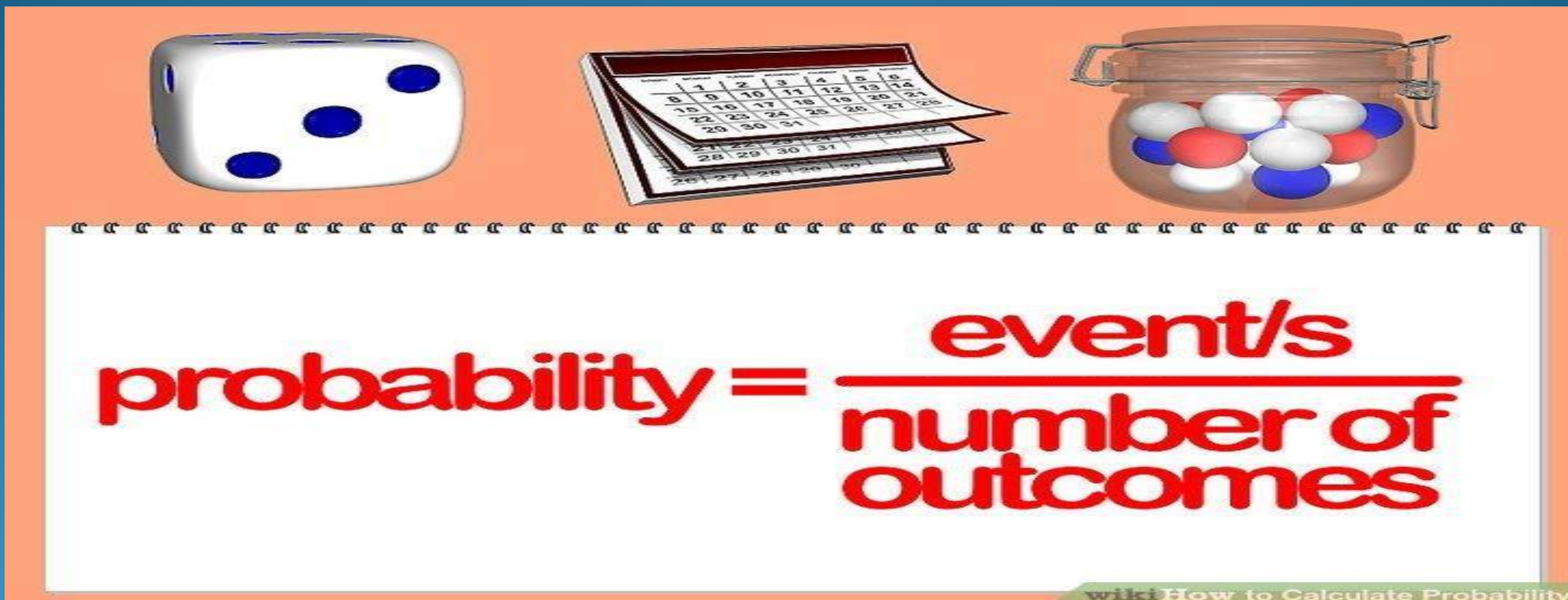
Lecture Foure

Dr.Shaymaa Adil

Msc.Rana Adnan

Probability



Probability

The concept of probability is not a foreign to health workers. For example we may hear a physician say that a patient has 50-50 chance surviving from a certain operation, or physician may say that a patient has 95% a particular disease. Most people express probabilities in terms of percentages. But, it is more convenient to express probabilities as fractions. Thus, we may measure the probability of the occurrence of some event by a number between 0 and 1.

The more likely the event, the closer the number is to one. An event that can’t occur has a probability of zero, and an event that is certain to occur has a probability of one.

Definitions

١.**Equally likely outcomes:**

Are the outcomes that have the same chance of occurring.

٢.**Mutually exclusive:**

Two events are said to be mutually exclusive if they cannot occur simultaneously.

The universal Set (S): The set all possible outcomes.

The empty set Φ : Contain no elements.

The event E : is a set of outcomes in universal set which has a certain characteristic.

Probability

Probability may be categorized into:

1- Classical probability:

If an event can occur in (N) mutually exclusive and equally likely ways, and if (m) of these possess a characteristics, (E), the probability of occurrence of (E) is equal to: P (E) = m / N.

For example, in the rolling of a dice each of the six sides is equally likely to be observed. So, the probability that a 4 will be observed is equal to 1/6.

Probability

2. Relative Frequency Probability:

The relative frequency of an event (E).

Example: If we toss a coin 100 times and find it comes up head 60 times. We estimate the probability of head to be,

P (H) = 60/100=0.6

$$P(E) = \frac{f_i}{\sum f_i}$$

3. Subjective Probability

Probability measures the confidence that a particular individual has in the truth of a particular proposition.

For example, the probability that a cure for cancer will be discovered within the next 10 years.

Probability

The probability of every set is between 0 and 1 inclusive.

The probability of the whole set of outcomes is 1.

A value of 0 means the event can not occur .

A value of 1 means the event will definitely occur .

A value of 0.5 means that the probability of occurrence of the event is equal to the probability of non-occurrence of that event.

The sum of the probabilities (or relative frequencies) of all events that can occur in the sample must be 1 (or 100%)

Probability

Conditional probability :

The probability of occurrence of an event given that another event had already occurred.

P(A I B) is the probability of A assuming that B has happened.

P (A I B) = P (A and B) / P(B)

Joint probability :

The probability of occurrence of two or more events simultaneously .

P(A and B)

Marginal probability:

refer to probability when numerator of probability is a marginal total from a table eg when compute probability that a person pick up from total persons is a male. **P(M) = Total male / N**

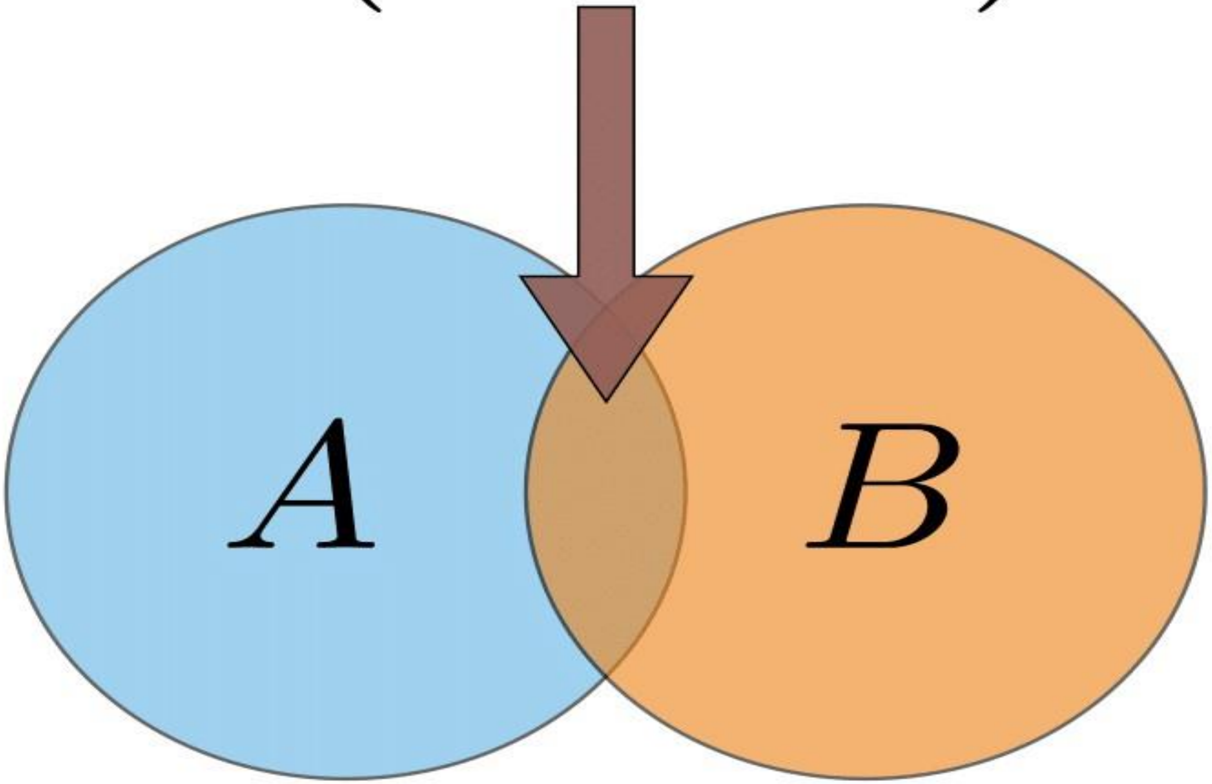
Marginal probability

P(A) = 35/120= 0.29
P(B) = 50/120= 0.41
P(C) = 35/120= 0.29
P(M) = 80/ 120 = 0.66
P(H) = 40/120 = 0.33

Age	Cancer (M)	Healthy (H)	Total
0-19 (A)	25	10	35
20-49 (B)	30	20	50
More than 49(C)	25	10	35
Total	80	40	120

Joint Probability

$$P(A \cap B)$$



Joint probability

P(A&M)= 25/120=0.2

P(H&B)= 20/120= 0.16

P(C&H)= 10/120 = 0.08

P(B&M) = 30/120 = 0.25

P(C&M)= 25/120 = 0.2

P(A&H) = 10/120 = 0.08

Age	Cancer (M)	Healthy (H)	Total
0-19 (A)	25	10	35
20-49 (B)	30	20	50
More than 49(C)	25	10	35
Total	80	40	120

Conditional probability

Probability of event A occured and event B occured

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

Probability of event A given B has occured

Probability of event B

Conditional probability

P(A I M)= P(A and M) / P(M)

= (25/120) / (80/120) = 25 / 80 = 0.31

Age	Cancer (M)	Healthy (H)	Total
0-19 (A)	25	10	35
20-49 (B)	30	20	50
More than 49(C)	25	10	35
Total	80	40	120

Rules of Probability

١ Addition Rule : When "or" is used or (∪)

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

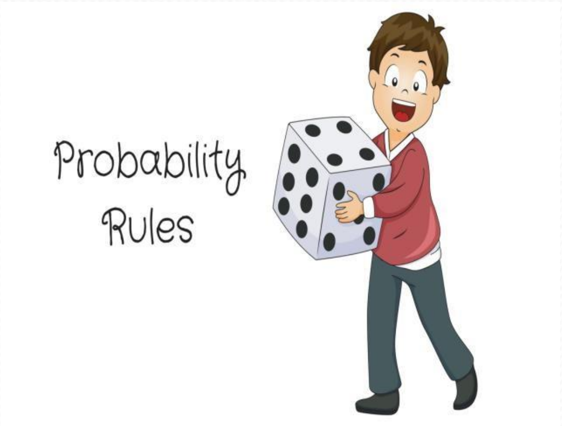
If A and B are mutually exclusive (disjoint) ,then P (A and B) = 0
Then , addition rule is

$$P(A \text{ or } B) = P(A) + P(B)$$

٢ Complementary Rule

$$P(A') = 1 - P(A)$$

where, A' = complement event.



Rules of Probability

3. Multiplicative Rule: (when " **and**" is used) or ($\cap$)

١. Independent events:

If the occurrence of event A is not affected by occurrence of event B

P(A and B) = P(A) X P(B)

٢. Non independent events:

Occurrence of event A is affected by occurrence of event B (the two events are related or associated)

P (A and B) = P (A I B) . P (B) = P(A and B)/P(B) x P(B)

=P (A and B).

Example

Life time use of cocaine	Male (M)	Female (F)	Total
1-19 (A)	32	7	39
20-99 (B)	18	20	38
100 (C)	25	9	34
Total	75	36	111

Answer the following questions:

Suppose we pick a person at random from this sample.

1-The probability that this person will be male .

P(M)=75/111 = 0.6757

٢ The probability that this person use cocaine 100 times (C) when the selected person was male (conditional probability)?

P(C **I** M) = P(C and M) /P(M) = 25/111/75/111 = 0.33

٣ The probability that this person has use cocaine 100 times and will be male (joint probability)?

P(C and M) = 25 /111 = 0.2252

٤ The probability that this person is male (M) <u>or</u> use cocaine 100 times

P(M or C)= P(M) + P(C) – P (M and C) = 75/111 + 34/111 - 25/111 = 0.6757+0.3063 – 0.2252 = 0.7568 .

5. P(M or F) = P(M) + P(F) = 75/111 + 36/ 111 = 1 .

Example (2)

Family history of Mood Disorders	< 18 (E)	Later >18 (L)	Total
Negative (A)	28	35	63
Bipolar Disorder(B)	19	38	57
Unipolar (C)	41	44	85
Unipolar and Bipolar (D)	53	60	113
Total	141	177	318

Answer the following questions

Suppose we pick a person at random from this sample.

١ The probability that this person will be less than18-years old (E)?

$P(E) = 141 /318 = 0.443$

٢ The probability that this person has family history of mood disorders Unipolar (C)?

$P(C) = 85/318 = 0.267$

٣ The probability that this person has no family history of mood disorders Unipolar only ($\bar{C}$)?

$P \quad = 1- 0.267 = 0.733$

٤ The probability that this person is less than18-years old or has no family history of mood disorders Negative (A)?

$P(E \cup A) = P(E) + P(A) – P (E \text{ and } A)$

$= 141/318 + 63/318 – 28/318 = 0.44 + 0.19 – 0.08 = 0.55$

Answer the following questions

5. The probability that this person is less than18-years old and has family history of mood disorders Unipolar and Bipolar (D)?

P(E and D) = P(E I D) . P(D) = P (E and D) /P (D) X P(D) = P(E and D) = 53 /318 = 0.1666 .

Example 1

Here is the data of a sample of adults in a certain city:

	Male (M)	Female (F)	Sum
Diabetic (D)	15	8	23
Normal (H)	40	62	102
Sum	55	70	125

Answer the following questions:

Suppose we pick a person at random from this sample.

١ The probability that this person will be diabetic .

٢ The probability that this person will be normal

٣ The probability that this person will be diabetic (D) when the selected person was male?

٤ The probability that this person will be diabetic and male ?

٥ The probability that this person is male (M) <u>or</u> normal (H)?

٦ P(M or F).

Example 2

For a sample of 80 recently born children, the following table is obtained:

	Boy (B)	Girl (G)	Sum
< 2.5 Kg (L)	4	3	7
2.5 - < 3 (N)	35	22	57
3 + (O)	10	6	16
Sum	49	31	80

Answer the following questions:

Suppose we pick a person at random from this sample.

١ The probability that the child will be > 3 Kg birth weight.

٢ The probability that child will be girl

٣ The probability that child will be boy when the selected birth weight < 2.5 Kg?

٤ The probability that the child will be girl and birth weight 2.5 - < 3 Kg ?

٥ The probability that the child is boy or > 3 Kg birth weight ?

٦ P(B or G).

Thank you