

## Ch 3.2 Independent and Mutually Exclusive Events

### Mutually exclusive events:

Two events are mutually exclusive (disjoint) if they will not occur at the same time.  $P(A \text{ and } B) = 0$

Ex1: Toss a 6-face die once, determine if the following are mutually exclusive:

a) Getting a “four” and “even”

No, four and even can occur at the same time, four and one are not mutually exclusive.

b) Getting a “four” and “five”

Yes, four and five cannot occur at the same time so four and five are mutually exclusive.

Ex2:

	Yes	no	no opinion
M	1	4	2
F	5	2	0

$P(F \text{ and no opinion}) = 0$

F and no opinion are mutually exclusive so they cannot occur at the same time.

### Independent Events:

Two events are independent when any of the following is true:

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

$$P(A) = P(A | B)$$

$$P(B) = P(B | A)$$

Ex1. Given a 2-way table below:

	iPhone	Samsung	others
male	18	2	1
female	24	4	2

GT = 51

Is iPhone uses independent on gender?

Check if  $P(\text{iPhone} | \text{female}) = P(\text{iPhone})$

a) Find  $P(\text{iPhone}) = (18+24)/51 = 0.824$

b) Find  $P(\text{iPhone} | \text{female}) = 24/51 = 0.471$

$P(\text{iPhone})$  and  $P(\text{iPhone} | \text{female})$  are not exactly equal, so iPhone use is not independent of gender.

We can conclude that iPhone use is not independent on gender. Gender affect the choice of iPhone.

Ex2. Given a 2-way table below

	Right-handed	Left-handed
Male	43	9
Female	44	4

Grand total = 100

Is Right-handedness independent on gender?

Check if  $P(M \text{ and } R) = P(M) \cdot P(R)$

$$P(M) = 52/100 = 0.52$$

$$P(R) = (43+44)/100 = 87/100 = 0.87$$

$$P(M \text{ and } R) = 43/100 = 0.43$$

$$\text{But } P(M) \cdot P(R) = 0.52 (0.87) = 0.45$$

So they are not exactly equal.

We can conclude they are not independent.

Note: we will visit this again in Ch 11 to take into consideration of sampling variation.

Note: mutually exclusive events are not necessarily independent events. They are two different concepts.

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