

Motivation (day-1 survey and discussion of it)

1. (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 patterns across the 7 categories were observed on one or more statements? **MTF**

We observed:

- A) Consensus 'truth,' in which most responses were in the left-most one or two categories.
- B) Strong bimodality, in which there were many responses at both extreme ends (at least 15% at each end), and fewer in between (strongly U-shaped)
- C) Consensus uncertainty, with a clear peak in one of the middle 3 categories and responses tapering off on both sides
- D) Scatter across all 7 categories without any obvious consensus.

2. (4 pts) More about motivation. Which of the following points are true? **MTF**

- A) A chief purpose of the survey was to test your background knowledge in science.
- B) Our discussion in class suggested that uncertainty about a statement necessarily reflected ignorance.
- C) At least one case was discussed in which emotional factors appeared to influence the responses against logic.
- D) The survey results were used to support the view that collective/social decisions need to have a more rational basis than do individual beliefs.

Scientific method

3. (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)? **MTF**

- A) Can psychics predict future events?
- B) Is the lottery random?
- C) Does one teaching method lead to better understanding than another?
- D) Does the earth orbit the sun?
- E) Have lizards and snakes evolved from a common ancestor?

4. (4 pts) Which are correct statements about the scientific method? **MTF**

- A) In the U.S. criminal justice system, where the goal is to identify perpetrators of crimes, the granting of a new trial (e.g., in response to new evidence) is a form of revision.
- B) A business that hopes to make money but has no business plan is lacking in Data.
- C) A student who hopes to graduate but makes no changes to his/her degree plan despite failing tough classes is lacking in Revision.
- D) If a model is rejected for one goal, then it is necessarily rejected for other goals.

5 (4 pts) Which options correctly explain the nature, purpose, or relationship of an element of the scientific method (SM)? **MTF**

- A) The goal is a search for data to support a particular model.
- B) Evaluation involves comparing data to a model to determine if the model should be accepted or rejected
- C) When a model is rejected by the SM, the data used to reject that model are also not used in future iterations.
- D) Revision is the choice of a new goal.

6 (4 pts). Which institutions or processes were described as (usually) lacking or weak in *at least* the MODELS component of the scientific method? Some of these were covered only in the book. **MTF**

| | | | | |
|--------------|--------------------|---------------|----------------------|----------------|
| (A) religion | (B) gov't agencies | (C) astrology | (D) a criminal trial | (E) car repair |
|--------------|--------------------|---------------|----------------------|----------------|

7-11 (5 pts total, 1pt each). In the lecture, the 'wheel of fortune' exercise 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 7-11 below:

- (A) hunches about what some of the words might be
- (B) solving the phrase
- (C) the blanks where the letters fall and don't fall at each step
- (D) changes in your hunches about the words after seeing a new letter
- (E) whether the new letters are compatible with your hunches about words

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|-----------------|---------------------|--------------------------|
| 7. Goal: | (A) (B) (C) (D) (E) | <u>(one answer only)</u> |
| 8. Model: | (A) (B) (C) (D) (E) | <u>(one answer only)</u> |
| 9. Data: | (A) (B) (C) (D) (E) | <u>(one answer only)</u> |
| 10. Evaluation: | (A) (B) (C) (D) (E) | <u>(one answer only)</u> |
| 11. Revision: | (A) (B) (C) (D) (E) | <u>(one answer only)</u> |

The goal is underlined in 12-14

12. (5 pts) The Lotto is a legal form of gambling in many states in which people attempt to predict (or guess) a set of numbers chosen randomly. The *Millionaire Company* has just developed a strategy for choosing numbers that it claims have a better-than random chance of winning the Lotto. A large number of people have used this strategy in recent drawings of the Lotto, and their choices along with the winning numbers have been sent to a statistical consultant to determine if the strategy does indeed perform as advertised, but the statistical consultant has not yet done the analysis.

Which elements of the scientific method are present for use of this method to win the Lotto? **MTF**

| | | | |
|-----------|----------|----------------|--------------|
| (A) Model | (B) Data | (C) Evaluation | (D) Revision |
|-----------|----------|----------------|--------------|

13. (5 pts) Therapeutic Touch (TT) is a controversial nursing practice that has been taught at UT and elsewhere. Like other nursing practices, TT purports to improve patient healing and overall well-being. People are trained in TT methods by taking classes that provide the basic concepts, and this training enables them to use TT on their own patients. Practitioners steadfastly refuse to subject their methods to rigorous tests that would show whether patients are actually healed faster by TT than without TT, so we don't know if TT has any validity.

Which elements of the scientific method are indicated? **MTF**

| | | | |
|-----------|----------|----------------|--------------|
| (A) Model | (B) Data | (C) Evaluation | (D) Revision |
|-----------|----------|----------------|--------------|

14. (5 pts) Astrologists claim 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.

Data is absent in this description. Why? **MTF**

- (A) Evaluation is absent, and there can be no data without evaluation.
- (B) Models are absent. Without models, you cannot gather data to test the models.
- (C) The problem states that there are no attempts to test the accuracy of the predictions; this statement directly indicates that data is absent.
- (D) The problem states that there are no formal observations, which means that data are not present.

Models

15. (6pts) For which options is the Limitation of the model likely important to the goal? **MTF**

| Option | Model | Goal | Limitation |
|--------|--|-------------------------------|--|
| (A) | the box of Loratadine in your medicine cabinet as a model of boxes of Loratadine at stores | relieve your allergy symptoms | your box is out of date and the medicine has deteriorated chemically |
| (B) | the box of Loratadine you buy at a store as a model of boxes of Loratadine at other stores | relieve your allergy symptoms | the medicine in your box should weigh 2 oz but instead weighs 1.98 oz |
| (C) | a picture of a person (unknown to you) whom you are supposed to pick up at the airport | to quickly find the person | the picture is merely ink on paper and contains nothing of or from the person it supposedly represents |
| (D) | DNA from a cigarette butt at a crime scene as a model of the perpetrator | to identify the perpetrator | the DNA is just a small sample of the person who left it |

16 (8 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. **MTF**

- A) Cancer
 - a. goal: prolong life of cancer victims
 - b. model: a drug that kills rapidly-dividing cells
 - c. data: survival rates of cancer patients on and off the drug
- B) In the context of condom use
 - a. goal: determine whether STD agents can pass through an intact condom
 - b. model: airburst test
 - c. data: rates at which the condoms pass the airburst test
- C) In the context of astrology,
 - a. goal: to predict a client's future
 - b. model: rules for making predictions based on birth date
 - c. data: the predictions of future outcomes for the client
- D) In the context of writing grants for money
 - a. goal: to have a better-than-average chance of getting a grant
 - b. model: an online course in grant writing that claims to improve your odds above average
 - c. data: the success rate of grants in the last round of competition (before you submitted yours)
- E) A strategy for winning the lottery
 - a. goal: to increase odds of winning the lottery
 - b. model: a strategy for lottery winning marketed by a company
 - c. data: winning rates of customers who used the method versus those who did not

17. (4 pts) Each of the following options compares two models for a particular goal. Bubble options in which the **first model (in bold)** is more *accurate* than the second model (underlined) for the goal. **MTF**

- (A) **Direct measures of BAC** obtained when the driver was stopped instead of back calculations of BAC in DWI tests to assess driver BAC while driving.
- (B) **Airburst test** instead of volunteers in tests of condom breakage during sex.
- (C) **Rats** instead of mice in testing the toxicity of rat poison
- (D) **High doses** of a substance versus low doses of it in evaluating the long-term effects of low exposures.

18. (6 pts) General points about models. In the following options, the **bold** font gives a possible theme from class, and the statement following explains it. Fill in only those options for which both apply: (1) the bold statement is indeed one of the points made, and (2) the statement following it also correctly explains it or correctly addresses it. **MTF**

- A) The **importance of model accuracy**. Ultimately, the most useful model (the one we most want to use) is the one that most closely matches what we are trying to represent. For example, human subjects are the most useful model for studying whether a food additive causes of cancer in humans, as opposed to mice or bacteria, because mice and bacteria are not humans.
- B) The **usefulness of a goal depends on the model**. In practice, if a model is found to be inadequate for one goal, we tend to look for another goal that suits it better. Science is a method of finding progressively better goals.
- C) **Pieces and parts as models of the whole**. Because all models are false, we make more progress by dissecting models into their component parts ('pieces') and working with the pieces instead of the whole.
- D) **One-to-many, many-to-one**. When pursuing one goal, we may at first use many different models (e.g., the airburst test and water-leak test of condoms), but eventually, we will converge on using just a single model for achieving that goal.

19 (5 pts) Which of the following demos and themes were given to illustrate models (i.e., used in any of the lectures on models)? Do not circle an option if it was not used. **MTF**

| | | | | | | |
|----------------------|---|-------------------------|---------------------------------|---------------------|---|-------------|
| (A) airburst test | (B) phone book cover illustration | (C) Wheel of fortune | (D) Lamp switch mechanism | (E) solar system | (F) <i>Newsweek</i> article on Christine Maggiore | (G) slogans |
|----------------------|---|-------------------------|---------------------------------|---------------------|---|-------------|

Condom testing

20 (4 pts) Which models in condom testing (real or hypothetical) were said to be strong on accuracy (we indicated these with + or ++)? **MTF**

- A) Trained technicians
- B) Volunteers
- C) Mechanical tests
- D) Airburst test

21. (4 pts). For which goals are the limitations of volunteer studies so serious that we would consider the study not useful? **MTF**

- A) can STDs be transmitted with invariant condom use?
- B) do condoms break during sex?
- C) do condoms reduce sensitivity?
- D) is latex irritating or abrasive to either partner?

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

22. (5pts) (MTF) Which of the following options are true about the SFST? **MTF**

- A) The fact that the SFST can be administered on the roadside and without equipment renders it a *convenient* model (of the three ACU properties).
- B) Two tests (walk and turn, one leg stand) are administered to assess both physical AND mental faculties.
- C) For the goal of assessing whether a driver is actually impaired (as opposed to legally impaired), the SFST is a more accurate model of performance than is the BAC.
- D) A person's performance when sober is used to provide a baseline for their performance when stopped.
- E) A person failing the SFST must also have a BAC at or above 0.08% to be *convicted* of DWI. In our language, the SFST is not a model that can be used by itself for conviction.

23 (5 pts) Which limitations (or other considerations) are relevant to 'back calculations' of blood alcohol concentration (BAC) as a model to determine whether a driver exceeded 0.08% when stopped by the police. (The goal is to determine whether someone exceeded 0.08% at the time they were stopped driving)? **MTF**

- A) The back-calculated BAC does not measure driving performance.
- B) The back calculation formula (the curve) is a model based on data gathered under idealized conditions and has been shown to be violated under conditions that would apply to many drivers.
- C) The back calculated BAC as currently done would necessarily be wrong if the driver's true BAC remained constant at 0.04% from the time stopped to the time tested hours later.
- D) The back calculation is administered at the time of the stop, usually along with reciting the alphabet backwards.

Infectious Disease

If needed in the next two questions, use the following formula.

$$R_0 = \beta S / (r + d),$$

β – infection rate parameter
 S – number of susceptible individuals in population
 r – recovery rate of infected individuals
 d – death rate of infected individuals

24. (5pts) The basic reproductive number (R_0) is a model of the spread of an infectious agent. Which of the following are true? **MTF**

- A) A drug that sped recovery would increase r and thus increase R_0 .
- B) If the R_0 value of a disease was 3 before vaccination, we would need to vaccinate 2/3 of the population to eradicate the disease.
- C) The epidemic threshold is the smallest value of R_0 for which the number of individuals with the disease increases over time.
- D) Recalling the table of R_0 values given in class, the R_0 for most infectious diseases was less than 2.
- E) If R_0 is less than S , it means that the disease will not expand epidemically in the human population.

25 (4 pts) Which points about infectious diseases were covered in class or the book? **MTF**

- A) R_0 is a measure of how sick people get when they have a disease.
- B) *Most vaccines are imperfect, meaning that not everyone who is vaccinated becomes immune.* Our ability to eradicate a disease through vaccination depends primarily on how perfect or imperfect a vaccine is.
- C) Diseases with larger R_0 values also tend to have larger S values (formula above).
- D) A limitation of the basic model used to derive R_0 is that it does NOT apply to STDs nor to diseases acquired from animals.

26 (4 pts) Key code AB. Bubble A and B on # 26 of your scantron to indicate which version of the test you have; do not fill in any other bubbles on that field. Correctly bubble in your EID and name in the appropriate blanks, and put your name on this form.