

Tutorial 2

Qn 1

Assume 45% of CityU undergraduates are male and 30% of CityU undergraduates are in the College of Engineering (CENG). Assume 70% of undergraduate students in CENG are male. If a student is selected at random, find the conditional probability that

- a) a CityU undergraduate student is male, given that the student is a CENG student.
- b) the student is in CENG, given that the student is male.

Qn 2

The Monte Hall Problem: <https://www.youtube.com/watch?v=mhlc7peGlGg>. Stop when the host gives you 10 seconds. Think about it carefully before continuing.

Find your own way to interpret the counter-intuitive result of the Monte Hall problem.

You are encouraged to use the concepts you have learnt in the lecture Probability to help you to answer this question.

Qn 3

Discuss some counter-intuitive probability results in Section 2.6: Challenging the Intuition of J. P. Marques De Sá, *The Life of Games & The Game of Life*, Springer 2006. The e-book is available in the library.

Qn 4

In the example concerning laboratory blood test in the lecture notes, if the disease is very rare and 1 in 1 million chance of the population has the disease, what is the probability that a person has the disease given that the test result is positive?

What can you learn from this exercise?

Note: Look up https://en.wikipedia.org/wiki/Rare_disease for the definition of rare disease.

Qn 5

Colorectum cancer is the most common cancer in Hong Kong according to the figures of the CancerFund ([Home -> All About Cancer -> Latest Cancer Statistics](#)).

To reduce the onset of Colorectum cancer, the Hong Kong Government is conducting the Colorectum cancer screening programme (https://www.colonscreen.gov.hk/en/public/programme/background_of_programme.html).

A patient comes to see a doctor and describes his symptoms. Based on the doctor's experience, he is 60% certain that the patient may have Colorectum cancer. He asks the patient to conduct a test, which will give a cancer index number. A number that exceeds the threshold indicates cancer and vice versa.

Suppose that the test has a false positive rate of 10% and a false negative rate of 1%. What is the conditional probability that the patient has the cancer given that

- a) the test indicates that he has the cancer?
- b) the test indicates that he does not have the cancer?
- c) Do you think the test is useful? Comment.

Qn 6

At a certain stage of criminal investigation, the inspector in charge is 60% convinced of the guilt of a certain suspect. Suppose now that a new piece of evidence that shows the criminal has a certain characteristic is uncovered. If 20% of the population possesses this characteristic, how certain of the guilt of the suspect should the inspector now be if it turns out that the suspect is among this group?

Qn 7

Let us now suppose that the new evidence is subject to different possible interpretations, and in fact only shows that it is 90% likely that the criminal possesses this certain characteristic. In this case, how likely would it be that the suspect is guilty (assuming, as before, that he has this characteristic)?