

R simulation: One-sample confidence interval (z versus t)

```
> A<-matrix(rnorm(90000,50,15),ncol=9,byrow=T)      ##### Sample n=9 10000 times
> xbar<-apply(A,1,mean)                             ##### Compute sample mean
> s<-apply(A,1,sd)                                  ##### Compute sample sd
> head(cbind(A,xbar,s))

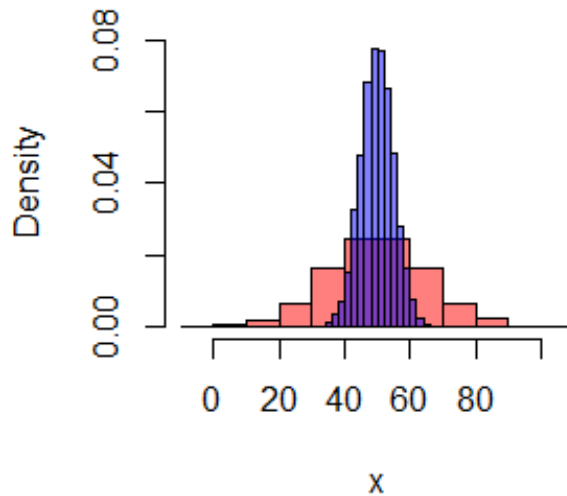
[1,] 46.39419 28.57578 38.37130 58.75215 80.49099 58.44661
[2,] 57.02083 35.41764 24.54493 47.77989 48.03354 64.85204
[3,] 66.69836 31.99845 57.77325 37.35554 44.26381 59.65797
[4,] 54.86365 37.81014 64.54133 28.68051 32.48561 48.24362
[5,] 46.82293 66.12428 51.92378 28.26393 40.58275 36.57626
[6,] 61.43394 36.82603 65.44746 45.52929 53.95023 60.40300
                                xbar      s
[1,] 58.71933 50.28913 58.741508 53.19789 14.77057
[2,] 34.58845 61.97402 55.800131 47.77905 13.73598
[3,] 49.93017 43.59922 65.723950 50.77786 12.41042
[4,] 72.90412 35.52318  9.885265 42.77083 19.43283
[5,] 53.20684 47.83887 48.569690 46.65659 10.79074
[6,] 29.38525 62.79544 61.247361 53.00200 12.84919

> tail(cbind(A,xbar,s))

[9996,] 45.39588 50.97909 33.26158 42.47199 32.96649 47.88498
[9997,] 57.23684 43.25975 61.77799 53.22248 41.04705 40.00071
[9998,] 60.40700 62.39143 28.53635 40.92932 53.39082 40.43433
[9999,] 36.74107 39.96189 43.08427 32.61094 54.47920 46.86977
[10000,] 56.32826 77.36078 51.17206 55.40847 67.75804 81.53660
                                xbar      s
[9996,] 64.38221 21.23417 18.91687 39.72147 14.59137
[9997,] 55.52802 15.88423 65.66786 48.18055 15.15413
[9998,] 65.77980 72.31763 40.24766 51.60382 14.69207
[9999,] 48.25361 69.66999 64.50456 48.46392 12.42848
[10000,] 39.74352 45.05306 49.48783 58.20540 14.37516

> x1<-A[,1]
> hist(x1, col=rgb(1,0,0,0.5),ylim=c(0,.08),freq=F,main="Histograms",xlab="x")
> hist(xbar, col=rgb(0,0,1,0.5), freq=F, add=T)
> mean(x1)
[1] 49.90123
> sd(x1)
[1] 14.99366
> mean(xbar)
[1] 49.94081
> sd(xbar)
[1] 4.970323
```

Histograms



```

> z<-(xbar-50)/(15/sqrt(9))
> t<-(xbar-50)/(s/sqrt(9))
> var(z)                                     ##### Compare to 1.0
[1] 0.9881643
> var(t)                                     ##### Too large!
[1] 1.300538
> zlower<-xbar-1.96*(15/sqrt(9))
> zupper<-xbar+1.96*(15/sqrt(9))
> tlower<-xbar-1.96*(s/sqrt(9))
> tupper<-xbar+1.96*(s/sqrt(9))
> head(cbind(zlower,zupper,tlower,tupper))
      zlower  zupper  tlower  tupper
[1,] 43.39789 62.99789 43.54778 62.84799
[2,] 37.97905 57.57905 38.80487 56.75323
[3,] 40.97786 60.57786 42.66971 58.88600
[4,] 32.97083 52.57083 30.07471 55.46694
[5,] 36.85659 56.45659 39.60665 53.70654

> (sum(50.0<zlower)+sum(zupper<50.0))/10000
[1] 0.0486
> (sum(50.0<tlower)+sum(tupper<50.0))/10000   ##### Too large!
[1] 0.0836
> ctlower<-xbar-2.306*(s/sqrt(9))
> ctupper<-xbar+2.306*(s/sqrt(9))
> (sum(50.0<ctlower)+sum(ctupper<50.0))/10000   ##### Better
[1] 0.0472

```