

# Data Science 1

## Probability

### Conditional Probability

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# Introduction

Recall the following:

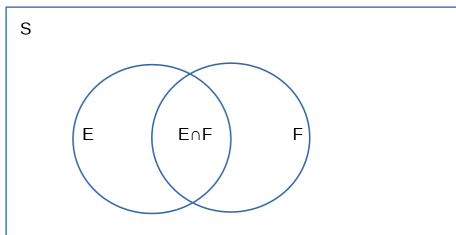
- $E$  is an event in a sample space  $\mathcal{S}$ .
- $P(\mathcal{S}) = 1$ .
- $E \cup F$  is the union of events  $E$  and  $F$ .
- $E \cap F$  is the intersection of events  $E$  and  $F$ .
- Probability behaves like area.

# Conditional Probability

Suppose we are interested in two events  $E$  and  $F$  and we observe an outcome that is in  $F$ , how does this change the probability of  $E$ ?

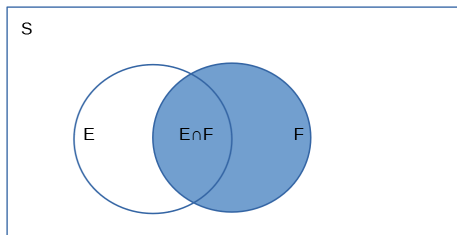
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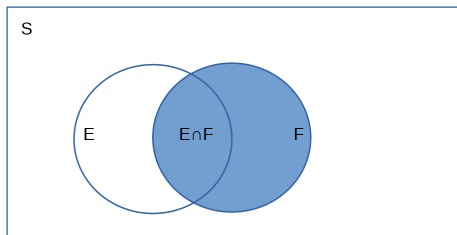
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$$P(E|F) = \frac{P(E \cap F)}{P(F)}$$

## Example

Example: A vendor is selling oranges and mangoes as well as other fruit. Suppose we know that the probability of selling an orange to a customer is 0.3 and we know the probability of selling both an orange and mango to a customer is 0.12. What is the probability that person who is buying an orange will also buy a mango?

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Write down what we know:

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- $P(\text{orange} \cap \text{mango}) = 0.12$

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$$\begin{aligned}P(\text{mango}|\text{orange}) &= \frac{P(\text{mango} \cap \text{orange})}{P(\text{orange})} \\ &= \frac{0.12}{0.3} \\ &= 0.4\end{aligned}$$

Hence there is a probability of 0.4 that a person buying an orange will also purchase a mango.

# Summary

Conditional probability is an extremely important concept in probability, statistics and data science.

$$P(E|F) = \frac{P(E \cap F)}{P(F)}$$

This gives us a mechanism to update our probability when we have more information.