name (required) _____

Extrapolating health risks

1-5 (3pts each) For each of the problems below, indicate which type(s) of extrapolations are present, if any. You are asked for the shape of any extrapolation across doses or rates (linear, accelerating, etc.) and/or whether any extrapolation is across effects, species, or hazards. For these problems, consider the threshold model to be the same as the accelerating model. Leave blank any extrapolation that is not indicated. **MTF for each – there may be no extrapolation of any kind, just one answer, or several.**

1. A researcher observes that rats fed 1 mg of resveratrol per day live longer than rats fed no reseveratrol. To emphasize the importance of his research, he proposes that, to live longer, humans should ingest foods with resveratrol.

      A) linear B) accelerating C) decelerating D) across species E) across effects F) across hazards   **MTF**

2. When a 10% cut to worker wages increased company profits 50% above the previous year, a company executive argues that a 20% cut would have increased profits 100%.

      A) linear B) accelerating C) decelerating D) across species E) across effects F) across hazards   **MTF**

3. In the early days of our understanding of fetal alcohol syndrome, it was known that high alcohol consumption by the mother was bad for the fetus; in the absence of direct evidence, it was proposed that low alcohol consumption was harmless.

      A) linear B) accelerating C) decelerating D) across species E) across effects F) across hazards   **MTF**

4. Different types of radiation have different biological effects. Some types of radioactive materials cause specific types of cancers. Yet the advice we offer about the hazards of radiation exposure is given as an overall cancer rate per excess rad (rem or Sievert) of ionizing radiation, regardless of radiation type or cancer type. Even the description of excess cancers per rad/rem is a form of extrapolation.

      A) linear B) accelerating C) decelerating D) across species E) across effects F) across hazards   **MTF**

5. As a young boy, Bruce Levin bakes a cake. Faced with a time crunch, he decides to double the cooking temperature to cut the cooking time in half.

      A) linear B) accelerating C) decelerating D) across species E) across effects F) across hazards   **MTF**

6. (4pts) The difficulties in estimating harmful effects of excess ionizing radiation include (**MTF**):

    A) We have few people exposed to the low, background radiation levels that are of greatest interest to us

    B) Science has not proposed a way to combine effects of different types of radiation for measuring its health effects.

    C) The effects of moderate excess doses (e.g., 3 times the annual average) are slight, which makes it difficult to estimate the effects of lower doses

    D) In cases of large exposures, time lags occur between radiation exposure and cancer appearance, so that people exposed may die before they have time to develop a cancer from the radiation

Errors in Data

7. (5pts) Lecture noted that some types of errors occurred when acquiring the subjects/objects that are to be measured, whereas other <u>errors occur when making the measurements themselves</u>. Which types of errors were said to occur in the second of these (underlined)? If a type of error was not mentioned, do not use it. If some aspect of this question was not fully covered in lecture, use your understanding of the material to answer it. **MTF**

A) Sampling   B) Human and technical   C) RPA

          D) The part of bias fixed by randomization   E) The part of bias fixed by blind observers.

8-14 (3pts each). In the following questions, indicate which type of error is indicated. Where it may not be clear what should be explained, the underlined phrase indicates the part to be explained by (A)-(E). **One answer per question.**

8. Two teenagers in the same car, one in the front seat of a car, the other in the back seat, are silently counting billboards along a road.   Over the same 5 mile stretch and on the same side of the road, <u>they come up with slightly different numbers</u>, even though their criteria for what to count are the same and they were each exposed to the same number of billboards.

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

9. Two lab technicians manually code fingerprint images obtained in an investigation for entry into a database, using the same protocol. The characteristics used for fingerprint scoring are discrete (all or none) so there is no ambiguity about how something should be scored. Even though they both work off the very same images as each other, each is unaware of the other's work, and <u>the two technicians enter different numbers for some of the characteristics</u>.

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

10. A firm uses two methods to assess customer satisfaction of its products. One method uses a postcard included with each product that the customer voluntarily returns anonymously. The other method uses a phone survey of a random sample of customers. The two methods yield the same level of customer satisfaction. <u>What type of error is indicated by the agreement between both sampling methods</u>?

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

11. A sheet of paper weighs 4 gm to the nearest gram. For the pre-stamped envelope you have, you can mail 40 gm of contents for a fixed rate, so you put in 10 sheets. However, the total weight of contents is 43 gm. What error likely explains the miscalculated total weight?

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

12 The failure to choose employees randomly for a company drug test could lead to what kind of 'error' in who gets tested?

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

13 The random choice of a few employees for a company drug test could lead to what kind of 'error' in who gets tested?

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

14 A teacher who grades written assignments while knowing who wrote each one is prone to what type of error in the grading?

      A) Sampling   B) Bias   C) RPA   D) Human and technical   E) None **(one only)**

15. (4pts) For which of the following is sampling error indicated or expected to have affected the numbers? **MTF**

    A) The observed numbers of cancers in a population as a measure of the underlying cancer rate

    B) You did not win the lottery with a single ticket when the odds of winning were 1 in a million.

    C) Your bathroom scale consistently reads 140 pounds, but your true weight is 139.

    D) Male and female responses to a questionnaire consistently show a large difference across multiple surveys (does sampling error likely account for the large difference)

    E) Use of a blind design yields one set of results, absence of blind gives a very different set of results (does sampling error likely account for the large difference)

Errors and Fixes

16 (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. **MTF**
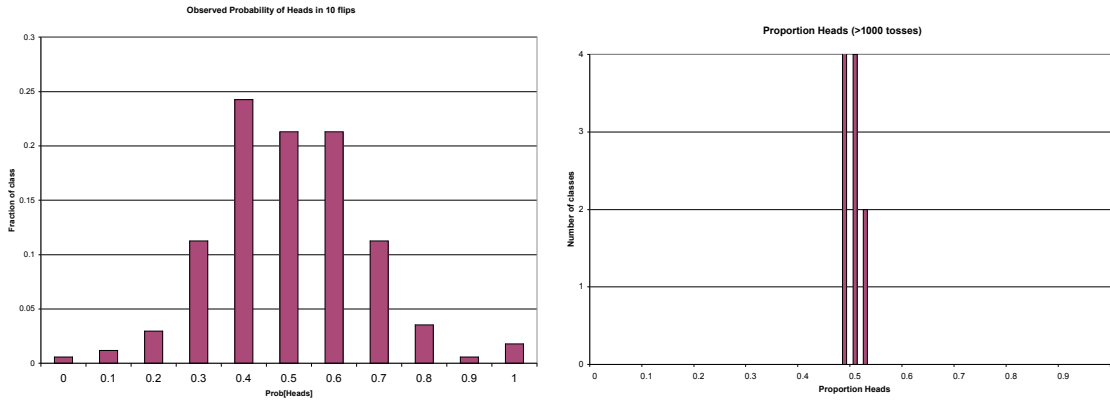
(A) Both graphs show the same amount of sampling error

(B) The distribution on the right is narrower than the one on the left because the proportion of heads is based on more replication on the right.

(C) In both graphs, bars to the either side of 0.5 are due to individual cases of bias, but there is no overall bias.

(D) Recalling how each graph was generated, we would conclude that a coin flip demo in which you calculated the proportion heads in 50 flips would give a shape in between the two distributions shown above.

17. (5pts) Which options 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) error: unintentional sample mixup during testing. **Fix**: code samples, leaving names off them.

B) error: RPA error that requires an extra decimal place of accuracy in the level of drugs detected **Fix**: use a more accurate test procedure

C) error: lab falsifies results to give the prosecution its desired results. **Fix**: randomize the samples to prevent bias

D) error: lab occasionally declares matches that are not real, but they often go undetected. **Fix**: subject the lab to blind proficiency tests

(**18-20**). (**4pts each**) 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. **all questions are MTF**

(A) explicit protocol   (C) standards   (E) blind
(B) replication   (D) random

18. Phase III clinical trials of drug efficacy typically use over a thousand patients. Half are randomly assigned to receive the treatment, half to receive a placebo. Blood tests are done by a lab that does not know the status of the patients but ensures data quality by subjecting its staff to blind proficiency tests.

(A)   (B)   (C)   (D)   (E)   **MTF**

19. Before subjecting your employees to drug tests, you decide to test the accuracy of the testing lab. You take a sample from yourself, split it into 3 tubes, each with completely different identifying information, and send all of them off for testing by the same lab. MTF

(A)   (B)   (C)   (D)   (E)   **MTF**

20. A professor wants to know whether ending a lecture with an unsolved problem increases attendance for the following lecture. On odd-numbered class days, she ends lecture with an unsolved question, even-numbered days does not; attendance is recorded for each of the following lectures. Her class is not told the purpose of this study, or even that the study is being conducted.

(A)   (B)   (C)   (D)   (E)   **MTF**

DNA and Criminal Justice

The following true statement applies to the next 2 questions. *We mentioned 4 features of an 'ideal' forensic method for matching a suspect with a forensic sample: (i) reference database, (ii) discrete characteristics, (iii) independent verification possible, (iv) labs/experts pass blind proficiency tests.*

21. (5 pts) For which types of matching method was it claimed (in the book and/or lecture) that the procedure satisfied at least 3 of the 4 features of an ideal forensic method ? **MTF**

A) Fingerprinting (before 1990)   D) Dog sniffing   G) Bite mark identification

B) Fingerprinting (after 2000)   E) Hair matching (not DNA based)

C) DNA typing   F) Shoe print identification

22. (5 pts) For which types of matching method was it claimed (in the book and/or lecture) that error rates exceeded 10% or were otherwise unreliable or discredited? **MTF**

A) Fingerprinting (before 1990)   D) Dog sniffing   G) Bite mark identification

B) Fingerprinting (after 2000)   E) Hair matching (not DNA based)

C) DNA typing   F) Shoe print identification

23. (5pts) Combining sources of error in wrongful matches. A match has been declared between a forensic sample and a suspect. The RMP (random match probability) is 1 in a million (= 0.000001). It has further been revealed that, through its own mistakes, the lab wrongfully declares matches 1 in 20 times (0.05). In addition, it has been revealed that the crime scene specialists sometimes mix up samples even before sending them to the lab; this mixup by itself leads to an erroneous match at a rate of 1 in 1000 (0.001). There are thus 3 separate reasons why a suspect may not be the source of a sample when a match is declared. Given these data, what is the chance that the suspect is not the source of the sample?

Choose the answer closest to correct – the exact answer is not listed. **One answer only.**

> A) 1 in ten (0.1)
>
> B) 1 in 20 (0.05).
>
> C) 1 in a thousand (0.001)
>
> D) 1 in ten thousand (0.0001)
>
> E) 1 in a million (0.000001)
>
> F) You cannot combine error rates from different sources

24-26. (5 pts each). New methods of sample matching have just been introduced into court, as described below. Which of the 4 features of 'ideal forensics' are indicated as being present? For 'independent verification' it is meant that the method has the characteristics such that independent verification is feasible. **MTF for all**

24. The method matches a knife blade to a stab wound. The blade and wound are each scored for 12 unambiguous characteristics. The person who has developed the method –Jerry Coyne - has published a protocol for scoring, but no one else is able to repeat the scoring. Jerry defends his method in court, pointing out that since the trial is the first use of his method, no one has identified anything wrong with it.

A) reference database B) discrete characteristics C) Independent verification D) pass blind proficiency tests **MTF**

25. A new hair identification method uses the abundances of trace chemical compounds as a type of chemical 'fingerprint' for matching samples. The match is based on similarity of profiles, not identity, because the chemical signatures are quantitative (measured to many decimal places). The method introduced in a court case claims that hair from the suspect matched forensic samples, but neither the suspect's hair nor forensic hair matched over 1000 profiles obtained from the population. The chemical fingerprinting method uses just one (expensive) piece of equipment that is found in many chemistry labs, and is obtained from one of the automated runs programmed into the machine at the factory. The statistical analysis uses a package that is widely available from a company called SAS. The company performing the test and providing the evidence in this case routinely processes standards (unknown to the technicians) and has so far gotten the standards correct every time.

A) reference database B) discrete characteristics C) Independent verification D) pass blind proficiency tests **MTF**

26. 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's car 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? **MTF**

A) reference database   B) discrete characteristics   D) independent verification possible D) pass blind proficiency tests

27. (4 pts.) Exam Key Code: **Fill in bubbles (AB)** on question 27 to indicate your exam code; leave the other bubbles blank. Also, fill in the correct <u>bubbles</u> for your name and EID on the scantron form.

  You must turn in this hard copy (with your name on it) and your scantron to receive credit for this exam.