Questions: Law of total probability and Bayes’ theorem

Sophie Chowgule

Summary

A selection of questions to test your understanding of the law of total probability and Bayes’ theorem.

*Before attempting these questions it is highly recommended that you read* [*Guide: Law of total probability and Bayes’ theorem.*](../studyguides/bayestheorem.qmd)

## Q1

Use the law of total probability to answer the following.

#### 1.1.

In a hospital:

* of patients are treated in Ward A,
* in Ward B,
* the probability of recovery within 3 days is in Ward A,
* the probability of recovery within 3 days is in Ward B.

Let be the event that a patient recovers in 3 days. What is ?

#### 1.2.

A school has three types of lunches:

* of students choose vegetarian
* choose chicken
* choose fish

The probability that a student finishes their lunch is:

* for vegetarian
* for chicken
* for fish

What is the probability that a randomly chosen student finishes their lunch?

#### 1.3.

The magnificent Mersenne Macarons are manufactured in three Cantor’s Confectionery factories:

* from Factory 1 (with a defect rate )
* from Factory 2 (with a defect rate )
* from Factory 3 (with a defect rate )

What is the probability that a randomly chosen Mersenne Macaron is defective?

#### 1.4.

A student can study in three locations:

* At home ( of the time)
* In the library ()
* In a café ()

The probability they complete their homework is:

* at home
* in the library
* in the café

What is the probability that a randomly selected student completes their homework?

## Q2

Use Bayes’ theorem to answer the following.

#### 2.1.

Statistics for a test for a disease is:

* accurate for infected individuals (true positive)
* accurate for uninfected individuals (true negative)
* of the population has the disease

Let be the event that a person has the disease and the event they test positive. What is ?

#### 2.2.

In St Andrews, Scotland:

* of days are dry
* are rainy

A forecast predicts rain:

* of the time on rainy days
* of the time on dry days

If the forecast predicts rain in St Andrews, what is the probability that it will actually rain?

#### 2.3.

In a Cantor’s Confectionery factory:

* of Bayes Biscuits are made by Machine A
* by Machine B

The probability of a broken Bayes Biscuit is:

* from Machine A
* from Machine B

If a biscuit is broken, what is the probability it came from Machine B?

#### 2.4.

A brand new bag of Gauss Gummies contains:

* red sweets
* blue sweets

A red sweet has a chance of having a wrapper and a blue sweet has a chance of having a wrapper. If a sweet is picked at random and has a wrapper, what is the probability it is red?

[After attempting the questions above, please click this link to find the answers.](../answers/as-bayestheorem.qmd)

## Version history and licensing

v1.0: initial version created 05/25 by Sophie Chowgule as part of a University of St Andrews VIP project.

[This work is licensed under CC BY-NC-SA 4.0.](https://creativecommons.org/licenses/by-nc-sa/4.0/?ref=chooser-v1)