Q1: $P(A \cap D) = P(A) \cdot P(D|A)$

$= (0.6) \cdot (0.04) = 0.024$

Q2: $P(B \cap D) = (0.4) \cdot (0.05) = 0.02$

Q3: $P(D) = ?$

$$D = \underbrace{(A \cap D)} \cup \underbrace{(B \cap D)}$$

mutually exclusive.

$P(D) = P(A \cap D) + P(B \cap D)$

$= 0.024 + 0.02 = 0.044$

Independent Events

A and B are independent events if:

1. $P(B|A) = P(B)$
2. $P(A|B) = P(A)$

* **Note:**

① $\underbrace{P(B|A)} = P(B)$

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

$$\boxed{P(A \cap B) = P(A)\,P(B)}$$

② $\underbrace{P(A|B)} = P(A)$

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

$$\boxed{P(A \cap B) = P(A)\,P(B)}$$

So, A and B are independent if

$$\boxed{P(A \cap B) = P(A) \cdot P(B)}$$

E.g. Toss a coin and roll a dice

A = event that we get a H

B = event that we get a 4

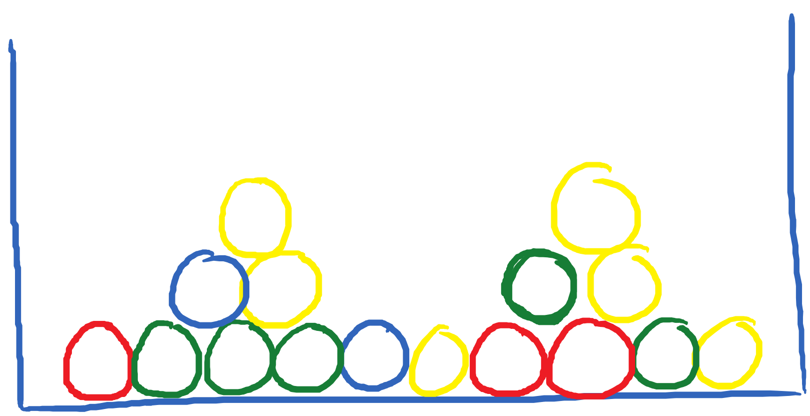
→ A and B are independent events.

$$P(A \cap B) = P(A) \cdot P(B)$$

$$= \frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12}$$

E.g. Experiment:

A jar contains 3 red, 5 green, 2 blue, and 6 yellow marbles.



Pick a marble at random from the jar.

Replace it in the jar.

Pick another marble at random from the jar.

→ Find the probability that we got a green and a yellow marble in succession.

G: event that we get a green in first draw

Y: ________________ yellow in second draw

$P(G) = \frac{5}{16}$; $P(Y) = \frac{6}{16}$

G and Y are independent events. So,

$$P(G \cap Y) = P(G) \cdot P(Y) = \frac{5}{16} \cdot \frac{6}{16} = \frac{30}{256}$$

$$= \frac{15}{128}.$$

Different Experiment:

1. Pick a marble at random (No Replacement)
2. Pick another marble at random.

Find $P(G \cap Y)$?

$P(G) = \frac{5}{16}$; $P(Y|G) = \frac{6}{15}$

$$P(G \cap Y) = P(G) \cdot P(Y|G) = \frac{5}{16} \cdot \frac{6}{15} = \frac{1}{8}$$

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Dependent Events:

Events A and B are dependent if they are not independent.

In other words, $\underline{P}(A \cap B) \neq \underline{P}(A) \cdot \underline{P}(B)$

Ex. Draw 2 cards in succession from a standard 52 card deck without replacement.

Find the probability that we get 2 aces in succession

$$\underline{P}(A_1 \cap A_2) = \underbrace{\underline{P}(A_1)}_{\frac{4}{52}} \cdot \underbrace{\underline{P}(A_2 \mid A_1)}_{\frac{3}{51}} = \frac{1}{221}$$