Sample_test_part_3

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Stats 3Y03/3J04

Sample Test Questions for Chapters 9, 10, 11, and 13

Name:____

(Last Name) (First Name)

Student Number:____________________ **Tutorial Number:**____________________

This test consists of 25 multiple choice questions worth 1 mark each (no part marks). All questions must be answered on the COMPUTER CARD with an HB PENCIL. Marks will not be deducted for wrong answers (i.e., there is no penalty for guessing). You are responsible for ensuring that your copy of the test is complete. Bring any discrepancy to the attention of the invigilator. Only the McMaster standard calculator Casio fx-991 is allowed.

1. An article in *Food Testing and Analysis* "Improving Reproducability of Refractometry Measurements of Fruit Juices" (1999, Vol. 4, No. 4, pp. 13-17) measured the sugar concentration (Brix) in clear apple juice. All measurements were taken at 20°C:

11.48, 11.45, 11.48, 11.47, 11.48, 11.50, 11.42, 11.49

$n = 8$

Test the hypothesis $H_0 : \mu = 11.5$ versus $H_1 : \mu \neq 11.5$ using $\alpha = .05$.

(a) Reject H_0 since $-3.21 < -1.8946$
(b) Reject H_0 since $-3.21 < -1.96$
(c) Reject H_0 since $-3.86 < -2.365$
(d) Reject H_0 since $-3.21 < -2.365$
(e) Reject H_0 since $-3.86 < -1.96$

$\alpha \Rightarrow$ Ho True falsely reject Ho

2. (Continuation of **1.**) Based on your conclusion in **1.**, which of the following is true?

(a) A Type I error might ahve occurred
(b) A Type II error might have occurred
(c) The population mean sugar concentration is not equal to 11.5
(d) The probability of Type I error is .025.
(e) The probability of Type II error is .95

5%

$\beta \Rightarrow$ Ha True Fail to reject Ho

not known

3. (Continuation of **1.**) Find the p-value.

(a) $.005 < P < .01$ **(b)** $.01 < P < .025$ **(c)** $.01 < P < .02$ **(d)** .0007 **(e)** .0014

4. (Continuation of **1.**) What assumptions (if any) are required for the above test?

(a) The population mean must be equal to 11.5
(b) None
(c) The population variance must be known
(d) The population must follow a t-distribution
(e) The population must be normal

5. (Continuation of **1.**) What method could be used to check the required assumption?

(a) Find the p-value for testing $H_0 : \mu = 11.5$ versus $H_1 : \mu \neq 11.5$ and see if it is less than α
(b) Check if the test statistic for testing $H_0 : \mu = 11.5$ versus $H_1 : \mu \neq 11.5$ and see if it is less than the critical value
(c) Construct a normal probability plot and see if the points fall close to a straight line
(d) Construct a normal probability plot and see if the plot is bell-shaped (like the normal curve)
(e) Draw a power curve and see if it is bell-shaped

6. During the 1999 and 2000 baseball seasons, there was much speculation that the unusually large number of home runs there were hit was due at least in part to a livelier ball. One way to test the "liveliness" of a baseball is to launch the ball at a vertical surface with a known velocity V_L and measure the ratio of the outgoing velocity V_O of the ball to V_L. The ratio $R = V_O/V_L$ is called the coefficient of restitution. A batch of 40 baseballs were tested by throwing each ball from a pitching machine at an oak surface. The average coefficient of restitution was found to be $\bar{x} = .6373$, with standard deviation $s = .013$. If the mean coefficient of restitution exceeds .635, then the population of balls from which the sample was taken will be too "lively", and considered unacceptable for play. Test the hypothesis that the balls in the sampled population are too lively using the 5% significance level.

$H_A: \mu > 0.635$

$n = 40 > 30$
$x = 0.6373$
$s = 0.013$
$\mu = 0.635$

(a) Do not reject H_0 since 1.119 is less than 1.64
(b) Do not reject H_0 since 1.119 is less than 1.96
(c) Do not reject H_0 since 1.437 is greater than .05
(d) Do not reject H_0 since 1.437 is less than 1.96
(e) Do not reject H_0 since 1.437 is less than 1.64

7. (Continuation of **6.**) Find the p-value.
(a) 0.2628 **(b)** 0.8686 **(c)** 0.0749 **(d)** 0.1314 **(e)** 0.7372

8. (Continuation of **6.**) Find the power of the test if the true mean coefficient of restitution is equal to .638

(a) 0.426 **(b)** 0.574 **(c)** 0.737 **(d)** 0.569 **(e)** 0.403

9. (Continuation of **6.**) What is the minimum sample size that would be required to detect a true mean coefficient of restitution of .638 if we want the power of the test to be at least 0.90?

(a) 82 **(b)** 161 **(c)** 134 **(d)** 217 **(e)** 53

10. A university library ordinarily has a complete shelf inventory done once every year. Because of new shelving rules instituted the previous year, the head librarian believes it may be possible to save money by postponing the inventory. The librarian decides to select at random 1000 books from the library's collection and have them searched in a preliminary manner. If evidence indicates strongly that the true proportion of misshelved or unlocatable books is less than .02, then the inventory will be postponed. Among 1000 books searched, 15 were misshelved or unlocatable. Test the relevant hypothesis and advise the librarian what to do (use $\alpha = .05$).

one tail $\hat{p} = \frac{15}{1000}$ $n = 1000$ $p_0 = 0.02$ $H_A: p_0 < 0.02$

(a) Do not reject H_0 since -1.13 is not less than -1.64. The inventory should not be postponed.
(b) Do not reject H_0 since -1.13 is not less than -1.64. The inventory should be postponed.
(c) Do not reject H_0 since -1.13 is not less than -1.96. The inventory should not be postponed.
(d) Do not reject H_0 since -1.13 is not less than -1.96. The inventory should be postponed.
(e) Do not reject H_0 since -1.48 is not less than -1.64. The inventory should not be postponed.

11. (Continuation of **10.**) Find the p-value.

(a) .5168 **(b)** .0694 **(c)** .2584 **(d)** .1292 **(e)** .1883

12. (Continuation of **10.**) If the true proportion of misshelved and lost books is actually .01, what is the probability that the inventory will be (unnecessarily) taken?

(a) .192 **(b)** .176 **(c)** .142 **(d)** .119 **(e)** .103

β H_0 false.

13. A person wants to test whether a die is unbalanced. He thinks that the die has been weighted so that "6"'s appear more often than the other numbers. So he wants to test

$$H_0 : p = \frac{1}{6} \text{ versus } H_1 : p > \frac{1}{6}$$

where p is the probability of rolling a "6". He decides to roll the die 8 times, and he will reject H_0 is he observes 3 or more "6"'s. What is the significance level of this test?

(a) .104 **(b)** .0023 **(c)** .35 **(d)** .057 **(e)** .012

$\alpha = P(\text{reject } H_0 \mid H_0)$

$= P(X \geq 3 \mid p = \frac{1}{6})$

$= 1 - \binom{8}{0}(\frac{1}{6})^0(\frac{5}{6})^8 - \binom{8}{1}(\frac{1}{6})^1(\frac{5}{6})^7 - \binom{8}{2}(\frac{1}{6})^2(\frac{5}{6})^6$

14. (Continuation of **13.**) Find the power of the test if the true value of p is $\frac{1}{4}$.

(a) .486 **(b)** .508 **(c)** .227 **(d)** .124 **(e)** .321

$1 - \beta$

$= P(\text{reject } H_0 \mid p = \frac{1}{4})$

$= 1 - \binom{8}{0}(\frac{1}{4})^0(\frac{3}{4})^8 - \binom{8}{1}(\frac{1}{4})^1(\frac{3}{4})^7 - \binom{8}{2}(\frac{1}{4})^2(\frac{3}{4})^6$

15. (Continuation of **13.**) Suppose that he rolls the die 8 times, observes 2 "6"'s, and does not reject H_0. Which of the following is true?

(a) A Type II error might have occurred.
(b) The die is not unbalanced.
(c) A Type I error might have occurred.
(d) The probability of Type II error is .0116.
(e) The die is unbalanced.

16. The "spring-like" effect in a golf club could be determined by measuring the coefficient of restitution (the ratio of the outbound velocity to the inbound velocity of a golf ball fired at the club head). Drivers are randomly selected from two club makers and the coefficient of restitution is measured. The data are as follows, and are summarized in the Minitab output below:

Club 1: 0.8906, 0.8104, 0.8234, 0.8198, 0.8235, 0.8562, 0.8123, 0.7976, 0.8184, 0.8265, 0.7173, 0.7871,

Club 2: 0.8305, 0.7905, 0.8352, 0.8380, 0.8145, 0.8465, 0.8244, 0.8014, 0.8309, 0.8405

Test and CI for Two Variances: C1 vs C2

```
Method

Null hypothesis         σ(1) / σ(2) = 1
Alternative hypothesis  σ(1) / σ(2) ≠ 1
Significance level      α = 0.05

F method was used. This method is accurate for normal data only.

Statistics

                             95% CI for
C2   N  StDev  Variance        StDevs
1   12  0.041     0.002   (0.029, 0.069)
2   10  0.018     0.000   (0.012, 0.033)

Ratio of standard deviations = 2.278
Ratio of variances = 5.188

95% Confidence Intervals
                              CI for
          CI for StDev       Variance
Method       Ratio            Ratio
F       (1.152, 4.315)  (1.326, 18.616)

Tests
                       Test
Method  DF1  DF2  Statistic  P-Value
F        11    9       5.19    0.020
```

Descriptive Statistics: C1

```
Variable  C2   N  N*     Mean  SE Mean    StDev  Minimum       Q1   Median
C1         1  12   0   0.8153   0.0118   0.0409   0.7173   0.8008   0.8191
           2  10   0  0.82524  0.00567  0.01794  0.79050  0.81123  0.83070

Variable  C2        Q3  Maximum
C1         1    0.8258   0.8906
           2   0.83863  0.84650
```

Is an assumption of equal variances justified?

(a) Yes, since the p-value of .02 is less than .05.
(b) No, since the p-value of .02 is less than .05.
(c) No, since .0409 is not equal to .01794
(d) No, since .002 is not equal to .000
(e) Yes, because .0409 is close to .01794

$H_a: \mu_1 < \mu_2$

17. (Continuation of **16.**) Test the hypothesis that the clubs from brand 2 have a greater mean coefficient of restitution than the clubs from brand 1. Use $\alpha = .05$.

(a) Do not reject H_0 since -0.76 is not less than -2.086
(b) Do not reject H_0 since -0.71 is not less than -1.725
(c) Do not reject H_0 since -0.76 is not less than -1.725
(d) Do not reject H_0 since -0.76 is not less than -1.753
(e) Do not reject H_0 since -0.71 is not less than -1.753

18. (Continuation of **16.**) Find the p-value for the test in **17.**.

(a) $.2 < P < .5$ **(b)** $.25 < P < .4$ **(c)** $.2236$ **(d)** $.4472$ **(e)** $0.1 < P < 0.25$

19. (Continuation of **16.**) Find a 95% two-sided confidence interval on the mean difference in coefficient of restitution between the two brands of golf clubs.

(a) $(-.1339, .1141)$ **(b)** $(-.0379, .0179)$ **(c)** $(-.0499,\ .0301)$ **(d)** $(-.0586,\ .0388)$
(e) $(-.1020,\ .0822)$

20. Suppose that we want to see if there is a linear relationship between serum cholesterol level and systolic blood pressure. Consider the following data and Minitab output:

Serum Cholesterol (x)	193	210	196	208	188	206	240	215
Systolic Blood Pressure (y)	126	120	128	?	?	?	?	163

$\Sigma x_i^2, \bar{x}$

```
Regression Analysis: SYSTOLIC versus SERUM-CHOL

Analysis of Variance

Source        DF   Adj SS   Adj MS   F-Value   P-Value
Regression     ?        ?        ?         ?         ?
  SERUM-CHOL   *        *        *         *         *
Error          ?        ?    197.9
Total          ?        ?

Model Summary

      S     R-sq   R-sq(adj)   R-sq(pred)
14.0687   12.03%       0.00%        0.00%

Coefficients

Term          Coef   SE Coef   T-Value   P-Value    VIF
Constant      70.0      68.0      1.03     0.343
SERUM-CHOL       ?         ?        ?1         ?      *

Regression Equation
SYSTOLIC = 70.0 + 0.297 SERUM-CHOL
```

$MSE = \hat{\sigma}^2$

β_0 β_1

$b_1 = 0.297$

$Y = \beta_0 + \beta_1 X$

Find the value of $?_1$ (the missing `T-Value` in the `SERUM-CHOL` row).

(A) 0.164 **(B)** 1.271 **(C)** 0.906 **(D)** 2.543 **(E)** 2.160

21. Referring to Question #20 above, which of the following is a correct normal probability plot of the residuals?

$n=8$

$\frac{j-0.5}{n}$

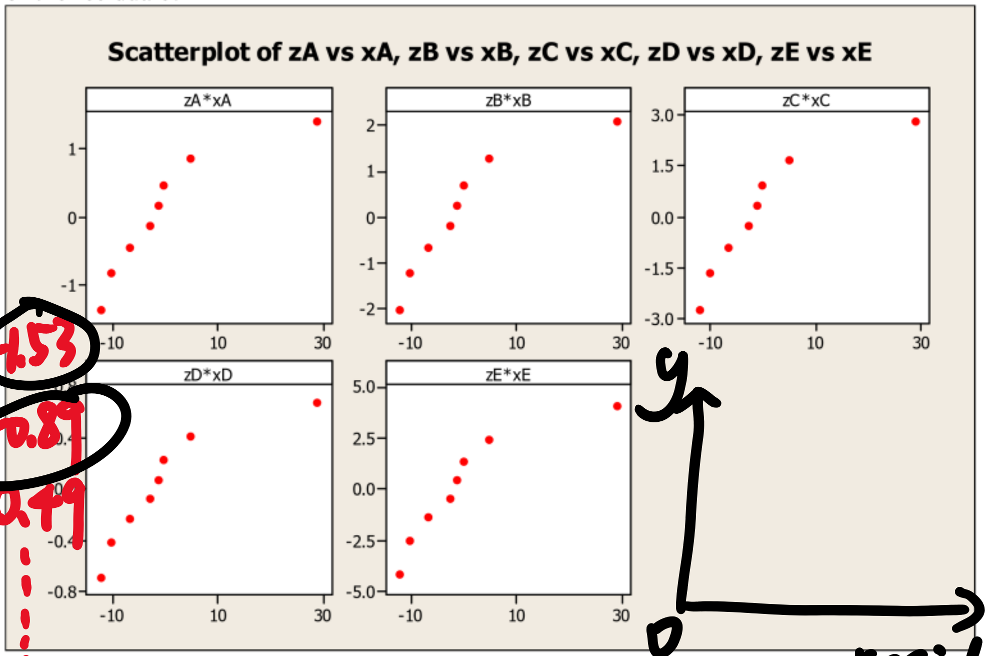
$\frac{1-0.5}{8} \Rightarrow -1.53$

$\frac{2-0.5}{8} \rightarrow -0.89$

$\rightarrow -0.49$

$\vdots$

$\frac{8-0.5}{8} \rightarrow 1.53$



22. Referring to Question #20 above, what assumption can be checked with a normal probability plot of the residuals and what should one look for in such a plot?

(a) The residuals all have the same variance. Look for a straight line pattern.

(b) The residuals follow a normal distribution. Look for a random scattering of points, with no patterns in the plot. The vertical variation in the plot should be roughly constant throughout the whole range of fitted values.

(c) The residuals follow a normal distribution. Look for a straight line pattern.

(d) The residuals all have the same variance. Look for a random scattering of points, with no patterns in the plot. The vertical variation in the plot should be roughly constant throughout the whole range of fitted values.

(e) The residuals all have the same variance. Look for a straight line pattern. The vertical variation in the plot should be roughly constant throughout the whole range of fitted values.

23. Referring to Minitab Output #1 (at the end of this test), what hypothesis is being tested in the ANOVA table?

(a) $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$ vs $H_1 : \mu_i \neq \mu_j$ for at least one pair (i, j)
(b) $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$ vs $H_1 : \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$
(c) $H_0 : \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2$ vs $H_1 : \sigma_i^2 \neq \sigma_j^2$ for at least one pair (i, j)
(d) $H_0 : \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2$ vs $H_1 : \sigma_1^2 \neq \sigma_2^2 \neq \sigma_3^2 \neq \sigma_4^2$
(e) H_0 : the residuals follow a normal distributioon vs H_1 : the residuals do not follow a normal distribution.

24. Referring to Minitab Output #1 (at the end of this test), find the missing `F-Value` in the ANOVA table.

(a) 3.87 **(b)** 4.55 **(c)** 13.21 **(d)** 9.51 **(e)** 5.92

25. Referring to Minitab Output #1 (at the end of this test), which pairs of means are significantly different?

(a) 0 and 1, 0 and 2, 1 and 2, 1 and 3, 2 and 3 only **(b)** 0 and 1 only **(c)** none of them
(d) 0 and 3, 0 and 1 only **(e)** 0 and 3, 0 and 2, 0 and 1 only

Minitab Output #1

One-way ANOVA: SYSTOLIC versus EXERCISE

Method

Null hypothesis	All means are equal
Alternative hypothesis	At least one mean is different
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
EXERCISE	4	0, 1, 2, 3

Analysis of Variance

$\downarrow$ $F_{3,96}$ 5%

Source	DF	Adj SS	Adj MS	F-Value	P-Value
EXERCISE	? $a-1=3$	? SSTr	? MSTr	?	0.005
Error	? $N-a=96$	? SSE	? MSE		
Total	? $N-1=99$	? SST			

$a=4$

$N=38+38+13+11$

$=100$

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
?	12.44%	9.71%	5.62%

Means

group summary

EXERCISE	N	Mean	StDev	95% CI
0	38	135.16	13.04 S_1	(131.26, 139.06)
1	38	129.42	12.12	(125.52, 133.32)
2	13	125.23	9.71	(118.56, 131.90)
3	11	? 122.09	11.09 S_4	(?, ?)

Fisher Individual Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
1 - 0	? $129.42-135.16=-5.74$	?	(? , ?)	?	?
2 - 0	-9.93	?	(-17.65, -2.20)	?	?
3 - 0	? -13.07	?	(? , -4.84)	?	?
2 - 1	-4.19	?	(-11.92, 3.53)	?	?
3 - 1	-7.33	?	(-15.56, 0.90)	?	?
3 - 2	-3.14	?	(-12.99, 6.71)	?	?

Simultaneous confidence level = 79.91%

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mean(3) $-$ 125.23 $= -3.14$

1-0 $\quad LSD = t_{N-a,\frac{\alpha}{2}}\sqrt{MSE\left(\frac{1}{n_0}+\frac{1}{n_1}\right)}$

$= 1.98 \cdot \sqrt{146.7492\left(\frac{1}{38}+\frac{1}{38}\right)}$

$= 5.502705.$

$-5.74 \pm LSD$

C.I. $(-11.24271, -0.2372946)$

Answers

≈ 5.56278 .

C.I. (−11.24271, −0.2372946)

0 not inside.

Answers

1. d **2.** a **3.** c **4.** e **5.** c **6.** a **7.** d **8.** a **9.** b **10.** b
11. d **12.** a **13.** c **14.** e **15.** a **16.** b **17.** d **18.** e **19.** b **20.** c
21. a **22.** c **23.** a **24.** b **25.** e