

You must turn in both this hard copy (with your name on it) and your scantron 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)

1-7 (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 (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 Two researchers set out to identify the effect of radiation on mutation across generations of animals. The first researcher studies flies, in which it is 2 weeks for an adult fly to produce the next generation of adults. The other works with mice, where it is 3 months for an adult to produce the next generation of adults. It takes 3 generations to show the effect of radiation. The researcher studying flies gets results and has their paper published inside of 2 months, whereas the other researcher takes a year. The first researcher gets all the credit for the discoveries. What ID accounts for the faster progress of the first researcher?

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

2. James's car develops a poor mileage problem during the winter. He suspects the cause is the new type of air filter he just bought, but he delays testing the problem, and by summer, the mileage is fine again without changing the air filter. So he decides the air filter is not the cause. Next winter, the problem occurs again. Yet when he changes the air filter back to the old type, the mileage improves immediately. What type of ID underlies discovering a pattern in which mileage is poor only in winter and then only with the new type of air filter?

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

3. A company's manufacturing facility releases a toxic chemical into a river system that is used as a water supply for 5 million people downstream. The chemical pollution has the effect of increasing leukemia (cancer) rates by 4% in people who drink the water. With baseline leukemia rates at 1/5,000 per year, the average number of leukemia cases per year in the affected population will increase from 1,000 to 1,040. This increase is high enough to be statistically detectable, but there are so many other pollutants entering the river – agricultural chemicals, waste from upstream towns, etc., that it is not possible to attribute the increase to the toxic chemical. What ID underlies this inability to attribute the increase to the actual cause?

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

4. Biological determinism is a concept that human behaviors have a genetic or otherwise intrinsic basis. The alternative is that the behaviors are learned. Many human behaviors have been studied from this perspective (sexuality, intelligence, gender roles, leadership ability, criminality). For the most part, it has been difficult to resolve the question of biological determinism because the data are correlational – we are unwilling to do the experiments necessary to resolve the genetic bases of human behavior. Which ID underlies this difficulty?

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

5. A company tests a new health product on 2,000 human subjects and discovers no ill effects. The product is marketed. However, when the product is used by 10 million consumers, a major health effect is found at a rate of 1/3,500 users. Which ID underlies the lack of detecting the effect in the initial human trial?

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

6. A company tests a new health product on 2,000 human subjects and discovers no ill effects. The design for the trial failed to randomize subjects between control and treatment groups, and as a consequence, the results from the trial suggest a benefit when the product in fact has no benefit. Which ID underlies the design flaw of this human trial?

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

7. Hantavirus is a virus of deer mice. It rarely infects people, but human cases have about a 50% death rate. The basis of human infections was discovered in the 1990s after an cluster of several cases in the 4-corners area of the US. The outbreak allowed researchers to realize there was a common cause, and they narrowed it down to a virus. Once the virus was discovered, a search through records of previous decades revealed several isolated deaths from the virus, but no one had ever suspected a common cause for those. What ID underlies the failure to identify hantavirus infections prior to the 4-corners outbreak?

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

Confirmation Bias

8-12. (10 pts) Confirmation bias can take which forms? **A=true, B = false**

- 8. **(A)(B)** Choosing or viewing information that supports what you already believe, while ignoring contrary information.
- 9. **(A)(B)** Unconsciously choosing items non-randomly
- 10. **(A)(B)** Deliberately distorting science to favor your financial gain.
- 11. **(A)(B)** Avoiding the attempt to reject/disprove models that you already believe
- 12. **(A)(B)** Setting higher standards for accepting evidence contrary to what you believe than is set for accepting what you already believe.

13-15 (6 pts) Which are consequences and properties of confirmation bias? **(A) True (B) false**

- 13. **(A)(B)** Confirmation bias is hard to demonstrate because it is not easy to design experiments to reveal it
- 14. **(A)(B)** Case-building is a form of confirmation bias
- 15. **(A)(B)** As more studies accumulate, confirmation bias leads to divergence rather than convergence among people who start with different views.

Conflict and Deliberate Bias

16-19 (10 pts) Which of the following paragraphs describe a tragedy of the commons (ToC) conflict or outcome?

A = is a ToC conflict, B = is not

- 16. **(A)(B)** Birds sometimes flock to collectively catch insects that they eat. As more birds flock together, the insects have a harder time escaping and are thus easier for the birds to catch. Furthermore, the benefit works so that, not only does a large flock catch more insects than a small flock, but individual birds catch more food in larger flocks than in smaller flocks. Indicate whether this property of flocking qualifies as a ToC.
- 17. **(A)(B)** Six men rob an armored car and escape with the money. Later, all six are apprehended, but the evidence to convict them is only marginally strong. If none of the 6 talk, each is likely to get a light sentence. However, the prosecution offers a benefit to any of the 6 who give evidence on the others, provided that their evidence proves critical to the case. Given this incentive, all 6 provide evidence against the others, and because all of them are providing the same evidence on each other, the evidence from any one man is no longer critical to the case. As a result, they are all given heavy prison sentences.
- 18. **(A)(B)** Hantavirus is a virus that people can get from deer mice, and if a person gets the infection, there is a high death rate. However, people who are infected virtually never infect other people – infection is almost always from deer mouse to humans. A vaccine against hantavirus is developed, but few people choose to get the vaccine. As a consequence, most people remain unprotected against getting hantavirus, and the vaccine does not greatly reduce the number of human infections. Indicate whether this lack of vaccination against hantavirus qualifies as a ToC.
- 19. **(A)(B)** Coffee clubs are common in offices with multiple workers. The usual protocol is that all employees pay in equally to purchase coffee and other supplies. All employees are also supposed to limit their consumption to 2 cups per day. However, there is no way to police the amount employees drink, and some invariably drink far more than 2 cups a day, while others get no more than one cup a day. Eventually the disgruntled participants pull out of the club, and the club collapses.

20-26 (2.5 pts each). Arguments indicative of bias. Identify the bias in the following questions using options (A)-(I). Only one answer per question, but an answer may be used once, never, or used on several questions. (I) is none of the others.

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

20. In his term paper, a student argues that the model he defends must be right because no data can possibly refute it.

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

21. A lawsuit against the University of California at Berkeley argues that the university actively discriminates against women applicants in all of its programs because the acceptance rate across the university is higher for men than for women.

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

22. The use of testimonials is a form of this.

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

23. A company gets its employees into positions on regulatory boards to obtain favorable regulation of its practices.

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

24. In an attempt to obtain bogus results in a study of dietary chocolate and weight loss, the study is intentionally designed to have small samples to increase the likelihood of 'significant' outcomes.

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

25. A company defends its health product against negative evidence obtained by independent researchers, arguing that those researchers have failed to show there is absolutely no benefit of the health product.

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

26. In a proficiency test that everyone agreed to in advance, an expert who fails the test then argues that the test wasn't set up right.

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

27-32. (2.5 pts each) Identify the appropriate type (or stage) of bias in the following questions. If the question gives an argument indicating bias, choose (D), if a way to reduce or avoid bias, choose (E). If none of (A)-(E), choose 'None' (option F).

(A) Bias independent of the study itself	(B) Bias in the design and/or conduct	(C) Bias in evaluation and description of results	(D) Arguments indicative of bias, instead of ways to bias	(E) Ways to avoid or anticipate deliberate bias	(F) None
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27. (A)(B)(C)(D)(E)(F) A drug company uses a flavored placebo to intentionally allow patients to figure out whether they are in the control or treatment group.
28. (A)(B)(C)(D)(E)(F) A drug company randomly assigns patients to the control versus treatment group.
29. (A)(B)(C)(D)(E)(F) A company selling dietary supplements influences regulatory boards to choose a null model for product approval that is favorable to their interests.
30. (A)(B)(C)(D)(E)(F) Specifying evaluation criteria in advance of the study.
31. (A)(B)(C)(D)(E)(F) The parents who cited one or two stories that FC worked for their child were illustrations of this option.
32. (A)(B)(C)(D)(E)(F) A bogus study on the health benefits of eating chocolate applies inappropriate statistics to obtain the appearance of a statistically significant conclusion.

Trustworthy sources

33-36. (6 pts) The following text is lifted from a website that advertises a product called *Sensa Clinical*.

Sensa was one of the most popular, beloved weight-loss formulas of all time. People loved it because it was so easy to use, and it took the guesswork (and the heartache) out of dieting. You didn't have to count calories. You didn't have to pay for expensive, prepackaged meals. You didn't have to swallow pills. you just sprinkled it on your favorite foods. New *Sensa Clinical* gives you the same sprinkle-on mode of action that made *Sensa* so famous and simple to use, but with an all-new, highly effective, clinical-strength formula. The original *Sensa* formula didn't have validated clinical science backing its claims.

Sensa Clinical really works! The *Sensa Clinical* community is full of loyal users who have been using the product and loving it. And there's only one way to know how it will work for you — try it for yourself! We stand behind our products 100%. We're so sure you're going to love *Sensa Clinical* that we back it with our ironclad, 100% satisfaction guarantee. All of our success stories are from real people just like you who are living testimonies of the power of *Sensa Clinical*. For more information on *Sensa Clinical's* research, you can view the research tab on www.newsensa.com

Which of the following indicators of trustworthiness is/are present?

A = is present B = absent

33. (A)(B) Claims are modest.
34. (A)(B) Uncertainties are noted
35. (A)(B) Work is replicated by independent sources
36. (A)(B) A balanced presentation of alternative explanations is offered

Applying your understanding

37-40. (8 pts) Which of the following actions is a (are) valid scientific course(s) of action? **(A) True (B) False**

- 37 (A)(B) A government agency relies heavily on two industry-funded studies in declaring a chemical found in plastics safe for humans, while ignoring studies linking the chemical with adverse health effects.
- 38 (A)(B) Journalists give equal credibility to both sides of a scientific story, even though one side has been disproven by many experiments.
- 39 (A)(B) A government agency decides to alter public health messages about breast-feeding in response to pressure from a council of businesses involved in manufacturing infant formula.
- 40 (A)(B) Several research studies have found a new drug to be effective for treating the symptoms of autism; however, a government agency refuses to approve the drug until long term effects are known.

41-43. (3.5 pts each) For each of the next 3 questions, choose one of (A)-(D)

41. The **most important** factor influencing you to categorize a research article as trustworthy science is which? (If you are not sure, rely on the book's list of ways to 'ensure legitimate science' to choose the best answer.)

- (A) The presence of data or graphs
- (B) The article was evaluated by unbiased third-party experts (peer review)
- (C) Plausibility of the results
- (D) The publisher of the article

42. Your doctor prescribed you a drug that is brand new. The drug has some possible side effects, so you do some research to determine the effectiveness of the new drug compared to similar drugs on the market. Which of the following sources would provide the **most trustworthy** information?

- (A) The drug manufacturer's pamphlet/website
- (B) A special feature about the drug on the nightly news
- (C) A research study conducted by independently funded researchers
- (D) Information from a trusted friend who has been taking the drug for six months

43. You've been doing research to help your grandmother understand two new drugs for osteoporosis. One publication, *Eurasian Journal of Bone and Joint Medicine*, contains only articles with data showing the effectiveness of one of these new drugs. A pharmaceutical company funded the *Eurasian Journal of Bone and Joint Medicine* studies and most advertisements in the journal are for this company's products. In your searches, you find other articles that show the same drug has only limited effectiveness.

Pick the **best** answer regarding the credibility of the *Eurasian Journal of Bone and Joint Medicine* for information about this drug.

- (A) It is not a credible source because there were advertisements within the journal.
- (B) It is not a credible source because only studies showing the effectiveness of the company's drugs were included in the journal.
- (C) It is a credible source because the studies published in the journal were later replicated by other researchers.
- (D) It is a credible source because the publication lists reviewers with appropriate credentials who evaluated the quality of the research articles prior to publication.

44. (2 pts) (A) Fill in **bubble A** on 44 to indicate your key. **Likewise make sure your name and EID are correctly bubbled in.**