Name: Key

Math 345, Elementary Statistics – Crawford

Exam 2-A

25 April 2018

- You may use a calculator and the given formula sheet(s).
- No books or notes (in any form) are not allowed. Having a cell phone out during the exam will result in an automatic 0 grade.
- Clearly indicate your answers.
- All answers must have work or justification. If you use the calculator extensively, be sure to write down the formula and/or syntax you are using.
- Most explanations need only be 1-2 sentences.
- Write all confidence intervals in the notation: lower limit < parameter < upper limit
- ***Show all your work*** – partial credit may be given for written work.
- Unless otherwise stated, round *final* answers to 3 decimal places. Use more decimal places for intermediate calculations.
- Good Luck!

Score

1	/12
2	/12
3	/12
4	/12
5	/12
6	/12
7	/8
8	/18
9	/6
Total	/100

1. (12 pts). A large shopping center reports that, on average, security catches a shoplifting incident once every 3 hours. The shopping center is open from 9 a.m. to 9 p.m. (12 hours).

(**a**). Find the mean number of shoplifting incidents caught by security in one 12-hour period the center is open.

$\frac{1 \text{ incident}}{3 \text{ hours}} \cdot \frac{12 \text{ hours}}{\text{day}} = \boxed{4 \text{ incidents}/_{12\text{-hour day}}}$

(**b**). Find the probability that there will be no shoplifting incidents caught by security during one 12-hour period the center is open.

$P(X=0) = \text{poissonpdf}(4,0) = \boxed{.0183}$ or $.018$

(**c**). Find the probability that there will be more than 4 shoplifting incidents caught by security during one 12-hour period the center is open.

$P(X>4) = 1-P(X\leq 4) = 1-\text{poissoncdf}(4,4)$
$= 1-.6288$
$\approx \boxed{.371}$

2. (12 pts). For the ***standard*** normal distribution, find the probability that

(**a**). z is between 1.36 and 2.45

$P(1.36 < Z < 2.45) = \text{normalcdf}(1.36, 2.45, \underbrace{0,1}_{\text{opt.}})$
$\approx \boxed{0.0798 \quad \text{or } .080}$

(**b**). z is less than 0.52.

$P(Z<0.52) = \text{normalcdf}(-9999, 0.52, \underbrace{0,1}_{\text{opt.}})$
$= \boxed{0.698}$

(**c**). z is greater than -2.21.

$P(Z>-2.21) = \text{normalcdf}(-2.21, 9999, \underbrace{0,1}_{\text{opt}})$

$\approx \boxed{0.986}$

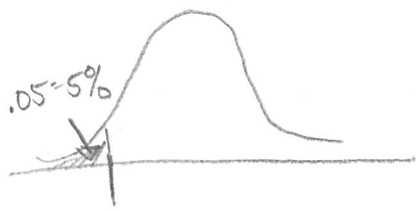
3. (12 pts). Researchers at a company that manufactures quartz crystal watches have determined that the number of months before some components deteriorate, possibly causing the watch to become unreliable and considered defective, is normally distributed with a mean of 30 months and standard deviation of 5.5 months.

(a). The company provides a full refund up to 2 years for any watches that are defective. Find the percentage (i.e. probability) of watches will become defective before 2 years (i.e. 24 months).

$$P(X < 24) = \text{normalcdf}(-9999, 24, 30, 5.5)$$

$$\approx \boxed{0.138}$$

(b). If they want to make refunds on no more than 5% of their watches, find the number months they should make the guarantee period. (i.e. How many months separates the bottom 5%?) [To the nearest month.]



$$\text{invNorm}(.05, 30, 5.5)$$

$$\approx 20.953 \approx \boxed{21 \text{ months}}$$

4. (12 pts). The weights in kilograms (kg) of healthy adult female deer (does) in December in Mesa Verde National Park is approximately normally distributed, with mean of 63.0 kg and standard deviation of 7.1 kg (Source: The Mule Deer of Mesa Verde National Park, by G. W. Mierau and J. L. Schmidt, Mesa Verde Museum Association).

(a). If one doe is randomly selected in December, find the probability that it will weigh less that 60 kg.

$$P(X < 60) = \text{normalcdf}(-9999, 60, 63.0, 7.1)$$

$$\approx \boxed{0.336}$$

(b). If 40 does in the park are randomly selected in December, find the probability that their mean weight will be less than 60 kg.

$$P(\bar{X} < 60) = \text{normalcdf}\left(-9999, 60, 63.0, \frac{7.1}{\sqrt{40}}\right)$$

$$\approx \boxed{.00377 \quad \text{or} \quad .004}$$

5. (12 pts). In a study of 1228 randomly selected medical malpractice lawsuits, it was found that 856 of them were dropped or dismissed (based on data from the Physicians Insurers Association of America). Construct a 95% confidence interval for the proportion of medical malpractice lawsuits that are dropped or dismissed.

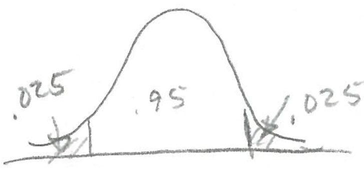
$\hat{p} = \frac{856}{1228} \approx .697$

$1-\alpha = .95$

$\alpha = .05$

$\frac{\alpha}{2} = .025$

$\hat{p} - E = .697 - .02565 \approx .671$



$z_{\frac{\alpha}{2}} = \text{invNorm}(.975, \underbrace{0,1}_{opt}) \approx 1.956$

$\hat{p} + E = .697 + .02565 \approx .723$

$E = z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}} = 1.956\sqrt{\frac{(.697)(.303)}{1228}} = .02565$

$\boxed{.671 < p < .723}$

6. (12 pts). You plan to conduct a survey to estimate the percentage of adults who have had chickenpox. Find the number of people who must be surveyed if you want to be 90% confident that the sample percentage is within 2 percentage points of the true percentage for the population of all adults.

$E = .02$

(a). Assume that nothing is known about the prevalence of chickenpox.

$1-\alpha = .90$

$\alpha = .10$

$\frac{\alpha}{2} = .05$

$z_{\alpha/2} = \text{invNorm}(.95) = 1.645$

$n = \frac{[1.645]^2(.25)}{(.02)^2} = 1691.3 \approx \boxed{1692}$

(b). Assume that about 95% of adults have had chickenpox.

$n = \frac{[1.645]^2(.95)(.05)}{(.02)^2} \approx 321.3 \approx \boxed{322}$

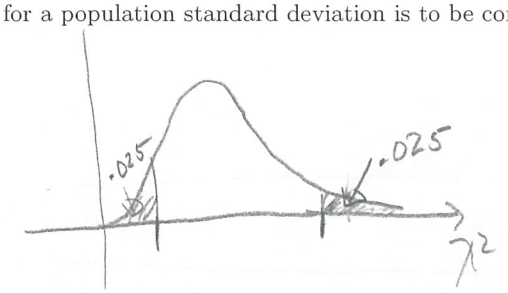
7. (8 pts). Find the critical values χ^2_L and χ^2_R that correspond to a confidence level of 95% and sample size $n = 26$. [Assume a confidence interval for a population standard deviation is to be constructed, but DO NOT attempt to construct it.]

$df = 25$

$1-\alpha = .95$

$\alpha = .05$

$\frac{\alpha}{2} = .025$



From Table A-4

$A_R = .975$ & $A_R = .025$

$\Rightarrow \boxed{\chi^2_L = 13.120 \quad \chi^2_R = 40.646}$

8. (18 pts). A FICO score is credit score between 300 and 850 that rates a consumer's credit worthiness. A simple random sample of 18 FICO scores of borrowers at a local bank branch has a mean of 660.3 and a standard deviation of 95.9. Use a 0.01 significance level to test the claim that the mean FICO score at this branch is less than the national mean of 700. [**Use the P-value method.** Use the correct symbol (p, μ, σ, σ^2) for the indicated parameter.]

(a). *Original* claim in symbolic form: $\mu < 700$

(b). Competing idea (complement) in symbolic form: $\mu \geq 700$

(c). H_0 : $\mu = 700$

H_1 : $\mu < 700$

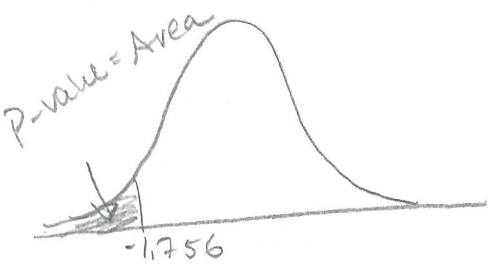
(d). $\alpha =$ .01

(e). Formula for the test statistic:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{660.3 - 700}{95.9/\sqrt{18}} = \boxed{-1.756}$$

(f). Observed value of the test statistic with calulations:

Graph showing the observed value of the test statistic and P-value:



df = 17

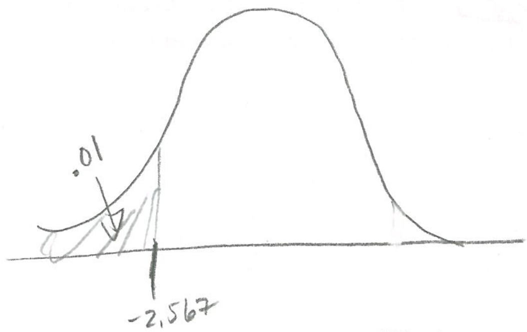
P-value: = $\rightarrow$ tcdf(-9999, -1.756, 17) = $\boxed{.0485}$ $>$ .01 $= \alpha$

(g). Circle one: Reject H_0 Fail to reject H_0

(h). Wording of the final conclusion in simple, nontechnical terms, addressing the *original* claim.

There is not sufficient evidence to support the claim that the mean FICO score at this branch is less than the national mean.

9. (6 pts). Sketch and label a picture and find the critical value(s) for the previous problem.



$\mu < 700$

Left-Tailed

$\alpha = .01 \quad df = 17$

$t_{crit} = \text{invT}(.01, 17)$

$= \boxed{-2.567}$

8. (18 pts). A FICO score is credit score between 300 and 850 that rates a consumer's credit worthiness. A simple random sample of 18 FICO scores of borrowers at a local bank branch has a mean of 721.6 and a standard deviation of 89.3. Use a 0.1 significance level to test the claim that the mean FICO score at this branch is greater than the national mean of 700. [**Use the *P*-value method.** Use the correct symbol (p, μ, σ, σ^2) for the indicated parameter.]

(a). *Original* claim in symbolic form: $\mu > 700$

(b). Competing idea (complement) in symbolic form: $\mu \leq 700$

(c). H_0 : $\mu = 700$

H_1 : $\mu > 700$

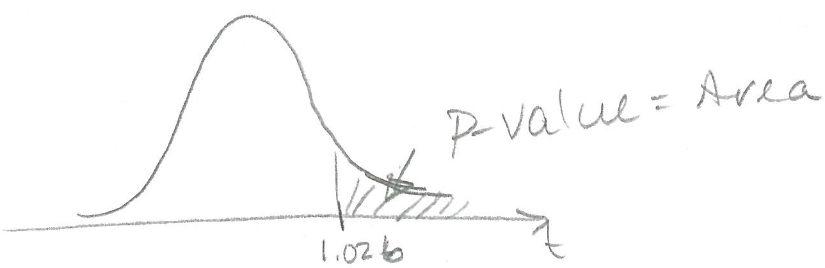
(d). $\alpha =$ 0.10

(e). Formula for the test statistic:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{721.6 - 700}{89.3/\sqrt{18}} \approx \boxed{1.026}$$

(f). Observed value of the test statistic with calulations:

Graph showing the observed value of the test statistic and *P*-value:



P-value:

$= \text{tcdf}(1.026, 9999, 17) \approx \boxed{0.160} > .10 = \alpha \Rightarrow$ Fail to Reject

0.1596

(g). Circle one: Reject H_0 Fail to reject H_0

(h). Wording of the final conclusion in simple, nontechnical terms, addressing the *original* claim.

There is not sufficient evidence to support the claim that the mean FICO score at this branch is less than the national mean.

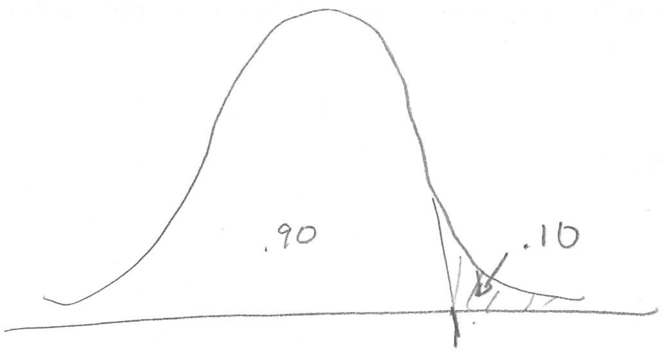
9. (6 pts). Sketch and label a picture and find the critical value(s) for the previous problem.

$\alpha = .10$

$df = 17$

$\mu > 700$

Right-Tailed



$t_{crit} = \text{invT}(.90, 17)$

$\approx \boxed{1.333}$