1920S MA482

Criteria for Successfully Completing an Analysis Task

An Analysis Task is an opportunity to apply the methodology we are discussing to problems similar to the homework as well as address key concepts discussed in the course.

Note: you may collaborate with another individual. See the **Guidelines for Appropriate Collaboration** to prevent committing academic misconduct. You are responsible for all answers submitted; the instructor reserves the right to require an oral examination over the answers submitted to ensure the work is that of the student.

General Instructions:

During the course of your analysis, you may use any resource available to you - including the internet, texts, notes, etc. If you consult with an individual who provides an idea you follow-up on, that person should be given credit in the text with an appropriate citation. You are responsible for all the work you submit, and the instructor reserves the right to hold an oral examination over the assignment to assess your knowledge of the work submitted.

An analysis task is similar to a homework assignment in that you will be responding to a series of prompts. Unlike a homework assignment, the validity of your answers is relevant to determining the grade on the assignment.

Criteria:

An analysis task is comprised of 5 "essay" or "short answer" type questions. Each question will be marked on a rubric out of 2 potential points. The rubric (discussed below) ensures that both your analysis as well as the clarity of the presentation are of an acceptable caliber. In order to successfully complete the analysis task, you must adhere to the following criteria:

- You must obtain at least 9 points on the assignment.

Essay (or "short answer") questions can be challenging because a part of you feels like writing a book report and "throwing up on the page" (stating every vocab word you have ever heard of in hopes of saying something close to the right answer for enough credit) and keeping it short and sweet when you think a single sentence explains your thoughts. Fundamentally, an instructor can only grade what you communicate, and a large part of this class is communicating often difficult concepts. There are different things that need to be communicated based on the type of question. Therefore, this page provides a guide both in how your essay questions will be graded but also in how to best answer those questions. The page is divided by the type of question that you might be asked.

Computation Questions:

Computation questions are those which ask you to provide a value (or set of values), using the computer to produce the values.

- Relevant computer code/output should be provided (or a sufficient justification of the steps performed by hand to reach the value requested).
- The value requested must be highlighted in the output or restated.

Graphical Summary:

Graphical summaries are when we request the raw data be summarized appropriately.

- The graphic provided addresses the question of interest.
- The x-axis is clearly labeled.
- The y-axis is clearly labeled.
- The legend has clear labels.
- Any additional requests made in the directions are provided (such as the use of color, etc.). A common request is that you describe the graphic:
  - A description should be given *in context* of the problem; that is, it should describe what story the graphic communicates about the data and research question.

Definition/Identification Statements:

Definition/Identification statements are those which ask you to identify some component of the problem (e.g., the population, the parameter, the test statistic from the provided output, etc.).

- If a value is requested, the value must be correctly identified.
- If a definition is requested, the definition must accurately reflect the technical definition and not include inaccurate statements.
- If you are to identify a component of the context (population, parameter, etc.), the component must be accurately defined without leaving out (or adding in) details that would fundamentally change the scope of the problem.

Hypotheses:

Hypotheses are the mathematical translation of the question of interest.

- All mathematical symbols must be defined.
- Unless previously defined in another problem, the parameter must be defined/present within the hypotheses.
- The correct equality term within the null hypothesis must be used.
- The correct strict inequality within the alternative hypothesis must be used.
- The hypotheses must accurately reflect the question of interest.

Conclusions:

Conclusions are those questions which ask you to address a research question using the data or state what can be stated as a result of the analysis.

- A statement about whether there is "evidence" to support the alternative or not (or whether a statement is "reasonable" depending on the question).
- The statement must be **in the context of the problem**. That is, do not use statistical jargon ("reject the null") or mathematical symbols (even if previously defined).
- "Evidence" must be supported by citing a p-value or confidence interval.
- The p-value (or confidence interval) must be appropriately applied.
- A statement must be given how the p-value or confidence interval was used to reach the conclusion.

Assessing Conditions:

Assessing conditions (which occurs during the latter part of the term) asks you to determine if a particular condition is reasonable to assume.

- If a graphic is appropriate and requested, the graphic must adhere to the requirements of a Graphical Summary.
- A statement indicating whether the data is consistent with the condition or not is made (unless **extremely** obvious, this statement need not agree with the instructor).
- A statement about what you observed in the graphic (or context if a graphic is not appropriate).
- A statement about what you expected if the data were consistent with the condition.
- The response has consistent logic.

Justification Questions:

Justification questions are those other open-ended questions which ask for a "justification" or "explanation." These generally ask you to agree/disagree with a statement or answer a question and then justify your position.

- The response should answer the question posed.
- The response should supply relevant facts from the context.
- The response provides implications of those facts based on the course content.
- The response links implications to the answer.
- The response does not include irrelevant facts.
- The response uses logic which is correct.

In order to ensure your written solutions address the above requirements, it is helpful to keep in mind the following guide (illustrated early on in class) regarding how to approach such questions:

1. Sentence 1: answer the question.
2. Sentence 2: supply the appropriate facts from the context.
3. Sentence 3: discuss the implications of these facts and how they **lead** to the answer.

Edit Questions:

Edit questions are those in which an incorrect statement has been given and you are asked to correct the statement.

- The correction provided must exceed negating the current statement.
- The correction must result in an accurate statement.

- The correction must accurately reflect the intent of the original statement (what the person was trying to say but messed up).
- The correction must not include inaccurate components.

Rubric:

Every question on an exam, regardless of the category specified above, will be graded on the following 2-point scale:

- 2 - Complete response
  - A response that adheres to all requirements for the corresponding type of question as described above.
  - No additional incorrect information is provided.
- 1 - Substantial response
  - A response which adheres to nearly all requirements for that type of question.
  - This often is the result of *one* of the following: leaving out a small piece of information, not linking thoughts together fully, making a minor error in the misuse of words while keeping intent intact, or adding incorrect information.
- 0 - Insufficient response
  - A response which adheres to less than half the requirements for that type of question.
  - This is often the result of misunderstanding the problem or misapplying concepts from the class.
  - This could include leaving out a critical piece of information, not linking thoughts together, making a major error in the misuse of terminology fundamentally changing the intent of the response, or making contradictory statements.
  - This could also be the result of making several minor errors, which individually are not problematic, but made together result in a response that does not demonstrate mastery of the course content.

Answering questions under this framework requires you to adjust your mindset. Your goal is not simply "get as many points as possible" as in other courses. Such thinking encourages you to put anything down in hopes of partial credit. Instead, to be successful in this course requires you to demonstrate mastery. Instead of being "okay" at everything, you want to be "really good" at a few things.

Examples:

The above is best understood in action. We provide example responses to the various types of questions based on a similar context. Consider the following problem set-up:

Brachydactyly Type D (commonly known as "clubbed thumb" or "stubby thumb") is a harmless genetic condition in which one or both thumbs are shorter with a wide nail. Research suggests approximately 2 percent of the population suffers from this condition (among them, Megan Fox and your instructor). Suppose that we are interested in determining if the proportion of current Rose-Hulman students who have this condition exceeds 2%. During their annual physicals, we examine the men on the football team, basketball team, and track team; for each student, we record whether he has the condition. The data is available in the data set **`example`** is constructed below.

```
example = data_frame(
  Student = seq(50),
  Status = rep(c("Has Condition", "Does not Have Condition"), times = c(2, 48)))
```

Consider the following **computation question**:

What fraction of the students observed have *the condition of interest?*

Now, consider the following responses:

1. ```
   summarize_variable((Status == "Has Condition") ~ 1, data = example, percent)
   ```
   - The observed proportion is 0.04.
2. 0.04
3. ```
   summarize_variable((Status == "Does not Have Condition") ~ 1, data = example, percent)
   ```
   - The observed proportion is 0.96.

For the above question, response (1) is the correct solution and would receive a 2. It has the correct numerical solution, and it clearly justifies the solution with appropriate code. It also highlights the answer from the code (which is especially useful when the code returns more than just the answer provided).

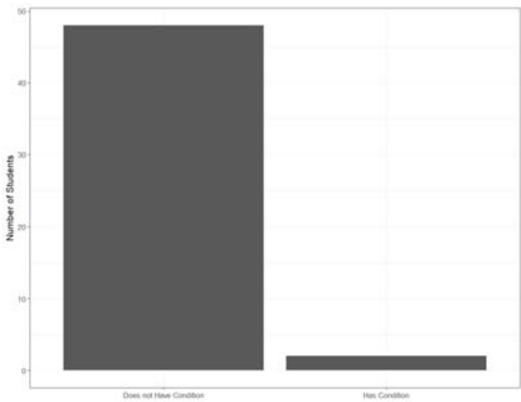
Response (2) has the correct numerical solution, but there is no justification for its computation (computer code/output). Therefore, it would receive a 0.

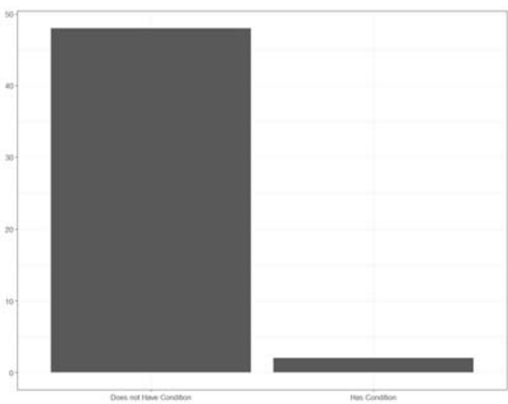
Response (3) has the correct idea but simply misread the problem. This does not fundamentally change the intent of this question (which is determined by the instructor) and therefore would receive a 1.

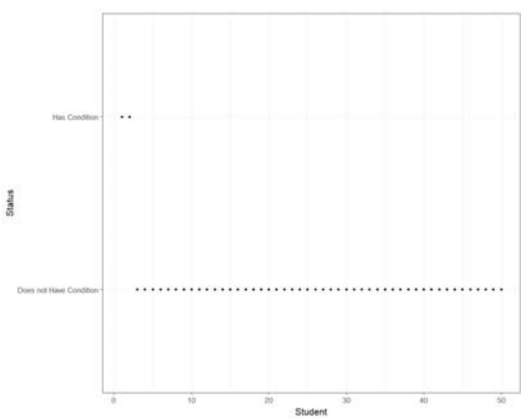
Consider the following **graphical summary**:

Provide a graphical summary of the raw data which would help address the question of interest.

Conser the following graphics:

1. 

2. 

3. 

For the above question graphic (1) would receive a 2. The graphic summarizes the distribution of the variable in the sample which is needed to answer the question. The axes are clear.

The second graphic, while similar to the first, does not provide a clear label on the y-axis. However, that is the only mistake, receiving a 1.

The third graphic is not an appropriate summary given the type of data (categorical and not quantitative). Further, neither label is clear. This would receive a 0.

Consider the following **definition/identification statement**:

Define the parameter of interest in this study.

1. The proportion of current Rose-Hulman students who have the condition.
2. The proportion.

3. The number of Rose-Hulman students who have the condition.
4. 0.04
5. Whether a Rose-Hulman student has the condition.
6. Whether the proportion of current Rose-Hulman students is greater than 0.02.

Response (1) is correct and would receive a 2; it indicates the summarizing component (proportion), the variable (whether they have the condition), and the population (current Rose-Hulman students).

Response (2) leaves out components required to adequately define the parameter; it is not clear what we are taking the proportion of, but it is clear that what is meant by a parameter is understood. This would receive a 1.

Response (3) is nearly correct, but the "number" refers to the statistic not the parameter; however, this fundamentally changes the problem and would therefore only receive a 0.

Response (4) mistakes the sample statistic with the parameter; this would receive a 0.

Response (5) correctly states the variable of interest, but not the parameter. This would receive a 0.

Response (6) would receive a 1; it includes inaccurate information by defining the parameter and embedding the question of interest.

Consider the following **hypotheses** question:

State the null and alternative hypotheses which capture the above question of interest.

1. Let θ be the parameter defined above; then $H_0 : \theta \leq 0.02 \quad \text{vs.} \quad H_1 : \theta > 0.02$
2. H0: the proportion of current Rose-Hulman students who have the condition does not exceed 0.02. H1: the proportion of current Rose-Hulman students who have the condition exceeds 0.02.
3. $H_0 : \theta < 0.02 \quad \text{vs.} \quad H_1 : \theta \geq 0.02$
4. $H_0 : \theta > 0.02 \quad \text{vs.} \quad H_1 : \theta \leq 0.02$
5. H0: whether Rose-Hulman students have the condition is less than or equal to 0.02. H1: whether Rose-Hulman students have the condition is greater than 0.02.

Response (1) is correct and would receive a 2; it references the previous answer and so defines the parameter. The hypotheses are correct and identify the question of interest.

Response (2) is also correct and would receive a 2; while it does not use mathematical notation, the hypotheses contain all the necessary components.

Response (3) would only receive a 1; the inequality is placed within the wrong hypothesis. This may seem subtle, but it is important for the mathematical justification of our analyses.

Response (4) would only receive a 0; the hypotheses are switched for capturing the question of interest, fundamentally changing the question.

Response (5) would only receive a 0; the hypotheses do not contain the parameter of interest (no proportion), violating a fundamental idea of the course.

Consider the following **conclusion:**

Suppose we compute a p-value of 0.264 for the above hypotheses using the data provided. What conclusions can be drawn?

1. There is no evidence that the proportion of current Rose-Hulman students with the condition exceeds 0.02. The p-value of 0.264 is much higher than commonly accepted thresholds such as 0.05.
2. Fail to reject the null because 0.264 > 0.05.
3. There is evidence that the proportion of current Rose-Hulman students with the condition exceeds 0.02 because the p-value is large, and large p-values provide evidence.
4. The proportion of Rose-Hulman students with the condition does not exceed 0.02 (p-value = 0.264).

Response (1) is correct and would receive a 2; it gives the conclusion in context (no jargon) and uses the p-value to justify the conclusion, including why the p-value gives the conclusion.

Response (2) is correct but is not placed in the context of the problem; it would receive a 1.

Response (3) misapplies the p-value; this would receive a 0.

Response (4) gives an inaccurate representation of the conclusion (cannot prove the null hypothesis); it also fails to explain how the p-value was used to reach the conclusion. It would only receive a 0.

Consider the following request to assess the **conditions** of the analysis:

Assuming the data is presented in the order in which it was collected, is it reasonable to assume the data is stationary? Explain.

1. No, it is not reasonable. Looking at a plot of the response over time, there is a clear trend in that the first two respondents had the condition and no one else did after that. If stationarity was met, we would expect there to be no pattern in the plot of the response over time.
2. Yes, it is reasonable. Looking at the plot of the response over time, there is no clear trend in the graphic. This is consistent with what we would expect if the data generating process were stationary.
3. No, it is not reasonable; there was a trend in the plot.
4. Yes, it is reasonable. I can't imagine how the condition of one individual could be related to another person having the condition.
5. Looking at a plot of the response over time, there is a clear trend in that the first two respondents had the condition and no one else did after that. If stationarity was met, we would expect there to be no pattern in the plot of the response over time.

Responses (1) and (2) are both deserving of a 2. Notice that they come to different conclusions, but given that this is a very subjective interpretation of the graphic (which is not clear cut), either answer is appropriate. Both are consistent in their logic and give the answer, discuss the trends observed in the graphic and what they expected.

Response (3) is only deserving of a 1. It does not describe what should be expected; therefore, the impact of the trend they observed is not clear.

Response (4) is only deserving of a 0. It does not rely on the course content and an appropriate method for assessing the condition.

Response (5) is only deserving of a 1. While it has two correct statements, it does not actually answer the question; the conclusion is not obvious.

Note: if this were an Analysis Task, you would also need to provide the graphic being referenced in the response.

Now, consider the following **justification question**:

Would you trust the conclusions of this study? Explain.

1. No, I would not trust the results. The study only examined male athletes. This is most likely not a representative sample of the population (which was all students) as it is entirely possible females are more or less likely to have the condition.
2. No, I would not because the p-value was high.
3. No, because this is not a random sample.
4. This is most likely not a representative sample of the population (which was all students) as it is entirely possible females are more or less likely to have the condition.

Response (1) would warrant a 2. It addresses the question posed; it then describes what in the problem is important for coming to their conclusion. Then, the third sentence describes why that is important.

Response (2) would receive a 0. It uses incorrect logic; high p-values do not mean that the study is not trustworthy.

Response (3) would receive a 0. While the statement is correct, the reason the observation is important is not clearly explained. A lack of random sampling is not always bad.

Response (4) has a correct discussion but does not actually answer the question posed; their conclusion is not clear. Therefore, it would receive a 1.

Now, consider the following **edit question**:

A coach for the men's athletic teams comes across the resulting p-value and states "we have evidence that no more than 2% of male athletes have clubbed thumb." This statement is incorrect; provide a corrected statement.

1. We do not have evidence that more than 2% of male athletes have clubbed thumb.
2. The data is consistent with no more than 2% of male athletes have clubbed thumb.
3. We do not have evidence that no more than 2% of male athletes have clubbed thumb.
4. We have evidence that more than 2% of male athletes have clubbed thumb.
5. In our sample 4% of male athletes had clubbed thumb.

Responses (1) and (2) would both receive a 2. While phrased differently, both responses give accurate statements reflecting the goal of the problem.

Response (3) would receive a 1. While the statement is accurate, it is simply a negation of the current statement, not a truly corrected statement.

Response (4) would receive a 0. This statement is also inaccurate as it misapplies the p-value (since the p-value was large).

Response (5) would receive a 0. While a true statement, this statement does not try to reflect the intent of the original statement, which was to interpret the p-value.

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