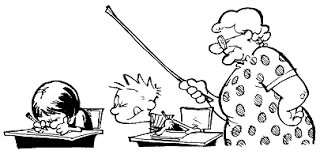
Midterm 1 Instructions

* Turn your cell phones completely off.
* You will have 50 minutes to complete this exam.
* Please legibly write your solutions on your own paper. Be neat.
* Point values appear in [brackets].
* If you have multiple solutions to a problem, I will give credit for the most incorrect solution unless you indicate which solution you want me to grade. Please identify the solution you want graded.
* For non-True/False or Multiple choice problems, you must show your work for full (or partial credit).
* Cell phones, tablets, laptops, etc. are not calculators. Sharing calculators is not permitted. Passing a calculator during the exam will be considered as cheating. See me if you do not have a calculator.
* There are 56 points possible on the exam.

## Integrity Statement

I don’t need to say this but…cheating is not tolerated. Direct or indirect sharing of information (giving or receiving) during this exam is inappropriate. Direct or indirect sharing of information on this exam with others who have not yet taken the exam is inappropriate. Students who violate these rules will be given an F grade and a report will be submitted to the Office of Students Rights and Responsibilities.

Please, make it obvious to me that you are working independently.



Midterm 1 Questions

*Disclaimer: This problem is motivated by data collected from the study described below, but has been modified for the purpose of this exam.*

Last year Dr. Hagobian in the Kinesiology and Public Health carried out a study to investigate the role of Bisphenol A[[1]](#footnote-1) (BPA) in metabolism and endocrine disruption. Forty-four subjects agreed to consume a cookie (a nilla wafer) that was either plain ( = 22), or treated with a moderate dose of BPA[[2]](#footnote-2) ( = 22). Thirty minutes after eating the cookie, they were given a glucose tolerance test to measure their glucose metabolism as well as other blood tests to measure levels of estrogen, pro-insulin, and c-peptide in the blood.

1. One variable measured was the amount of glucose in the blood (mmol/L) (measured 2 hours after the glucose tolerance test was administered).
   1. [2 points] Is this variable **numeric** or **categorical**? *No explanation needed.*
   2. [2 points] If numeric, is this variable inherently **discrete** or **continuous**? If categorical, is this variable **nominal** or **ordinal**? *No explanation needed.*
2. [4 points] Dr. Hagobian needed to put the BPA on a food product for subjects to ingest. He used cookies. Give **two** reasons why all 44 subjects received cookies, not just the 22 who received the BPA.

|  |  |  |  |
| --- | --- | --- | --- |
| Exposure | n | Mean | Std Dev |
| Control | 22 | 7.361 | 1.589 |
| BPA | 22 | 6.350 | 1.646 |

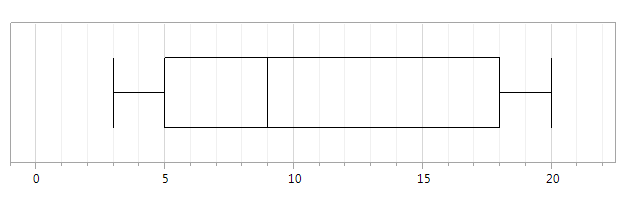
1. [4 points] The table to the right lists summary statistics for blood glucose (mmol/L) for the BPA exposed and control groups. Compute an approximate 95% confidence interval for the mean glucose for **people not exposed** to BPA. *Round your answer appropriately.*
2. [4 points] Why would it *not* be appropriate to refer to the interval you just computed as a 95% confidence interval for the mean glucose for the control subjects *in this study*? *Briefly explain.*
3. [1 point] While you can’t do this by hand, if we used JMP to make a 99% confidence interval, would the resulting interval be **wider** or **narrower** than the interval you computed above? *No explanation needed.*
4. [1 point] If the sample sizes were 50 and 50 instead of 22 and 22 and we used JMP to make a 95% confidence interval, would the resulting interval be **wider** or **narrower** than the interval you computed above? *No explanation needed.*
5. [4 points] Dr. Hagobian was hoping to have more precision in his results. Ideally, he would like to be able to estimate the mean glucose for unexposed people to within 0.4 mmol/L with 95% confidence. If he was planning a future study, how many control subjects should he have? Hint: Approximately what is his desired standard error? *Show your work for full credit.*
6. [4 points] JMP provides the output to the right for the test to compare the blood glucose levels for the BPA exposed and unexposed. Is there evidence that blood glucose is affected when BPA is consumed? *Write a sentence summarizing the conclusions regarding glucose levels and BPA exposure?*
7. [2 points] Considering the output above, is there statistically significant evidence that BPA affects glucose levels at the = 0.05 level of significance? *Briefly explain your reasoning.*
8. [1 point] What type of error could you have made regarding your conclusions in part 9 Type I or Type II? *No explanation needed.*
9. [1 point] If instead 100 subjects were studied (50 in each group) would the chance of the error described in part 10 *increase*, *decrease*, or *stay the same*? *No explanation needed.*
10. [4 points] Healthy glucose values after a 2-hour glucose tolerance test are usually around 7 mmol/L for the type of glucose tolerance test Dr. Hagobian is using. A 10% shift (a change of 0.7 mmol/L) would be considered medically important. Do the results shown above suggest BPA causes such a shift? *Use the results from the output above to support your answer.*
11. [2 points] Dr. Hagobian is trying to determine if consuming BPA can *affect* glucose metabolism. He’s doing this by feeding some people BPA laced food and others “clean” food. Another approach would be to conduct the glucose test on many subjects and also ask them about their recent history of BPA exposure (e.g., whether they drink out of plastic bottles, eat certain packaged foods, use certain cosmetic products etc.). He could then compare the glucose levels of people with high BPA exposure to low BPA exposure. There is an important reason why he did not do this. What is that reason?
12. [4 points] To verify that consumption of BPA was really getting into the bloodstream, Dr. Hagobian also measured **blood BPA levels** (ng/ml) 30 minutes after eating the cookies. The JMP output to the right displays an analysis of the data. The p-value from the t-test output seems to suggest that he is successful getting BPA into the blood. Do you agree that this analysis can be used to support that conclusion? *Briefly explain.*
13. [4 points] The mean **insulin level** for healthy individuals is 65 μU/ml with individuals mostly ranging (95%) from 26 to 104 μU/ml. Assuming insulin levels roughly follow a bell-shaped curve, would it be unusual to obtain a random sample of 22 healthy subjects with a sample mean insulin below 50? *Show calculations or graphs to support your answer.*
14. [6 points, 1 each] Another variable studied was c-peptide (pmol/L). The 95% confidence interval for , the difference in population mean c-peptide for the two exposures was computed to be (–560, 70) pmol/L. Indicate True or False for each of the following statements. *No explanations are needed.*  
    1. True or False? The interval provides compelling evidence that, on average, the mean c-peptide concentration for those exposed to BPA will be no different from those unexposed.
    2. True or False? Because the interval is more negative, there is compelling evidence that, on average, the mean c-peptide concentration will be greater for those unexposed compared to those exposed.
    3. True or False? 95% of the time, c-peptide concentrations for those exposed will be 560 pmol/L less to 70 pmol/L more than for those unexposed.
    4. True or False? There is no compelling evidence that the mean c-peptide concentration differs with exposure.
    5. True or False? We’re 95% confident that the population mean c-peptide concentration for exposed people will be between 560 pmol/L less to 70 pmol/L more than the c-peptide concentration for unexposed people.
    6. True or False? If we carried out a non-directional two-sample test to compare the two means, the p-value would be less than 0.05.

*And now for some questions unrelated to this research …*

1. [2 points, 1 each] For each situation below researchers measured the mean height of the sample.

For each question below identify whether the standard error of the mean would be larger for (i), larger for (ii), or about the same for (i) and (ii).

* 1. (i) a sample of ten women aged 18-24, or (ii) a sample of 100 women aged 18-24.
  2. (i) a sample of 20 male college basketball players, or (ii) a sample of 20 college aged men.

1. [4 points, 2 each] Below is a boxplot of some data. 
   1. What is the value of the interquartile range?
   2. Which is larger for these data, the mean or the median, or will they be about the same?

1. BPA is used in many plastics. Some are concerned about its presence in plastics that make contact with food and drinks because of the potential exposure hazards of ingestion and our incomplete understanding of any risks associated with ingestion. [↑](#footnote-ref-1)
2. The dose was considered safe according to US and European guidelines for exposure in food. [↑](#footnote-ref-2)