73 questions, 5 pages name_____(req'd)

**Answer every question (1-73) with a single bubble. If not specified otherwise, assume**

**A = True/yes B =False/no**

**Motivation** (day-1 survey and discussion of it)

**1-4. (4 pts)** The following options pertain to the survey given on day 1, in which the class responded to statements read aloud. The survey results were graphed as histograms with 7 categories per statement (from 'definitely true' to 'definitely false'). Which of the following are true about the patterns observed or the conclusions we drew?

**1. (A) (B)** We observed a progression of knowledge toward the present: compared to your class, responses to the same statement from previous years were shifted toward increasing levels of ignorance the further back in time we went.

**2. (A) (B)** There were wide differences of opinion – some students at each extreme – about the truth of some statements (e.g., communication with the dead).

**3. (A) (B)** Many people scored it plausible that events occurred or phenomena exist for which there is no scientific evidence.

**4. (A) (B)** We suggested that the main reason for different responses is because the scientific method is misunderstood by many.

**5-8. (4 pts)** More from lectures on motivation. Which of the following points are true?

**5. (A) (B)** We suggested that understanding Nature is a matter of being clever and figuring things out from first principles.

**6. (A) (B)** We presented several lines of evidence that our brains are intrinsically rational.

**7. (A) (B)** A theme of this class is that the scientific method needs to be modified before it can be used to address many everyday problems that are not part of traditional science.

**8. (A) (B)** *Several images/pictures were shown during a lecture in the first week of class.* The purpose of those pictures was to reveal the myriad of potential hazards that we face in modern society and thus to motivate the need for a rational basis of making decisions in society.

## Scientific method

**9-12. (4pts)** The use of evidence to evaluate a model is part of what we are calling the scientific method. Which of the following questions/problems could be addressed with evidence-based evaluation of models (or more generally, could be studied with the scientific method) as we are using it in this class? **A = could be addressed, B = could not be addressed**

**9. (A) (B)** Does smoking cause cancer?

**10. (A) (B)** Have humans and monkeys evolved from a common ancestor?

**11. (A) (B)** Is there more criminal activity on nights with full moons than on other nights?

**12. (A) (B)** Do astrologers more accurately predict future events than non-astrologers?

**13-15. (4 pts)** Which are correct statements about the scientific method (SM)?

**13. (A) (B)** In the U.S. criminal justice system, where the goal is to identify perpetrators of crimes, evidence that is relevant to the case is sometimes suppressed. Omission of evidence is a weakness/violation in the **models** component of the SM.

**14. (A) (B)** In a business whose goal is to make money, never changing its budget plan is an absence of **evaluation**.

**15. (A) (B)** If there is no evaluation step, there can be no **data**.

**16-19 (5 pts)** Which below correctly explain(s) the nature or purpose of the scientific method (SM) or the workings of its elements?

**16. (A) (B)** Models <u>accepted</u> on the basis of current evidence can be rejected at a later time.

**17. (A) (B)** We noted that a useful shortcut toward deciding if a process/institution fits the SM is to determine whether the use of evidence is paramount (vitally important) in that process/institution.

**18. (A) (B)** When a model is finally <u>proven</u> by the SM, it is no longer tested in the future.

**19. (A) (B)** <u>Revision</u> is the choice of a new model.

**20-24 (5 pts)**. In the book, cooking from a recipe was said to resemble the scientific method. Which steps from that example illustrate each of the five elements of the scientific method?

Use these 5 answers as your list of choices in 20-24 below:

(A) the recipe
(B) changes to the recipe
(C) tastings during the cooking phase
(D) prepare an enticing food dish
(E) decisions on whether the dish tastes good

**20.** Goal: (A) (B) (C) (D) (E)
**21.** Model: (A) (B) (C) (D) (E)
**22.** Data: (A) (B) (C) (D) (E)
**23.** Evaluation: (A) (B) (C) (D) (E)
**24.** Revision: (A) (B) (C) (D) (E)

**25-28. (5pts)** Indicate which elements of the Sci Met. are present. The goal is underlined.

A driver hopes for a quick trip across town and starts driving the most direct route. He then changes that route because the heavy traffic he encounters is slowing him down more than he likes.

**A= indicated, B = not indicated.**

**25. (A) (B)** Model
**26. (A) (B)** Data
**27. (A) (B)** Evaluation
**28. (A) (B)** Revision

**29-32. (5 pts)** Astrologists claim to be able to predict your future and give insights to your being, and they have well-defined rules to use in reaching those forecasts, based on your birthday and birth hour. However, there are no attempts to test the accuracy of those predictions – no formal observations, no comparisons of observations to predictions, and no consequent changes in the rules used.

*Evaluation is absent in this description.* Which of the following correctly explains why? (the underlined phrase is the goal) A question statement must be correct in all respects to be considered 'true.'

**29. (A) (B)** Revision is absent, and there can be no evaluation without revision.

**30. (A) (B)** Models are absent, and evaluation involves comparing a model with data. Without models, evaluation cannot exist.

**31. (A) (B)** The problem states that there are no attempts to test the accuracy of the predictions; this statement directly indicates that evaluation is absent.

**32. (A) (B)** Data are absent. Without data, there can be no evaluation.

**33-35. (5 pts)** The State of Texas developed an emergency operations management team used in responding to hurricane Rita. This body was established to reduce casualties and manage evacuations for hurricanes and other types of potential disasters, They consulted with personnel who have experience in prior disasters to develop response plans for different types of emergencies. They also used computer simulations and mock exercises/drills (one on the UT campus) to assess the efficacy of their plans, and the performance in these drills was measured and used to modify their plans slightly. Hurricane Rita was the first large-scale emergency that this team faced, and the team has begun gathering "information about the evacuation process and other emergency operations" during Rita to assess performance.

Which of the following points about the scientific method are true, based on the above description? The underlined phrase consists of the goal for this problem.

**33. (A) (B)** The response plans constitute models of how actual operations will go.

**34. (A) (B)** The only description of data above is in the quoted phrase ("information about...").

**35. (A) (B)** Revision is absent from the above description, because Rita was the first actual emergency, and the problem does not state that any modifications to plans were made in response to Rita.

**36-40 (7 pts)** You want to predict outcomes of football games better than the odds makers. You generate a computer model that uses player statistics and past performances of the different teams to make these predictions. Given this goal (underlined), which options constitute **data** to evaluate your model? Mark as true only if the statement provides some data for testing your model toward this goal. **A = constitute data for testing … B = do not constitute data for testing …**

**36. (A) (B)** The complete set of player statistics used by your model

**37. (A) (B)** The odds-makers' predicted outcomes

**38. (A) (B)** Your model's predicted outcomes

**39. (A) (B)** The team past performances used by your model to make predictions

**40. (A) (B)** The outcomes of the actual games for which the predictions were made

## Models

**41-44. (6pts)** For which options is the limitation of the model likely important to the goal – could prevent attaining the goal?
**A= the limitation could prevent attaining the goal; B= the limitation would NOT prevent attaining the goal**

| Question | Model | Goal | Limitation |
|---|---|---|---|
| **41 (A) (B)** | a photo of Abe Lincoln as a model of Lincoln | to give a talk and create a mental image of him in the audience | there is no biological material from Lincoln in the photo |
| **42 (A) (B)** | a photo of Abe Lincoln as a model of Lincoln | to know if he had a specific genetic disease | there is no biological material from Lincoln in the photo |
| **43 (A) (B)** | answer filled in on question 10 of the person sitting next to you as a model of the answer you should put down | to get question #10 correct | the person sitting next to you likely has a different version of the exam than you |
| **44 (A) (B)** | a university's listed cost of tuition as a model of the cost of going to school | to know how much money you need to go to school (neglecting room and board) | tuition does not include the substantial fees, subscriptions, materials and book costs that are required for the classes |

**45-49 (10 pts)** Consider the following goal-model-data combinations. For which goal-model pairs would the 'data' enable someone to evaluate the model? Do not worry about whether appropriate controls exist or not.
**A = the data can be used to evaluate the model B= the data cannot be used to evaluate the model**

**45 (A) (B)** Smoking
goal: reduce cancer deaths of smokers
model: have smokers cut tobacco consumption in half
data: survival rates of people who have never smoked

**46 (A) (B)** Agriculture
goal: raise income from a farmer's crops
model: have the farmer increase fertilizer use above past levels
data: the farmer's income and expenses in years with and years without increased fertilizer use

**47 (A) (B)** Academia
goal: for you to get acceptable exam scores in Bio301D
model: study with a group of students in class
data: exam scores achieved by the other group members, excluding yours

**48 (A) (B)** Deceit
goal: to determine whether someone is telling the truth
model: a lie detector machine
data: the lie detector output for a person when you don't know if they are telling the truth

**49 (A) (B)** A strategy for winning the lottery
goal: to increase odds of winning the lottery above random
model: a strategy for lottery winning marketed by a company
data: winning rates of customers who used the method versus those who did not

## Condom testing

**50-53 (4 pts)** Which models in condom testing (real or hypothetical) were said to be strong on uniformity (we indicated these with + or ++)? **A = strong on uniformity B = weak or worse on uniformity**

**50(A) (B)** Trained technicians

**51 (A) (B)** Volunteers

**52 (A) (B)** Mechanical tests

**53 (A) (B)** Airburst test

**54-57. (5 pts).** The main points of the condom lectures specifically included:

**54. (A) (B)** There is a complex network of personal goals and overlapping manufacturing goals for condoms

**55. (A) (B)** The choice of models to use in condom testing is currently based heavily on how well the model predicts breakage during use.

**56. (A) (B)** We rely on different models with complementing strengths to overcome weaknesses of individual models

**57. (A) (B)** It was argued that governments should rely more on testing with humans because of the limitations of mechanical models.

### DWI testing

(BAC = blood alcohol concentration; SFST = standardized field sobriety test)

**58-60. (5 pts)** Class included a demonstration with a breathalyzer. Which of the following are points that the demo was used to illustrate? NOTE: a statement must both be correct AND address a point of the demo for the question to be considered TRUE.

**58. (A) (B)** The demo was used to show that a BAC measured in breath need not match that measured in blood.

**59. (A) (B)** The demo was used to show that a BAC measured in blood is not an accurate model of driving performance.

**60. (A) (B)** The demo was used to show that the time course of the true BAC differs from that of the back-calculated BAC.

**61-65. (7 pts)** Which of the following options are true about the DWI testing?

**61. (A) (B)** The fact that the BAC can be measured to within 2% of the true value (at least in blood) means that it is a more accurate model of driving perfornace than the SFST, which is measured only subjectively.

**62. (A) (B)** A limitation of using the same BAC threshold in all drivers to measure actual impairment is that not everyone is equally impaired at the same alcohol concentration.

**63. (A) (B)** A limitation of the SFST for measuring driver impairment is that there are no baseline data from the person when sober.

**64. (A) (B)** Two tests (walk and turn, one leg stand) are administered to assess physical faculties only.

**65. (A) (B)** The BAC and SFST tests can be considered overlapping models for assessing driver impairment in that the driver must fail both to be considered legally impaired.

## Extrapolation

**66-69. (2.5 pts each)** Which shape of extrapolation relationship is indicated? If no extrapolation is indicated, use (E).

**66.** In flight, a passenger notes that the rivets on the wing of an airplane are popping out at one per 15 minutes. 4 are missing when the crew is alerted. The plane should land in 75 minutes, and the crew calculates that only 5 more rivets will be lost before the plane lands.

A) linear B) threshold C) accelerating D) decelerating E) None

**67.** The early advice after FAS (fetal alcohol syndrome) was first recognized as a health problem was that heavy drinking by the mother was harmful for the fetus. Moderate drinking was considered harmless, but all that was actually known at the time was that the effect of moderate drinking was less than the effect of heaving drinking. What shape of extrapolation is indicated by the suggestion that moderate drinking was harmless?

A) linear B) threshold C) accelerating D) decelerating E) None

**68.** In early days of widespead tobacco use, it was clear that lung cancer rates were higher in heavy smokers than in non-smokers, but it was not clear if low levels of exposure constituted a risk because levels of exposure could not be determined. The development of an assay for nicotine breakdown products subsequently allowed us to measure <u>all</u> levels of tobacco exposure, and it was discovered that risk was proportional to exposure.

A) linear B) threshold C) accelerating D) decelerating E) None

**69.** In 1962, a 'researcher' in Oklahoma gave an elephant LSD for some kind of test. The LSD dose given to the elephant was the human dose multiplied by the number of humans it takes to equal the weight of an elephant. (The elephant died.) What kind of dose extrapolation was used in the choice of dose for the elephant?

A) linear B) threshold C) accelerating D) decelerating E) None

**70-72. (3 pts each)** For the following 3 questions, indicate the types of extrapolations, if any (across doses, across species, across related hazards).

**70.** The rat poison warfarin is sold in pellets. Experiments using rats determine how much a rat typically ingests and how much it takes to kill it. The dose of poison per pellet is chosen from these tests as the dose observed to kill 99% of rats.

A) dose B) species C) related hazards D) None

**71.** Bruce Ames has noted that the cancer test using rodents is flawed because it artificially inflates cancer rates in rodents. That is, cancers may appear in the rodents because the test is flawed rather than because the compound being tested causes cancer in rodents. Which extrapolation(s) underlie(s) the basis of his concern (as in the book)?

A) dose B) species C) related hazards D) None

**72.** Dioxin was once considered one of the most toxic substances in our environment. That concern has abated in the last few decades due to a realization about the early data on dioxin toxicity. Which type of extrapolation(s) was/were at the root of the early concern about high levels of dioxin toxicity? (You must rely on the book for this one.)

<u>A)</u> dose <u>B)</u> species <u>C)</u> related hazards <u>D)</u> A,B <u>E)</u> A,C <u>F)</u> B,C <u>G)</u> A, B, C <u>H)</u> None

**<u>73 (4 pts)</u>** <u>Key code AB</u>. Bubble A and B on #73 of your scantron to indicate which version of the test you have; do not fill in any other bubbles. Correctly bubble in your EID and name in the appropriate blanks, and put your name on the first page of this exam form.