One Sample Z-Test

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PROBLEM 1

A sample of 100 tires is taken from a lot. The mean life of tyres is found to be 39, 350 kilo meters with a standard deviation of 3, 260. Could the sample come from a population with mean life of 40, 000 kilometers?

Null hypothesis: μ =40000 km
Alternative hypothesis: μ not equal to 40000 km

```
> xbar=39350
> muo=40000
> sigma=3260
> n=100
> z=(xbar-muo)/(sigma/sqrt(n))
> z
[1] -1.993865
> alpha=0.05
> zhalfalpha=qnorm(1-(alpha)/2)
> c(-zhalfalpha,zhalfalpha)
[1] -1.959964  1.959964
> pval=2*pnorm(z)
> pval
[1] 0.04616681
```

NULL HYPOTHESIS IS REJECTED BECAUSE Z DOES NOT LIE BETWEEN - Z HALF ALPHA AND Z ALPHA

PROBLEM 2

The mean life time of a sample of 400 fluorescent light bulbs produced by a company is found to be 1, 570 hours with a standard deviation of 150 hours. Test the hypothesis that the mean life time of bulbs is 1600 hours against the alternative hypothesis that it is greater than 1, 600 hours at 1% and 5% level of significance**.**

Null hypothesis: μ <=1600
Alternative hypothesis: μ >1600

```
> xbar=1570
> muo=1600
> sigma=150
> n=400
> z=(xbar-muo)/(sigma/sqrt(n))
> z
[1] -4
> alpha=0.05
> zalpha=qnorm(1-alpha)
> zalpha
[1] 1.644854
> pval=pnorm(z)
> pval
[1] 3.167124e-05
> 1-pval
[1] 0.9999683
```

REJECT THE NULL HYPOTHESIS BECAUSE -Z>Z ALPHA THAT MEANS THE A LTERNATIVE HYPOTHESIS

PROBLEM 3

In the sample of 1000 people in Maharashtra,540 are rice eaters and the rest are wheat eaters. Can we assume that both rice and wheat are equally popular in this state at 1% level of significance

OUTPUT:

```
> #q3
> #H0:p=0.5 i.e. both rice and wheat are equally popular in this state at 1% level of
significance
> #H1:p not= 0.5 i.e. both rice and wheat are not equally popular in this state at 1% level
of significance
> n=1000
> p=540/1000
> p0=0.5
> q0=1-p0
> z=(p-p0)/(sqrt(p0*q0/n))
> z
[1] 2.529822
> alpha=0.01
> zhalfalpha=qnorm(1-(alpha)/2)
> zhalfalpha
[1] 2.575829
> if(z<=-zhalfalpha || z>=zhalfalpha){
```

```
+   print("H0:p=0.5 rejected i.e. both rice and wheat are not equally popular in this state at 1% level of significance")
+ }else{
+   print("H0:p=0.5 accepted i.e. both rice and wheat are equally popular in this state at 1% level of significance")
+ }
[1] "H0:p=0.5 accepted i.e. both rice and wheat are equally popular in this state at 1% level of significance"
> pval=pnorm(z)
> pval
[1] 0.994294
```

PROBLEM 4

A particular brand of tires claims that its deluxe tire averages at least 50,000 miles before it needs to be replaced. From past studies of this tire, the standard deviation is known to be 8000. A survey of owners of that tire design is conducted. From the 28 tires surveyed, the average lifespan was 46,500 miles with a standard deviation of 9800 miles. Do the data support the claim at the 5% level?

OUTPUT:

```
#q3
> #H0:mu>=50000
> #H1:mu<50000
> mu0=50000
> n=28
> psd=8000
> xbar=46500
> ssd=9800
> z=(xbar-mu0)/(psd/sqrt(n))
> z
[1] -2.315032
> alpha=0.05
> zalpha=qnorm(1-(alpha))
> zalpha
[1] 1.644854
> if(z<=-zalpha){
+   print("H0:mu>=50000 rejected")
+ }else{
+   print("H0:mu>=50000 accepted")
+ }
[1] "H0:mu>=50000 rejected"
```

```
> pval=pnorm(z)
> pval
[1] 0.01030558
```

PROBLEM 5

From generation to generation, the average age when smokers first start to smoke varies. However, the standard deviation of that age remains constant of around 2.1 years. A survey of 40 smokers of this generation was done to see if the average starting age is at least 19. The sample average was 18.1 with a sample standard deviation of 1.3. Do the data support the claim at the 5% level?

A)

Null hypothesis: $\mu \geq 19$

Alternative hypothesis: $\mu < 19$

Z=(mean-mew)/(sd)/(n^(1/2))

Reject null hypothesis when z<-z alpha

n=40

OUTPUT:

```
> #left tailed
> xbar=18.1
> muo=19
> sigma=2.1
> n=40
> z=(xbar-muo)/(sigma/sqrt(n))
> z
[1] -2.710524
> alpha=0.05
> zalpha=qnorm(1-alpha)
> -zalpha
[1] -1.644854
> t=-zalpha
> pval=pnorm(z)
> pval
[1] 0.003358852
> if(z<t)
+ {
+   print("h0 is rejected")
+ }
[1] "h0 is rejected"
> if(z>t)
```

```
+ {
+   print("h0 is accepted")
+ }
```

PROBLEM 6

The cost of a daily newspaper varies from city to city. However, the variation among prices remains steady with a standard deviation of 6¢. A study was done to test the claim that the average cost of a daily newspaper is 35¢. Twelve costs yield an average cost of 30¢ with a standard deviation of 4¢. Do the data support the claim at the 1% level?
A)
Accept Null hypothesis if z<=-z half alpha or z>=z half alpha
Null hypothesis: μ =35
Alternative hypothesis: μ not equal to 35
xbar=30

```
> muo=35
> sigma=6
> n=12
> z=(xbar-muo)/(sigma/sqrt(n))
> z
[1] -2.886751
> alpha=0.01
> zhalfalpha=qnorm(1-(alpha)/2)
> t=-zhalfalpha
> c(-zhalfalpha,zhalfalpha)
[1] -2.575829  2.575829
> pval=2*pnorm(z)
> pval
[1] 0.003892417
> if(z>t && z<zhalfalpha)
+ {
+   print("accept h0")
+ }
> if(z<=t || z>=zhalfalpha)
+ {
+   print("rejected h0")
+ }
[1] "rejected h0"
```

PROBLEM 7

An article in the San Jose Mercury News stated that students in the California state university system take an average of 4.5 years to finish their undergraduate degrees. Suppose you believe that the average time is longer. You conduct a survey of 49 students

and obtain a sample mean of 5.1 with a sample standard deviation of 1.2. Do the data support your claim at the 1% level?

```
> xbar=5.1
> muo=4.5
> sigma=1.2
> n=49
> z=(xbar-muo)/(sigma/sqrt(n))
> z
[1] 3.5
> alpha=0.01
> zalpha=qnorm(1-alpha)
> -zalpha
[1] -2.326348
>
> if(z<=-zalpha){print("Null hypothesis is rejected")} else{print("Null hypothesis is accepted")}
[1] "Null hypothesis is accepted"
```

PROBLEM 8

The average number of sick days an employee takes per year is believed to be about 10. Members of a personnel department do not believe this figure. They randomly survey 8 employees. The number of sick days they took for the past year are as follows: 12; 4; 15; 3; 11; 8; 6; 8. Let X = the number of sick days they took for the past year. Should the personnel team believe that the average number is about 10?

```
xbar=10
> m<-c(12,4,15,3,11,8,6,8)
> n=8
> muo=sum(m/n)
> mm=m*m
> sd=sum(mm)/n-(muo*muo)
> z=(xbar-muo)/(sd/sqrt(n))
> z
[1] 0.3119368
> alpha=0.05
> zhalfalpha=qnorm(1-(alpha/2))
> c(-zhalfalpha,zhalfalpha)

[1] -1.959964  1.959964
```

```
> if(z<=-zhalfalpha | z>=zhalfalpha){print("Null hypothesis is rejected")}
else{print("Null hypothesis is accepted")}
[1] "Null hypothesis is accepted"
```

PROBLEM 9

In 1955, *Life Magazine* reported that the 25 year-old mother of three worked [on average] an 80 hour week. Recently, many groups have been studying whether or not the women's movement has, in fact, resulted in an increase in the average work week for women (combining employment and at-home work). Suppose a study was done to determine if the average work week has increased. 81 women were surveyed with the following results. The
sample average was 83; the sample standard deviation was 10. Does it appear that the average work week has increased for women at the 5% level?

```
xbar=80
> mu0=83
> sigma=10
> n=81
> z=(xbar-mu0)/(sigma/sqrt(n))
> alpha=0.05
> z
[1] -2.7
> zalpha=qnorm(1-alpha)
> zalpha
[1] 1.644854
> if(z<=-zalpha){print("Null hypothesis is rejected")} else{print("Null hypothesis is
accepted")}
[1] "Null hypothesis is rejected"
>
```

PROBLEM 10

Your statistics instructor claims that 60 percent of the students who take her Elementary Statistics class go through life feeling more enriched. For some reason that she can't quite figure out, most people don't believe her. You decide to check this out on your own. You randomly survey 64 of her past Elementary Statistics students and find that 34 feel more enriched as a result of her class. Now, what do you think?

```
p=34/64
> p0=0.60
> n=64
> q0=1-p0
> alpha=0.05
```

```
> z=(p-p0)/sqrt(p0*q0/n)
> z
[1] -1.122683
> zalpha=qnorm(1-alpha)
> zalpha
[1] 1.644854
> pval=pnorm(z)
> pval
[1] 0.1307861
> if(z<=-zalpha){print("Null hypothesis is rejected")} else{print("Null hypothesis is
accepted")}
[1] "Null hypothesis is accepted
```

PROBLEM 11

According to an article in *Newsweek*, the natural ratio of girls to boys is 100:105. In China, the birth ratio is 100: 114 (46.7% girls). Suppose you don't believe the reported figures of the percent of girls born in China. You conduct a study. In this study, you count the number of girls and boys born in 150 randomly chosen recent births. There are 60 girls and 90 boys born of the 150. Based on your study, do you believe that the percent of girls born in China is 46.7?

```
p=60/90
> p0=0.467
> n=150
> q0=1-p0
> alpha=0.05
> z=(p-p0)/sqrt(p0*q0/n)
> z
[1] 4.901502
> zalpha=qnorm(1-(alpha/2))
> zalpha
[1] 1.959964
> if(z>=zalpha){print("Null hypothesis is rejected")} else{print("Null hypothesis is
accepted")}
[1] "Null hypothesis is rejected"
>
```

PROBLEM 12

A poll done for *Newsweek* found that 13% of Americans have seen or sensed the presence of an angel. A contingent doubts that the percent is really that high. It conducts its own survey. Out of 76 Americans surveyed, only 2 had seen or sensed the presence of

an angel. As a result of the contingent's survey, would you agree with the *Newsweek* poll? In complete sentences, also give three reasons why the two polls might give different results.

```
p=2/76
> p0=0.13
> n=76
> q0=1-p0
> alpha=0.05
> z=(p-p0)/sqrt(p0*q0/n)
> z
[1] -2.687745
> zalpha=qnorm(1-alpha)
> -zalpha
[1] -1.644854
> pval=pnorm(z)
> pval
[1] 0.003596812
> if(z<=-zalpha){print("Null hypothesis is rejected and the poll by newsweek is very different from the survey")} else{print("Null hypothesis is accepted and the poll by newsweek is very similar to the survey")}
[1] "Null hypothesis is rejected and the poll by newsweek is very different from the survey"
```