Errors in Data

1. (4 pts.) Exam Key Code: Fill in bubbles (AB) on question 1 to indicate your exam code; leave the other bubbles blank. Also, fill in the correct bubbles for your name and EID on the scantron form. EID goes in the ID field.

2. (4 pts) Which of the following demonstrations were used to illustrate <u>errors or fixes in data</u>, and which options also correctly identify the type of error/fix illustrated? MTF

> A) "choose a random odd number" to illustrate randomization
>
> B) width of a coin to illustrate RPA error
>
> C) choose your favorite color to illustrate bias
>
> D) coin flip to illustrate how to reduce sampling error
>
> E) video clip from the movie Spinal Tap to illustrate (bad) standards: "it's one louder"

3. (4pts) Two samples of opinion from the same student body differ but the difference is not statistically significant. To what type of error do we attribute the difference? **One answer only**.

> A) Sampling   B) Bias   C) RPA   D) Human & technical   E) Protocol   F) None

4. (5pts) For which of the following is RPA error present (even if irrelevant)? MTF

A) When data are randomized

B) For discrete characters (present/absent)

C) Measuring something quantitative (length, weight) to 3 decimals when you only need 2 decimals

D) When taking two or more quantitative measurements of the same object twice

E) When using laser technology to measure a distance

5. (5pts) Lecture noted that some types of errors occurred when <u>acquiring the subjects/objects that are to be measured</u>, whereas other errors occur when making the measurements themselves. Which types of errors were said to occur in the <u>first of these</u> (<u>underlined</u>)? If a type of error was not mentioned, do not use it. MTF

A) Sampling error

B) Human and technical

C) RPA

D) the part of bias fixed by randomization

E) the part of bias fixed by blind observers

6, 7. In the following two questions, indicate which types of error are indicated. one only per question

6. (4 pts) An employer decides to test his 200 employees for drugs. Using urine, he first checks creatinine levels to look for any diluted samples. He finds that, while nearly all of his employee samples have creatinine levels within the normal range, one employee has a low level, below 1% of that found in the population, and a second test of the same sample shows that the level is indeed low. Based on this evidence, he fires that employee for diluting their sample. What type of error could account for the unusually low creatinine level in one employee? (<u>one only</u>)

A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None

7. (4 pts) Caucasian researchers in the late 1800s and early 1900s attempted to measure the "intelligence" of different human races by filling empty skulls with lead shot to determine brain volume. They knew the race of each skull at the time they were filling it and apparently (and unconsciously) took more care to settle the shot in some skulls – of Caucasians – than in others. Thus, the brain volumes of the non-Caucasians were measured to be smaller than actual volumes but not so for volumes of the Caucasian skulls. What type of error is the *systematic underestimation of skull volumes for non-Caucasians compared to Caucasians*? (<u>one only</u>)

(A) sampling   (B) H&T   (C) RPA   (D) Bias   (E) None

Errors and Fixes

8 (5 pts). The following pair of graphs (or something similar) was shown in relation to the coin flip demo in class. Which points were illustrated by either or both graphs? The horizontal axis is the proportion heads, and both horizontal axes span 0 to 1. The left graph is based on 10 flips per observation the right is based on over 1000 flips per observation. The vertical axis is the number of observations. MTF
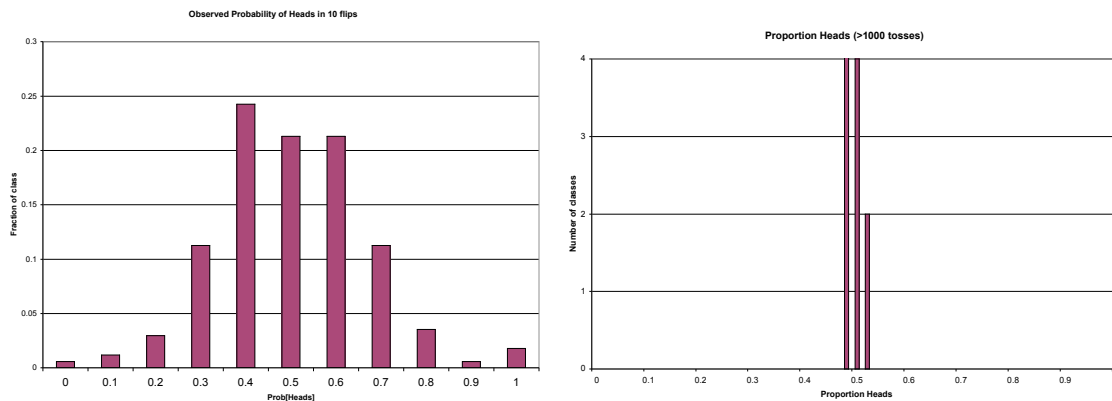
(A) There is greater bias in the left graph, because the left shows that more people failed to get the right proportion of heads.

(B) Classes from different years generated different distributions of the proportion of heads in 10 flips

(C) Replication reduces sampling error

(D) The right graph has the least RPA error.

9. (4pts) Which options correctly identify a "fix" for the type of error indicated; a "fix" may either reduce that error or at least allow you to detect/measure that error. MTF

A) <u>error</u>: sample mixup. **<u>Fix</u>**: code tubes blindly

B) <u>error</u>: unintentional failure to follow protocol because it is difficult to understand. **<u>Fix</u>**: design a protocol that is easier to understand but achieves the same objectives

C) <u>error</u>: lab fails to conduct analyses carefully and fails to check results because they know which samples belong to the suspect and know what results are consistent with suspect being guilty. **<u>Fix</u>**: code samples so that lab does not know which belong to suspect.

D) <u>error</u>: lab occasionally declares false matches, but they are inconsistent and often go undetected. **<u>Fix</u>**: replicate samples without the lab's knowledge so that false matches are evident as differences between results for the same samples.

(**10-11**). For each of the following statements, mark the appropriate letters that describe the data design features present. Mark a data feature only if it is explicitly present at some level in the problem description. MTF

(A) explicit protocol   (C) standards   (E) blind
(B) replication   (D) random   (F) none

10. (4 pts) Some high school students decide to test the power of prayer on plant growth. They plant 50 bean seeds individually in pots, and when 40 of the seeds have germinated, the pots are divided into two groups of 20 each. Both groups are subjected to daily prayers for good growth. At the end of one month, the height of each plant is measured, and the averages between the two groups are compared. MTF

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

11. (4pts) You are hired as a consultant for a company selling home pregnancy tests to help them market a product that will be easy to use and give accurate results. You advise them to put a picture of a woman on the front of the box and directions for use on the back. Furthermore you suggest that they provide supplies for just a single test, so that if a woman wants to test herself again, she has to purchase a second kit. Finally you suggest that they include a sample solution in the kit that will provide a definite positive result that can be used if the woman tests negative. Which aspects of the ideal data template would be satisfied by a single kit if your recommendations are followed? MTF

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

12. (5pts) Which of the following about explicit protocol are true? MTF

     A) the protocol influences the *types* of errors that will be present in data

     B) the protocol influences the *magnitudes* of errors that will be present in data

     C) an explicit protocol allows someone else (who did not gather the data) to identify the types of errors present

     D) explicit protocols are typically needed for gathering data and also for analyzing data

     E) lecture used a study of a medical/hospital checklist as an example of protocol improvement reducing H&T error

Drugs and DWI testing

13. (5pts) What constitutes a form of replication in DWI testing? MTF

     A) multiple air blanks in the breathalyzer test

     B) multiple breath samples from the suspect in the breathalyzer test

     C) an air blank plus the breath sample from the suspect in the breathalyzer test

     D) multiple tests used to assess SFST performance

     E) a sample of known alcohol content tested by the breathalyzer

14. (5pts) The SFST has been validated in several U.S. studies with the following protocol ("officer" means an SFST-certified officer).

       i) Hundreds of drivers were tested by dozens of officers under normal ('field') conditions

       ii) Drivers were first given the SFST, then tested for their BAC (again in normal conditions)

       iii) The officers were accompanied by trained observers and knew they were being observed

Overall, the SFST scores were found to be reliable indicators of BAC in these validation studies.

From these published validation studies, courts now argue that an SFST score by an officer when NOT BEING OBSERVED is a reliable indicator of BAC. The following options address issues behind this assumption. Which are true? MTF

    A) The validation tests were not done <u>blindly</u> because the officer knew he/she was being tested. Thus an officer's scoring of the SFST in the presence of an observer may be <u>biased</u> compared to a scoring in the absence of an observer.

    B) The validation tests were not done on drivers chosen <u>randomly</u>. Thus an officer's scoring of the SFST in the presence of an observer may be <u>biased</u> compared to a scoring in the absence of an observer.

    C) A bias due to officers being observed would be indicated if the SFST scores for a given BAC were consistently <u>lower</u> in the validation study than when observers were absent.

    D) A bias due to officers being observed would be indicated if the SFST scores for a given BAC were consistently <u>higher</u> in the validation study than when observers were absent.

DNA and Criminal Justice

15. (4pts) MTF A standard to evaluate whether a DNA typing lab is making mistakes could consist of which of the following. "Coded" means that a number is attached to the sample but without the name of the person whose DNA it is (the 'donor'). Assume that you are the one sending the standards to the lab for testing. You want to know if the results could possibly tell you if a mistake has been made without further testing on your part. A standard in this case would be:

    A) a sample of DNA with the donor's name on the tube but whose DNA type/barcode is unknown to you

    B) a coded sample whose DNA type/barcode is known to you in advance

    C) a coded sample of DNA whose type/barcode is unknown to you

    D) two samples of the same DNA that you have labeled differently but you know are the same even though you don't know the DNA type/barcode in advance

16. (4pts) For a technique used to declare a match between a forensic sample and a suspect, such as DNA typing, fingerprinting, or hair matching, what is the consequence of not having a reference database from the population? MTF

Without a reference database:

    A) it is not possible to conduct proficiency tests of lab error rates.

    B) it is not possible to calculate a RMP (random match probability)

    C) it is not possible to detect sample mixup

    D) there is no benefit of blind procedures.

17. (5pts) Which are true (MTF)? A proficiency test allows you to:

A) measure the RMP	B) measure a lab error rate	C) detect H&T error	D) identify split samples	E) reduce sampling error

18. (4pts) Which of the following properties apply to DNA and/or DNA typing? (MTF)

A) The RMP (random match probability) is low for DNA typing because we can work with such tiny quantities of DNA.

B) DNA typing using mitochondrial DNA is the preferred method because it has the smallest RMPs of available methods (closer to zero).

C) Among the improvements in DNA typing methods over the last two decades, the chance of sample mixup has been virtually eliminated.

D) It is easy for a person to inadvertently leave DNA because cells of so many tissue types have DNA

19. (5pts) An eyewitness video was shown in class in which a single young male was observed. Following that video, the individuals in the class were asked to identify that person in a line-up. Which of the following is/are true about that demo? MTF

A) After viewing the video, the multiple choice options given to both sections consisted of the 6 people in the line-up and the option 'none.' In both sections, approximately half the students chose 'none.'

B) Among those who chose one of the people in the line-up, there was over 90% agreement on who it was.

C) The book and lecture suggested that the level of mis-identification demonstrated by our class is NOT typical of eyewitness ID in general.

D) The demonstration illustrated that the <u>instructions</u> given before the llineup are critical to reducing mis-identification

E) The incident shown in the video was a staged auto theft.

20 (5pts). How is a catalog of suspect photographs used inappropriately as a reference database for eyewitness identification? MTF

A) It <u>is</u> an appropriate reference database (if you chose this option, ignore the others).

B) The photographs do not include the entire population

C) The eyewitness is not allowed to choose all photos that might be the person seen.

D) The characteristics being observed in the photos are not discrete.

E) Memories are dynamic, and you cannot use a reference database when important details may be forgotten

21 (5pts). From the forensic table posted online, which methods lack discrete characters? MTF

A) Fingerprinting (before 1990)

B) DNA typing

C) Dog sniffing

D) Hair matching (not DNA based)

E) Shoe print identification

22 (5pts). Where have proficiency tests been lacking or experienced a high rate of failure in the US (as given in the Table)? MTF

    A) Fingerprinting (before 1990)

    B) Fingerprinting (after 2000)

    C) DNA typing

    D) Dog sniffing

    E) Hair matching (not DNA based)

    F) bullet lead analysis

23 (5pts). The following paragraph describes a forensic scenario (inspired by a study found by one of you). Which features of 'ideal forensics' are indicated? MTF

The only evidence in a murder trial to connect the defendant to the crime is a match between the duct tape used to bind the victim and a roll of tape found in the defendant's car. The lab providing the evidence based the match on the fiber dimensions in the tape: the microscopic widths of fibers and spacings between fibers were claimed to be too similar between the victim sample and the suspect sample to be from different rolls. The lab also analyzed 813 tape rolls from stores in 15 states in reaching this conclusion. Although the defense attempted to find an expert to challenge this testimony, it discovered that no other lab in the world does this kind of analysis, and the lab uses a proprietary analytical method to declare a match (that it keeps secret) so that no one else can compete with its business. This court case is in fact the first time the lab has applied its method in testing whether two samples match.

Which features are indicated?

    A) Reference database

    B) Pass proficiency tests

    C) Discrete characteristics

    D) Independent verification possible

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