

I. Probability ← chance that something may happen  
 $0 \leq P \leq 1$

i. Defn

The probability is the calculation of events occur over the overall procedure of an experiment.

- simple event is an outcome of a procedure. (your outcome that you find.)
- sample space is consisting of all possible simple events.

It contains of all outcomes that we can not break down any further.

Notation: A, B and C are events,

$P_r(A)$  - the probability of event A.

$P_r(B)$  - . . . . B.

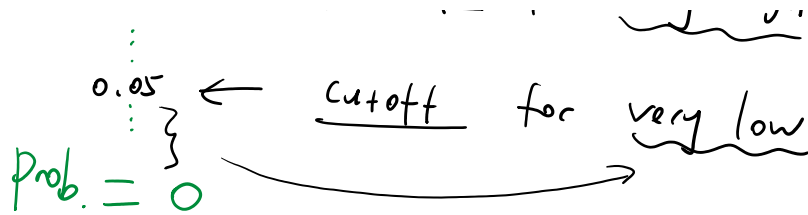
$P_r(C)$  - . . . . C

$P_r(\text{phrase})$  - . . . . phrase

eg  $P(\text{math major})$

rule

Prob. =  $\frac{1}{2}$   
0.95 ← cutoff for very high  
0.05 ← cutoff for . . . . 1



\* Remember: 0.95 is the cutoff for very high probability.  
 0.05 is the cutoff for very low probability.

Overall,

$$P_r(A) = \frac{\text{num of times occurred}}{\text{total num of times}}$$

$$0 \leq P(A) \leq 1$$

(0%)  (100%)

eg What event(s) has a very very high probability?  $\approx 1$

- the sun will come out tomorrow
- lightening in a thunder storm
- you are learning
- you alert your Exam 1's mistake
- ⋮

eg What event(s) has a very very low probability?  $\approx 0$

- ...

✓ ... has a very very low probability?

- winning a Jackpot in a lottery.
- Snow in August here in Turlock.
- Commercial airplane accidents
- ⋮

\*. Now, when can't calculate the probability, but it is a possibility that may happen (it can not be predicted) is called a random variable.

The process is called the random process.

- health issue
- weather
- earthquake
- games winning
- ⋮

← all of these has probabilities, but they are random variables

eg	<u>Procedure</u>	<u>Events</u>	<u>Sample Space</u>
	birth	'1 girl'	$2^n$
	1	.	$2^1 = \{b, g\}$
	2	.	$2^2 = \{bb, bg, gb, gg\}$

3

$$2^3 = \{bbb, bbg, bgb, bgg, gbb, gbg, ggb, ggg\}$$

4

$$2^4 = \{bbbb, \dots, gggg\}$$

16 of them

⋮

⋮

⋮

eg When two children are born, find the probability of getting the children of the same gender.

S: Sample space =  $\{bb, bg, gb, gg\}$

$$\begin{aligned} P_r(\text{same gender}) &= \frac{\text{'bb, gg'}}{4} \\ &= \frac{2}{4} \\ &= \boxed{\frac{1}{2}} \end{aligned}$$

eg When three children are born, find the probability of getting the children of the same gender.

S: Sample space =  $\{bbb, bbg, bgb, bgg, gbb, gbg, ggb, ggg\}$

$$\begin{aligned} P_r(\text{same gender}) &= \frac{\text{'bbb, ggg'}}{8} \\ &= \frac{2}{8} \\ &= \boxed{\frac{1}{4}} \text{ or } \boxed{0.25} \end{aligned}$$

eg When three children are born, find the probability of having exactly one boy.

S: Sample space =  $\{bbb, bb\overset{2}{g}, b\overset{2}{g}b, b\overset{1}{g}g, g\overset{2}{b}b, g\overset{1}{b}g, g\overset{1}{g}b, g\overset{0}{g}g\}$

$$P_r(\text{one boy}) = \frac{b\overset{1}{g}g, g\overset{1}{b}g, g\overset{1}{g}b}{8}$$
$$= \boxed{\frac{3}{8}} \text{ or } \boxed{0.375}$$

eg When three children are born, find the probability of getting at least one girl.

S: Sample space =  $\{bbb, bb\overset{1}{g}, b\overset{1}{g}b, b\overset{2}{g}g, g\overset{1}{b}b, g\overset{2}{b}g, g\overset{2}{g}b, g\overset{3}{g}g\}$

At least one: one or more — 1✓, 2✓, 3✓

$$P(\text{at least one girl}) = P(\text{one or more girls})$$

$$= \boxed{\frac{7}{8}} \text{ or } \boxed{0.875}$$

ii. Complement ← "the other pair"

The complement of event A, denotes  $\bar{A}$ , with  $P_r(\bar{A})$  for probability.

The  $P_r(\bar{A})$  is the probability of event A that does not occur.

$$\boxed{P_r(\bar{A}) = 1 - P_r(A)}$$

eg 1010 U.S. adults were surveyed and 202 of them were smokers.

Let  $A = \text{smokers}$

$$\text{Then, } P_r(A) = \frac{202}{1010} = 0.2 \quad \leftarrow \text{Prob. of smokers}$$

$$\text{Now, } P(\text{not a smoker}) = P_r(\bar{A})$$

$$= 1 - P_r(A)$$

$$= 1 - 0.2$$

$$= \boxed{0.8}$$

eg When five children are born, find the probability of not getting the children of the same gender.

S:

Sample Space = {bbbbb, bbbb, . . .

ggggg}

Let  $S$  be the same gender, then

$\leftarrow 2^5 = 32$  of them

$$P_r(S) = \frac{\text{'bbbb, gggg'}}{32} = \frac{2}{32}$$

$$P_r(\bar{S}) = 1 - P(S) \quad \leftarrow$$

$$= 1 - \frac{2}{32}$$

$$= \frac{30}{32}$$

$$= \frac{15}{16} \text{ or } 0.9375$$