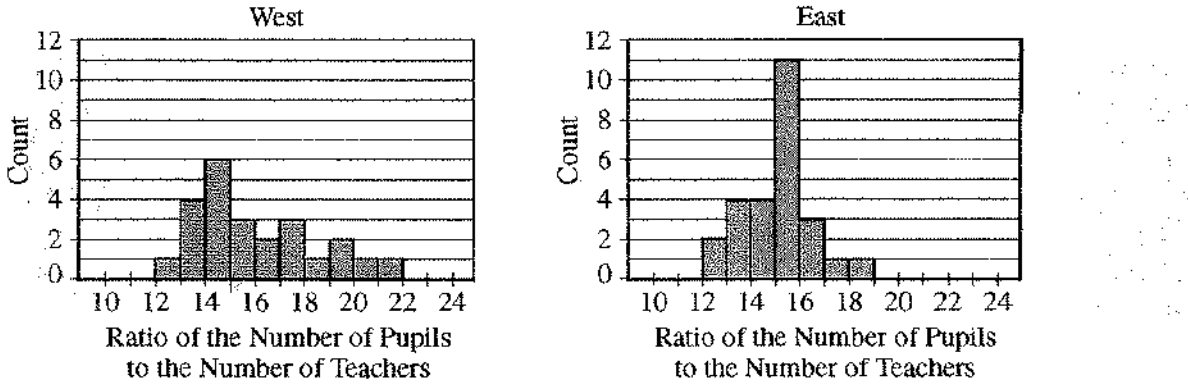
STATISTICS
SECTION II
Part A
Questions 1-5

Spend about 65 minutes on this part of the exam.
Percent of Section II score—75

Directions: Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

1. Records are kept by each state in the United States on the number of pupils enrolled in public schools and the number of teachers employed by public schools for each school year. From these records, the ratio of the number of pupils to the number of teachers (P-T ratio) can be calculated for each state. The histograms below show the P-T ratio for every state during the 2001–2002 school year. The histogram on the left displays the ratios for the 24 states that are west of the Mississippi River, and the histogram on the right displays the ratios for the 26 states that are east of the Mississippi River.



(a) Describe how you would use the histograms to estimate the median P-T ratio for each group (west and east) of states. Then use this procedure to estimate the median of the west group and the median of the east group.

(b) Write a few sentences comparing the distributions of P-T ratios for states in the two groups (west and east) during the 2001–2002 school year.

(c) Using your answers in parts (a) and (b), explain how you think the mean P-T ratio during the 2001–2002 school year will compare for the two groups (west and east).

2. People with acrophobia (fear of heights) sometimes enroll in therapy sessions to help them overcome this fear. Typically, seven or eight therapy sessions are needed before improvement is noticed. A study was conducted to determine whether the drug D-cycloserine, used in combination with fewer therapy sessions, would help people with acrophobia overcome this fear.

   Each of 27 people who participated in the study received a pill before each of two therapy sessions. Seventeen of the 27 people were randomly assigned to receive a D-cycloserine pill, and the remaining 10 people received a placebo. After the two therapy sessions, none of the 27 people received additional pills or therapy. Three months after the administration of the pills and the two therapy sessions, each of the 27 people was evaluated to see if he or she had improved.

   (a) Was this study an experiment or an observational study? Provide an explanation to support your answer.

   (b) When the data were analyzed, the D-cycloserine group showed statistically significantly more improvement than the placebo group did. Based on this result, would the researchers be justified in concluding that the D-cycloserine pill and two therapy sessions are as beneficial as eight therapy sessions without the pill? Justify your answer.

   (c) A newspaper article that summarized the results of this study did not explain how it was determined which people received D-cycloserine and which received the placebo. Suppose the researchers allowed the therapists to choose which people received D-cycloserine and which received the placebo, and no randomization was used. Explain why such a method of assignment might lead to an incorrect conclusion.

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3. An airline claims that there is a 0.10 probability that a coach-class ticket holder who flies frequently will be upgraded to first class on any flight. This outcome is independent from flight to flight. Sam is a frequent flier who always purchases coach-class tickets.

   (a) What is the probability that Sam's first upgrade will occur after the third flight?

   (b) What is the probability that Sam will be upgraded exactly 2 times in his next 20 flights?

   (c) Sam will take 104 flights next year. Would you be surprised if Sam receives more than 20 upgrades to first class during the year? Justify your answer.

4. During a flu vaccine shortage in the United States, it was believed that 45 percent of vaccine-eligible people received flu vaccine. The results of a survey given to a random sample of 2,350 vaccine-eligible people indicated that 978 of the 2,350 people had received flu vaccine.

   (a) Construct a 99 percent confidence interval for the proportion of vaccine-eligible people who had received flu vaccine. Use your confidence interval to comment on the belief that 45 percent of the vaccine-eligible people had received flu vaccine.

   (b) Suppose a similar survey will be given to vaccine-eligible people in Canada by Canadian health officials. A 99 percent confidence interval for the proportion of people who will have received flu vaccine is to be constructed. What is the smallest sample size that can be used to guarantee that the margin of error will be less than or equal to 0.02 ?

1

a] Since median is in the middle, I would count to the middle ... Since each group has an Even amount I will Avg the two middles if need be

P-T med West = between 15 and 16
P-T med East = between 15 and 16

b] The Both Distributions are centered (in terms of med) at the same place, But the West P-T ratio Distribution is more variable. Clearly the East has a large # of states in the 15-16 range with no data above 19. Where as the West states are more Uniform (although not completely) with a max around 22

c] MEAN P-T will be around 15 For East and slightly more For West (Since west is more right Skewed

2a] An Experiment Since treatments were controlled and administered

b) NO ... they didn't compare against 8 regular sessions ... they can only conclude the pill and 2-sessions were better than the placebo and 2 sessions

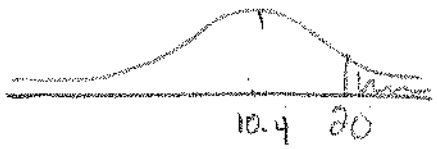
c) Maybe they "chose" the people they figured would have improved anyway No Matter what (pill or not) and gave them the pill ... that would make it look like the pill did Something.

3. Not Not Not yep

a) $(.9)(.9)(.9)(.1) = .0729$ 7.3%

b) binompdf(20, .1, 2) = 28.52%

c] with n = 104 that is large enough to approx w/a N.D



$SD = \sqrt{pqn} = \sqrt{(.1)(.9)(104)} = 3.06$

$\frac{20 - 10.4}{3.06} = 3.14$ So yes I'd be surprised since the chances of that happening ~~if~~ .0008 or .08%.

at least 21

or 1-binomcdf(104, .1, 20) = .0014 or ~~.23~~ .14% chance

yes Surprised

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(1) To construct a CI for the 1prop I will first need to check conditions

a) 1) the 2,350 were randomly picked ✓

2) 2,350 is less than 10% of all possible people that could have been picked ✓(assumed)

3) was the sample was large enough since there were at least 10 successes and 10 failures.

1-prop z int (99%) ⇒ (~~.28~~.39, .44) 39% to 44%

I am 99% confident that the true proportion of people who are elgable for the vaccine is between 39% and 44%. so 45% of the people may not have really gotten the vaccine

b) $.02 = 2.576\sqrt{\frac{(.5)(.5)}{n}}$ $n = 4,146.8$ [4147]