Stat 241/251 Lab 6: Confidence Intervals and Hypothesis Testing

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#	R commands	Details

1	`> x1 = rnorm(20, 0, 2)`
	`> x1`
	`[1] -1.11471959 2.12738009 -2.36266866 -0.31370973 -0.47777851 -3.59455165`
	`[7] 0.09441916 2.44806514 1.87983557 1.87810492 1.21651508 -2.92230222`
	`[13] 2.37626660 1.69471913 1.03551591 3.75373745 -1.86254592 -4.21430249`
	`[19] -1.23022088 -2.37823939`
		Generate random sample data with **mean 0** from Normal distribution

2	`> width1 = 1.96*2/sqrt(length(x1)) # check 22, SD = 2`
	`> c(mean(x1)-width1, mean(x1)+width1)`
	`[1] -0.9748626 0.7782146`
		Calculate C.I. Using formula (**2-sided**)

3	`> x2 = rnorm(20, 5, 2)`
	`> x2`
	`[1] 2.878436 3.858332 8.829186 2.788827 8.435223 6.970660 7.332432 1.319389`
	`[9] 5.256069 5.809369 5.310621 2.152157 8.369990 4.525245 2.500189 3.745879`
	`[17] 6.359793 8.959776 4.863178 5.087099`
		Generate data with **mean 5** from Normal distribution

4	`> width2 = 1.96*2/sqrt(length(x2)) # check 22, SD = 2`
	`> c(mean(x2)-width2, mean(x2)+width2)`
	`[1] 4.391054 6.144131`
		Calculate C.I. Using formula (**2-sided Z** test)

5	`# for mu <= mu0 and mu >= mu0`
	`> width = 1.645*2/sqrt(length(x1)) # check 22, SD = 2`
	`> c(-Inf, mean(x1)+width)`
	`[1] -Inf 0.6373424`
		Calculate C.I. Using formula (**1-sided Z** test).

6	`install.packages("TeachingDemos") # select Canada BC server` `require(TeachingDemos)`	Install **R package**
7	`> z.test(x1, mu = 0, stdev=2, alternative = "less", conf.level = 0.95)$conf.int[1:2]` `[1] -Inf 0.6372769`	Do the same using R package.

8	`> c(mean(x1)-width, Inf)`
	`[1] -0.8339904 Inf`
	`> z.test(x1, mu = 0, stdev=2, alternative = "greater", conf.level = 0.95)$conf.int[1:2]`
	`[1] -0.8339249 Inf`
		Calculate C.I. Using formula (**1-sided Z** test). Check using R package.

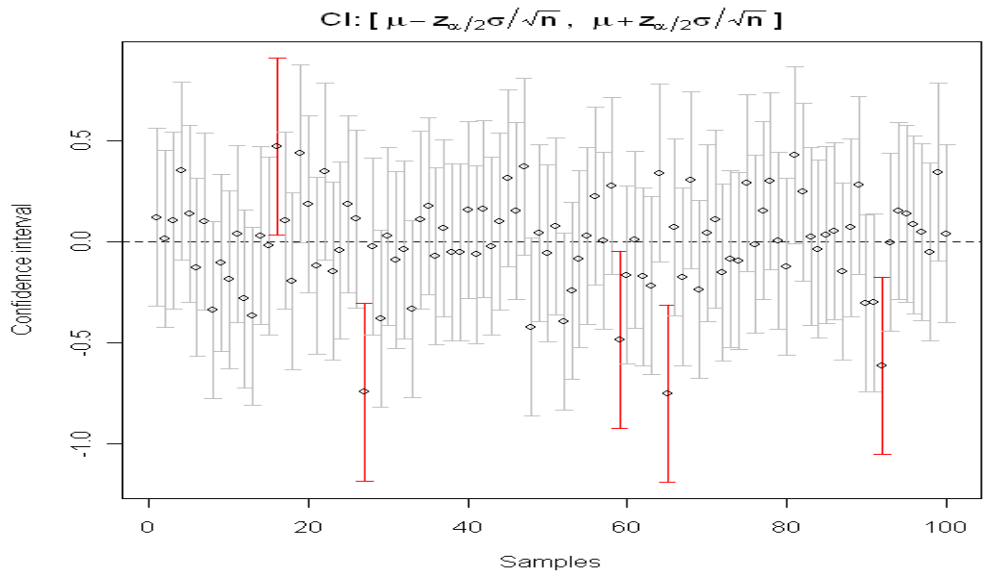
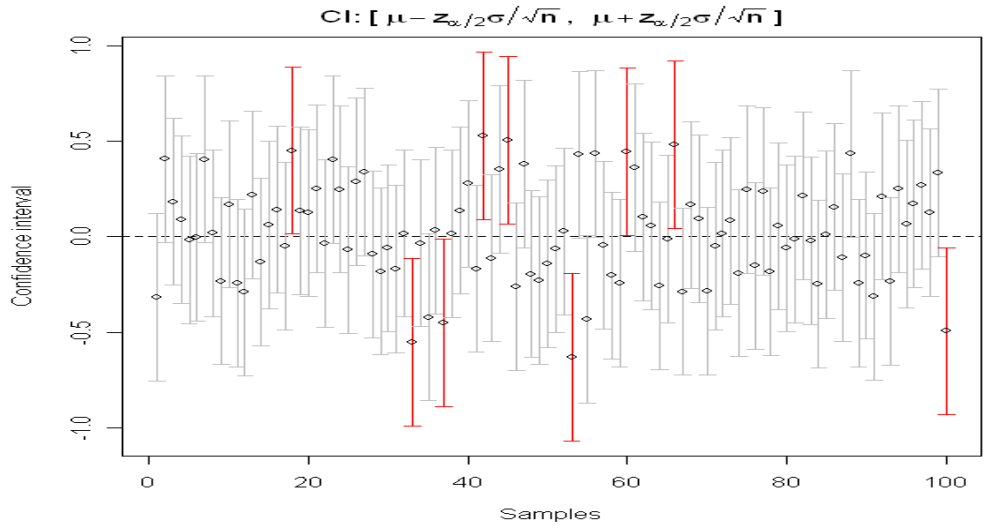
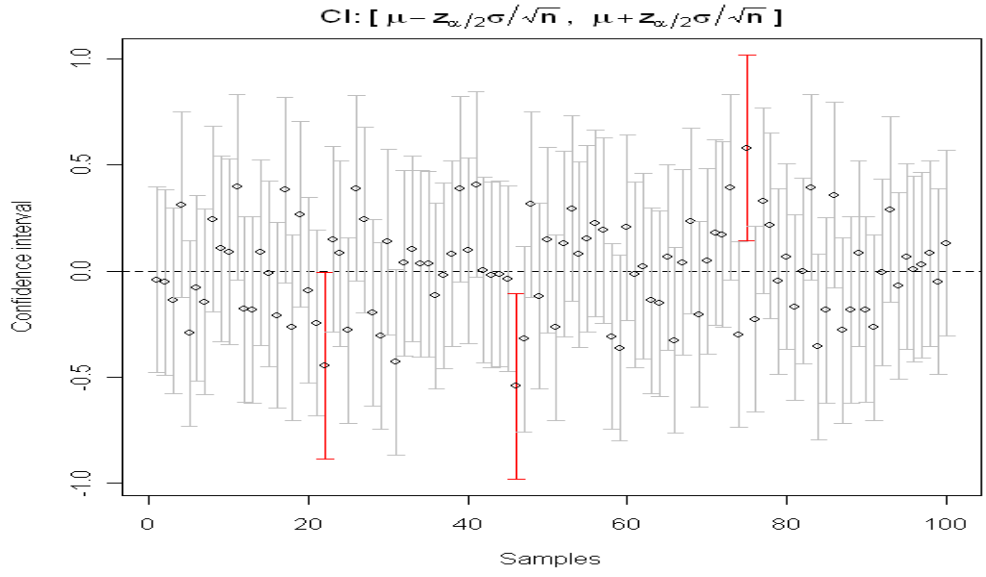
9	`> z.test(x1, mu = 0, stdev=2, alternative = "two.sided", conf.level = 0.95)`
	`One Sample z-test`
	`data: x1`
	`z = -0.2199, n = 20.000, Std. Dev. = 2.000, Std. Dev. of the sample`
	`mean = 0.447, p-value = 0.826`
	`alternative hypothesis: true mean is not equal to 0`
	`95 percent confidence interval:`
	`-0.9748465 0.7781985`
	`sample estimates:`
	`mean of x1`
	`-0.098324`
		Check **2-sided C.I** using R package (Z test) for **x1 data**

10	`> z.test(x2, mu = 0, stdev=2, alternative = "two.sided", conf.level = 0.95)`
	`One Sample z-test`
	`data: x2`
	`z = 11.7787, n = 20.000, Std. Dev. = 2.000, Std. Dev. of the sample`
	`mean = 0.447, p-value < 2.2e-16`
	`alternative hypothesis: true mean is not equal to 0`
		Check 2-sided C.I using R package (Z test) for **x2 data**

	95 percent confidence interval: 4.391070 6.144115 sample estimates: mean of x2 5.267593	
11	> t.test(x1, mu=0, alt="two",conf=0.95) One Sample t-test data: x1 t = -0.1921, df = 19, p-value = 0.8497 alternative hypothesis: true mean is not equal to 0 95 percent confidence interval: -1.1697004 0.9730524 sample estimates: mean of x -0.098324	Using R, find the **2-sided t-test** for **x1 data**
12	> t.test(x1, mu=0, alt="two",conf=0.95)$conf.int[1:2] [1] -1.1697004 0.9730524	Using R, find the **2-sided t-test** C.I.
13	> t.test(x2, mu=0, alt="two",conf=0.95)$conf.int[1:2] [1] 4.170095 6.365091	Do the same for **x2 data**

14	source("http://ehsan.karim.googlepages.com/tsim.R")
	sim.t.ci(nsim = 100,coln = 10,Mu = 0,StDev = 2) # for ss = 20
	install.packages("TeachingDemos") # select Canada BC server
	source("http://ehsan.karim.googlepages.com/zsim.R")
	sim.z.ci(nsim = 100,coln = 10,Mu = 0,StDev = 2) # for ss = 20
	source("http://ehsan.karim.googlepages.com/simzciplot.R")
	sim.z.ci.plot(n = 100, alpha = 0.95, ss = 20, times = 1)
	sim.z.ci.plot(n = 100, alpha = 0.95, ss = 20, times = 1)
	# repeat again
		Check results in **repeated samples**

15	> sim.t.ci(nsim = 100,coln = 10,Mu = 0,StDev = 2) # for ss = 20 [Simulation #] [Sample Result] [Ideal case] [Deviation (in %)] [1,] 1 95 95 0 [2,] 2 97 95 -2 [3,] 3 97 95 -2 [4,] 4 95 95 0 [5,] 5 93 95 2 [6,] 6 92 95 3 [7,] 7 97 95 -2 [8,] 8 98 95 -3 [9,] 9 96 95 -1 [10,] 10 94 95 1	In t-test
16	> sim.z.ci(nsim = 100,coln = 10,Mu = 0,StDev = 2) # for ss = 20 [Simulation #] [Sample Result] [Ideal case] [Deviation (in %)] [1,] 1 96 95 -1 [2,] 2 96 95 -1 [3,] 3 95 95 0 [4,] 4 95 95 0 [5,] 5 96 95 -1 [6,] 6 94 95 1 [7,] 7 92 95 3 [8,] 8 92 95 3 [9,] 9 97 95 -2 [10,] 10 99 95 -4	In z-test

17		**95% C.I.** From z-test
18		95% C.I. From z-test in different sample
19		95% C.I. From z-test in different sample

20	**<u>Additional Materials</u>:**
	`> tt<-t.test(x1, mu=0, alt="two",conf=0.95)`
	`> names(tt)`
	`[1] "statistic"  "parameter"  "p.value"  "conf.int"`
	`"estimate"`
	`[6] "null.value"  "alternative" "method"  "data.name"`
	`> tt$statistic`
	`  t`
	`-0.1920842`
	`> tt$parameter`
	`df`
	`19`
	`> tt$p.value`
	`[1] 0.8497143`
	`> tt$estimate`
	`mean of x`
	`-0.098324`
	`> tt$method`
	`[1] "One Sample t-test"`
	`> tt$null.value`
	`mean`
	`  0`
	`> tt$alternative`
	`[1] "two.sided"`
		Check the values the t-test offers in R

21	`> zt <- z.test(x1, mu = 0, stdev=2, alternative = "greater",`
	`conf.level = 0.95)`
	`> names(zt)`
	`[1] "statistic"  "parameter"  "p.value"  "conf.int"`
	`"estimate"`
	`[6] "null.value"  "alternative" "method"  "data.name"`
		Check the values the z-test offers in R

22	`> qnorm(0.975)`
	`[1] 1.959964`
	`> qnorm(0.95)`
	`[1] 1.644854`
		'qnorm' gives the quantile function from normal distribution

23	`> qt(0.975,df=tt$parameter)`
	`[1] 2.093024`
	`> qt(0.95,df=tt$parameter)`
	`[1] 1.729133`
		'qt' gives the quantile function from t distribution

24	`> summary(x1)`
	`  Min.  1st Qu.  Median  Mean  3rd Qu.  Max.`
	`-4.21400 -1.98800 -0.10960 -0.09832  1.87900  3.75400`
	`> summary(x2)`
	`  Min. 1st Qu.  Median  Mean 3rd Qu.  Max.`
	`  1.319  3.529  5.172  5.268  7.061  8.960`
		Check data summary, whether they relate to the results obtained from C.I.

******* when you run the package **"TeachingDemos"**, it requires you to create a temporary directory on the C: drive. If you do not have permission to make directory on C: drive, then you might not be able to install it properly, and hence the codes related to this package will not work.