Wednesday, February 27, 2019

- Warm-up
  - A new vaccine was recently tested to see if it could prevent the painful and recurrent ear infections that many infants suffer from. *The Lancent*, a medical journal, reported a study in which babies about a year old were randomly divided into two groups. One group received vaccinations; the other did not. During the following year, only 333 of 2455 vaccinated children had ear infections, compared to 499 of 2452 unvaccinated children in the control group.
    - Check conditions for inference
    - Find a 95% confidence interval for the difference in rates of ear infection.
- Check Homework
- A little practice and spot-check

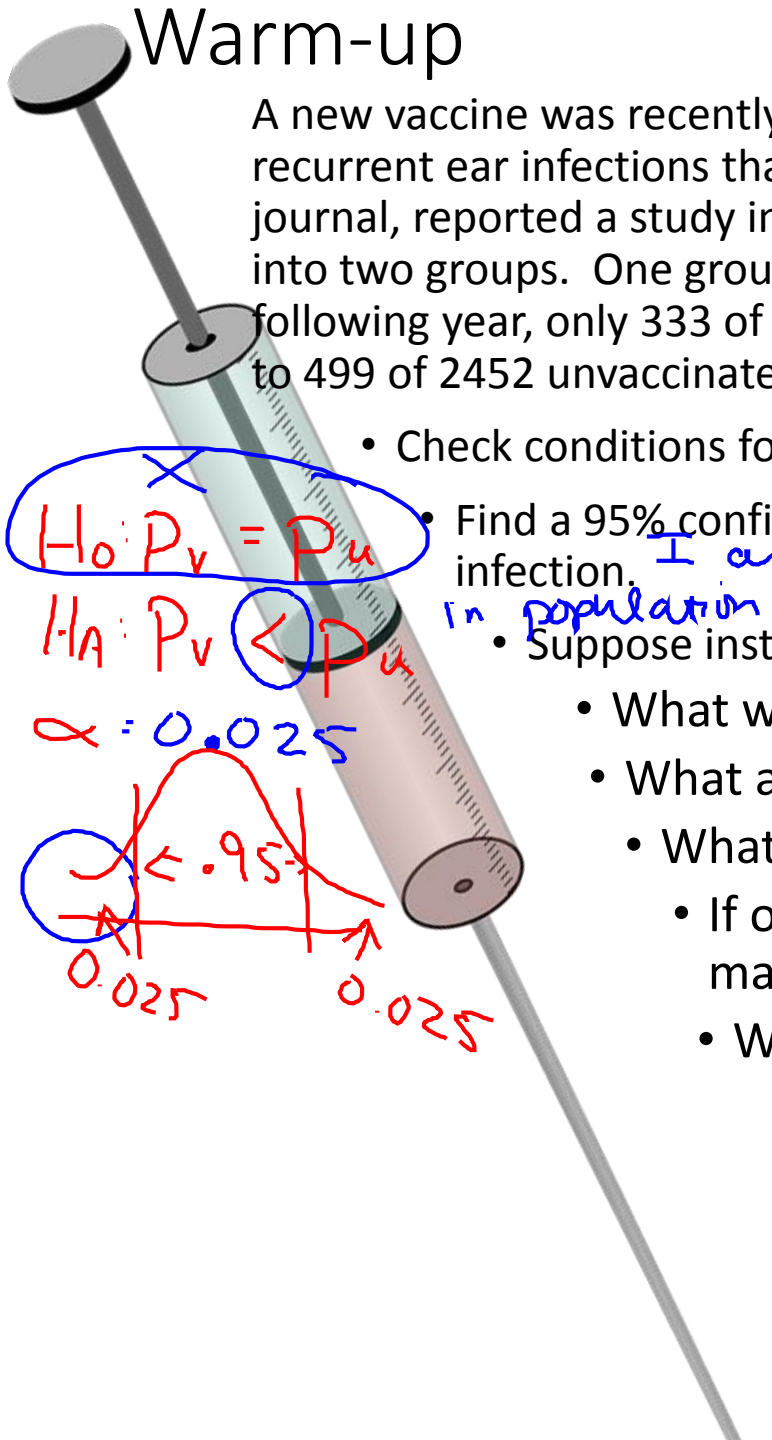
Objectives

- Content Objective: I will calculate and interpret two sample intervals and significance tests sample proportions.
- Social Objective: I will listen well and participate in class.
- Language Objective: I will read questions carefully and answer them fully while explaining my reasoning clearly.

Warm-up

A new vaccine was recently tested to see if it could prevent the painful and recurrent ear infections that many infants suffer from. *The Lancent*, a medical journal, reported a study in which babies about a year old were randomly divided into two groups. One group received vaccinations; the other did not. During the following year, only 333 of 2455 vaccinated children had ear infections, compared to 499 of 2452 unvaccinated children in the control group.

- Check conditions for inference
- Find a 95% confidence interval for the difference in rates of ear infection.
- Suppose instead we conducted a hypothesis test
  - What would our hypothesis be?
  - What alpha level did we use?
    - What conclusion could we make?
      - If our conclusion is wrong, what type of error did we make?
        - What would be the consequences of the error?



Randomly assigned

2 prop confidence interval
(-0.08, -0.046) 0.068 ± 0.020

I am 95% confident that the true difference in population proportion of ear infections between vaccinated & unvaccinated children is 6.8% ± 2%.

p-value 1.19E-10

I

April 3
Mock Exam
2nd MC
4th FR

"FRAPPY"

{Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Researchers want to determine whether drivers are significantly more distracted while driving using a cell phone than when talking to a passenger in the car. In a study involving 48 people, 14 people were randomly assigned to drive in a driving simulator while using a cell phone. The remaining 24 were assigned to drive in the driving simulator while talking to a passenger in the simulator. Part of the driving simulation for both groups involved asking drivers to exit the freeway at a particular exit. In the study, 7 of the 24 cell phone users missed the exit, while 2 of the 24 talking to a passenger missed the exit.

Scoring:

(a) Would this study be classified as an experiment or an observational study? Provide an explanation to support your answer.

E P I

(b) State the null and alternate hypotheses of interest to the researchers.

E P I

(c) One test of significance that you might consider using to answer the researchers' question in a two-sample z-test. State the conditions required for this test to be appropriate. Then comment on whether each condition is met.

E P I

(d) Using an advanced statistical method for small samples to test the hypotheses is part (b), the researchers report a p-value of 0.0683. Interpret, in everyday language, what this p-value measures in the context of this study and state what conclusion should be made based on this p-value.

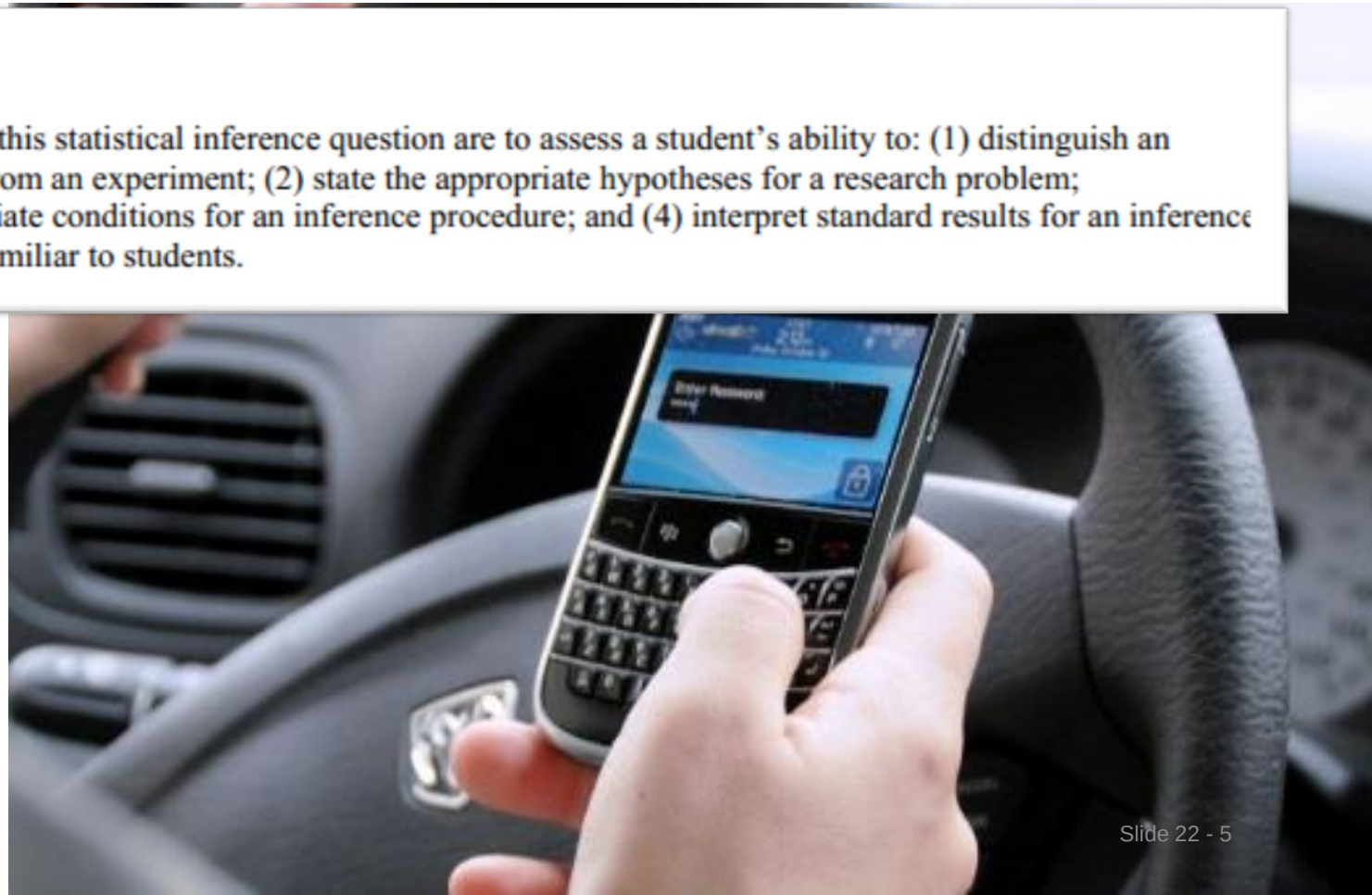
E P I

FRQ

5. Researchers want to determine whether drivers are significantly more distracted while driving when using a cell phone than when talking to a passenger in the car. In a study involving 48 people, 24 people were randomly assigned to drive in a driving simulator while using a cell phone. The remaining 24 were assigned to drive in the driving simulator while talking to a passenger in the simulator. Part of the driving simulation for both groups involved asking drivers to exit the freeway at a particular exit. In the study, 7 of the 24 cell phone users missed the exit, while 2 of the 24 talking to a passenger missed the exit.

Intent of Question

The primary goals of this statistical inference question are to assess a student's ability to: (1) distinguish an observational study from an experiment; (2) state the appropriate hypotheses for a research problem; (3) check the appropriate conditions for an inference procedure; and (4) interpret standard results for an inference procedure that is unfamiliar to students.



5. Researchers want to determine whether drivers are significantly more distracted while driving when using a cell phone than when talking to a passenger in the car. In a study involving 48 people, 24 people were randomly assigned to drive in a driving simulator while using a cell phone. The remaining 24 were assigned to drive in the driving simulator while talking to a passenger in the simulator. Part of the driving simulation for both groups involved asking drivers to exit the freeway at a particular exit. In the study, 7 of the 24 cell phone users missed the exit, while 2 of the 24 talking to a passenger missed the exit.

   (a) Would this study be classified as an experiment or an observational study? Provide an explanation to support your answer.

Part (a):

This is an experiment because the researchers imposed treatments by randomly assigning drivers to the two different conditions (simulated driving while talking on a cell phone versus simulated driving while talking to a passenger).

Part (a) is scored as essentially correct (E) if the student indicates that this is an experiment because treatments were imposed.

Part (a) is scored as incorrect (I) if no explanation is provided, or the student says that this is an observational study.

5. Researchers want to determine whether drivers are significantly more distracted while driving when using a cell phone than when talking to a passenger in the car. In a study involving 48 people, 24 people were randomly assigned to drive in a driving simulator while using a cell phone. The remaining 24 were assigned to drive in the driving simulator while talking to a passenger in the simulator. Part of the driving simulation for both groups involved asking drivers to exit the freeway at a particular exit. In the study, 7 of the 24 cell phone users missed the exit, while 2 of the 24 talking to a passenger missed the exit.

(b) State the null and alternative hypotheses of interest to the researchers.

$H_0: p_{cell} = p_{pass}$

$H_A: p_{cell} > p_{pass}$

Part (b):

Let p_{cell} denote the proportion of drivers who miss an exit while using a cell phone and p_{pass} denote the proportion of drivers who miss an exit while talking to a passenger.

H_0: $p_{cell} = p_{pass}$
H_A: $p_{cell} > p_{pass}$

p_1
p_2

Part (b) is scored as essentially correct (E) if the student correctly identifies the two population proportions with the correct hypotheses. Nonstandard notation must indicate reference to population proportions.

Part (b) is scored as incorrect (I) if the student is *clearly* referring to the sample proportions.

$\hat{p}$

5. Researchers want to determine whether drivers are significantly more distracted while driving when using a cell phone than when talking to a passenger in the car. In a study involving 48 people, 24 people were randomly assigned to drive in a driving simulator while using a cell phone. The remaining 24 were assigned to drive in the driving simulator while talking to a passenger in the simulator. Part of the driving simulation for both groups involved asking drivers to exit the freeway at a particular exit. In the study, 7 of the 24 cell phone users missed the exit, while 2 of the 24 talking to a passenger missed the exit.

(c) One test of significance that you might consider using to answer the researchers' question is a two-sample z-test. State the conditions required for this test to be appropriate. Then comment on whether each condition is met.

Part (c):

The conditions required for a two-sample z-test of equal proportions are:
(1) independent random samples or random assignment, and
(2) large sample sizes $\left[n_1 \hat{p}_1 \geq 10, n_1(1-\hat{p}_1) \geq 10, n_2 \hat{p}_2 \geq 10, n_2(1-\hat{p}_2) \geq 10 \right]$.

Random assignment is stated in the stem so the first condition is met. However, the numbers of successes ($n_{cell}\hat{p}_{cell} = 7$ and $n_{pass}\hat{p}_{pass} = 2$) are both smaller than 10, so the large sample condition is not met in this situation. Note: If the student uses the rule of thumb with 10 replaced by 5, then the number of successes for the second sample is still too small.

Part (c) is scored as essentially correct (E) if the student provides both conditions and correctly comments on both.

Part (c) is scored as partially correct (P) if the student provides and correctly comments on only one of the conditions.

Part (c) is scored as incorrect (I) if conditions are provided but no correct comments are given.

5. Researchers want to determine whether drivers are significantly more distracted while driving when using a cell phone than when talking to a passenger in the car. In a study involving 48 people, 24 people were randomly assigned to drive in a driving simulator while using a cell phone. The remaining 24 were assigned to drive in the driving simulator while talking to a passenger in the simulator. Part of the driving simulation for both groups involved asking drivers to exit the freeway at a particular exit. In the study, 7 of the 24 cell phone users missed the exit, while 2 of the 24 talking to a passenger missed the exit.

(d) Using an advanced statistical method for small samples to test the hypotheses in part (b), the researchers report a *p*-value of 0.0683. Interpret, in everyday language, what this *p*-value measures in the context of this study and state what conclusion should be made based on this *p*-value.

Part (d):

Interpretation: Assuming that talking on a cell phone and talking to a passenger are equally distracting (there is no difference in the two population proportions of drivers who will miss the exit), the *p*-value measures the chance of observing a difference in the two sample proportions as large as or larger than the one observed.

Conclusion: Since the *p*-value 0.0683 is larger than 0.05, we cannot reject the null hypothesis. That is, we do not have statistically significant evidence to conclude that using a cell phone is more distracting to drivers than talking to another passenger in the car.

Notice that if we increase the significance level to 0.1, then we could reject the null hypothesis and conclude that drivers are significantly more distracted when using a cell phone.

art (d) is scored as essentially correct (E) if the *p*-value is correctly interpreted *AND* the correct conclusion is provided *AND* context is given.

Part (d) is scored as partially correct (P) if:

i) either the *p*-value is correctly interpreted OR the correct conclusion is provided
AND
ii) context is given.

Part (d) is scored as incorrect (I) if *neither* a correct interpretation of the *p*-value in context *NOR* a correct conclusion in context is provided.

In part (d) if both an α and a *p*-value are given together, the linkage between the *p*-value and the conclusion is implied. If no α is given, the solution must be explicit about the linkage by giving a correct interpretation of the *p*-value or explaining how the conclusion follows from the *p*-value.

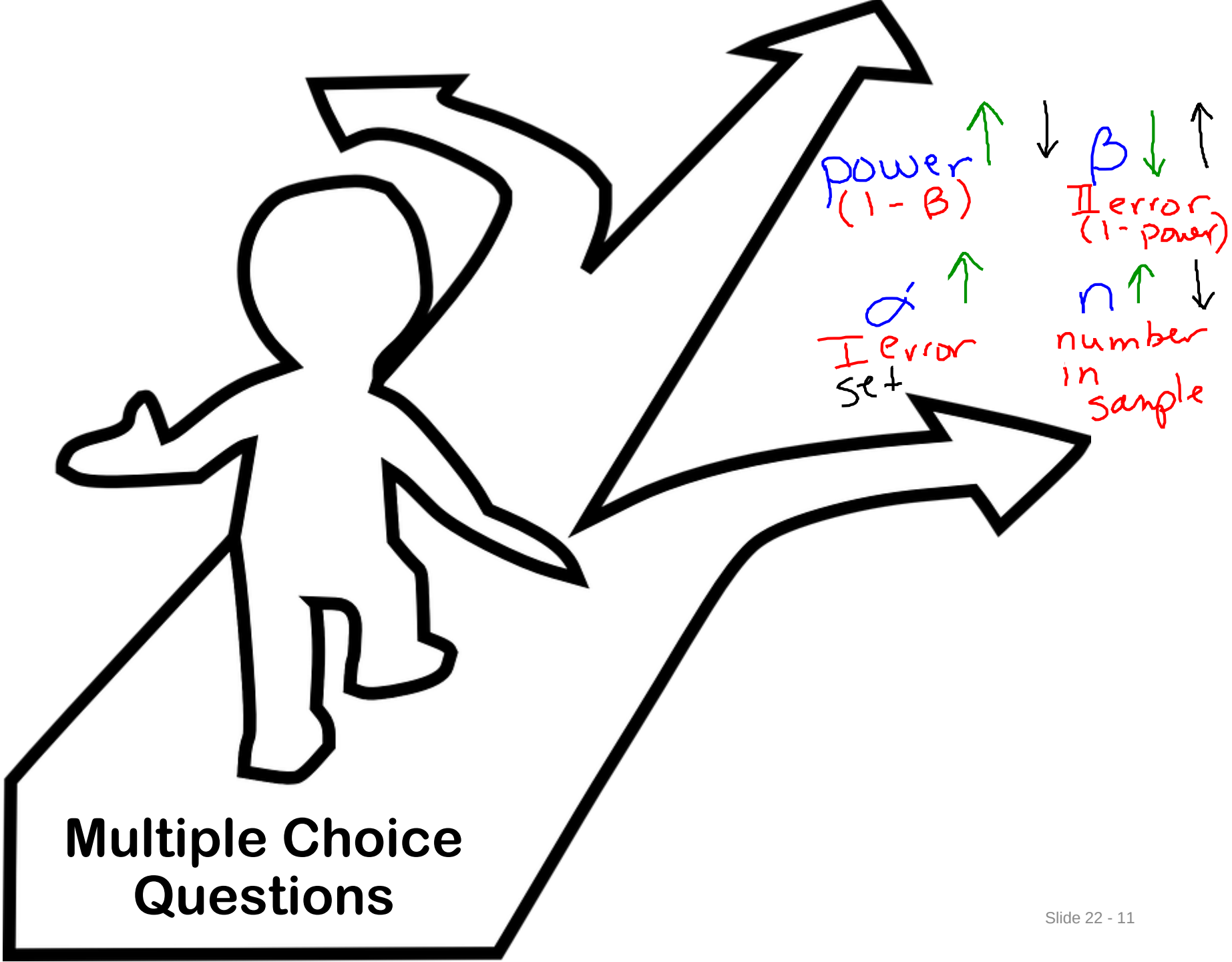
Note: Any choice of an α could have been made as long as the appropriate interpretation is made relative to that choice of α.

Overall Score

Each essentially correct (E) response counts as 1 point; each partially correct (P) response counts as ½ point.

4	**Complete Response**
3	**Substantial Response**
2	**Developing Response**
1	**Minimal Response**

If a response is between two scores (for example, 2½ points), use a holistic approach to determine whether to score up or down depending on the strength of the response and communication.


power
(1 - β)
β
II error
(1 - power)
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n
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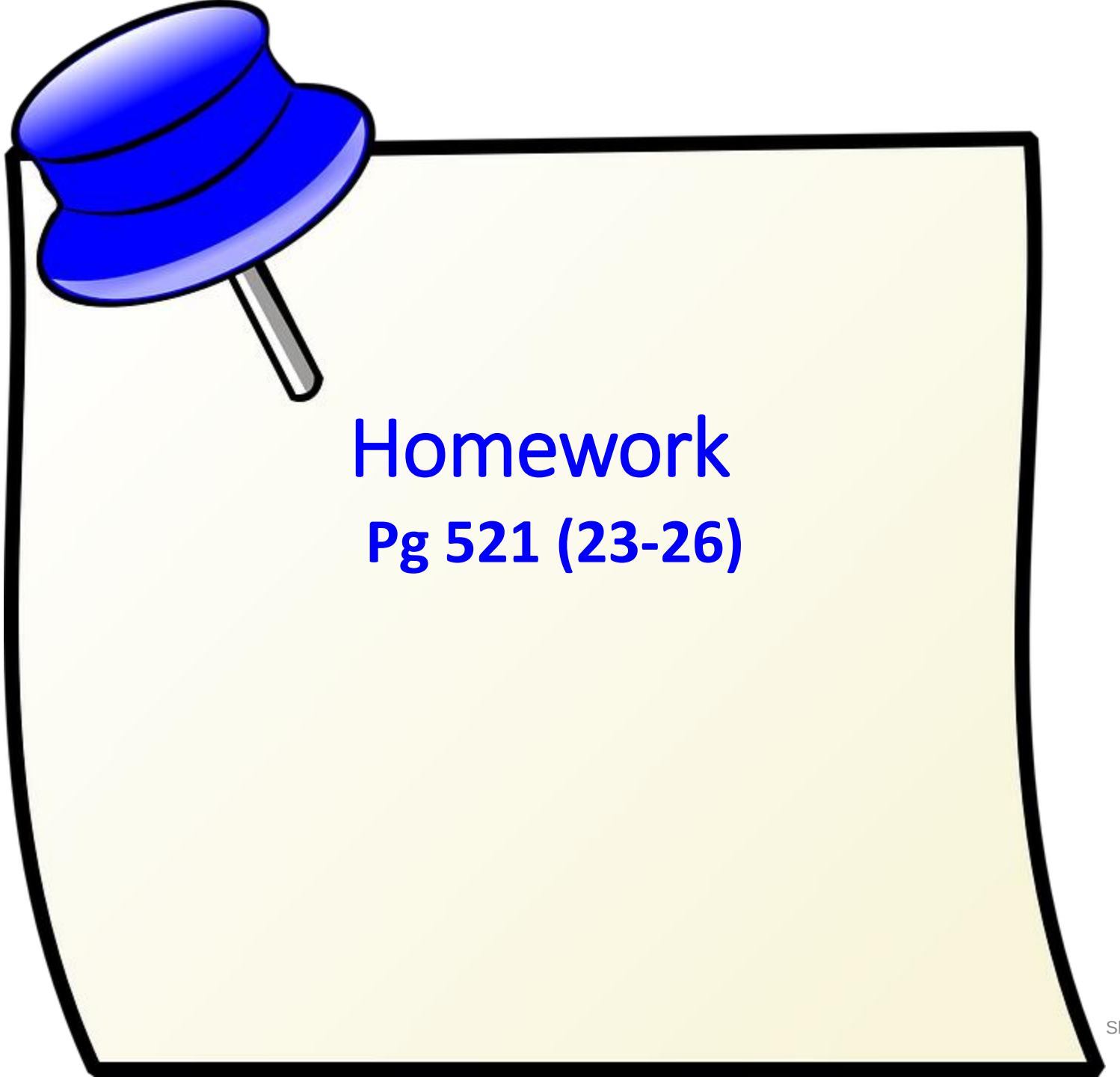
Multiple Choice
Questions



Homework

Pg 521 (23-26)