Two Sample Z-Test

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Aim :

To Test the hypothesis for large samples by using Two-Sample Z-Test

Test :

Tests about a proportion using x and n

Formula :

Z = (P1-P2)/S.E.~N(0,1)
where, S.E=sqrt(PQ((1/n1)+(1/n2))),P=(n1P1+n2P2)/(n1+n2) and Q=1-P

Problem 1 :

A popular cold-remedy was tested for its efficacy. In a sample of 150 people who took the remedy upon getting cold, 117 (78%) had no symptoms one week later. In a sample of 125 people who took the placebo upon getting a cold, 90 (75%) had no symptoms one week later. The table summarizes this information.

Code:

```
> p2 = 0.75

> n1 = 150

> n2 = 120

> alpha = 0.05

> P=(n1*p1+n2*p2)/(n1+n2)

> Q=1-P

> SE=sqrt((P*Q/n1)+(P*Q/n2))

> zcal=(p1-p2)/SE

> zcal
[1] 0.5791405
```

```
> ztab=qnorm(1-alpha)

> ztab
[1] 1.644854

> if (zcal<ztab) {print("Accept H0")} else {print("Reject H0")}
[1] "Accept H0"
```

Interpretation:

We accept the null hypothesis because the zcal value is lesser than the ztab value. Therefore, we can't support the claim that the proportion of all remedy users who are symptom-free after one week is greater than the proportion for placebo users.

Problem 2:

The Trial Urban District Association (TUDA) is a study sponsored by the government of student achievement in large urban school district. In 2009, 1311 of a random sample of 1900 eighth-graders from Houston performed at or above the basic level in mathematics. In 2011, 1440 of a random sample of 2000 eighth-graders from Houston performed at or above the basic level. (The study reports the proportions). Is there an increase in the proportions of eighth-graders who performed at or above the basic level in mathematics from 2009 to 2011 at the 5% significance level.

H0 = p2 against H1:p1>p2

Code:

```
> n1 = 1900

> n2 = 2000

> x1 = 1311

> x2 = 1440

> p1 = x1/n1

> p2 = x2/n2

> alpha = 0.05
```

```
> P=(n1*p1+n2*p2)/(n1+n2)

> Q=1-P

> SE=sqrt((P*Q/n1)+(P*Q/n2))

> zcal=abs(p1-p2)/SE

> zcal
[1] 2.054187

> ztab=qnorm(1-alpha)

> ztab
[1] 1.644854

> if (zcal<ztab) {print("Accept H0")} else {print("Reject H0")}
[1] "Reject H0"
```

Interpretation:

We reject the null hypothesis because the zcal value is greater than the ztab value. Thus, there is evidence that there is an increase from 2009 to 2011 in the proportion of eighth-graders who performed at or above the basic level at 5% significance level.

Problem 3:

The use of helmet among recreational alpine skies and snowboarders are generally low. A study from Norway wanted to examine if helmet use reduces thye risk of head injury. In the study, they compared the helmet use among skiers and snowboarders that was injured with a control group. The control group consisted of skiers and snowboarders that was uninjured. 96 of 578 people with head injuries used a helmet and 656 of 2992 people in the uninjured group used a helmet. Is helmet use lower among skiers and snowboarders who had head injuries ?

Solution: Let pl be the proportion of helmet use among injured skiers and snowboarders. Let p2 be the proportion of helmet use among uninjured skiers and snowboarders. We wish to test.

Code:

```
> n1 = 578

> n2 = 2992
```

```
> x1 = 96

> x2 = 656

> p1 = x1/n1

> p2 = x2/n2

> alpha = 0.05

> P=(n1*p1+n2*p2)/(n1+n2)

> Q=1-P

> SE=sqrt((P*Q/n1)+(P*Q/n2))

> zcal=abs(p1-p2)/SE

> zcal
[1] 2.86943
```

Interpretation:

We have strong evidence that helmet use is lower among skiers and snowboarders who had head injuries compared to uninjured skiers and snowboarders.

Problem 4:

A survey is taken two times over the course of two weeks. The pollsters wish to see if there is a difference in the results as there has been a new advertising campaign run. Test at 1% significance level. Also find 99% confidence limit for the difference of proportion. Here is the data.

-	Week 1	Week 2
Favourable	45	56
Unfavourable	35	47

H0: P1 = P2 against the alternative (two-sided)
H1: P1 = P2

Code :

```
> n1 = 45+35

> n2 = 56+47

> x1 = 45

> x2 = 56

> p1 = x1/n1

> p2 = x2/n2

> alpha = 0.01

> P=(n1*p1+n2*p2)/(n1+n2)

> Q=1-P

> SE=sqrt((P*Q/n1)+(P*Q/n2))

> zcal=abs(p1-p2)/SE

> zcal
[1] 0.2538201

> ztab=qnorm(1-(alpha/2))

> ztab
[1] 2.575829

> if (zcal<ztab) {print("Accept H0")} else {print("Reject H0")}
[1] "Accept H0"

> lowerlimit = (p1-p2)-ztab*SE

> upperlimit = (p1-p2)+ztab*SE

> CI_for_99p=c(lowerlimit,upperlimit)
```

```
> CI_for_99p
[1] -0.1720848  0.2097061
```