**Chapter 9.2 & 9.3 – Significance Tests Practice SOLUTIONS**

**1. Are boys more likely?**We hear that newborn babies are more likely to be boys than girls. Is this true? A random sample of 25,468 firstborn children included 13,173 boys.Boys do make up more than half of the sample, but of course we don’t expect a perfect 50-50 split in a random sample.

Do these data give convincing evidence that boys are more common than girls in the population? Carry out a significance test to help answer this question at the α=0.05 significance level.

State: What are the hypotheses? What is the parameter of interest?

$$H\_{0}:p=0.5$$

$$H\_{a}:p>0.5$$

p = proportion of firstborn children who are boys

Plan: Are the random, normal and independent conditions met?

We will carry out a one-sample z test for p.

Conditions: Random – yes, the problem tells us a random sample of 25,468 firstborn children was taken

 Normal – We can assume a normal distribution since our sample size is large enough:

 np0 = (25,468)(0.5) = 12,734 > 10 n(1 – p0)= (25,468)(0.5) = 12,734 > 10

Independent – We don’t know if the children were sampled without replacement, but the 10% condition is satisfied: 10(25,468) = 254,680 < whole population of newborns.

Do: Compute the test statistic $z=\frac{\hat{p}-p\_{0}}{\sqrt{\frac{p\_{0}(1-p\_{0})}{n}}}$, then find the p-value (appropriate area under the normal distribution). Or use the instructions to complete the whole test on the calculator. You should still compute the test statistic and draw the picture to earn full credit on the AP exam, then check your answer with your calculator.

$z=\frac{0.5172-0.50}{\sqrt{\frac{0.5(1-0.5)}{25,468}}}=\frac{0.0172}{0.0031}≈5.55$ p-value $≈0$

Conclude: How does your p-value compare to the stated α=0.05 significance level? Interpret your result in the context of the problem.

Since our p-value is smaller than 0.05, we reject $H\_{0}$. It appears that boys are more prevalent among newborn firstborn children.

**1.** **Sweetening colas** Cola makers test new recipes for loss of sweetness during storage. Trained tasters rate the sweetness before and after storage. From experience, the population distribution of sweetness losses will be close to Normal. Here are the sweetness losses (sweetness before storage minus sweetness after storage) found by tasters from a random sample of 10 batches of a new cola recipe:



Do these data give convincing evidence that the cola lost sweetness? Carry out a significance test to help answer this question at the α=0.01 significance level.

State: What are the hypotheses? What is the parameter of interest?

$H\_{0}:μ=0$ $μ$ = mean amount of sweetness loss

$H\_{a}:μ>0$

Plan: Are the random, normal and independent conditions met?

We will use a one-sample *t* test for the mean.

Conditions: Random – a random sample of 10 batches of a new cola recipe was taken

Normal – though the sample size is small (n = 10), the population distribution of sweetness losses will be close to Normal.

Independent – the 10% condition is satisfied: 10(n) = 10(10) = 100 < population of batches of new cola.

Do: Find the sample mean $\overbar{x} $using the lists in your calculator (or do it by hand). Compute the test statistic $t=\frac{\overbar{x}-μ}{\frac{s\_{x}}{\sqrt{n}}}$, then find the p-value (appropriate area under the t-distribution with appropriate degrees of freedom). Or use the instructions to complete the whole test on the calculator. You should still compute the test statistic and draw the picture to earn full credit on the AP exam, then check your answer with your calculator.

Use the calculator list and 1-variable statistics features to find the mean and standard deviation of the sample: $\overbar{x}=1.02, s\_{x}=1.1961 t=\frac{1.02-0}{\frac{1.1961}{\sqrt{10}}}=2.70, df=9$ p-value = 0.0122

Conclude: How does your p-value compare to the stated α=0.01 significance level? Interpret your result in the context of the problem.

Since our p-value is greater than 0.01, we fail to reject $H\_{0}$. There is not enough evidence to conclude that there is an average loss of sweetness for this cola.