Name: Key

Math 127 Exam 3 Fall 2017

Version Venus

Oath: *"I will not discuss the exam contents with anyone on Earth until the answer key is posted to BB."*

Sign Name: Key

Permitted Materials: One-sheet of handwritten or typed notes. No copies of published materials.
The datasets are found on www.statcrunch.com. No other webpages.
Any calculator is permitted or use the calculator found on the computers.
No cell phones on the desk. No cell phone calculators.
You must staple your sheet of notes to the exam.

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- Show all work when appropriate. StatCrunch can be used for everything unless you are explicitly asked to show a calculation.
- Points are in parentheses for each problem.
- This test is graded out of 100 points and counts for 25% of your Math 127 grade.
- The graded exams are kept on file for at least one year and students are welcome to come collect them whenever I am available in my office.
- An answer key should be posted on Blackboard by Friday, December 15 after the testing is completed.
- Final letter grade cutoffs should be posted to Blackboard by Friday, December 15 around 5 pm. Your numerical "Course Grade" on Blackboard is your final grade in Math 127 and you will know your letter grade based on my announcement. 89.5% is a guaranteed A. 79.5% for a B. 69.5% for a C. 59.5% for a D.
- Letter grades will be posted to MyCecil, but students may see WIP for a few days.
- Good luck on this exam. It has been my pleasure to work with you this semester.

1. Let's suppose we know with certainty that 73% of all Cecil students were born in Maryland. We will cook up the sampling distribution model for $\hat{p}$ and then use the model to answer a few hypothetical questions.

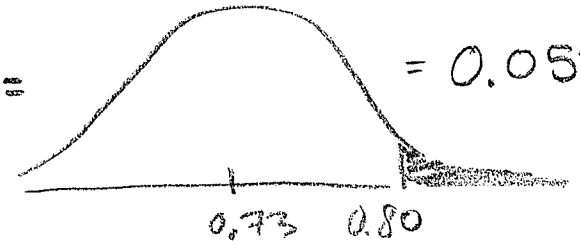
Presume the sample size is $n = 100$ random Cecil students. $p = 0.73$

1a. (1) First, we need the mean and standard deviation for the Normal model for the sample proportion:

$\mu_{\hat{p}} = p = 0.73$ $\quad \sigma_{\hat{p}} = \sqrt{\frac{0.73(0.27)}{100}}$

$= 0.0444$

1b. (2) Second, take a hypothetical sample of 100 Cecil students. What's the probability that we get 80% or more being born in Maryland?

$P(\hat{p} > 0.80) =$  $= 0.0574$

1c. (2) Third, for the sampling distribution Normal model, determine the 9th percentile: 0.6705

1d. (2) Fourth, suppose a sample of $n = 100$ had 68 students from Maryland. Convert the sample proportion to a z-score:

$\hat{p} = \frac{68}{100}$

$\hat{p} = 0.68$

$z = \frac{0.68 - 0.73}{0.0444} = -1.126$

1e. (2) Fifth, suppose we take an unbiased sample of 100 Cecil students and the sample proportion gave us a z-score of $z = 1.505$. Do the algebra to solve backwards for that sample proportion.

$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sigma_{\hat{p}}}$ $\quad 1.505 = \frac{\hat{p} - 0.73}{0.0444}$

$\hat{p} = 0.73 + 1.505(0.0444)$

$\hat{p} = 0.7968$

2. (1) We are testing $H_0: \mu = 45$ mins vs. $H_A: \mu > 45$ mins and you are given the test statistic of $t = 2.314$ with $n = 40$ and df = 39. Give the P-value: 0.013

(shade up on T Calculator)

3. (2) You ran a 95% confidence interval for a proportion and got (14.15%, 20.94%). Give the margin of error: 3.395% Length/2

Name one action you could take to reduce the margin of error: Increase n OR Reduce Confidence

4. (1) You ran a 99% confidence interval for a population mean and got (205.65 lbs., 215.35 lbs.).

Determine the sample mean: ~~209.5 lbs.~~ 210.5

$\bar{y}$ is the midpoint of the CI

5. (2) You'd like to estimate Professor Kupe's true mean thyroid hormone (T3) to within 20 nanograms. You can live with 95% confidence. It is reasonable to assume the standard deviation is about 25 nanograms, because typical ranges for healthy adults are (80 – 180 ng / dl).

How many times do you recommend he get blood work drawn? Solve for the sample size.

$$n = \left[\frac{z(SD)}{ME}\right]^2 = \left[\frac{1.96(25)}{20}\right]^2 = 6.0025$$

So $n = 6$ or 7 is fine.

6. (2) Let's get to the bottom of this Alabama Senate Special Election (Roy Moore (R) vs. Doug Jones (D)). We'd like to know the proportion of likely Alabama voters who support Roy Moore. We will collect our own unbiased data, but most internet sites today (Friday, December 8, 2017) have Moore at about 48%. We need 99% confidence and we will use a margin of error of 3%.

Solve for the sample size we'll need for our last minute data collection in Alabama.

$$n = \frac{(2.576)^2(0.48)(0.52)}{(0.03)^2} = 1840.3 \quad \text{so } n = 1841$$

If put $\hat{p} = 0.5$, $n = 1844$

7. Here's your $\bar{y}$ model problem. Pretend with certainty we know that the mean IQ of all $N = 2861$ Cecil students is 101.17 and we assume the standard deviation to be 15 points.

7a. (2) Determine the mean and standard deviation of the $\bar{y}$ model if we took a sample of size $n = 10$ students.

$\mu_{\bar{y}} = \mu_y = 101.17$ $\quad \sigma_{\bar{y}} = \frac{\sigma_y}{\sqrt{n}} = \frac{15}{\sqrt{10}} = 4.743$

7b. (1) Why can we blow off the "*sample size at least 30*" condition for the Normal model to kick in?

Since IQ is Normal

7c. (2) P(10 Cecil students have a mean IQ over 110) = $P(\bar{y} > 110) = 0.0313$

7d. (2) P(10 Cecil students have a mean IQ under 100) = $P(\bar{y} < 100) = 0.4026$

7e. (2) Give a range of values for $\bar{y}$ that would ***not*** be surprising if you took a sample of $n = 10$ Cecil students.

Inside $\mu_{\bar{y}} \pm 2(\sigma_{\bar{y}})$ not unusual

$101.17 \pm 2(4.743)$

$(91.684, 110.656)$

8. (1) Which hypothesis is presumed true before you collect your data? Null, H_0

9. (1) Which hypothesis is presumed true if you got a P-value of 0.0007? Alt. H_A

10. (1) What kind of mistake could you make if the null hypothesis is true? Type I

11. (1) All things held constant, except crank up the sample size. P-value would:

Increase (Decrease) Stay the Same

12. (1) All things held constant, except crank up the sample size. Margin of error would:

Increase (Decrease) Stay the Same

11 ~~ZZZ Retired~~

13. Use the "**Calendar Year 2017 Personality Types**" dataset. Do we have evidence more than half of all Cecil College students are "*S*" = "*Sensing*"?

13a. (2)Hypotheses: $H_0: p = 0.50$ vs. $H_A: p > 0.50$

13b. (3)Check conditions #1 S/N variable is categorical ✓

#2 Presume Sample unbiased ✓

#3 215 S, 190 N Sucess/Fail exceed 10 ✓

#4 Who cares, $n = 405 < 10\%$ of Cecil College population size

13c. (2)Summarized Data: $\hat{p} = 215/405 = 0.5309$

13d. (2)Test Statistic: $Z = 1.242$

13e. (2)P-value: 0.1071

13f. (2)Decision: Fail to Reject H_0

13g. (2)Conclusion: We do not have evidence to say more than half of all Cecil students are S = Sensing on the Myers-Briggs.

13h. (2)Interpret the test statistic with a sentence in context: Our $\hat{p} = 53.09\%$ was 1.242 Standard Errors above the hypothesized value of $p_0 = 50\%$.

13i. (2)Interpret the standard error of 0.0248 = 2.48% with a sentence in context: With repeated samples, we'd expect $\hat{p}$ to vary by about 2.48%.

13j. (2)If you made a mistake, what type? II Explain the reality of the situation if that did happen:

It means @ Cecil, more than 1/2 the population really is S = Sensing.

ZZZ Retired

14. (12) Use the "**Calendar Year 2017 Food Bank**" dataset. Run the appropriate test to determine if the mean "***Calories***" for non-perishable foods exceeds 100 calories per serving. Points awarded for hypotheses, summarized data, test statistic, P-value, decision, and conclusion.

$H_0: \mu = 100$ cal. vs. $H_A: \mu > 100$ Cal

$n = 644$, $\bar{y} = 102.15$, $s = 75.52$

Test Stat: $t = 0.723$

P-Value = 0.235

Decision: Fail to Reject H_0.

Concl: We are not convinced that the mean Calories per serving exceeds 100.

ZZZ Retired

15. (12) Use the "**Calendar Year 2017 Large Survey**" dataset. Test if, on average, "***Males***" watch more "***TV***" than "***Females***" do. Run the two-sample test. Points awarded for hypotheses, summarized data, test statistic, P-value, decision, and conclusion.

$H_0: \mu_M = \mu_F$ vs. $H_A: \mu_M > \mu_F$

Male: $n = 160$, $\bar{y} = 14.21$, $s = 13.99$

Female: $n = 339$, $\bar{y} = 9.86$, $s = 8.54$

Difference: 4.35 Hours.

Test Stat: $t = 3.63$

P-Value = 0.0002

Decision: Reject H_0

Concl: We do have evidence that, on average, our male students watch more TV than our female students.

ZZZ Retired

16. (12) Use the "**Calendar Year 2017 Large Survey**" dataset. Test if a higher proportion of "***Female***" students have "***Student Loans***" when compared to the "***Male***" students. Points awarded for hypotheses, summarized data, test statistic, P-value, decision, and conclusion.

$H_0: P_F = P_M$ vs $H_A: P_F > P_M$

$\hat{P}_F = \frac{116}{345} = 0.3362$ $\hat{P}_M = \frac{45}{162} = 0.2778$

Difference: 0.0584

Test Stat: $Z = 1.318$

P-Value = 0.0937

Decision: Fail to Reject H_0.

Concl: Not quite convinced that @ Cecil, a higher proportion of Female students have Student Loans.

17. (12) Confidence interval questions. Use 95% confidence for all intervals.

ZZZ Retired

Use the "**Calendar Year 2017 Large Survey**" dataset.

CI for the true proportion of all Cecil students who have been in the "***Military***":

(4.02%, 8.18%)

CI for the true difference in proportions for "***Males***" vs. "***Females***", "***Favor***" the "***Death Penalty***":

(−8.54%, +8.64%)

CI for the true mean "***Credit Card***" debt, all Cecil students:

($595.72, $1021.30)

CI for the true difference in means, "***Males***" vs. "***Females***", for amount of "***Sleep***":

(−0.17 Hours, +0.38 Hours)