ELEMENTS OF PROBABILITY

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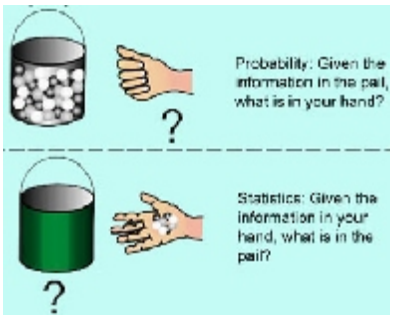
1/7/96, 5 Jan 00, 7 Jan 05, 9 Jan 08, 7Jan09, 6Jan10, 7Jan11, 9Jan12
Tamarin, p64-67, GMSLG 5th: p 30-31, GMSLG 7th: 37-38, 8th: 94-99

Mendel was successful in part because he could fit inexact numbers to ratios following the **rules of probability**

Random (stochastic [*stochastos*: guess at]) events cause variation in the outcome of RATIOS (the H or T of a flip).



probability of an event = $\frac{\text{\# favorable cases}}{\text{\# total cases}}$

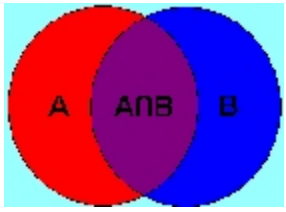
six sided di: rolling a 1 has probability of 1/6
52 card deck: 7 of clubs from a deck = 1 card /52 total cards
any spade = 13 spades/52 total cards

event with certainty has probability of 1/1 = 1 (*not* rain or rain...)

***PRODUCT RULE* (THE *AND* RULE): probability of X *AND* Y happening.** *(Lower* probability than either alone)

Probability of the occurrence of two or more **independent events** is the **product** of their probabilities:

What is the chance of rolling a one **and** then a six?	[= 1/6 x 1/6 = 1/36]
Rolling snake eyes? (1 *and* 1)	[= 1/6 x 1/6 = 1/36]
Role a di and flip a coin: what is chance of H *and* a six?	[= ½ * 1/6 = 1/12]
What is the chance of rain both today (50%) *and* tomorrow(20%)?	[= 0.5 x 0.2 = 0.10]
What is prob of getting phenotype abc from AaBbCc times self?	[= (1/4 x 1/4 x 1/4) = 1/64]
What is the probablility of phenotype ABC from AaBbCc times self?	[=(3/4 x 3/4 x 3/4) = 27/64]

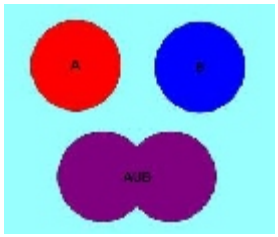


***SUM RULE* (THE *EITHER/OR* RULE: X *OR* Y happening:** *Higher* probability than either alone)

probability of an event A *or* probability of a non-A event = 1

Probability of any one of several **mutually exclusive events** occurring is equal to the **sum** of their individual probabilities:

What is the chance of rolling a 1 **or** a 6 with a di?	[= 1/6 + 1/6 = 2/6]
What is chance of drawing a queen *or* a king?	[=4/52 + 4/52 = 2/13]
What is the chance of any precip? (chance: 10% of snow, 30% rain)	[=0.1 + 0.3 = 0.4]
harder: What is chance of rain either today (50%) and/or tomorrow (20%)?	
(Must restate as the opposite: 1 - chance of *no* rain	[= 1 - (1-0.5) + (1-0.2)= 0.6]



What is the probability a brown-eyed man is heterozygous who has 4 brown-eyed children with a blue-eyed woman?

First, assume he *is* heterozygous:

Then calculate the prob of each successive child being brown-eyed: [= (½*½*½*½) = 1/16 = prob if heterozygous]

What is the probability that he is homozygous?

He is either heterozygous or homozygous, thus, the prob. heterozygous [= 1 - 1/16 = 15/16]

BINOMIAL THEOREM:

Probability of the occurrence of **events with unspecified order** is defined by binomial theorem

Rolling a seven?	[= 1 x 1/6 = 1/6]
Tossing two pennies and getting a H and a T?:	1st coin: prob of getting H or T = 1/1
	2nd coin: probability of getting the *other* face, ½
	Therefore prob = 1*1/2 = 1/2

What is the probability that a family with 6 children has 5 boys and one girl? Use factorials =[x!]

P = (n!/s!t!) x psqt	n = number of trials	= 6
	s = number of times X happens (boy)	= 5
	t = number of times Y occurs (X does not happen)	= 1
	p = probability that X will occur	= 1/2
	q = probability that Y occurs	= 1/2

P = (n!/s!t!) x psqt = (6!/(5! x 1!)) x (1/2)5 (1/2)1
= 6(1/2)6 = 6/64