AP Statistics **Name:**
Mr Murphy **Date:**
Hypothesis Testing and Confidence Intervals for proportions worksheet **Period:**

A.M.D.G.

Formulae:

Confidence Intervals (generally): statistic ± (critical value)(standard deviation)

One Proportion:

Confidence Interval

$$\hat{p} \pm z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Hypothesis Testing

$$z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$$

Two Proportions:

Confidence Interval

$$\hat{p}_1 - \hat{p}_2 \pm z\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

Hypothesis Testing

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}_c(1-\hat{p}_c)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$\hat{p}_c = \frac{x_1 + x_2}{n_1 + n_2}$$

Confidence Level (CI)	*z* Critical Value (C.V.)
90%	1.645
95%	1.96
99%	2.58

Type I Error: (false positive) – rejecting the null hypothesis and accepting the alternative when the null hypothesis is actually true.

Type II Error: (false negative) – failing to reject the null hypothesis (rejecting the alternative) when the alternative hypothesis is actually true.

Process for Hypothesis Testing:

1. Define the population characteristics for each proportion to be tested
2. State the null hypothesis H_0
3. State the alternate hypothesis H_a
4. State the significance level for the test α
5. Check all assumptions (for each proportion)
6. State the name of the test to be used
7. State degrees of freedom if applicable
8. Write the test statistic (the formula you will use to find the z-value)
9. Calculate the test statistic showing your work
10. Calculate the P-value
11. Sketch a picture of the situation (Let the reader know which tail test you are using)
12. State the conclusion in two sentences:
    I. Reject or fail to reject
    II. State evidence in favor of or against

Interpreting Confidence Interval and Level:

Confidence Intervals

"We are <u>(confidence level)</u> % confident that p, the true proportion of <u>(proportion in context of probem)</u>, is between ___% and ___%."

Confidence Level

"We used a method to construct this estimate that in the long run will successfully capture the true value of p <u>(confidence level)</u> % of the time."

Explanation of Hypothesis Test Conclusion:

A. Summarize in theory discussing H_0. Always start by stating the P – value compared to the significance level, α, of the test
   - If the P – value is **<u>less than</u>** α, then we **reject the null hypothesis (H_0)** at the significance level we tested.
   - If the P – value is **<u>greater than</u>** α, then we **fail to reject the null hypothesis (H_0)** at the significance level we tested.

B. Summarize in context discussing H_a .
   - **If we reject H_0** state that "we have evidence that the proportion of _______ is …, therefore, the *(initial claim)* is incorrect."
   - **If we fail to reject H_0** state that "we have insufficient evidence that the proportion of _______ is …, therefore, we cannot reject the *(initial claim)*."

1. Mr. Maychrowitz was recently playing through the video game “Dark Souls” again, and noticed that the drop rate of a certain item was approximately 15.7% (after creating a sampling distribution with $n = 100$). Use this information to do each of the following:
   a. Construct and interpret a 95% confidence interval to capture the true value of the proportion.

   b. While playing, in one sample of 100 enemies, he found the item dropped 22 times. Does this provide evidence at the 0.01 level of significance that the actual drop rate is greater than 15.7%? Perform and interpret a complete hypothesis test.

2. A certain treatment is being tested for its effectiveness in suppressing flu symptoms. The researchers randomly assign treatments (placebo or new treatment) to individuals randomly selected from the population who have the flu and get the results that are detailed in the table below.

Group	**Sample Size**	**Number with significant symptom alleviation**
Placebo	576	201
New Treatment	576	239

   a. Does this provide significant evidence that the new treatment is better than a placebo? Perform a hypothesis test at the 0.05 level of significance.

   b. Construct a 95% confidence interval to capture the true difference between the treatment and the placebo. Does this result validate the results of the hypothesis test? Explain.

3. A recent report stated that less than 40% of the adult residents of a certain county would be able to pass a basic fitness test. As a result, the county's Recreation Department is trying to convince the county government to fund more physical fitness programs. Since the county is facing significant budgetary constraints, they will only fund more programs if the recreation department can provide convincing evidence that the 40% claim in the report is true.

The Recreation Department plans to collect data from a sample of 185 adult residents of the county and perform a test of significance at a significance level of 0.05 for the following hypotheses:

$$\mathrm{H}_0 : p = 0.40$$
$$\mathrm{H}_0 : p < 0.40$$

Where p is the proportion of adult residents in the city able to pass the physical fitness test.

a. Describe a Type II error for this situation and describe a consequence of making this type of error.

b. The Recreation Department recruits 185 adult residents who volunteer to take the physical fitness test. The test is passed by 85 out of the 185 residents, resulting in a z–score = 1.651 and a resulting p-value of 0.97 for the hypotheses stated above. If this was a reasonable test of significance for the hypotheses using the data collected from these 185 volunteers, what would the p-value of 0.97 lead you to conclude?

c. Describe the primary flaw in the study described in part b.