

You must turn in both this hard copy and your scantron (both with your name) to receive credit for this exam. **One answer and only one answer per question.** Leaving a question blank or filling in 2+ answers will be incorrect no matter what.

Intrinsic Difficulties (IDs)

1-8 (2.5 pts each). These questions ask for the intrinsic difficulty illustrated by the given statement. Do not assume any more than what is explicitly given in the question – address only the difficulty or case specifically described. Also, a paragraph may describe NO intrinsic difficulty (option F). Note that the terms used in options (A)-(E) below may not be the full description given in class, but the terms are sufficient for you to identify them.

(A)	(B)	(C)	(D)	(E)	(F)
Intrinsically limited replication	Small effects	Time lags	Interactions	Humans are difficult subjects	None

1. The board of a private company knows that their new product, something used in furniture, increases liver cancer rates by 1% in people who keep the furniture in their homes for 20 years. But the same board realizes that although the 1% would be statistically detectable among the many of people who buy the furniture, there will be many other factors contributing to differences in liver cancer rates in the US population. Likely no one will attribute an increase to the furniture. What ID underlies the company's confidence in the liver cancer effect going undetected?

(A) (B) (C) (D) (E) (F)

2. The board of a private company knows that their new lucrative product, something used in furniture, increases liver cancer rates by 3% in people who use the furniture. But the same board realizes that the cancers won't start occurring until 20 years after exposure to the furniture. In any case, the product is so lucrative that the company will likely be sold in under 20 years, so any lawsuits will affect only future owners. The board chooses to use the product despite realizing its harmful effects will be uncovered. What ID underlies the company's confidence in the liver cancer effect going undetected before they cash out?

(A) (B) (C) (D) (E) (F)

3. A casino advertises a 1 in a million chance of winning \$1M for each pull of a slot machine. They expect to retire the machine after 10 million pulls. They arrange the odds to truly be 1 in 1.3 million, realizing that they should save 2-3 million dollars on payouts and that no one will be able to statistically show they did not have 1/million odds. What ID underlies the casino's assurance that their strategy will not be detected?

(A) (B) (C) (D) (E) (F)

4. Psychologists often use undergrads for experimental research on human behavior. It's not that undergrads are more representative than other possible subjects. Rather, undergraduates are more convenient: they can be used for research during courses and don't have to be paid. Otherwise, psychological research requires identifying people willing to participate, paying the volunteers, educating the volunteers about how to respond to questionnaires, and motivating the volunteers to respond in a timely fashion. Which ID underlies the reason that undergrads are so commonly used in human behavior studies?

(A) (B) (C) (D) (E) (F)

5. Identifying common sources of some infections is challenging because victims are often scattered across the country. For example, a lettuce processing plant may contaminate food and distribute it to 30 different states, but single victims in each of those states will not be recognized as related. Which ID underlies this difficulty in identifying common sources of infection?

(A) (B) (C) (D) (E) (F)

6. An 'emergent property' occurs when several ingredients together have a property that none of the individual members have. Flavor in foods is a familiar example – a mix of spices may taste different than any of the individual spices. Consequently, emergent properties are difficult to predict. Which ID accounts for the difficulty of predicting emergent properties?

(A) (B) (C) (D) (E) (F)

7. Compounds that might cause cancer/tumors in humans are screened in mice, since regulators consider any tumor-causing compound in mice a cancerous agent in humans. However, to assess tumorigenicity, the mice are given unrealistically high doses of substances. Such high doses do not represent human exposures and may themselves cause tumors in mice even though lower doses would not. The screening of low doses in mice is not practical because of financial reasons, that a hundred-fold more mice would need to be used to measure tumorigenicity levels adequately. Thus, the method used for assessing tumors in mice has a flaw, but the method continues to be used. What ID underlies the difficulty in using a more accurate method of measuring tumorigenicity in mice?

(A) (B) (C) (D) (E) (F)

(A)	(B)	(C)	(D)	(E)	(F)
Intrinsically limited replication	Small effects	Time lags	Interactions	Humans are difficult subjects	None

8. Progress in solving crimes (and finding the right perpetrator) has been immensely aided by DNA technology. Until we understood just how unique each person's DNA was and could manipulate that DNA, it was not possible to apply this technology. DNA technology has been aided by many advances, such as the ability to amplify DNA and to easily 'type' people at highly variable regions of their chromosomes. Some discoveries that led to these advances can be traced to the early 1900s. The long time it took to acquire the necessary knowledge and technology for DNA typing is an example of which intrinsic difficulty?

(A) (B) (C) (D) (E) (F)

Tragedy of the Commons

9-13 (15 pts) In each of the following problems, indicate whether the situation describes a tragedy of the commons (ToC) conflict/outcome -- it must satisfy the ToC criteria given in class to do so. Problem 13 asks you to design a business to minimize a ToC conflict and uses different choices.

for problems 9-12: **A = is a ToC conflict, B = is not**

9. (A)(B) All 30 professors at Vermont Law School are told that the school needs to make serious financial cuts to prevent bankruptcy. A 20% reduction of faculty salary across-the-board will enable the school to stay afloat. Instead, the school takes a voluntary approach and allows each professor to choose what level of salary reduction they will accept for themselves. If the combined reduction is 20% or more, regardless of how the reduction is distributed among the individual professors (whether every individual accepts a 20% cut to their salary), the School will stay afloat. The voluntary reduction plan leads to only a 13% reduction in total salary obligation.
10. (A)(B) Two brothers inherit land with a single oil reservoir under it. Each brother is free to sell drilling rights to his half of the land even though oil drawn from either lease comes from the shared reservoir; the royalties from the oil pumped on his lease go to just him. Out of worry that the other brother might get more than his share, both brothers secretly sign leases that pay them collectively much less than what the oil is worth.
11. (A)(B) Ten individuals collectively own a patch of forest that contains the last population of a plant with medicinal value. The owners calculate that it is financially beneficial to harvest all remaining individuals of the plant and invest the money, rather than to maintain the population. Their calculation is based on a conservative estimate of the future value of the plant, which proves to be wrong. In future years, they realize that they would have made more money if they had maintained the population.
12. (A)(B) A professor tries to encourage class cooperation with a policy where class grades are based 80% on their own performance and 20% on the class average. The professor expects that this will encourage good students to both learn the material on their own and help teach their peers, to raise the class average (since everyone benefits from a high class average). Midway through semester, the professor realizes that this class's performance is worse than when students simply get the grade they earn without respect to the class average.
13. (A)(B)(C) You run a house-cleaning service with 5 employees. Collectively, these employees will be cleaning 40 houses per week. You wish to structure your company to avoid a ToC in which your employees are not incentivized to work. Your concern is that some employees will let others do most of the work, and that everyone will soon quit working to capacity. For each house cleaned, the house owners give feedback on how good a job was done, and the amount the owner pays is scaled to the quality of the job – better service means more money for you and your employees. Which design – A, B, or C – will best avoid or minimize a ToC?
 - (A) All 5 employees work together on a house, then work together on the next house, and so on. You split the pay equally among the 5 employees.
 - (B) Each employee is assigned a different house. You pay each employee according to the owner payment on that house.
 - (C) Each employee is assigned a different house. You pool the money from all houses and pay 1/5 of the total to each employee.

Bias

14-17. 6 pts What is p-hacking and/or how is it manifested? p-hacking was referenced in a video, discussed in lecture, and was part of the bogus chocolate study of Quiz 11. **A = True B = false**

- 14 (A)(B) It refers to any use of statistics to analyze data
- 15 (A)(B) It leads to the false appearance of statistically significant results
- 16 (A)(B) It involves doing many statistical tests on results from a single study
- 17 (A)(B) p-hacking relies on the study being poorly designed such that the data have flaws

18-27 (16 pts). For each of the following statements, you are to classify the nature or type of a described bias. You have the following options (A-F). The last option (F) is used for cases that do not fit any of the other options. Note that your options depend on a familiarity with the tables in Chap 25. Some of the questions come directly from the tables.

- (A) Signatures of untrustworthiness or indicators of bias in articles and verbal arguments
- (B) Ways to bias independent of the actual study (outside the scientific conduct of a study)
- (C) Ways to bias science: in the design or during the data-gathering phase of a study
- (D) Ways to bias science: after the data are gathered, in evaluation, analysis and presentation
- (E) Ways to protect against or reduce bias
- (F) None – not tied to bias

- 18. (A)(B)(C)(D)(E)(F) A parent defends Facilitated Communication by recalling one or two instances when the child's typing appeared to make sense
- 19. (A)(B)(C)(D)(E)(F) A study on the health benefits of eating chocolate uses small sample sizes to increase the possibility of an apparently statistically significant finding.
- 20. (A)(B)(C)(D)(E)(F) A health researcher publishes the raw data.
- 21. (A)(B)(C)(D)(E)(F) A company Influences government regulatory agencies in their favor
- 22. (A)(B)(C)(D)(E)(F) A company controls the null model to help ensure an outcome favorable to its interests
- 23. (A)(B)(C)(D)(E)(F) In a story for public consumption, alternative interpretations of the results are avoided to lead readers to a specific conclusion
- 24. (A)(B)(C)(D)(E)(F) The model used for testing product safety is convenient rather than accurate because the accurate models are unethical
- 25. (A)(B)(C)(D)(E)(F) A researcher searches for a statistical test of the data to support the desired conclusion
- 26. (A)(B)(C)(D)(E)(F) A company conducting a study assays for a narrow spectrum of unlikely results to make a product seem harmless
- 27. (A)(B)(C)(D)(E)(F) A scientist throws out valid results because they are unwanted

28-34 (2 pts each). Arguments indicative of bias. In the following questions, identify the type of argument that indicates a person is biased. Use options (A)-(I). Only one answer per question, but an answer may be used once, never, or used on several questions. (I) is to be used when none of the other options applies.

(A) defend an unfalsifiable model	(D) build causation from correlation	(G) identify trivial flaws in an opponent's model
(B) refuse to admit error (that a model may be wrong)	(E) require refutation of all alternatives	(H) post hoc rationalization of unexpected outcomes
(C) appeal to authority	(F) use anecdotes or testimonials as evidence of generality	(I) None of A-H

- 28. Your friend continues to claim horoscopes are legitimate despite tests suggesting otherwise because, he says, none of those tests shows that horoscopes are completely useless.
(A) (B) (C) (D) (E) (F) (G) (H) (I)
- 29. A politician who is trying to oust an opponent from office claims that the economic downturn of the last 4 years is due to his opponent's bad performance.
(A) (B) (C) (D) (E) (F) (G) (H) (I)
- 30. A teacher who thinks himself popular receives negative student evaluations but then argues that those evaluations were negative because the course is challenging.
(A) (B) (C) (D) (E) (F) (G) (H) (I)

(A) defend an unfalsifiable model	(D) build causation from correlation	(G) identify trivial flaws in an opponent's model
(B) refuse to admit error (that a model may be wrong)	(E) require refutation of all alternatives	(H) post hoc rationalization of unexpected outcomes
(C) appeal to authority	(F) use anecdotes or testimonials as evidence of generality	(I) None of A-H

31. A researcher uses statistical p-hacking in their study to make it seem to have important results.

- (A) (B) (C) (D) (E) (F) (G) (H) (I)

32. A car salesman attempts to sell cars by having prospective customers watch videos of selected favorable comments from previous buyers.

- (A) (B) (C) (D) (E) (F) (G) (H) (I)

33. Defenders of Facilitated Communication argue after the fact that, since the testing environment was not the environment the child was accustomed to, the results are not useful.

- (A) (B) (C) (D) (E) (F) (G) (H) (I)

34. Douglas Biklen claims that it doesn't matter how often Facilitated Communication fails in tests, what matters is to keep looking for successes.

- (A) (B) (C) (D) (E) (F) (G) (H) (I)

Trustworthy sources

35-38. (7 pts) You read an article which makes some claims about a product. Which of the following would be suspicious features – lead you to question whether the claims are trustworthy? (If you are not sure, rely on the book's lists of ways to 'ensure legitimate science' and of 'trustworthiness' to choose the best answer.) **A = suspicious (not likely trustworthy)** **B = likely trustworthy (not suspicious)**

35 (A)(B) The same company selling the product also funds the journal publishing the positive results

36 (A)(B) The article was evaluated by unbiased third-party experts (peer review)

37 (A)(B) The research was supported by federal research funds.

38 (A)(B) The article contains testimonials from satisfied individuals instead of references to published studies

39-42. (7 pts) Consider the following description from a website discussing the benefits of tea tree oil.

A randomized, placebo-controlled, blinded study conducted in Australia tested the efficacy of tea tree oil in the treatment of athlete's foot compared to placebo. Patients in the treatment group received either 25 percent tea tree oil solution, 50 percent tea tree oil solution or a placebo. They were instructed to apply the solution twice daily to the affected areas for four weeks. Researchers reported a clinical response in 68 percent of the group treated with 25 percent tea tree oil, 72 percent of the group treated with 50 percent tea tree oil, and 39 percent in the placebo group. Of the 158 patients that participated in the study, four experienced moderate to severe skin reactions to the treatment that improved quickly after they stopped using the solution. (a Medline link is provided here to a 2002 publication)

The preceding paragraph exhibits which of the following indicators of trustworthiness?

A = is present B = absent

39. (A)(B) Claims not sensational

40. (A)(B) Original references included

41. (A)(B) Details of data from controlled studies are included

42. (A)(B) The findings are replicated by multiple studies

43-47. (8 pts) Which of the following correctly describes properties given in book or lecture as indicative of trustworthiness? All parts of the question must be true for you to mark 'A.' **A = true B = false**

- 43. (A)(B) The more sensational the claim, the more trustworthy it is, because sensational claims must survive greater scrutiny than modest claims.
- 44. (A)(B) The more that uncertainty is acknowledged, the less trustworthy the claim.
- 45. (A)(B) Reports giving lots of details about the data are less trustworthy than reports with few details, because the details are commonly used to distract attention from the actual result.
- 46. (A)(B) Reports from 3rd parties who have no specific interest in the work/claim are less trustworthy than reports from 'interested' parties because 3rd parties have no reason to get the facts right.
- 47. (A)(B) Work from reputable investigators and reputable institutions are more trustworthy than work from private and unknown researchers and institutions.

Videos

48- 52 (8pts). Three videos were shown (*John Oliver, The Corporation, Facilitated Communication* part 2). Answer the following questions about the content of those videos. Choices are

- | | |
|--|--|
| (A) Oliver only | (E) Both Oliver and FC but not Corporation |
| (B) Corporation only | (F) Both Corporation and FC but not Oliver |
| (C) FC only | (G) All 3 |
| (D) Both Oliver and Corporation but not FC | (H) None of the 3 |

- 48 (A)(B)(C)(D)(E)(F)(G)(H) Which video(s) were used by class to illustrate some aspect of bias (including media distortion of science)?
 - 49 (A)(B)(C)(D)(E)(F)(G)(H) Which video(s) mentioned statistical issues in data analysis?
 - 50 (A)(B)(C)(D)(E)(F)(G)(H) Which video(s) devoted a large part of its story (their stories) to the use of the media to as a vehicle to promote a company's interests?
 - 51 (A)(B)(C)(D)(E)(F)(G)(H) Which video(s) emphasized the media as uncritically accepting results of scientific studies?
 - 52 (A)(B)(C)(D)(E)(F)(G)(H) Which video(s) mentioned controlling the null model as a means of bias?
53. (3 pts) (B) Fill in **bubble B** on 53 to indicate your key. Likewise **make sure your name and EID are correctly bubbled in**, and your name is on the first page of this exam.