



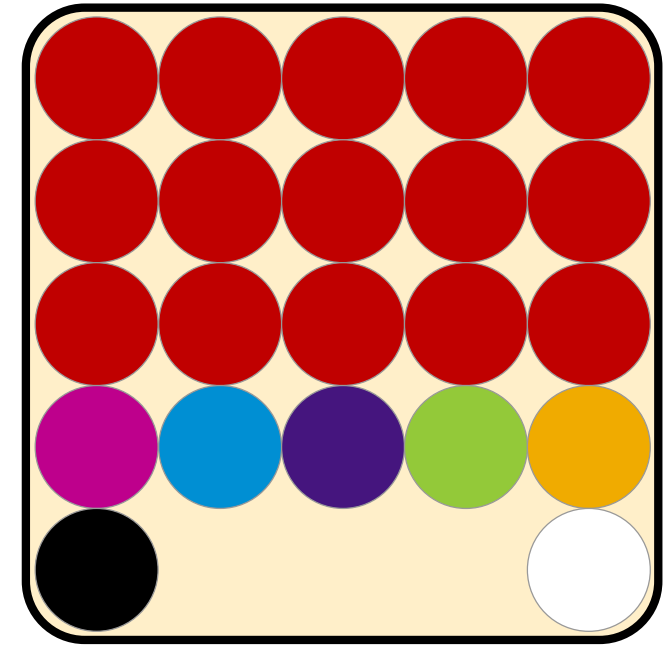
Week 4: Introduction to Probability

## Unit 2: Conditional Probability

## Conditional Probability

### Introduction

- It often happens that the probability of an event is conditional on a previous event.
- If you have a bag of snooker balls, you can calculate the probability that you will pull out a red one or a green one.
- However, what is the probability that you will pull out a second red or a second green?



### What is conditional probability?

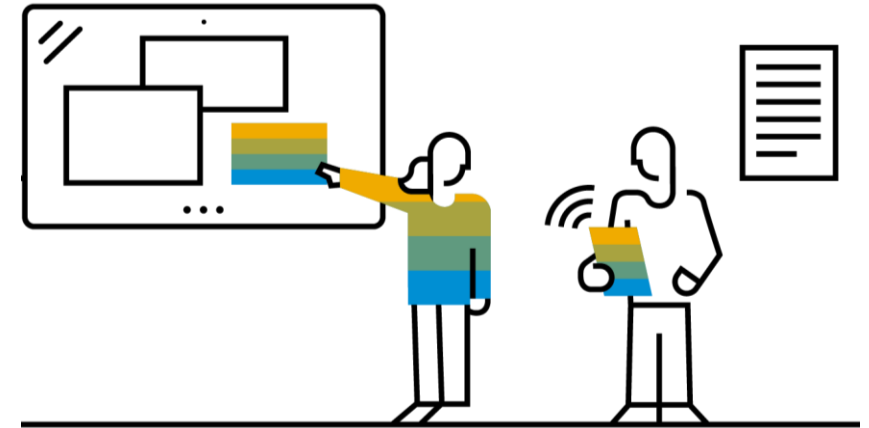
- **“Conditional probability”** is a measure of the probability of an event given that another event has occurred.
- There are 15 red balls out of a total of 22 balls.
  - Therefore, the probability  $P(E)$  of taking out a red ball is:  
 $P(E) = 15/22 = 0.68$
- However, now you have reduced the number of red balls to 14.
  - Therefore, the probability of the next random ball being red is slightly less:  
 $P(E) = 14/21 = 0.66$



## Conditional Probability

### Combining probabilities

- The upright symbol  $|$  is used to indicate **conditional probability**.
- For example:
  - $P(B|A)$  means the conditional probability of B given A.
- This is calculated in the following way:
  - $P(B \text{ and } A) = P(A) * P(B|A)$
- So the probability of getting 2 red balls is:
  - $P(B \text{ and } A) = 15/22 * 14/21 = 210/462 = 0.4$



### Pulling 2 aces

- What is the probability of pulling an ace from a pack of cards having already picked out an ace?
- There are 52 cards in a standard pack of cards and 4 are aces. Therefore the simple probability of picking out the first ace is 4/52:
  - $P(A) = 4/52 = 1/13$  or 7.7%
- Once this ace has been picked out there are only 3 other aces left and 51 cards in total. Therefore the simple probability of drawing the second ace is 3/51:
  - $P(B|A) = 3/51 = 5.9\%$
- However we want to combine these to calculate the combined probability of pulling two aces –  $P(A \text{ and } B)$  This can be done by multiplying together the above simple probabilities:
  - $P(A \text{ and } B) = P(A) * P(B|A) = 4/52 * 3/51 = 12/2652 = 1/221$  or 0.45%



## Conditional Probability

### Desserts

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

- 80% of your team like Tiramisu.
- 20% like Tiramisu and Sticky Toffee Pudding.
- What is the probability of team members liking Sticky Toffee pudding given that they like Tiramisu?

$$P(STP|T) = \frac{P(T \cap STP)}{P(T)} = \frac{0.2}{0.8} = 0.25 \text{ or } 25\%$$



## Conditional Probability

### Summary

- Using probability you can calculate the likelihood of an event or series of events.
- You need to understand all possible outcomes in the sample space and the particular event or group of events you are analysing.
- Events which are conditional upon each other can be combined to calculate probabilities.
- By rearranging the formula, you can calculate the probability of more than one dependent event,  $P(A \text{ and } B)$ , as well as the probability of one event being contingent on a second event,  $P(B|A)$ .



# Thank you.

**Contact information:**

**open@sap.com**



Follow all of SAP



[www.sap.com/contactsap](http://www.sap.com/contactsap)

© 2019 SAP SE or an SAP affiliate company. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or for any purpose without the express permission of SAP SE or an SAP affiliate company.

The information contained herein may be changed without prior notice. Some software products marketed by SAP SE and its distributors contain proprietary software components of other software vendors. National product specifications may vary.

These materials are provided by SAP SE or an SAP affiliate company for informational purposes only, without representation or warranty of any kind, and SAP or its affiliated companies shall not be liable for errors or omissions with respect to the materials. The only warranties for SAP or SAP affiliate company products and services are those that are set forth in the express warranty statements accompanying such products and services, if any. Nothing herein should be construed as constituting an additional warranty.

In particular, SAP SE or its affiliated companies have no obligation to pursue any course of business outlined in this document or any related presentation, or to develop or release any functionality mentioned therein. This document, or any related presentation, and SAP SE's or its affiliated companies' strategy and possible future developments, products, and/or platforms, directions, and functionality are all subject to change and may be changed by SAP SE or its affiliated companies at any time for any reason without notice. The information in this document is not a commitment, promise, or legal obligation to deliver any material, code, or functionality. All forward-looking statements are subject to various risks and uncertainties that could cause actual results to differ materially from expectations. Readers are cautioned not to place undue reliance on these forward-looking statements, and they should not be relied upon in making purchasing decisions.

SAP and other SAP products and services mentioned herein as well as their respective logos are trademarks or registered trademarks of SAP SE (or an SAP affiliate company) in Germany and other countries. All other product and service names mentioned are the trademarks of their respective companies.

See [www.sap.com/copyright](http://www.sap.com/copyright) for additional trademark information and notices.