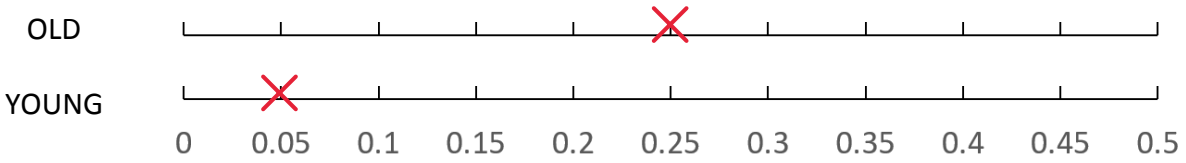
GER1000 QUANTITATIVE REASONING
TUTORIAL 1

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

1. Let us designate Covid-19 patients aged over 70 years as "old", and other Covid-19 patients as "young". Let "D" stand for death from Covid-19.

(a) In Country X, rate(D | old) = 0.25 and rate(D | young) = 0.05. Mark with "X", the first rate on the top scale, and the second rate on the bottom scale.

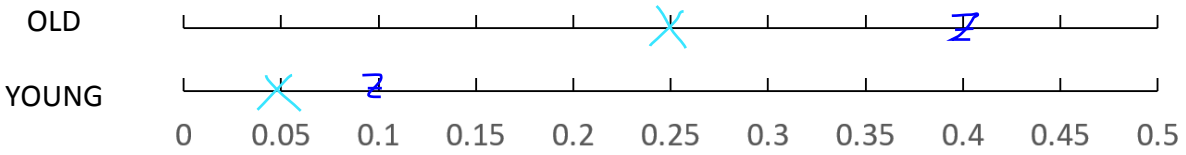


(i) The overall rate of old patients, rate(old), can be any number strictly between 0 and 1. Indicate the range where rate(D), the overall death rate for X, must be located, and state a reason.
(ii) Suppose that in X, most Covid-19 patients are over 70 years old. Can you be more specific about where rate(D) must be?

↪rate(D | everyone)

(b) In Country Y, rate(D | old) = 0.50, rate(D | young) = 0.35. Mark with "Y", these rates on the scales above, as before. Like X, rate(old) in Y is also a number strictly between 0 and 1. Explain why it is not possible for rate(D) to be lower in Y than X.

(c) In Country Z, rate(D | old) = 0.40, rate(D | young) = 0.10. Mark with "Z", these rates on the scales below, as before. Also mark with "X", the rates for X on the same scales.



Is it possible for rate(D) to be lower in Z than X? If yes, say something about whether rate(old) should be large or small in the two countries.

Challenge question (not discussed in tutorial). Can you propose values of rate(old) for the two countries so that rate(D) is lower in Z than X? The formula is

$$\text{rate(D)} = \text{rate(D | old)}\ \text{rate(old)} + \text{rate(D | young)}\ \text{rate(young)}$$

(i) This problem is inspired by a report that overall Covid-19 death rate is lower in Z than X, but in various age-groups, death rate is higher in Z than X, paradoxically.
(ii) For any population with two characteristics A and B, provided both rate(A) and rate(B) are strictly between 0 and 1, rate(B) = rate(B | A) rate(A) + rate(B | not A) rate(not A).

2. Imagine that you are an intern at a large tuition centre catered to students of age 11 and 12 years. Your employer wants to know if it is worthwhile to invest in iPads to improve students' proficiency in English. He gives you authority and resources, and asks you to design an experiment on the thousands of customers.

(a) How would you enrol subjects and assign them into two groups?

(b) How feasible is it to use a placebo, or to implement double-blinding?

Challenge questions (not discussed in tutorial)

(i) Will you measure English proficiency twice (before and after the intervention), or will it be sufficient to just measure once (after the intervention)?

(ii) How easy is it to generalize your experimental findings to the population of all children of age 11 or 12 years old in Singapore?