Introduction to Probability Part 1

Data Science for Quality Management: Probability and Probability Distributions

with **Wendy Martin**

Learning objectives:

Describe the concept of probability

Use the rules of probability to perform basic probability calculations

Probability Definitions

- Probability is the chance that an event will or will not occur. The terms are typically expressed in fractions or decimals.
- An event is one or more of the possible outcomes of a situation or experiment

Probability Definitions

- An experiment is an activity which produces an event.
- Sample space is the set of all possible outcomes from an experiment

Probability Definitions

- Events are termed mutually exclusive when one and only one can take place at the same time.
- Collectively Exhaustive refers to lists containing all of the possible events which may result from an experiment.

Classical Probability

- The probability that an event will occur

where

- P = Probability of an event
- N = Number of outcomes where the event occurs
- S = Total Number of possible outcomes; and where each of the possible outcomes are equally likely

Rules / Conditions of Probability

Typical conditions of concern:

- The case where one event or another will occur
- The situation with two or more events where both may occur

Marginal or Unconditional Probability

P(A) = the probability P of event A occurring

Where a single probability is involved, only one event can take place

Marginal or Unconditional Probability Example

A production lot of 100 parts contains one defective part. What is the P of selecting one part randomly from the lot, and drawing the defective?

Marginal or Unconditional Probability Example

$$P(D) = \frac{1}{100} = 0.01 = 1.0\%$$

Addition Rule for Mutually Exclusive Events

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

Addition Rule for Mutually Exclusive Events Example

- Suppose an investigator has planned to run an experiment, where they wish to select two machines randomly from the ten units on the floor for testing.

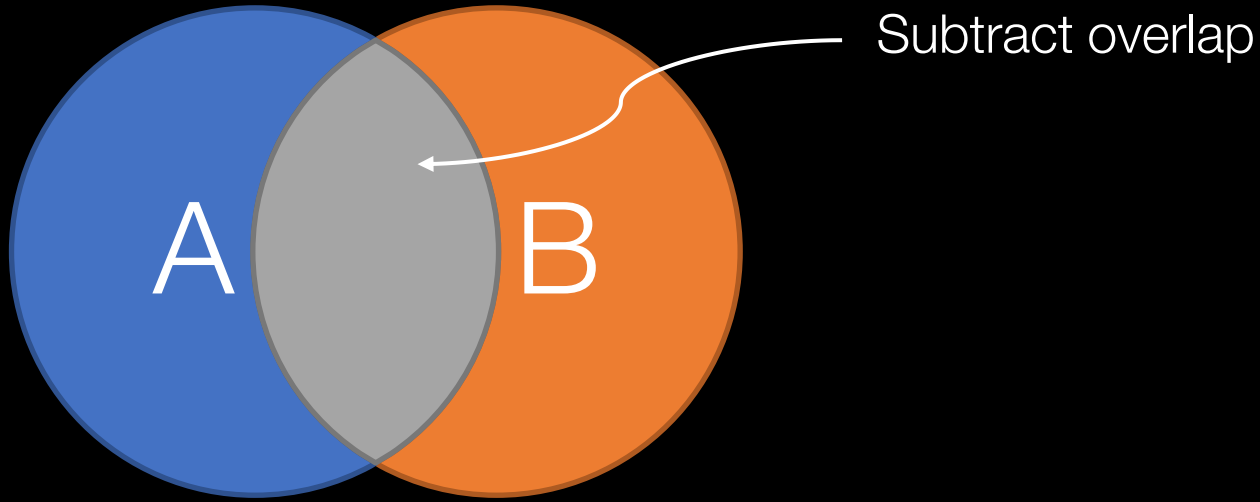
Addition Rule for Mutually Exclusive Events Example

- If each machine is numbered from 1 to 10, what is the probability that machine 4 or 8 will be selected on a single draw?
- P(4 or 8) = P(4) + P(8)

$$= \frac{1}{10} + \frac{1}{10} = \frac{2}{10} = 0.2 \; or \; 20\%$$

Addition Rule for Non-Mutually Exclusive Events

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



Addition Rule for Non-Mutually Exclusive Events Example

- Given a mixed lot with the following characteristics:

Vendor	# Defective	# Not Defective
Vendor A	15	85
Vendor B	10	55

Addition Rule for Non-Mutually Exclusive Events Example

- What is the probability, on a single random draw, of selecting a part from Vendor A or a defective part?

Addition Rule for Non-Mutually Exclusive Events Example

- If we were to simply use P(A) + P(B), then

Addition Rule for Non-Mutually Exclusive Events Example

- Note, however, that there are 15 more parts credited to the total than should be!

Vendor	# Defective	# Not Defective
Vendor A	15	85
Vendor B	10	55

Addition Rule for Non-Mutually Exclusive Events Example

- P(A and B) =

- So, P(A or B) = P(A) + P(B) – P(A+B)

Addition Rule for Non-Mutually Exclusive Events Example

- P(Vendor A or Defective) =

Sources

The material used in the PowerPoint presentations associated with this course was drawn from a number of sources. Specifically, much of the content included was adopted or adapted from the following previously-published material:

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