Name: ____________________
ID: ____________________
Quiz section or time: ____________________

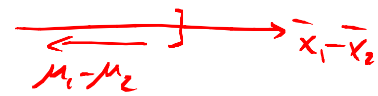
Stat/Math 390, Spring, Test 3, June 3, 2016; Marzban

9+15

Same deal as test 1, ...

Points

1 **1.** We have computed a 95% upper confidence bound for the difference between two means, $\mu_1 - \mu_2$; it is 13. Then, about 95% of



a) $\overline{x_1} - \overline{x_2}$ values will be less than 13.
b) observed upper confidence bounds will be greater than 13.
c) observed upper confidence bounds will be less than 13.
d) observed upper confidence bounds will be less than $\mu_1 - \mu_2$.
e) observed upper confidence bounds will be greater than $\mu_1 - \mu_2$.

9.27

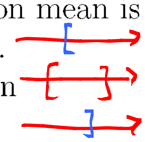
1 **2.** Suppose 100 samples of size $n = 500$ are taken from a population, and the 95% CI for a population mean is computed for each of the 100 samples. The number of times the CIs will cover the population parameter is

a) 5 b) a random number around 5 c) 95 d) a random number around 95 e) 100

Lect 18 p.4

1 **3.** At a fixed confidence level, the 2-sided CI for a population mean is ______ the interval between the lower confidence bound and the upper confidence bound.

a) narrower than b) equal to c) wider than d) Statement is ill-phrased



9.28

1 **4.** Consider a situation wherein you compute a p-value for the test $H_0 : \mu = 0$, $H_1 : \mu \neq 0$. Suppose your data come from a population for which μ is truly and identically zero. As the sample size increases, the p-value of a test will generally

a) converge to 1 b) fluctuate randomly between 0/1 c) converge to 0 d) insufficient info.

9.28

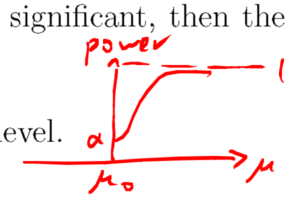
1 **5.** In the previous problem, suppose your data come from a population for which μ is very small, but nonzero. As the sample size increases, the p-value of a test will generally

a) converge to 1 b) fluctuate randomly between 0/1 c) converge to 0 d) insufficient info.

sp15/11

1 **6.** Suppose physical significance is measured by the difference between the true mean and the null value. Circle the correct statement(s).

a) If the difference between the true mean and the null value is statistically significant, then the difference must be physically significant as well.
b) As physical significance increases, then power increases.
c) As physical significance decreases, then power approaches the significance level.
d) None of the above.



9.29

1 **7.** A team in a computer manufacturing company wants to see if there is a difference between three CPU brands (A, B, C) in terms of their sensitivity to heat. So the team tests 10 CPUs of each brand, raises their temperature by some fixed amount, and then records the number of CPUs that stop functioning completely, the number of CPUs that slow down, and the number of CPUs that are unaffected. What is the most appropriate test?

a) paired t-test
b) Anova F-test
c) Chi-squared test of multiple props in one pop
d) Chi-squared test of homogeneity

of 3 pops (A, B, C) w.r.t. 3 categories (stop, slow, ...)

$$\begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{ccc} \text{stop} & \text{slow} & \text{unaffected} \\ \# & \# & \# \\ \# & \# & \# \\ \# & \# & \# \end{array}$$

10 temperature measurements A - - - $\bar{y}_1$ B - - - $\bar{y}_2$ C - - - $\bar{y}_3$ $H_0: \mu_1=\mu_2=\mu_3$

1 979 **8.** In previous problem, another team takes 10 CPUs of each brand, raises the temperature of each CPU, and records the temperature at which each CPU stops functioning completely. What is the most appropriate test for answering the same question as above?

a) paired t-test b) Anova F-test
c) Chi-squared test of multiple props in one pop d) Chi-squared test of homogeneity

9. In a regression setting, as sample size increases, circle all of the correct statements:
a) The width of CI for the true mean of y, at a given x, approaches zero.
b) The width of PI for a single y, at a given x, approaches zero.
c) The CI becomes wider than PI.
d) The center of the PI becomes larger than the center of the CI.

~ 2 **10.** There is a concern that air-quality inside cars may be worse than that outside cars. Let x denote a quantity which measures the concentration of harmful contaminants. We make measurements of x inside and outside of 100 cars. What are the appropriate hypotheses for testing our concern? **Clearly define all symbols.**

μ_{in} = mean concentration of harmful contaminants inside, μ_{out} = ... outside

Bad error = ($\mu_{in} < \mu_{out}$ | $\mu_{in} > \mu_{out}$)
α = (Data reject H_0 in favor of H_1 | H_0=T)
$\Rightarrow$ $\boxed{H_0: \mu_{in} > \mu_{out} \quad H_1: \mu_{in} < \mu_{out}}$ Paired test

~ ~~2~~ 1.5 Lect26 **11.** What is the numerical value of the F-ratio in 1-way ANOVA, if the sample means in all categories are all exactly equal? **Show work.** Hint: concentrate on the numerator, and ask yourself what the grand mean would be.

$$F = \frac{SS_{between}/df...}{SSE\ /df...} \propto \frac{\sum n_i(\bar{y}_i - \bar{\bar{y}})^2}{...} = \frac{\sum n_i (c-c)^2}{...} = \boxed{0}$$

if $\bar{y}_1 = \bar{y}_2 = \cdots = \bar{y}_k \equiv c$, Then $\bar{\bar{y}} = \sum \frac{n_i}{n} \bar{y}_i = \frac{1}{\cancel{n}} c \cancel{\sum n_i} = c$

12. A random sample of 20 students was taken from a large class, and the following histogram of grades was found: 3 As, 8 Bs, 6 Cs, and 3 Ds. We want to perform a test for seeing if the teacher is not giving the same number of letter grades (A, B, C, D) in the whole class. Specifically,

~ 2 a) Write the hypotheses, in terms of well-defined quantities.

$H_0: \pi_A = \frac{1}{4}, \ \pi_B = \frac{1}{4}, \ \pi_C = \frac{1}{4}, \ \pi_D = \frac{1}{4}$ $\pi_i \equiv$ prop. of i grades in class.
H_1: At least one of These is wrong

~ 2 b) Compute a p-value (or a range for it). $exp_i = \frac{1}{4} 20 = 5$

$$X^2_{obs} = \sum_i^4 \frac{(exp_i - obs_i)^2}{exp_i} = \frac{(5-3)^2}{5} + \frac{(5-8)^2}{5} + \frac{(5-6)^2}{5} + \frac{(5-3)^2}{5}$$

$$= \frac{4}{5} + \frac{9}{5} + \frac{1}{5} + \frac{4}{5} = \frac{18}{5} \approx \boxed{3.?}$$

$$\text{p-value} = pr(X^2 > X^2_{obs}) = pr(X^2 > 3.?) > \boxed{0.1}$$

df = 4-1 = 3

11.2c

13. Suppose the true/population regression fit in a problem is $y = 5 - 0.01x + \epsilon$, with $\sigma_\epsilon = 4$.

~ 2 a) If the typical deviation in x, in a random sample of size 101 from that population, is 2.0, what is the typical deviation in the slope of an OLS fit to a random sample taken from that population?

$$\sigma_{\hat\beta} = \frac{\sigma_\epsilon}{\sqrt{S_{xx}}} = \frac{\sigma_\epsilon}{\sqrt{n-1}\; s_x} = \frac{4}{10\,(2)} = \boxed{\frac{1}{5}}$$

$\sim \cancel{2}$ 2.5 b) What is the probability of observing a y value in the population between 2.9 and 6.9 at $x = 10$?

$$pr(2.9<y<6.9) = pr\left(\frac{2.9-y(x)}{\sigma_\epsilon} < \frac{y-y(x)}{\sigma_\epsilon} < \frac{6.9-y(x)}{\sigma_\epsilon}\right) \qquad y(x=10) = 5-(0.01)10 = 4.9$$

$$= pr\left(\frac{2.9-4.9}{4} < z < \frac{6.9-4.9}{4}\right) = pr(-0.5<z<0.5)$$

$=$ 

$= 0.6915 - 0.3085 = \boxed{0.383}$

11.21

$\sim \cancel{2}$ 3 **14.** The results of a regression analysis on rainfall (x) and runoff (y), are given below. For rainfall, a sample of 16 cases yields a sample mean of 5. Predict the runoff for a single case, when rainfall = 10, in a way that conveys reliability and precision. Your answer must be in terms of numbers, but DO NOT simplify. Use $t^* = 2.131$. Hint: for S_{xx}, use the "stdev" column.

Predictor	coef	stdev	t-ratio	p
constant	-1.0	2.5	-0.4	0.694
rainfall	1.0	0.1	10	0.000

$s = 4$, $R^2 = 0.975$.

$\hat y(x) = \hat\alpha + \hat\beta x = -1 + 1(x)$

$\hat y(x=10) = 9$

P.I. for $y(x)$: $\hat y(x) \pm \overset{2.131}{t^*} \sqrt{s_{\hat y}^2 + s_e^2}$

$s_e^2 \to (4)^2$

$s_e^2\left[\frac{1}{n} + \frac{(x-\bar x)^2}{S_{xx}}\right] = (4)^2\left[\frac{1}{16} + \frac{(10-5)^2}{S_{xx}}\right]$

$S_{\hat\beta} = \frac{\sigma_\epsilon}{\sqrt{S_{xx}}}$

$0.1 \approx \frac{4}{\sqrt{S_{xx}}}$

$\therefore S_{xx} = \left(\frac{4}{0.1}\right)^2$

$S_{xx} = (40)^2$
