4.2 Assignment of Probabilities

Probability: measure of likelihood

Pr(event) = 0 means event cannot happen

Pr(event) = 1 " is guaranteed to happen

Probability distribution:

Outcome	Probability
⋮	⋮

Properties of a probability distribution:

1) Each probability is between 0 and 1 (inclusive)

2) The sum of all probabilities is 1

Ex: Probability Distribution for roll of a die

Outcome	Probability
1	1/6
2	1/6
3	↓
4	↓
5	↓
6	1/6

Ex: Students are polled on their program. Determine the P.D.

Program	# of Students
Business	13
Technology	18
Nursing	9

Total = 40

Outcome	Probability
Business	13/40 = 0.325
Technology	18/40 = 0.45
Nursing	9/40 = 0.225

Ex: Toss a coin 3 times. Record # of heads. Determine the P.D.

Outcome	Description	# of Ways	Probability
0	TTT	1	1/8 = 0.125
1	HTT, THT, TTH	3	0.375
2	HHT, HTH, THH	3	0.375
3	HHH	1	0.125

Total = 8

Outcome	Probability
0	0.125
1	0.375
2	0.375
3	0.125

Ex: Roll a red die and a blue die.

a) Describe the P.D.

$6 \times 6 = 36$ possible outcomes

red ↑ blue ↑

Outcome	Probability
(1,1)	1/36
(1,2)	↓
⋮	
red → (6,6) ← blue	

b) Pr(roll on red is even and roll on blue is greater than roll on red)?

Call this E

$E = \{(2,3), (2,4), (2,5), (2,6), (4,5), (4,6)\}$

$Pr(E) = \frac{1}{36} + \frac{1}{36} + \cdots + \frac{1}{36}$ (6 times)

$= \frac{6}{36}$

$= \frac{1}{6}$

Ex: An unfair four-sided die has the following P.D.

Outcome	Probability
1	0.1
2	0.35
3	0.3
4	0.25

Find:

a) Pr(roll is less than 3)

= Pr(roll is 1) + Pr(roll is 2)

= 0.45

b) Pr(roll is odd)

= Pr(roll is 1) + Pr(roll is 3)

= 0.4

c) Pr(roll is less than 2 and even)

= 0 ← impossible

Ex: An experiment has possible outcomes A, B and C.

Pr(A) = 0.4

B is three times as likely as C.

Find the P.D.

Let Pr(C) = x

Pr(B) = $3x$

Pr(A) + Pr(B) + Pr(C) = 1

$0.4 + 3x + x = 1$

$4x = 0.6$

$x = 0.15$

Outcome	Probability
A	0.4
B	0.45 ← $3x$
C	0.15 ← x

Inclusion - Exclusion Principle

$$Pr(E \cup F) = Pr(E) + Pr(F) - Pr(E \cap F)$$

Ex: $Pr(E) = 0.6$ $Pr(F) = 0.5$

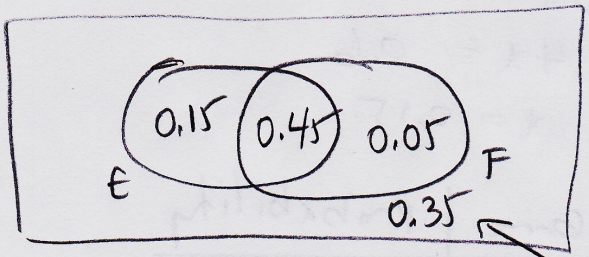
$Pr(E \cup F) = 0.65$ Find:

a) $Pr(E \cap F)$

$$Pr(E \cup F) = Pr(E) + Pr(F) - Pr(E \cap F)$$

$$0.65 = 0.6 + 0.5 - Pr(E \cap F)$$

$$Pr(E \cap F) = 0.45$$



$1 - 0.15 - 0.45 - 0.05$

b) $Pr(E' \cap F)$

$= 0.05$

Ex: A company has 2 suppliers.

Pr(Supplier 1 is late) = 0.2

Pr(" 2 ") = 0.15

Pr(both suppliers are late) = 0.08

Find Pr(neither is late).

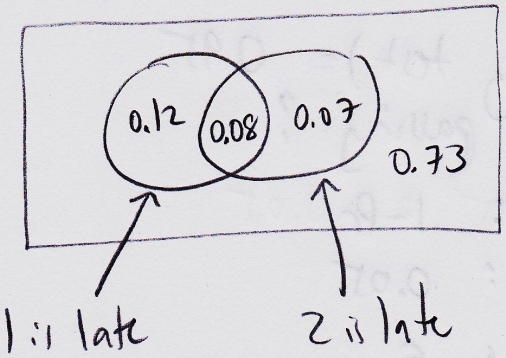
$$\Pr(1 \text{ or } 2 \text{ is late}) = \Pr(1 \text{ is late}) + \Pr(2 \text{ is late}) - \Pr(\text{both are late})$$

$$= 0.2 + 0.15 - 0.08$$

$$= 0.27$$

$$\Pr(\text{neither is late}) = 1 - \Pr(1 \text{ or } 2 \text{ is late})$$

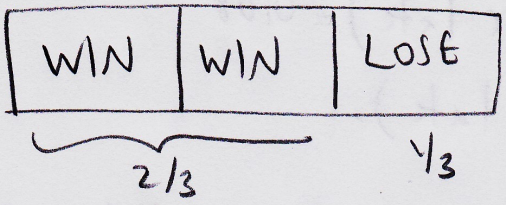
$$= 0.73$$



Odds

"Odds of winning are 2 : 1" means

You are twice as likely to win as to lose



If the odds of an event are $a : b$

then $Pr(\text{event}) = \frac{a}{a+b}$

Ex: a) Odds of getting a promotion are 2 : 7

$Pr(\text{promotion})$?

$$\frac{2}{2+7} = \frac{2}{9}$$

b) $Pr(\text{passing test}) = 0.95$

Odds of passing?

	Pr : 1-Pr
	0.95 : 0.05
(×100)	95 : 5
(÷5)	19 : 1

c) $Pr(\text{graduating}) = \frac{33}{36}$

Odds of graduating ?

	Pr	:	1 − Pr
	$\frac{33}{36}$	:	$\frac{3}{36}$
(×36)	33	:	3
(÷3)	11	:	1