CCJS 200 Statistics for Criminology and Criminal Justice

Week 10 Discussion Sessions

4/4/2025

This Week's Agenda

- Review of this week's lecture
- Homework questions

  Note: the tests in this homework assignment are all *non-directional* tests.
- Reminders

Review: Hypothesis testing using CI

- **Step 1:** Specify the null hypothesis to be tested. Generally, we test a null hypothesis about a population parameter value based on sample data. In this case, we will say that the population parameter is p0, and the hypothesis to be tested is that p0 = 1/2.
- **Step 2:** We can approach this problem by considering a 95% confidence interval or 95% margin of error interval for the sample estimate of the probability. We need to get the sample estimate of the probability, which we will call p_s. We will fail to reject the hypothesis that p0 = 1/2 if the 95% confidence interval or margin of error around p_s includes 1/2.
- **Step 3:** Collect appropriate data to calculate p_s
- **Step 4:** Based on the CI lookup table, determine if the 95% confidence interval associated with this estimate includes the number ½, and determine whether reject/fail to reject the null hypothesis that p0 = 1/2

Review: Hypothesis testing using binomial probability formula

- **Step 1:** state the null hypothesis that p0 = 1/2.
- **Step 2:** Create a table of probabilities. We use the binomial probability function to make these calculations. Based on this table, construct the critical region with p(Type I error) less than 0.05. If we get numbers in this range, we conclude that our evidence is strong enough to reject the Ho that p0 = 1/2 because the probability of getting this specific number in this range is small if p0 is really 1/2.
- **Step 3:** we collect our data to calculate p_s
- **Step 4:** determine whether the number is in the critical region or not, and conclude that we reject/fail to reject the hypothesis that p0 = 1/2.

Question No.1

- The local police department implements a neighborhood policing program in 9 neighborhoods where the police regularly interact with citizens to strengthen trust and confidence in law enforcement at the neighborhood level. Random samples of residents in each of the neighborhoods were surveyed both before and after implementation to measure trust and confidence in the police. In 4 of the neighborhoods, trust and confidence in the police increased after the program was implemented.
- **Conduct a test of the hypothesis that $p_0 = \frac{1}{2}$ using a $p < .05$ significance level using both the textbook's binomial test and the confidence interval test I presented in class. Interpret your results.** A binomial table is provided below (next page) for you to identify the critical region for your binomial test.

Question No.1 (cont.)

- A binomial table is provided here for you to identify the critical region for your binomial test.

# of Increases	p(# of Increases if p0 = 1/2)
0	0.001953125
1	0.017578125
2	0.070312500
3	0.164062500
4	0.246093750
5	0.246093750
6	0.164062500
7	0.070312500
8	0.017578125
9	0.001953125

Question No.1 KEY

- 9 neighborhoods observed; trust and confidence in the police increased in 4 out of the 9 neighborhoods.
- The critical region for the textbook binomial test is:

  p(0 or 1 or 8 or 9) =
  0.001953125+0.017578125+
  0.017578125+0.001953125
  = 0.0390625

- So, if # of increases is 0, 1, 8, or 9, we would reject the Ho that p0=1/2.

Question No.1 KEY (cont.)

- The data analysis reveals that 4 of the 9 neighborhoods increased, so our sample estimated probability of an increase is $p_s = 4/9 = 0.4444444$.
- Since 4 increases is not in the critical region, we fail to reject the hypothesis that p0 = ½
- The 95% confidence interval for p_s is [0.173,0.746]; since this confidence interval includes the number 1/2, we fail to reject the hypothesis that $p_0 = ½$.

Question No.2

- Suppose that over the last 7 years, we have 17 states that have adopted stronger gun laws. As part of a policy analysis, we decide to test the hypothesis that the chance a state's homicide rate increases after a gun law is passed is 1/2 at the $p < .05$ significance level (using both the binomial test in the textbook and the confidence interval procedure I used in class). When we collect our data, we find that 4 of the 17 states experienced an increase in the homicide rate after the new laws took effect. **What is our conclusion?** (Again, a binomial table is provided below for you to use in identifying the critical region for the test).

Question No.2

A binomial table is provided here for you to use in identifying the critical region for the test

# of Increases	p(# of Increases if p0 = 1/2)
0	0.000007629395
1	0.000129699707
2	0.001037597656
3	0.005187988281
4	0.018157958984
5	0.047210693359
6	0.094421386719
7	0.148376464844
8	0.185470581055
9	0.185470581055
10	0.148376464844
11	0.094421386719
12	0.047210693359
13	0.018157958984
14	0.005187988281
15	0.001037597656
16	0.000129699707
17	0.000007629395

Question No.2 KEY

- A total of 17 states adopted stronger gun laws; 4 of the 17 states experienced an increase in the homicide rate after the new gun laws took effect.
- The critical region for the textbook binomial test is:

  p(0 or 1 or 2 or 3 or 4 or 13 or 14 or 15 or 16 or 17) =
  0.000007629395+0.000129699707+0.001037597656+
  0.005187988281+0.018157958984+0.018157958984+
  0.005187988281+0.001037597656+0.000129699707+
  0.000007629395 = 0.04904175 (which is less than 0.05)

- So, if the # of increases is 0, 1, 2, 3, 4, 13, 14, 15, 16, or 17, then we would reject the H_o that p0 = 1/2.

Question No.2 KEY (cont.)

- The data analysis reveals that 4 of the 17 neighborhoods increased, so our sample estimated probability of an increase is $p_s = 4/17 = 0.2352941$.
- Since 4 increases is in the critical region, we reject Ho that $p_0 = 1/2$.
- The 95% confidence interval for p_s is [0.085,0.467]; since this confidence interval excludes the number 1/2, we reject the hypothesis that p0 = 1/2 and conclude that p0 is not equal to 1/2.

Question No.3

- A large nearby city decides to implement an intervention where 15 vacant untended lots were "cleaned and greened" (trees and shrubbery planted, litter picked up, etc.). For each treated lot, we compare crime rates in the years before and after the intervention. Test the hypothesis that a treated lot has a 1/2 chance of its crime rate increasing after the intervention at the $p < .05$ significance level (using both the textbook binomial approach and the confidence interval app r oach discussed in class). Our data analysis reveals that 4 of the 15 lots experienced an increase. What do you conclude?

Question No.3

A binomial table is provided here for you to use in identifying the critical region for the test

# of Increases	p(# of Increases if p0 = 1/2)
0	0.00003051758
1	0.00045776367
2	0.00320434570
3	0.01388549805
4	0.04165649414
5	0.09164428711
6	0.15274047852
7	0.19638061523
8	0.19638061523
9	0.15274047852
10	0.09164428711
11	0.04165649414
12	0.01388549805
13	0.00320434570
14	0.00045776367
15	0.00003051758

Question No.3 KEY

- There are 15 vacant lots that were treated (cleaned and greened); 4 of the 15 lots experienced an increase in crime after treatment.
- The critical region for the textbook binomial test is:

  p(0 or 1 or 2 or 3 or 12 or 13 or 14 or 15) = 0.00003051758+ 0.00045776367+0.00320434570+0.01388549805+0.01388549805+ 0.00320434570+0.00045776367+0.00003051758 = 0.03515625
- So, if the # of increases is 0, 1, 2, 3, 12, 13, 14, or 15 then we would reject the Ho that p0 = 1/2.

Question No.3 KEY (cont.)

- The data analysis reveals that 4 of the 15 lots experienced an increase in crime after treatment, so our estimated probability of an increase in our sample is 4/15 = 0.2666667.
- Since 4 increases is not in the critical region, we fail to reject H_o that $p_0 = 1/2$. Our evidence is not strong enough to reject the H_o.
- The 95% confidence interval for p_s is[0.097,0.517]; since the confidence interval includes the number 1/2, we fail to reject the hypothesis that p0 = 1/2.

Reminders

Exam#2 is scheduled for Tuesday, 4/15/25, and we will have time for review and questions on Thursday, 4/10/25.

Let us know if you have questions!