

## GER1000 QUANTITATIVE REASONING

### TUTORIAL 4

*Please work on the problems before coming to class. In class, you will engage in group work.*

#### Question 1

Suppose a country has 2.9 million adults, comprising of young adults (age 21 to 65) and old adults (more than 65 years old). The table classifies both groups by whether a person is an alcoholic. For example, there are 600,000 young adults who are alcoholic.

|              | Alcoholic (thousand) | Non-alcoholic (thousand) |
|--------------|----------------------|--------------------------|
| Young adults | 600                  | 1800                     |
| Old adults   | 50                   | 450                      |

- (a) An investigator writes: “The odds for alcoholism among young adults is estimated as 3 times the odds for alcoholism among old adults.” Explain how the number is obtained. Comment on the word “estimated” in the sentence.
- (b) Investigators of a study randomly choose 10% of the alcoholics, and 20% of the non-alcoholics, from the country. The chosen individuals are classified as young or old adults through interviews. Is the risk ratio for alcoholism between young adults and old adults in the sample smaller than, or larger than, the population risk ratio? Support your answer with some calculations.

#### Question 2

A game about the impact of climate change on human life uses ten independent rolls of a fair die to simulate the weather for ten years. If the die shows one spot or six spots, then there is a crisis.

- a) Calculate the probability that there is no crisis in a ten-year period, to 2 significant digits.
- b) The quality of life increases by 10 points if there is no crisis in a ten-year period, and decreases by 2 points otherwise. Calculate the average amount by which the quality of life increases after ten years. Interpret this number in terms of a large number of worlds independently controlled by this game.

### Question 3

A taxi was involved in a hit-and-run accident at night. Two taxi companies, Green and Blue, operate in the city. An eye-witness reported the taxi involved as Blue. You are given the following data:

- There are a total of 10,000 taxis in the city. 85% of them are Green, 15% are Blue.
- When presented with a Blue taxi at night, the eye-witness reports it as Blue 8 out of 10 times; when presented with a Green taxi at night, the eye-witness reports it as Blue 3 out of 10 times.

What is the likelihood that the taxi involved in the hit-and-run is Blue, given the eye-witness' report? Does it seem too low? How does it compare with (i) the overall percentage of Blue taxis in the city, (ii) the likelihood of the eye-witness reporting Blue, when presented with a Blue taxi at night?

### Question 4

On Alan's first visit to Macau, he decided to try his luck in at the Venetian Casino Resort. He played a game that is supposed to offer a 40% chance of winning. Out of five independent plays, he won the first 4 games and lost the last game. His friend Brad suspects that the game is rigged in Alan's favour and decides to carry out a hypothesis test.

- (a) State Brad's null and alternative hypotheses.
- (b) If the null hypothesis is true, what is the chance of winning 4 games in a row and losing the next one?
- (c) Calculate the P value based on Alan's data, to one significant figure.
- (d) What can Brad conclude, based on 5% level of statistical significance?