

**GROUND RULES:**

- **Print** your name clearly at the top of this page.
- This is a closed-book and closed-notes exam. You can not use external notes of any kind. You may use a calculator.
- This exam contains **two parts**:
  - Part 1. Multiple Choice. 20 questions, 1 point each (20 points total)
  - Part 2. Short Answer. 5 questions, 6 points each (30 points total).

This exam is worth 50 points.

- Any discussion or inappropriate communication between you and another examinee, as well as the appearance of any unnecessary material, will result in a very bad outcome for you (it will be very bad).
- You have **75 minutes** to complete this exam.

**HONOR PLEDGE FOR THIS EXAM:**

After you have finished the exam, please read the following statement and sign your name below it.

*I promise that I did not discuss any aspect of this exam with anyone other than the instructor, that I neither gave nor received any unauthorized assistance on this exam, and that the work presented herein is entirely my own.*

**MULTIPLE CHOICE.** Circle the best answer. Make sure your answer is clearly marked. Ambiguous responses will be marked wrong.

1. The progress of a type of cancer differs in women and men. A clinical experiment to compare 4 therapies for this cancer acknowledges this fact and randomizes subjects to therapies within each gender separately. In this situation,

- (a) the therapies are the blocks and genders are the treatments.
- (b) the therapies are the treatments and the genders are the blocks.

2. What positive outcome occurred after the **Tuskegee syphilis experiment** ended?

- (a) Randomization, control, and replication emerged as accepted experimental design principles.
- (b) The US government started to require that human subjects research would adhere to strict ethical standards.
- (c) The World Health Organization was created.
- (d) Schools in the United States were allowed to discuss safe sex practices in health classes.

3. At a recent grant review panel on cancer clinical trials, one panel member (i.e., me) said that “the investigators have yet to obtain approval from their institutional review board.” What was the underlying point of my objection?

- (a) The authors had not provided evidence that the risk to study participants would be minimized.
- (b) The authors had not described how their sample sizes would be able to find statistically significant results.
- (c) The authors had not ensured that all confounding variables would be eliminated.
- (d) The authors had not described if their trial would be multi-center or housed all at one common location.

4. In 2014, there were 2,823 firearm deaths in Texas and 69 firearm deaths in Vermont. However, the **rate** of firearm deaths per 100,000 inhabitants was very similar for each state. Why is this?

- (a) The two states have different criteria on what exactly classifies as a “firearm death.”
- (b) The rates for all 50 states are forced to be similar because of national laws requiring equality of funding.
- (c) The population sizes of Texas and Vermont are different.
- (d) The number of firearm deaths has predictive validity to measure risk of death. Rates do not.

5. What is the **main difference** between Phase II and Phase III clinical trials?

- (a) Phase II trials use double-blinding. Phase III trials do not.
- (b) Phase II trials establish the correct dosing amount. Phase III trials modify the dose amount on a per-subject basis.
- (c) Phase II trials use a small number of subjects. Phase III trials use a large number of subjects.
- (d) Phase II trials use voluntary response samples. Phase III trials use simple random samples.

6. I read this statement on a media web site:

*Government has increased medical consultation fees for general practitioners by one hundred percent, state media has reported.*

What does this mean?

- (a) Medical consultation fees have increased by 100 dollars per practitioner.
- (b) This statement does not make sense. It is not possible for a quantity to increase by 100%.
- (c) Medical consultation fees have doubled.
- (d) Medical consultation fees have increased by 100 times their previous amount.

7. According to the National Household Survey on Drug Use and Health, 31% of adolescents used alcohol in 2008, 12% used marijuana or hashish, 18% used cigarettes, and 1% used cocaine. Why should we **not** use a pie chart to display these data?

- (a) Drug use is a quantitative variable.
- (b) The percentages are not ordered from low to high.
- (c) A line graph would be more appropriate.
- (d) The numbers do not add to 100%.

8. Which **graphical display** should we use to display the number of deportable (illegal/undocumented) immigrants caught by the United States Border Patrol each year during 1971-2016? We would like to see if the trend is increasing, decreasing, or if it remains the same over time.

- (a) boxplot
- (b) histogram
- (c) line graph
- (d) stemplot

9. In class, we discussed an experiment (from the 1970s) that took place in a men's public restroom. Investigators installed cameras and placed observers at inconspicuous locations in the restroom so they could observe the behavior of men and their bathroom-use practices. For example, they noted which urinal each man picked and how long it took for men to start and finish urinating. Men using the restroom were never aware that this study was taking place.

This experiment would not be approved today by any institutional review board. Why?

- (a) Information on one men's public restroom does not give a sufficient amount of information on bathroom-use practices for a larger population.
- (b) There is no control group; therefore, investigators have no basis for a statistical comparison.
- (c) Stall choice and urination times are examples of variables that do not have predictive validity.
- (d) Men using the restroom did not agree beforehand to participate in the study.

10. Congress wants the medical establishment to show that progress has been made in fighting cancer between 1970 and 2016. What is a **valid** way to measure this property?

- (a) Record the total number of deaths from cancer each year.
- (b) Record the percentage who die from cancer each year.
- (c) Record the percentage of cancer patients who survive for at least 5 years. Do this in 1970 and again in 2011.
- (d) None of these variables are a valid representation of progress made.

11. What is a **matched-pairs** experiment?

- (a) It is an experiment that matches control subjects with experimental subjects.
- (b) It is an experiment where subjects are randomly assigned to one of two treatments.
- (c) It is an experiment where each subject provides two responses; one to one treatment, and one to another.
- (d) It is an experiment where each subject appears in two blocks.

12. A large-scale Phase III clinical trial will study a new drug treatment for breast cancer. Before the trial is approved, the director of the trial must demonstrate that she and her research team cannot say with certainty how the new drug will compare to the currently used drug. This is known as

- (a) control.
- (b) equipoise.
- (c) informed consent.
- (d) blocking.

13. What does the **distribution** of a variable tell us?

- (a) Whether the variable is measured with bias and random error.
- (b) What values the variable takes and how often it takes these values.
- (c) Whether the variable has predictive validity.
- (d) What sampling design was used to measure the variable.

14. During the 5th set of this year's Australian Open final between Roger Federer and Rafael Nadal, ESPN displayed the results to the question, "Who do you think will win?" Viewers used the internet to answer this question. At one point, the results posted on the screen were

Federer: 60%    Nadal: 44%

What is **wrong** with these results?

- (a) The results were based on multiple simple random samples; not a single one.
- (b) Because of the 16 hour time change between here and Melbourne, we should not trust the results due to time delay.
- (c) Percents are biased measures of a property. Percentage changes should be used.
- (d) The numbers simply do not make sense.

15. In a Phase III clinical trial evaluating the effects of enzalutimide to treat men with metastatic prostate cancer, the researchers concluded from their trial,

*"Data showed enzalutamide exhibited a statistically significant benefit in overall survival compared to placebo."*

Suppose the positive benefits of enzalutamide did not carry over to the larger population of metastatic prostate cancer patients. That is, when the drug was introduced to all patients, the benefits of enzalutamide disappeared. This is an example of

- (a) non-adherence.
- (b) blocking.
- (c) a lack of realism.
- (d) replication.

16. True or False. A histogram can be used to display the distribution of a **quantitative** variable.

- (a) True
- (b) False

17. In class, we discussed the **Michael LaCour gay-marriage experiment**. The article describing this experiment was published in *Science* but later was retracted. What happened?

- (a) The journal *Science* accepted the paper by accident. After correcting their mistake, this caused a media uproar on academic publication bias.
- (b) The research team failed to provide the names of the subjects used in the experiment.
- (c) The results were thought to be statistically significant. However, there were serious sampling errors discovered after the fact.
- (d) None of the above.

18. When we did the FATHERLY FRIENDLY FARMS example in class, one student counted the number of F's to be 28, 35, and 43. The true number of F's is 48. This student's measurements suffered from

- (a) bias only.
- (b) random error only.
- (c) bias and random error.

19. Members of an advocacy group in Washington DC (e.g., for the environment, etc.) state that "the world's rainforests are being decimated at a 10% increase each year." This figure is soon after reported in a *New York Times* editorial and then later on Anderson Cooper's 8:00pm CNN show. Policy makers in Washington DC soon after cite this statistic when lobbying Congress for more EPA funding, and the UN's environmental group presents this statistic to world leaders throughout Asia and South America.

All the while, the "10%" statistic was based on faulty information. What did we call this type of statistic; i.e., one that comes from an unreliable source and then spreads?

- (a) a lachrymose statistic
- (b) a mutant statistic
- (c) a proliferative statistic
- (d) a recalcitrant statistic

20. Which of the following variables is best regarded as **categorical**?

- (a) birth weight
- (b) gestational age
- (c) time to discharge
- (d) nutrition type

**SHORT ANSWER.** Give detailed responses. Please write clearly and legibly.

1. Three hundred children, aged 6-17, will participate in a randomized experiment to compare three painkillers:

- **Group 1:** Ibuprofen
- **Group 2:** Acetaminophen
- **Group 3:** Codeine.

A standard dose of each drug will be administered.

- (a) Outline the design of the experiment as a completely randomized design. Provide as many details as possible (including how you would carry out the randomization).
- (b) What should the response variable be? Describe precisely how this would be measured on each child.
- (c) Is your response variable in part (b) quantitative or categorical? Explain.

2. In class, we discussed the unethical research investigation at Duke University involving Dr. Anil Potti. We also watched a 60 Minutes story on this investigation.

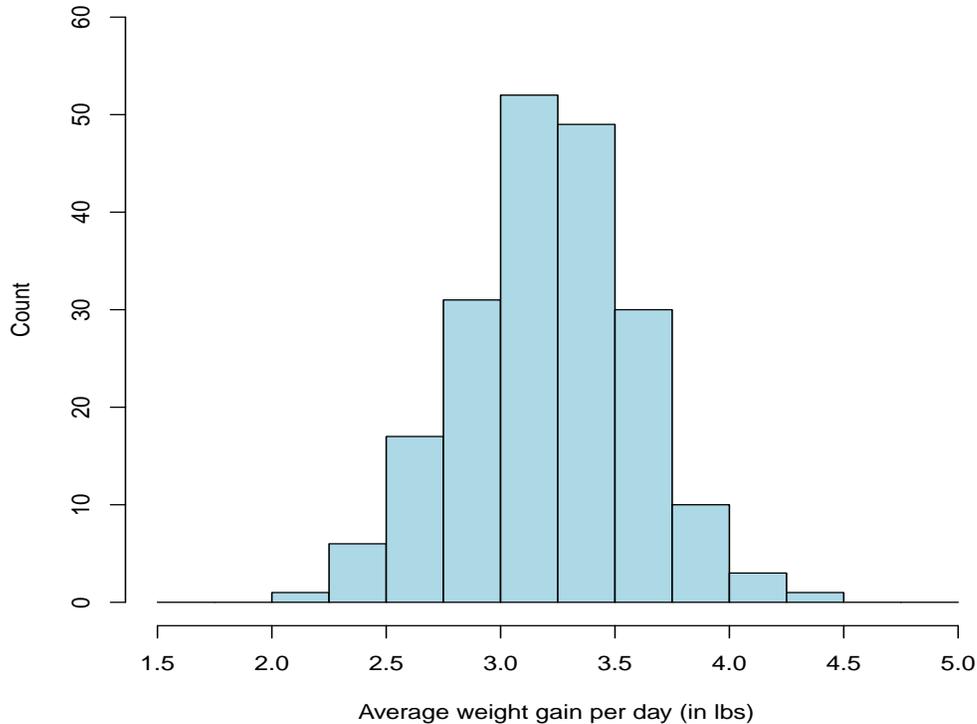
Summarize the 60 Minutes story and our subsequent classroom discussion on this investigation. In particular,

- What research hypothesis did Dr. Potti propose? In other words, what was the underlying motivation for his research at Duke? Be specific.
- What did Dr. Potti do that was unethical? Be specific.
- What happened as a result of his unethical behavior? Name at least two things.

3. We have used the term “innumeracy,” as described in Joel Best’s book *Damned Lies and Statistics*.

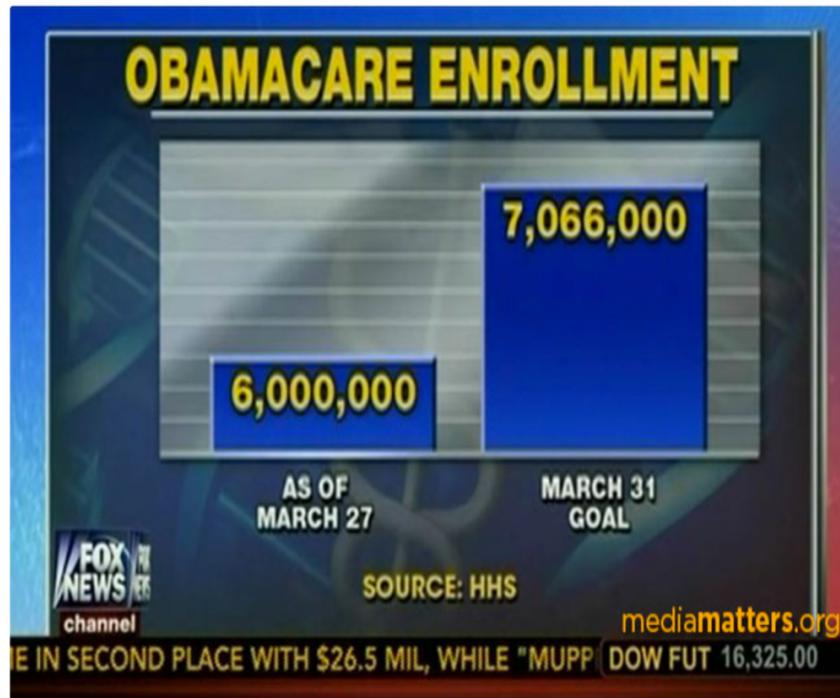
- (a) Explain what innumeracy means.
- (b) Give a real-life example where innumeracy might arise. Your example can be one that we discussed in class or you can make up your own.
- (c) What is Dr. Best’s book about?

4. A new diet was given to a simple random sample (SRS) of  $n = 200$  beef cattle during a test period of 140 days. For each cattle in the sample, researchers recorded the average weight gain per day (in lbs). A histogram of the 200 observations is shown below:



- (a) Describe all of the physical characteristics you see in this histogram. I would like for you to describe **four** characteristics in particular.
- (b) Sketch a graph of what you think the population density curve looks like (please identify/label it clearly). Describe in words what this curve represents.

5. In March 2014, Fox News displayed this graph on one of its nightly programs:



- (a) Explain why this is not a good graph to display this information.
- (b) If the numbers in the figure are correct and the March 31 enrollment goal was met, calculate the **percentage increase** in enrollment between March 27 and March 31. You can also use this calculation to answer part (a).