GBS 221 Trollen **Exam 3** **NAME ___________**

1. [15 pts] Circle the ***best*** answer in the brackets.
   a) The probability of a Type I error is denoted by **[** a **|** b **| 1-**a **| 1-**b **]**.
   b) When a decision maker doesn't reject the null hypothesis, she runs the risk of a Type **[** a **| I | II | p]** error.
   c) A researcher cites that the p–value for her sample result was .20. You prefer to perform hypothesis tests at the 5% level of significance. Applying your level of significance to her results, you **[can | cannot]** reject H_0.
   d) When all of the values plotted on a control chart lie within the upper and lower control limits and exhibit random variation, we conclude that **[no | common cause | assignable cause | pooled]** variation was present.
   e) A(n) **[X-bar | R | np | p]** chart is used to track item variation over time.

2. [3 pts] Joe Zin's financial advisor predicted his portfolio's mean rate of return would be at least 12.1%. What are the appropriate hypotheses?

   H_0: ____

   H_A: ____

3. [4 pts] Consider the hypotheses:

   H_0: The new plan is superior to the old plan

   H_A: The new plan is inferior to the old plan

   a) Explain *in terms of this scenario* what a Type I error would be.

   b) Explain *in terms of this scenario* what a Type II error would be.

4. [4 pts] A researcher was testing H_0: $\mu \leq 40$ vs. H_A: $\mu > 40$. A summary of the results is given below. Unfortunately the p-value didn't print. What is the p-value?

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TEST OF MU = 40.0 VS MU G.E. 40.0
            N      MEAN    STDEV   SE MEAN      Z     P VALUE
C1        150     40.79     4.57      .373   2.12        ????
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5. [3 pts] When testing the difference between means, what is the advantage of using *paired samples*?

6. [3 pts] A large shipment actually contains 10% defective items. If the receiving organization's acceptance sampling plan calls for n=20 and c=3, what is the probability that the shipment will be *accepted*?

7. [3 pts] A sample of 15 parts will be taken from a large shipment. Given that p_0 and p_1 each =.05, what acceptance number will limit the Producer's risk to 10% or less?

Use the worksheets to perform a hypothesis test for each of the next three problems.
In step 6, ***state your conclusion in terms relevant to the scenario****.*

8. [18 pts] A study conducted 5 years ago revealed that 18 percent of adults wore seat belts. Since then, an alliance of government, insurance industry and civic leaders has coordinated a 5-year advertising blitz to promote seat belt usage. A survey has just been completed to determine whether the advertising has been effective. Of 2,000 adults polled, 604 indicated they regularly use seat belts. Can the alliance conclude that seat belt usage has increased? Test at the 3% level of significance.

9. [18 pts] Last year the mean expenditure for Christmas presents at Goldwadders department store was $37.50 per gift. Since the economy seems weaker this year, a retailer thinks the mean expenditure this year will be lower. To test her theory, a random sample of 25 Christmas expenditures was selected. The mean was $35.92 and the standard deviation was $4.00. Test the appropriate hypothesis at the 1% level.

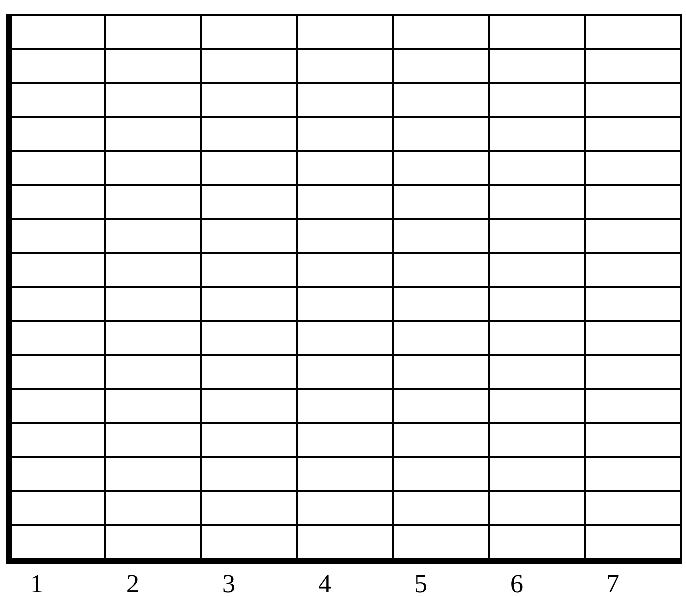
10. [18 pts] Hurts Rent-A-Car will purchase new sub-compact cars to add to its fleet. Before making the final decision, management wants to determine whether there is any difference in the first-year maintenance & repair costs associated with the Chevy Nova and Toyota Corolla. For a random sample of 12 Novas, the mean first-year maintenance & repair costs was $43.22 with a standard deviation of $12.32. A random sample of 18 Corollas averaged $32.72 with a standard deviation of $8.32. What should management conclude at the 5% level. Assume the populations have equal variances.

11. [11 pts] BriteCo makes light bulbs. They periodically sample and test 20 newly-made bulbs to monitor the production process. You've been asked to prepare a control chart to monitor the proportion of defects.

Sample	1	2	3	4	5	6	7
# of defectives	3	0	2	3	6	1	2

a) Calculate the centerline and control limits.

b) Sketch the control chart.



c) Interpret the chart.

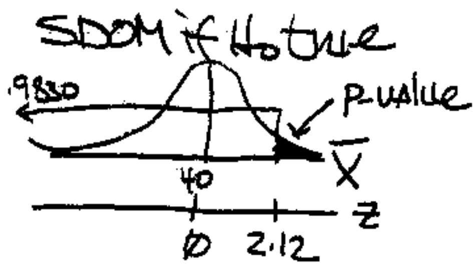
EXAM 3 SOLUTIONS

1A) α B) II C) CANNOT, SINCE p-VALUE $> \alpha$
D) COMMON CAUSE E) R-chart

2) $H_0: \mu \geq 12.1$ $H_A: \mu < 12.1$

3A) concluding the new plan is inferior when it is actually superior
B) " " " " " superior " " " " inferior

4) given $Z_{sample} = 2.12$, find p-value
CUMULATIVE PROB FOR Z is .9830
SO TAIL AREA = $\boxed{.0170}$ = P-VALUE



5) THE PRIMARY BENEFIT IS THAT OTHER VARIABLES ARE HELD CONSTANT, WHICH HELPS ISOLATE THE FACTOR UNDER STUDY. THEN, IF A DIFFERENCE IS OBSERVED, IT CAN BE ATTRIBUTED TO THE FACTOR UNDER STUDY - NOT TO OTHER VARIABLES.

6) $P_B(X \leq 3 / n = 20, p = .10) = \boxed{.8670}$

7) $P_B(X = c / n = 15, p = .05) \geq .90$, from tables, $\boxed{c = 2}$

PROBLEM # 8

1) H_o: $p \le .18$

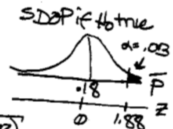
H_a: $p > .18$ seat belt usage has increased

2) α = .03

3) Test statistic: $\bar{p}$ whose sampling distribution follows Z distribution.

4) Critical value(s) $Z_{crit} = 1.88$

SDOP if H_o true



5) Analyze sample results

$n = 2000$

$\bar{p} = \frac{604}{2000} = .302$ $\sigma_{\bar{p}} = \sqrt{\frac{.18(.82)}{2000}} = .0086$

$z_{sample} = \frac{\bar{p} - p_{H_o}}{\sigma_{\bar{p}}} = \frac{.122}{.0086} = 14.19$

crit $\bar{p} = .18 + 1.88(.0086) = .1962$

6) The sample result [**is** | is not] significantly different from the hypothesized value. The researcher [**can** | cannot] reject H_o and should conclude Proportion of Adults who wear seat belts has increased.

PROBLEM # 9

1) H_o: $\mu \ge 37.50$

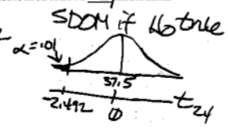
H_a: $\mu < 37.50$ mean expenditure is lower this year

2) α = .01

3) Test statistic: $\bar{X}$ whose sampling distribution follows t_{24} distribution.

4) Critical value(s) $t_{crit} = 2.492$

SDOM if H_o true



5) Analyze sample results

$n = 25$ $\bar{X} = 35.92$ $s = 4$

$s_{\bar{X}} = \frac{4}{\sqrt{25}} = .80$

$t_{sample} = \frac{\bar{X} - \mu_{H_o}}{s_{\bar{X}}} = \frac{35.92 - 37.50}{.80} = -1.98$

crit $\bar{p} = 37.5 - 2.492(.80) = 35.51$

6) The sample result [is | **is not**] significantly different from the hypothesized value. The researcher [can | **cannot**] reject H_o and should conclude insufficient evidence to demonstrate that mean expenditure has decreased.

PROBLEM # 10

1) H_o: $\mu_N = \mu_C$ { $\mu_N - \mu_C = 0$ NO DIFF IN MEAN FIRST-YEAR MAINT COSTS

H_a: $\mu_N = \mu_C$ { $\mu_N - \mu_C \ne 0$

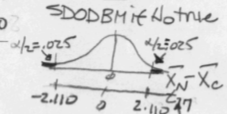
$df = \frac{\left(\frac{12.32^2}{12} + \frac{8.32^2}{18}\right)^2}{\frac{1}{11}\left(\frac{12.32^2}{12}\right)^2 + \frac{1}{17}\left(\frac{8.32^2}{18}\right)^2} = 17.65$

2) α = .05

3) Test statistic: $\bar{X}_N - \bar{X}_C$ whose sampling distribution follows t_{17} distribution.

4) Critical value(s) $t_{crit} = \pm 2.110$

SDODBM if H_o true



5) Analyze sample results

NOVA		Corolla
12	n	18
43.22	$\bar{X}$	32.72
12.32	s	8.32

$\bar{X}_n - \bar{X}_c = 10.50$

$s_{\bar{X}_N - \bar{X}_C} = \sqrt{\frac{12.32^2}{12} + \frac{8.32^2}{18}} = 4.06$

$t_{sample} = \frac{10.50 - 0}{4.06} = 2.59$

crit $\bar{X}_N - \bar{X}_C = 0 \pm 2.110(4.06) = \pm 8.5667$

6) The sample result [**is** | is not] significantly different from the hypothesized value. The researcher [**can** | cannot] reject H_o and should conclude THERE IS A DIFFERENCE IN MEAN FIRST-YEAR REPAIR COSTS... & COROLLA'S is lower.

11A) P-Chart $p = \frac{\text{total defects}}{\text{total sampled}} = \frac{3+0+2+6+13+1+2}{140} = \frac{17}{140} = .1214$

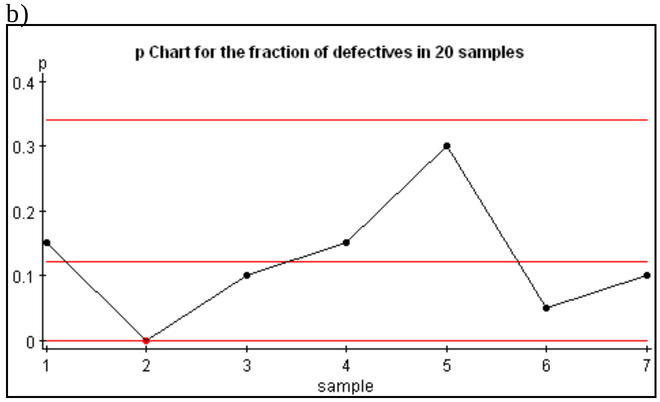
$\sigma_{\bar{p}} = \sqrt{\frac{.1214(.8786)}{20}} = .0730$ UCL & LCL $= .1214 \pm 3(.0730)$

$= .1214 \pm .2191$

$= 0$ to $.3405$

c) PROCESS WAS OUT OF CONTROL IN PERIOD 2. SEEK OUT POSSIBLE SOURCES OF ASSIGNABLE CAUSE VARIATION IN THAT PERIOD & IDENTIFY WHY THE PROPORTION OF DEFECTIVES WAS SO LOW. PERHAPS THEY CAN UNCOVER A CHANGE TO THE PROCESS TO CONSISTENTLY REDUCE DEFECTS IN THE FUTURE.

b)



p Chart results for the fraction of defectives in 20 samples:

Center line at 0.12142857

Upper control limit at 0.34053504

Lower control limit at 0