Conditional Probability

Conditional Probability

- Probability that event A has occurred given that event B has *definitely* occurred

- Conditional Probability of A given B is denoted as $P(A \mid B)$

- $P(A \mid B) = P(A \cap B) / P(B)$

Conditional Probability

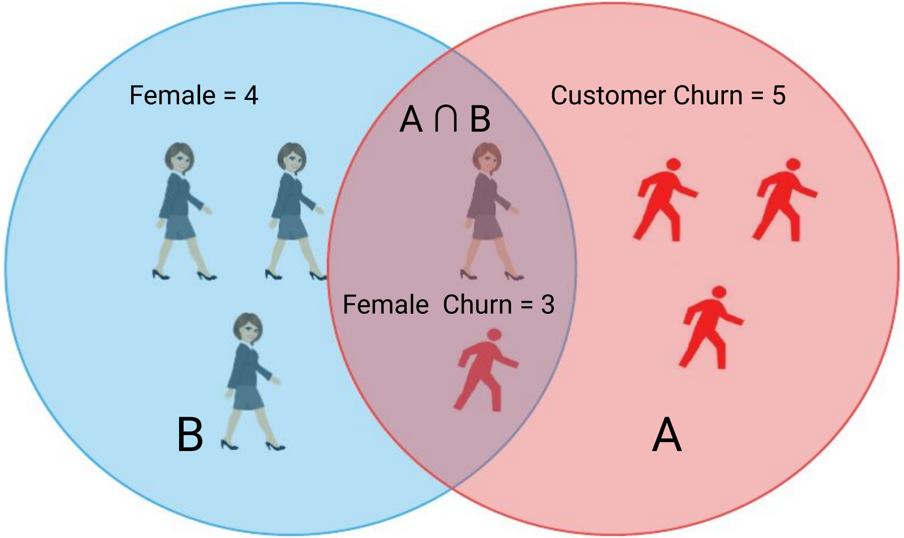
Ex. Probability of a Customer is going to churn given that she is a female.

Event B = Customer is female

Event A = Customer Churn

Conditional Probability

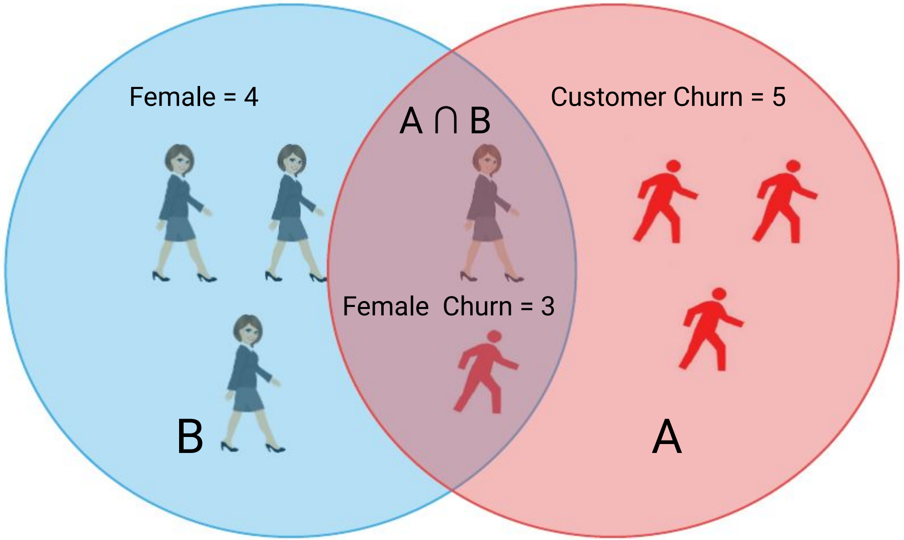
Ex. Probability of a Customer is going to churn given that she is a female.



	gender	age	occupation	churn
0	Male	young	salaried	0
1	Male	young	self_employed	0
2	Male	old	self_employed	0
3	Male	young	self_employed	0
4	Female	young	salaried	1
5	Male	old	salaried	0
6	Female	young	self_employed	1
7	Male	young	self_employed	0
8	Male	young	salaried	1
9	Male	young	salaried	0
10	Male	young	self_employed	1
11	Female	young	self_employed	1
12	Male	young	retired	0
13	Female	young	self_employed	0
14	Male	old	self_employed	0

Conditional Probability

Ex. Probability of a Customer is going to churn given that she is a female.



Total Customers → 15

$$P(A \mid B) = P(A \cap B) / P(B)$$

$$P(A \mid B) = (3/15) / (4/15)$$

$$= \tfrac{3}{4} \rightarrow 0.75$$

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Independent and Dependent Events

What if $P(A \mid B) = P(A)$??

Event B has no impact on the likelihood of Event A.

A is **Independent** of the event B.

Ex.Entrepreneurial Skill is independent of the length of hair

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Independent and Dependent Events

If $P(A \mid B) \neq P(A)$??

Event B has impact on the occurance of Event A.

A is **Dependent** on the event B

Ex. Chances of Contracting Polio

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Independent and Dependent Events

- For two independent events A and B,

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

Independent and Dependent Events

- For two independent events A and B,

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

- By Conditional Probability Calculations

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

Independent and Dependent Events

- For two independent events A and B,

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

- By Conditional Probability Calculations

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

- For two events to be independent

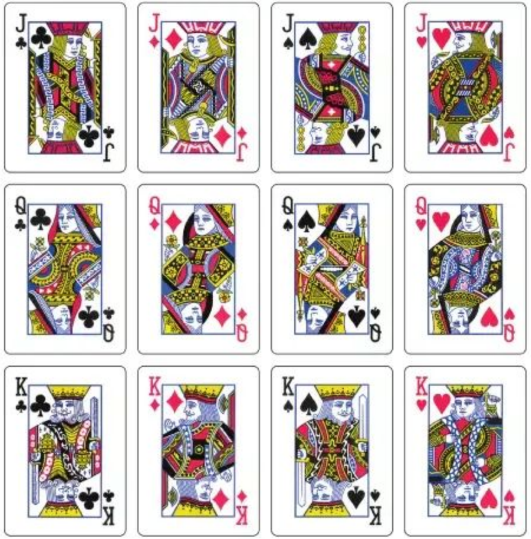
$$P(A \cap B) = P(A) \,.\, P(B)$$

Independent Events

Event A : Draw a card from the deck. Probability of card being a face card ?

Put that card back in the deck.

Event B: Again Draw a card from the deck. Probability of card being a face card ?



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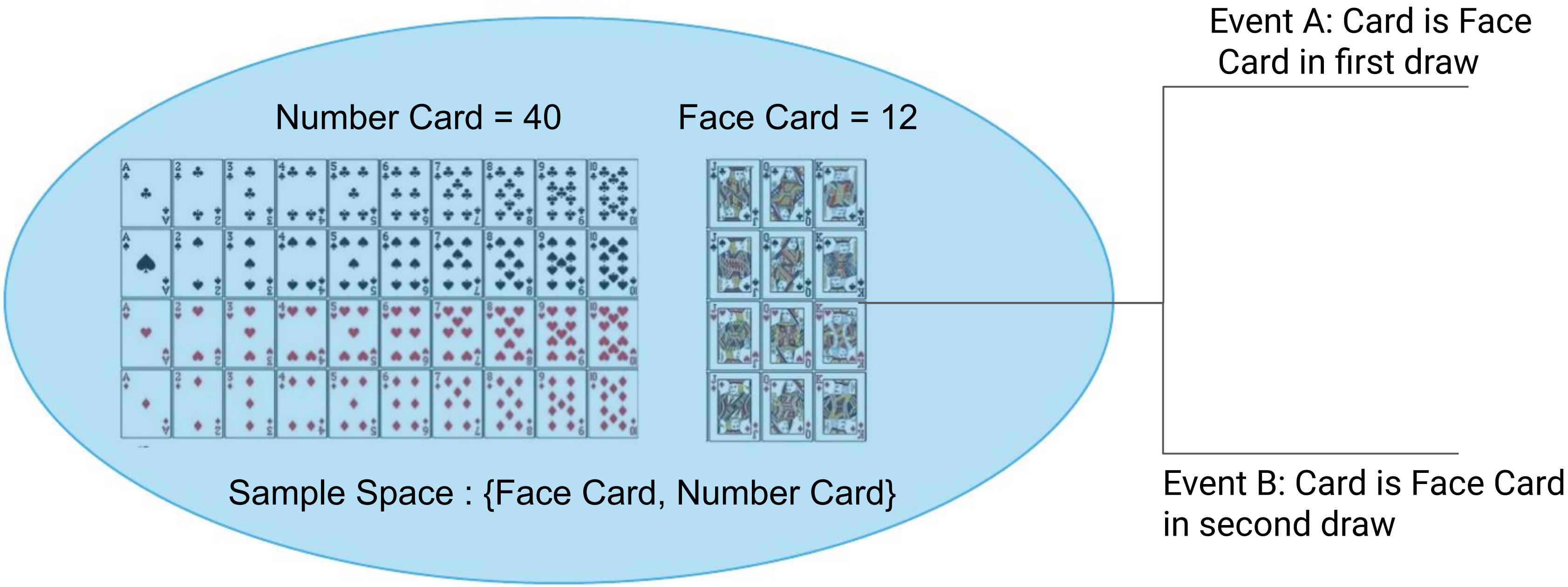
Independent Events



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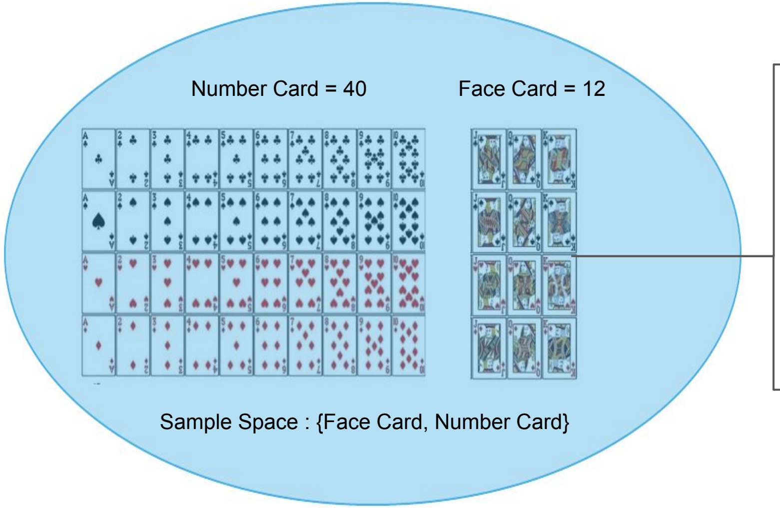
Independent Events

Event A: Card is Face Card in first drawn



Event B: Card is Face Card in second drawn

$$P(A) = 12/52$$

$$P(B \mid A) = 12/52 = P(B)$$

$$P(A \cap B) = P(A).P(B \mid A)$$

$$= 12/52 \times 12/52$$

$$= 144/2704$$

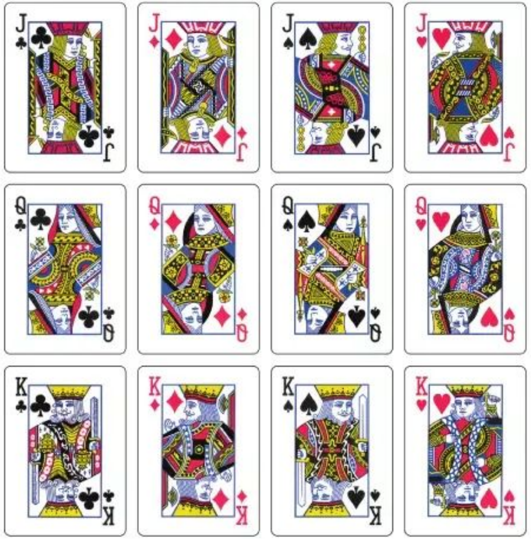
$$= 0.053$$

Dependent Events

Event A : Draw a card from the deck. Probability of card being a face card ?

Don't Put that card back in the deck.

Event B: Again Draw a card from the deck. Probability of card being a face card ?



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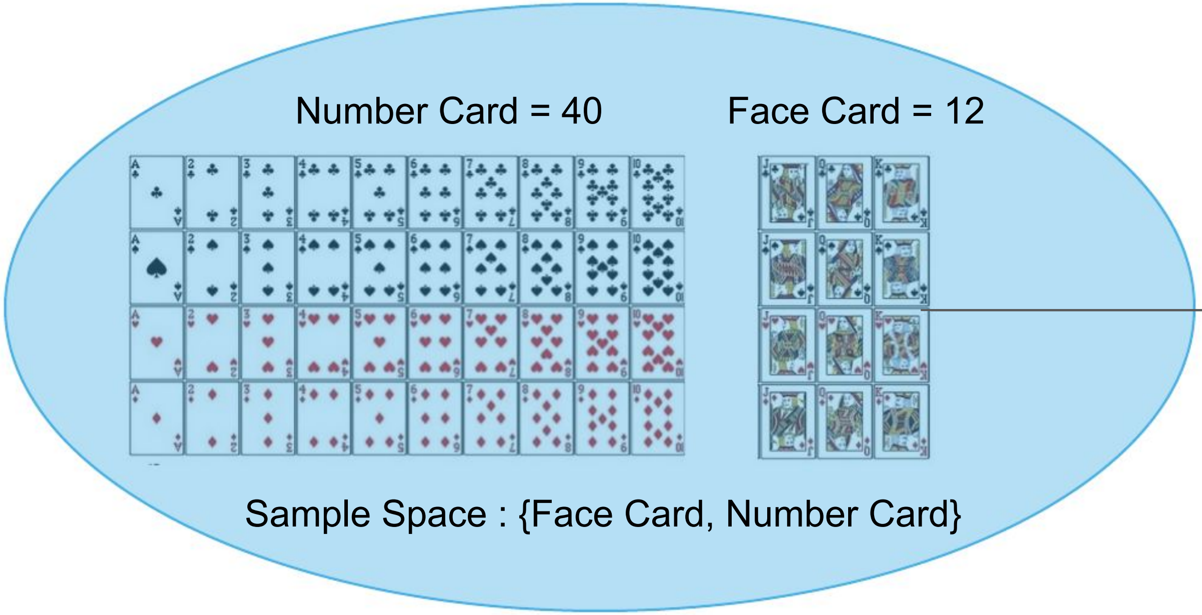
Dependent Events



Event A: Card is Face
Card in first drawn
12 choices among 52 cards

Event B: Card is Face Card
in second drawn
11 choices among 51 cards

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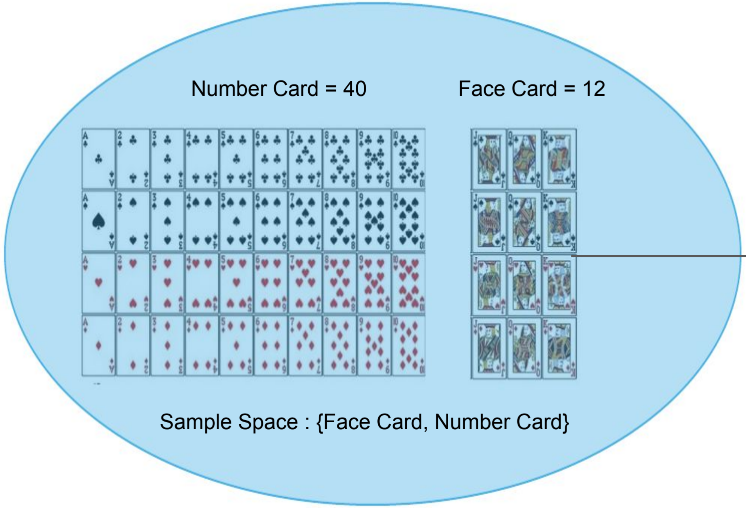
Dependent Events



Event A: Card is Face Card in first drawn
12 choices among 52 cards

Event B: Card is Face Card in second drawn
11 choices among 51 cards

$$P(A) = 12/52$$

$$P(B \mid A) = 11/51$$

$$P(A \cap B) = P(A).P(B \mid A) \neq P(B)$$

$$= 12/52 \times 11/51$$

$$= 132/2652$$

$$= 0.049$$

Bayes Theorem

An alternative to calculate the conditional probability

$$P(A \mid B) = P(A \cap B) / P(B) \quad \text{.... (1)}$$

$$P(B \mid A) = P(B \cap A) / P(A) \quad \text{.... (2)}$$

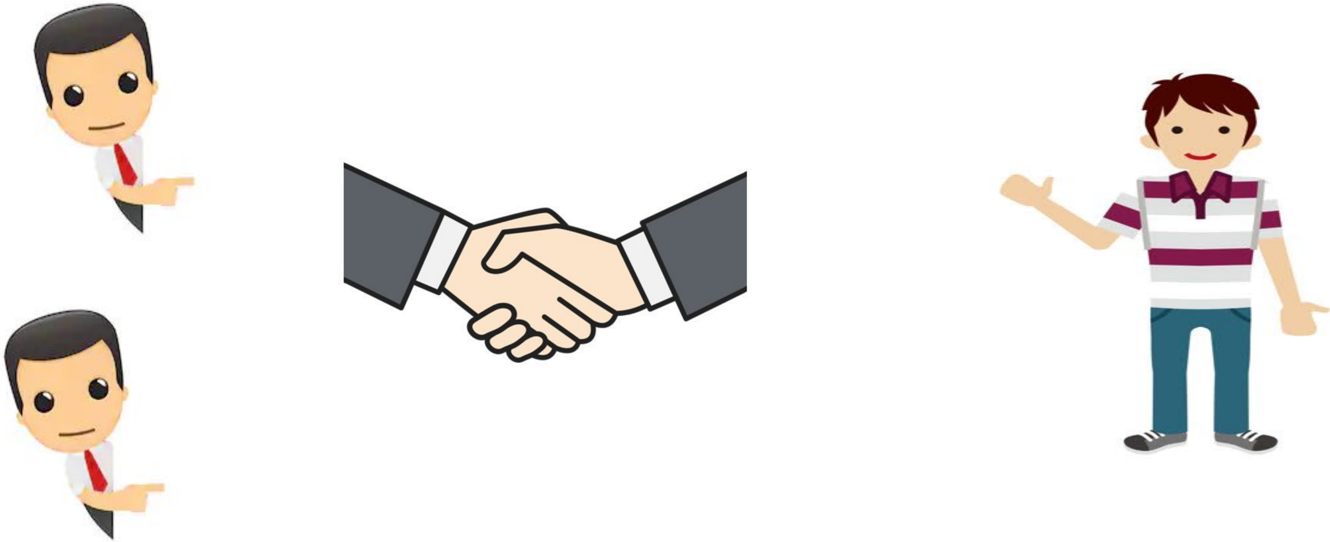
$$P(A \mid B) = P(B \mid A) \,.\, P(A) / P(B)$$

<u>Bayes Theorem</u>

Thank You!

Independent Events

Ex. Two different bank managers randomly greet to one customer.



What is the probability that both of them will choose self employed customer?

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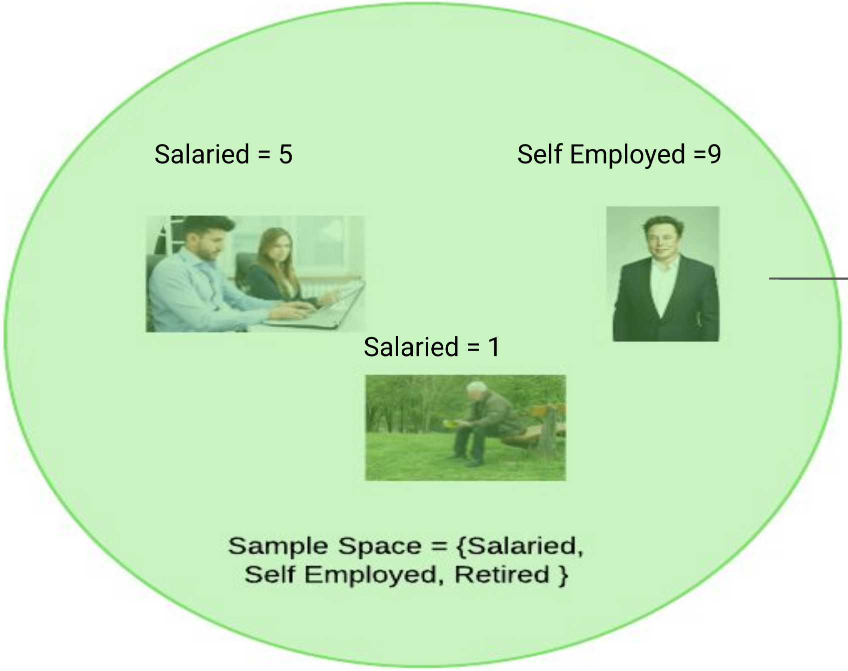

Event A : Manager 1 choosing self employed person

Event B : Manager 2 choosing self employed person

$$P(A) = 9/15$$

$$P\ (B \mid A) = 9/15 = P(B)$$

$$P(A \cap B)\ = P(A).P(B \mid A)$$

$$= \ 9/15 \times 9/15$$

$$= 99/225$$

$$= 0.44$$

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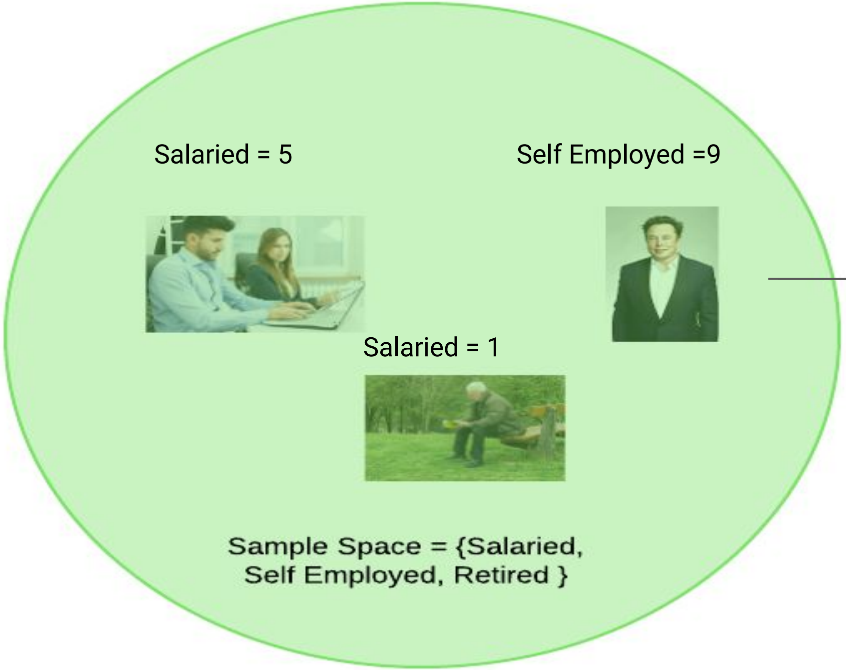
Dependent Events

Ex. One bank managers randomly greet to two different customers.

What is the probability that he will choose self employed customer both the times?

Dependent Events



Event 1 : Manager choosing self employed person

Event 2 : Manager choosing self employed person again

$$P(A) = 9/15$$

$$P(B \mid A) = 8/14$$

$$
\begin{aligned}
P(A \cap B) &= P(A).P(B \mid A) \\
&= 9/15 \times 8/14 \\
&= 72/210 \\
&= 0.34
\end{aligned}
$$

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