can occur:

$$\boxed{P(E) = \frac{n(E)}{n(S)}}$$

$P(7) = 0$
$P(\text{between } 1 \& 6) = 1$

Basic Rules of Probability

1. All events have a probability between zero and one. $0 \le P(E) \le 1$
2. The probability of the sample space, S, is one. $P(S) = 1$

Example 1: In a shipment of 93 calculators, 8 are defective. If a calculator is chosen at random from the shipment, what is the probability that it is not defective?

93
8 Def. 85 Good

$\frac{85}{93} = \boxed{.9140}$

Basic Rules of Probability Continued

3. Complement Rule: $P(E^c) = 1 - P(E)$ or $P(E) = 1 - P(E^c)$
4. Addition Rule: If E and F are mutually exclusive events, then $P(E \cup F) = P(E) + P(F)$.
5. If E and F are any events of an experiment, then $P(E \cup F) = P(E) + P(F) - P(E \cap F)$.

or $\cup$
and $\cap$

answer first!

Example 2: If one card is drawn from a well-shuffled standard 52-card deck, what is the probability that the card drawn is a:
(a) nine or a face card? (b) five or a heart?

$P(\text{nine} \cup \text{face})$
$= \frac{4}{52} + \frac{12}{52} = \frac{16}{52} = \boxed{.3077}$

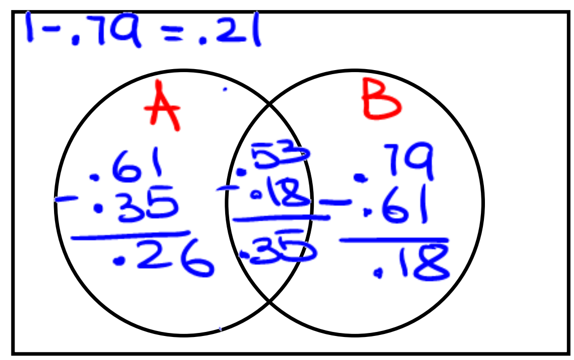
$\frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \boxed{.3077}$

Are the two events in part (a) mutually exclusive? YES
Are the two events in part (b) mutually exclusive? NO

Sometimes it's easier to summarize information using a Venn diagram.

Example 3: In a consumer survey conducted at a pharmacy, 61% of the consumers indicated that they buy brand A of a certain product, 53% buy brand B, and 79% buy brand A or brand B or both. A consumer surveyed is chosen at random, what is the probability that he/she:

Let A = the set of consumers that buy brand A; B = the set of consumers that buy brand B



a. buys brand B but not A ? ← strictly B

$.18 = P(B \cap A^c)$

b. does not buy both brands?

$1 - .35 = .65 = P((A \cap B)^c)$

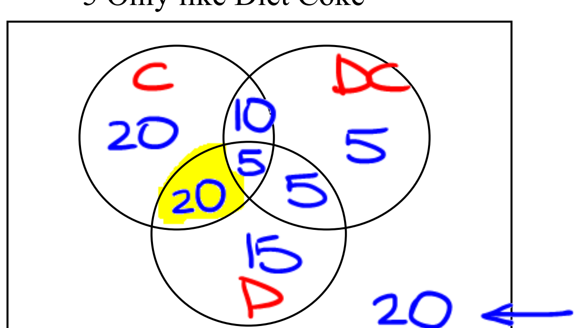
c. any brand other than brand A?

$1 - .61 = .39 = P(A^c)$

Try this one: 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



What is the probability that a randomly chosen person likes Coke and Pepsi but not Diet Coke?

$P(C \cap P \cap DC^c) = \frac{20}{100} = \boxed{.2}$

Coke or Pepsi but not DC

Example 4: In a shipment of 60 vials, 44 have hairline cracks. If you randomly select 2 vials from the shipment, what is the probability that none have hairline cracks?

60

44 Bad → 0 Bad

16 Good → 2 Good

$$\frac{C(16,2)}{C(60,2)}$$

Command: choose(16,2) / choose(60,2)

Answer: $\boxed{.0678}$

Example 5: A committee contains 8 women and 9 men. A subcommittee of 4 members is to be selected from this group.

a. What is the probability that 1 woman and 3 men are selected to be on the subcommittee?

17

8W → 1W

9M → 3M

$$\frac{C(8,1) * C(9,3)}{C(17,4)}$$

Command: choose(8,1) * choose(9,3) / choose(17,4)

Answer: $\boxed{.2824}$

Try b. What is the probability that 2 woman are selected to be on the subcommittee?

17

8W → 2W

9M → 2M

$$\frac{C(8,2) * C(9,2)}{C(17,4)}$$

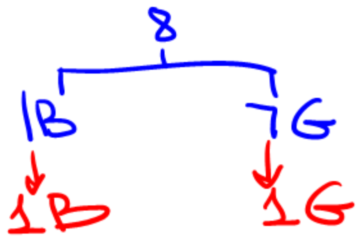
Command: choose(8,2) * choose(9,2) / choose(17,4)

Answer: $\boxed{.4235}$

Example 6: Among 8 electrical components exactly one is known not to function properly. If 2 components are randomly selected, find the probability that at least one does not function properly.

one or more

Can NOT have more than 1 bad!



$$\frac{C(1,1)*C(7,1)}{C(8,2)}$$

Command: Answer:

choose(1,1) * choose(7,1) / choose(8,2)

$\boxed{.25}$

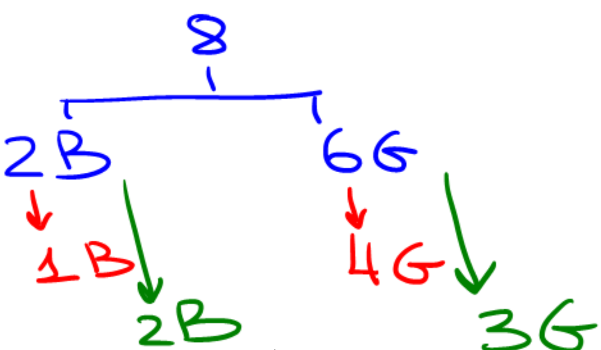
Try this one: Among 8 electrical components 2 are known to be defective. If 5 components are randomly selected, find the probability that at least one is defective.

add

one or more

1 or 2

Cannot have more than 2 Bad!



Command: Answer:

$$\frac{\left(C(2,1)*C(6,4) + C(2,2)*C(6,3)\right)}{C(8,5)}$$

(choose(2,1) * choose(6,4) + choose(2,2) * choose(6,3))

/ choose(8,5)

$\boxed{.8929}$