

GER1000 Practice questions – part 1.

1. Which of the following statements is correct:
 - a. An observational study does not have a control group.
 - b. A case-control study cannot be a controlled experiment.
 - c. We cannot have randomness in observational studies.
2. A study on a new invented drug is being tested on rabbits. The rabbits being assigned to the treatment group will receive the drug while those in the control group will not. Due to limited supply, the researchers can only have 2 rabbits per day. Thus they decided to send the rabbits coming on odd days to treatment group and those coming on even days to control group.
 - a. This is a cohort study.
 - b. This is a case-control study.
 - c. This is a randomized controlled experiment.
 - d. This is a non-randomized controlled experiment
3. A study on “Do healthy sleep habits lead to greater happiness?” is conducted in two countries, UK and US. The researcher used a survey to collect information from participants. The survey asked the participants to rate their sleep habits using very unhealthy, unhealthy, healthy, and very healthy. However, the researcher decided to merge the four categories into two. Very unhealthy and unhealthy were then considered as unhealthy. Very healthy and healthy were then considered as healthy. The data shows that people with better sleep habits are more likely to be happy. Which of the following statements is correct?
 - a. There is likely to be an ecological fallacy in the study, since it was done on two separate populations.
 - b. We have a chance to observe a Simpson’s paradox, when comparing the original data which has four categories of sleep habits with the merged data which has only two categories of sleep habits.
 - c. If the study was done on a voluntary sample, we cannot conclude that there is a possible association between healthiness of sleep habits and happiness.
 - d. None of the above
4. A box contains 3 marbles: Red, Blue and Green. Randomly pick one marble from the box, and then, without replacement, pick another one from the box. List out all possible outcomes. And calculate the probability of the event that, the second marble picked out is a red one.
5. Given that the probability of raining tomorrow is 0.5, and the probability of raining the day after tomorrow is 0.8. Using the information given, can we determine the probabilities of the following events?
Raining tomorrow and the day after tomorrow.
Raining tomorrow or the day after tomorrow.
6. Given that the probability that Tom will eat dinner today is 0.5, and the probability that Tom will eat supper is 0.6. Moreover, the probability that Tom will eat both dinner and supper is 0.3. Are the two events independent?
Tom will eat dinner
Tom will eat supper

7. Given that the probability that Jerry will eat dinner but not supper today is 0.5, and the probability that Jerry will eat supper but not dinner is 0.6. Moreover, the probability that Jerry will eat both dinner and supper is 0.3. Are the two events independent?
Jerry will eat dinner but not supper
Jerry will eat supper but not dinner
8. Two fair dice are rolled. Let X be the outcome of the first dice and Y be the second. Compute the expected value of $X*Y$.
9. A drug is invented for some disease, which has a fatal rate of 0.6. Conduct hypothesis test, using a critical value of 0.05, to test whether the drug is effective given the following situations:
 - a. 4 out of 5 patients survived
 - b. 3 out of 5 patients survived
10. Two fair dice are rolled. What is the conditional probability that one dice lands on 6, given that the dice land on different numbers?
11. Consider the following adjacency matrix. What is the distance between vertices a and b.

	a	b	c	d
a	0	1	0	1
b	1	0	1	1
c	0	1	0	1
d	1	1	1	0

ANS:

1. B
2. D
3. D
4. $\{R,B\};\{B,G\};\{R,G\};\{B,R\};\{G,B\};\{G,R\}$ $P(R \text{ in the second draw}) = 1/3$
5. We cannot, unless independence and mutual exclusivity are known. However, the weather of consecutive days are likely to be dependent. And apparently, "It will be raining tmw" and "it will be raining the day after tmw" are not mutually exclusive.
6. Yes. Though eating dinner may affect Tom's desire for a supper, the probabilities given satisfies the definition of independence.
7. No, these two events are mutually exclusive, thus they cannot be independent.
8. 12.25
9. Hypothesis: The drug is not effective.
 Case (a): $P(4 \text{ patients survived}) = (0.4)^4 (0.6) = 0.0768$
 $P(5 \text{ patients survived}) = (0.4)^5 = 0.01024$
 Thus, P-value = 0.08704
 Case (b): $P(3 \text{ patients survived}) = (0.4)^3 (0.6)^2 = 0.2304$

If you don't know combinatorics, you can ignore part (b). The combinatorics formulas will not be tested, thus such cases will not appear in the exam.

Thus P-value = 0.31744

In either case, we cannot reject the hypothesis, thus the drug might be ineffective.

10. $1/3$

11. The distance is 1 because the two vertices are adjacent.