

**Your answers go on Canvas Test\_4\_2023.**

**One answer and only one answer per question.** Leaving a question blank or filling in 2+ answers will be incorrect no matter what. (Canvas should not allow you to choose more than 1.)

**A = True, B = False** unless indicated otherwise. If any part of an answer is incorrect, treat all of it as incorrect. If different parts of an option are inconsistent with each other, consider it incorrect.

**Evaluation basics**

**1 (1.5 pt)** A new study, just published, is the first to report an association between herbicide use in a community and miscarriage rate in that community. The study evaluated 213 rural communities in the US West, and the association between herbicide use and miscarriage rate is so statistically significant that it would be expected by chance only 1 in 10,000 times. Surprisingly, this new study is in fact the first to investigate the possibility of an association between the two. Which one of the following possible consequences of this study do we expect? One answer only.

- (A) The FDA (or some other government agency) will impose an immediate ban on use of the herbicide.
- (B) Further studies will be undertaken to see if the results are repeatable before any action is taken to halt sales of the herbicide.

**2-5 (4 pts)** What is the meaning when a study reports a 'significant' result at  $P = 0.045$ ? **(A) = true (B) = false**

- 2 (A)(B) The observed data are expected only 4.5% of the time if the null model/hypothesis is true.
- 3 (A)(B) The data are expected 95.5% of the time if the null model/hypothesis is true.
- 4 (A)(B) There is only a 4.5% chance that similar results would be found if the study was repeated.
- 5 (A)(B) The study results should be ignored because there is only a 4.5% chance of them being true – they need to exceed a 5% threshold to be considered true.

**Weak versus strong statements**

**6-10 (5 pts)** Which statements are weak -- can legitimately be made in the absence of evidence?

- 6. (A)(B) There are no wolverines in Idaho **(A) = can be made in absence of evidence (B) = cannot**
- 7. (A)(B) We do not know if wolverines are currently residing in Idaho
- 8. (A)(B) The exposure of a factory worker to radiation at a nuclear power plant resulted from a breach in protocol.
- 9. (A)(B) There is no evidence that compound X is harmful.
- 10. (A)(B) There is nothing to suggest that compound X is NOT harmful.

**11-13 (3 pts)** Three years ago, the World Health Organization (WHO) revised its advice about ibuprofen and covid-19 infections to: "We do not currently believe there is any proven scientific evidence linking over-the-counter use of ibuprofen to the aggravation of COVID-19." What does this statement mean – how should it be interpreted?

(A) = True – is a valid interpretation of the statement (B) = False

- 11. (A)(B) Ibuprofen is known to be safe for treating COVID-19
- 12. (A)(B) Ibuprofen is known to be harmful for treating COVID-19
- 13. (A)(B) Ibuprofen has not been established as being harmful in treating covid.

**Correlations, Causation & 3rd variables**

**14-19** Recall the hypothetical table in which each cell gives the accident rate per 1000 cars of that type and color per year. Also remember that this table does not give the number of vehicles that occur in each cell. There are 3 different tables, and you are asked to indicate which tables (could) have a specific property. Ignore the possibility of other variables (besides color and type of car) affecting accident rates – assume the tables give you all relevant variables.

|           |         |             |      |
|-----------|---------|-------------|------|
| Table     |         | W           |      |
|           |         | Type of car |      |
|           |         | risky       | safe |
| Car color | red     | 17          | 5    |
|           | not red | 12          | 4    |

|             |      |
|-------------|------|
| X           |      |
| Type of car |      |
| risky       | safe |
| 4           | 1    |
| 3           | 2    |

|             |      |
|-------------|------|
| Y           |      |
| Type of car |      |
| risky       | safe |
| 8           | 6    |
| 5           | 1    |

**14-16. (6 pts)** Which tables indicate that:

- (A) red always has the higher accident rate for each type
- (B) red never has the higher accident rate for each type
- (C) red has the higher accident rate for one type of car but not the other

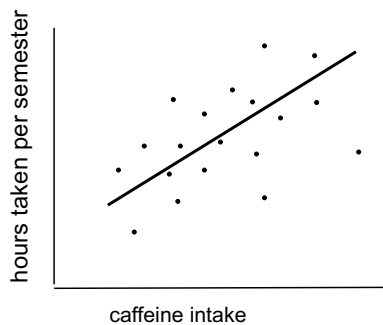
14. (A)(B)(C) Table W    15. (A)(B)(C) Table X    16. (A)(B)(C) Table Y

**17-19 (3 pts)** For which tables could the overall correlation between accident rate and color go in the opposite direction from the effect of red (Simpson’s paradox)? There must be a consistent effect of red across both types of car for this to possibly apply.

- (A) Could go in opposite direction
- (B) could not go in opposite direction
- (C) The effect of red is not consistent

17. (A)(B)(C) Table W    18. (A)(B)(C) Table X    19. (A)(B)(C) Table Y

**20-23 (4 pts)** Consider the following graph of data, showing that students who consume more caffeine are the students who take a higher course load (hours) per semester; each point is for a different student. Which of the following models can be rejected? To reject a model, the model cannot possibly yield data like the pattern in the graph.



- (A) Can be rejected    (B) Cannot be rejected
- 20. (A)(B) Hours taken is negatively correlated with caffeine intake
- 21. (A)(B) Hours taken is positively correlated with caffeine intake
- 22. (A)(B) Caffeine consumption causes students to take more hours
- 23. (A)(B) Caffeine consumption causes students to take fewer hours

**24-27 (6 pts)** People with higher levels of tooth decay are also those with higher alcohol consumption. Which of the following models use(s) a 3rd variable to explain the cause of this correlation? You may use the method given in class to decide if a third variable is invoked.

**A = 3<sup>rd</sup> variable is used, B = no 3<sup>rd</sup> variable**

| Choose (A) if third variable is used | Causal model  |
|--------------------------------------|---|
| <b>24.</b> (A)(B)                    | People who drink more alcohol are also those who brush their teeth less. Brushing teeth is what reduces tooth decay.                      |
| <b>25.</b> (A)(B)                    | Alcohol kills bacteria that protect the teeth from decay. Avoiding alcohol thus keeps those bacteria alive and protects teeth from decay. |
| <b>26.</b> (A)(B)                    | People who drink more alcohol are also those who often smoke tobacco. Smoking tobacco causes the decay.                                   |
| <b>27.</b> (A)(B)                    | Alcohol consumption increases with age. Regardless of alcohol consumption, older teeth have more decay than young teeth.                  |

**28-34. (10.5 pts)** Which of the following options is indicated? Base your answer only on the information provided.

- (A) no correlation or causation is described.
- (B) correlation only – the statement merely describes one or more non-zero correlations, with no causation.
- (C) causation only – the statement describes one or more causal models with no correlation described.
- (D) correlation and causation are both described. Also choose this if a correlation inspires people to change their behavior

- 28.** (A)(B)(C)(D) Studying improves a student's exam scores. Yet students who study more have lower exam scores than students who study less.
- 29.** (A)(B)(C)(D) A study reveals that athletic teams wearing red uniforms have higher winning rates than teams wearing other colors. To offset a losing streak, the Guthrie Panthers change their uniform from green to red.
- 30.** (A)(B)(C)(D) A specific brand of fertilizer is applied to crops grown in regions that normally produce large plants even without fertilizer. The company advertises the large plants grown with their fertilizer without informing their audience that large plants would result even without the fertilizer. People who see the ad think the fertilizer is the reason for the large plants and buy the fertilizer to get large plants in their own gardens.
- 31.** (A)(B)(C)(D) Eating a high-carbohydrate diet causes higher levels of heart disease. Frequent exercise reduces heart disease.
- 32.** (A)(B)(C)(D) In the past 3 decades, STD rates have usually declined after taxes on beer were raised.
- 33.** (A)(B)(C)(D) 98% of convicted felons eat bread
- 34.** (A)(B)(C)(D) People who eat lots of sugar have high levels of tooth decay. People who avoid dental checkups have high levels of tooth decay. People who eat sugar and avoid dental checkups have the highest levels of tooth decay.

**35-36 (2 pts).** How or why can Simpson's paradox exist? Choose any explanation that is correct, even if it does not give a full explanation of Simpson's paradox. **(A) = a valid explanation**

- 35. (A)(B)** Since correlation does not imply causation, a correlation is compatible with potentially any causation, regardless of direction.
- 36. (A)(B)** When there is a causal relationship between two variables (X and Y), a third variable can potentially overwhelm any pattern that results from X and Y.

**37-39 (4 pts).** In 2013, the following email was sent out to all UI advisors. (The full email is not included.) In the following questions, indicate whether the advice to advisors is valid. For an answer to be correct, any reasoning provided must also be legitimate.

Dear advisors:

**All Students Should Enroll in at Least 15 credits every semester**

According to the Complete College America initiative (and the Complete College Idaho plan), students who attempt at least fifteen credits per term are significantly more likely to graduate from a university. They are also more likely to persist from the first to the second year and feel more connected to their institution. Over the last six years, less than 50% of UI students have been enrolled in 15 or more credits and we would like to address this issue immediately.

Please work with your incoming and current students to identify the best fifteen (or more) credits to fit their needs and developmental level. There are certainly cases where a student cannot undertake this course load (e.g. working full time, overextended in other areas, etc.) but we believe the typical UI student is fully capable of completing a 15 credit semester.

Which of the following are true? A = True

37. **(A)(B)** The advice (gray highlight) is valid because taking at least 15 hours will increase the likelihood of graduation for all students.
38. **(A)(B)** The advice is valid because the first paragraph describes a causal relationship between graduation and hours taken.
39. **(A)(B)** Even though we cannot be sure that the association between hours/semester and graduation is causal, we can be confident that taking 15 hours/semester will increase anyone's graduation rate.

**40. (2 pts)** Consider the correlation between car accident rate and car color: 'red cars have higher accident rates.' For the model

'safe drivers prefer colors other than red,'

what is the causal variable?

- (A) color    (B) type of car    (C) type of driver    (D) car age    (E) None of these