Roll No-12

M.sc. 3rd semester

Date of Assignment-02/12/2020

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**Experiment No -08**

**Topic**- Tracing the power curve for Normal distribution with unknown mean and variance

**Problem** – Consider the following example of size 11 from  where  and  both are unknown. The sample values are 5.2, 10.8, 7.1, 16.4, 12.5, 12, 10.3, 10.0, 12.7, 9.7, 10.5

Obtain the most powerful similar regions for testing  against

1. 
2. 
3. 

Also, draw the power curve for each of the cases considering the level of significance as 

**Theory and Calculation**-

i) The CR for testing  against  is given by



S can be computed from the sample values and to obtain the values of  ,we use the following R-command.

alfa=0.05

n = 11

t\_tab\_1=qt(1-alfa,n-1)

t\_tab\_1=qt(0.95,10)

t\_tab\_1

t\_tab1= 1.812461

To find out the value of S, we use the following R-program

sv = c(5.2,10.8,7.1,15.4,12.5,12,10.3,10,12.7,9.7,10.5)

variance\_sv = var(sv)

variance\_sv

sqs = sqrt(variance\_sv)

sqs

sqs=2.751826

To obtain the CR, we use the following R-command

sr\_1 = 11+(sqs\*t\_tab\_1)/(sqrt(n))

sr\_1

 sr\_1= 11.99752

The CR is given by



Now, the power of the test is given by















Where  follows student’s t-distribution with (n-1) df.

Now, to draw the power curve we construct the following table considering different values of 

**TABLE 1**

|  | **mu\_1** | **power\_1** |
| --- | --- | --- |
|  |  |  |
| **1** | 11.5 | 0.1270818 |
| **2** | 11.6 | 0.1507847 |
| **3** | 11.7 | 0.1777487 |
| **4** | 11.8 | 0.2080664 |
| **5** | 11.9 | 0.2417317 |
| **6** | 12.0 | 0.2786215 |
| **7** | 12.1 | 0.3184837 |
| **8** | 12.2 | 0.3609342 |
| **9** | 12.3 | 0.4054635 |
| **10** | 12.4 | 0.4514549 |
| **11** | 12.5 | 0.4982127 |
| **12** | 12.6 | 0.5449989 |
| **13** | 12.7 | 0.5910740 |
| **14** | 12.8 | 0.6357376 |
| **15** | 12.9 | 0.6783660 |
| **16** | 13.0 | 0.7184407 |
| **17** | 13.1 | 0.7555676 |
| **18** | 13.2 | 0.7894846 |
| **19** | 13.3 | 0.8200591 |
| **20** | 13.4 | 0.8472765 |
| **21** | 13.5 | 0.8712228 |
| **22** | 13.6 | 0.8920630 |
| **23** | 13.7 | 0.9100195 |
| **24** | 13.8 | 0.9253507 |
| **25** | 13.9 | 0.9383330 |
| **26** | 14.0 | 0.9492454 |
| **27** | 14.1 | 0.9583579 |
| **28** | 14.2 | 0.9659237 |
| **29** | 14.3 | 0.9721739 |
| **30** | 14.4 | 0.9773153 |

**Programming in R for case 1-**

library('ggplot2')

alfa = 0.05

n = 11

t\_tab\_1 = qt(1-alfa, n-1)

t\_tab\_1

#To find out the value of similar region, we use the following R-Program

sv = c(5.2,10.8,7.1,15.4,12.5,12,10.3,10,12.7,9.7,10.5)

variance\_sv = var(sv)

variance\_sv

sqs = sqrt(variance\_sv)

sqs

sr\_1 = 11+(sqs\*t\_tab\_1)/(sqrt(n))

sr\_1

#To find the power curve

n\_1 = 11

a = sqs

mu\_1 = seq(from=11.5, by=0.1, length.out=30)

mu\_1

power\_1 = mat.or.vec(30,1)

for(i in 1:30){

power\_1[i] = 1-pt((t\_tab\_1-(((mu\_1[i]-n\_1)\*sqrt(n))/a)), n-1)

}

power\_1

Table = data.frame(mu\_1, power\_1)

Table

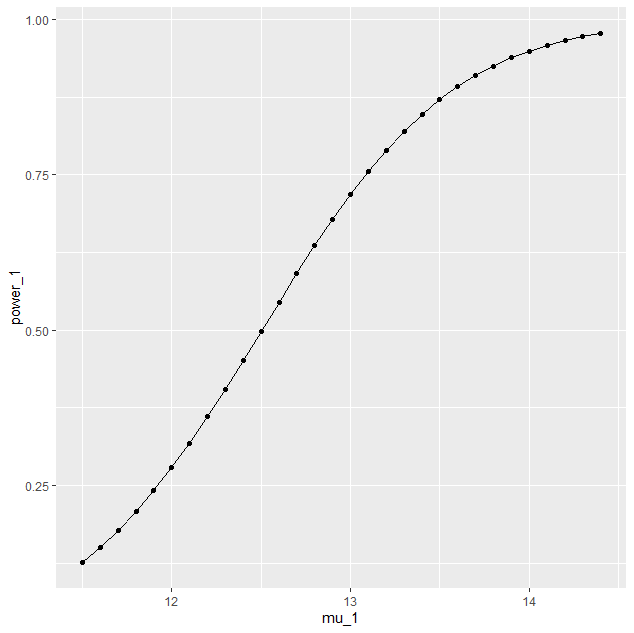
View(Table)

ggplot(data=Table,mapping=aes(x=mu\_1,y=power\_1))+geom\_point()+geom\_line()

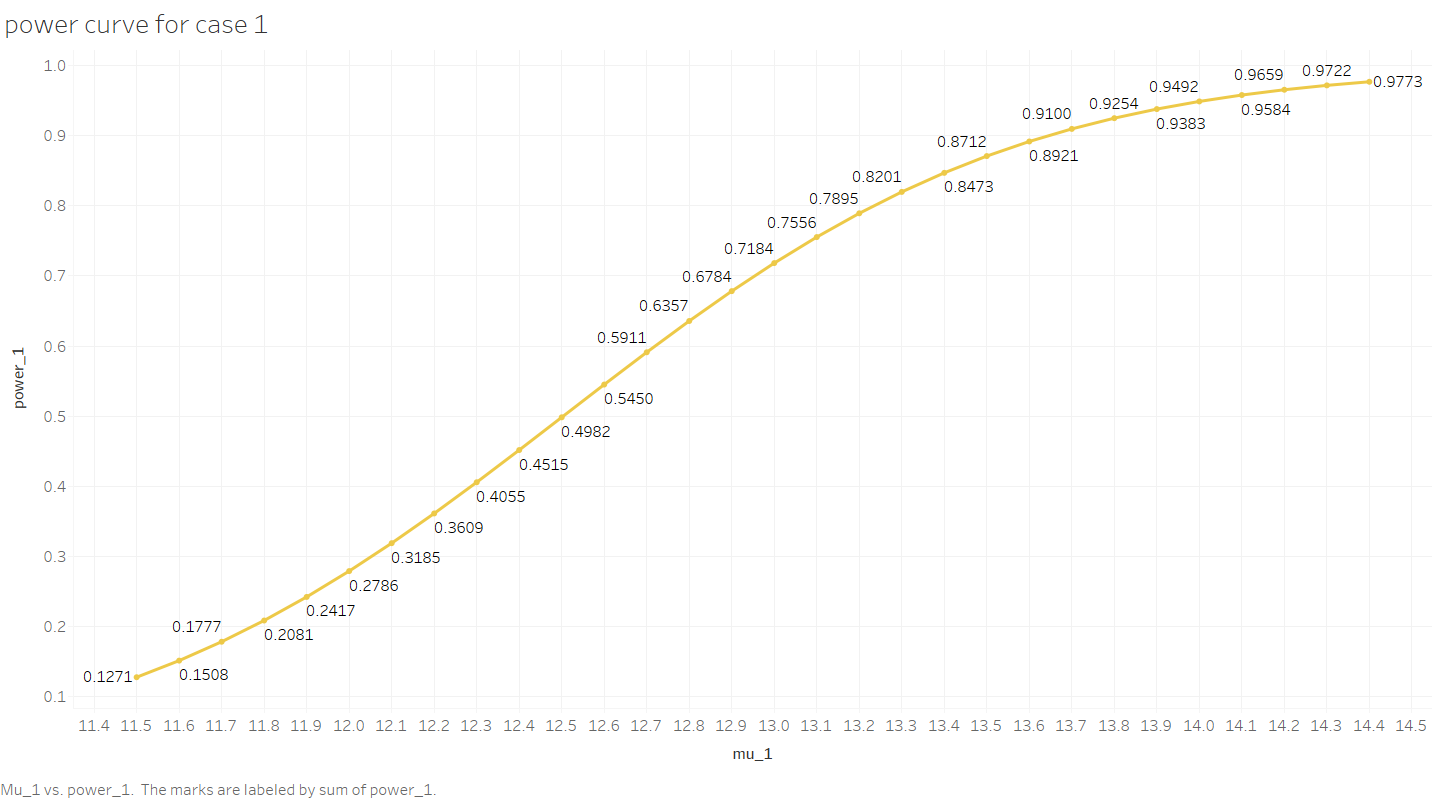
data.frame(mu\_1)

data.frame(power\_1)

**Power curve by using ggplot 2**



**Power curve generated by using Tableau**



ii) The CR for testing  against  is given by



S can be computed from the sample values and to obtain the values of (-) ,we use the following R-command.

alfa = 0.05

n = 11

t\_tab\_2 = qt(alfa, n-1)

t\_tab\_2

t\_tab2= -1.812461

To find out the value of S, we use the following R-program

sv = c(5.2,10.8,7.1,15.4,12.5,12,10.3,10,12.7,9.7,10.5)

variance\_sv = var(sv)

variance\_sv

sqs = sqrt(variance\_sv)

sqs

sqs= 2.751826

To obtain the CR, we use the following R-command

sr\_2 = 11+(sqs\*t\_tab\_2)/(sqrt(n))

sr\_2

 sr\_2 = 9.496189

The CR is given by



Now, the power of the test is given by













Where  follows student’s t-distribution with (n-1) df.

Now, to draw the power curve we construct the following table considering different values of 

**TABLE 2**

|  | **mu\_2** | **power\_2** |
| --- | --- | --- |
|  |  |  |
| **1** | 8.0 | 0.94924537 |
| **2** | 8.1 | 0.93833301 |
| **3** | 8.2 | 0.92535070 |
| **4** | 8.3 | 0.91001947 |
| **5** | 8.4 | 0.89206302 |
| **6** | 8.5 | 0.87122282 |
| **7** | 8.6 | 0.84727654 |
| **8** | 8.7 | 0.82005907 |
| **9** | 8.8 | 0.78948456 |
| **10** | 8.9 | 0.75556758 |
| **11** | 9.0 | 0.71844072 |
| **12** | 9.1 | 0.67836601 |
| **13** | 9.2 | 0.63573760 |
| **14** | 9.3 | 0.59107395 |
| **15** | 9.4 | 0.54499892 |
| **16** | 9.5 | 0.49821269 |
| **17** | 9.6 | 0.45145488 |
| **18** | 9.7 | 0.40546353 |
| **19** | 9.8 | 0.36093422 |
| **20** | 9.9 | 0.31848370 |
| **21** | 10.0 | 0.27862146 |
| **22** | 10.1 | 0.24173172 |
| **23** | 10.2 | 0.20806642 |
| **24** | 10.3 | 0.17774867 |
| **25** | 10.4 | 0.15078469 |
| **26** | 10.5 | 0.12708184 |
| **27** | 10.6 | 0.10646985 |
| **28** | 10.7 | 0.08872293 |
| **29** | 10.8 | 0.07358059 |
| **30** | 10.9 | 0.06076583 |

**Programming in R for case 2-**

library('ggplot2')

alfa = 0.05

n = 11

t\_tab\_2 = qt(alfa, n-1)

t\_tab\_2

#To find out the value of similar region, we use the following R-Program

sv = c(5.2,10.8,7.1,15.4,12.5,12,10.3,10,12.7,9.7,10.5)

variance\_sv = var(sv)

variance\_sv

sqs = sqrt(variance\_sv)

sqs

sr\_2 = 11+(sqs\*t\_tab\_2)/(sqrt(n))

sr\_2

#To find the power curve

n\_2 = 11

b = sqs

mu\_2 = seq(from=8.0, by=0.1, length.out=30)

mu\_2

power\_2 = mat.or.vec(30,1)

for(i in 1:30){

power\_2[i] = pt((t\_tab\_2-(((mu\_2[i]-n\_2)\*sqrt(n))/b)), n-1)

}

power\_2

Table = data.frame(mu\_2, power\_2)

Table

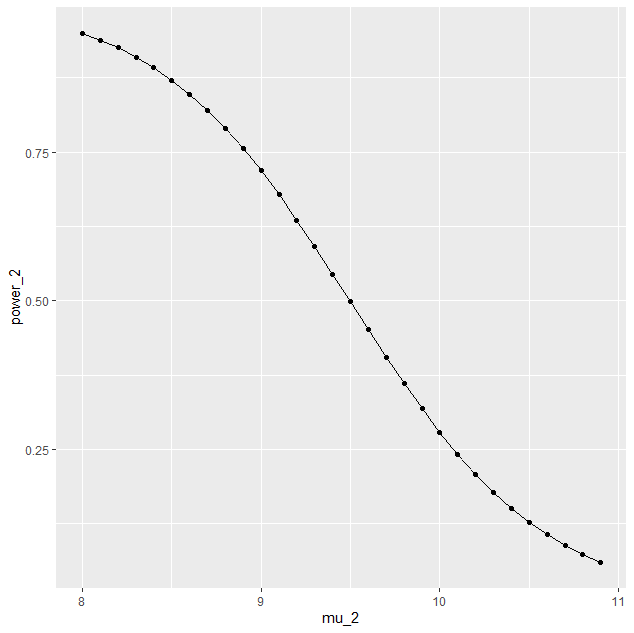
View(Table)

ggplot(data=Table,mapping=aes(x=mu\_2,y=power\_2))+geom\_point()+geom\_line()

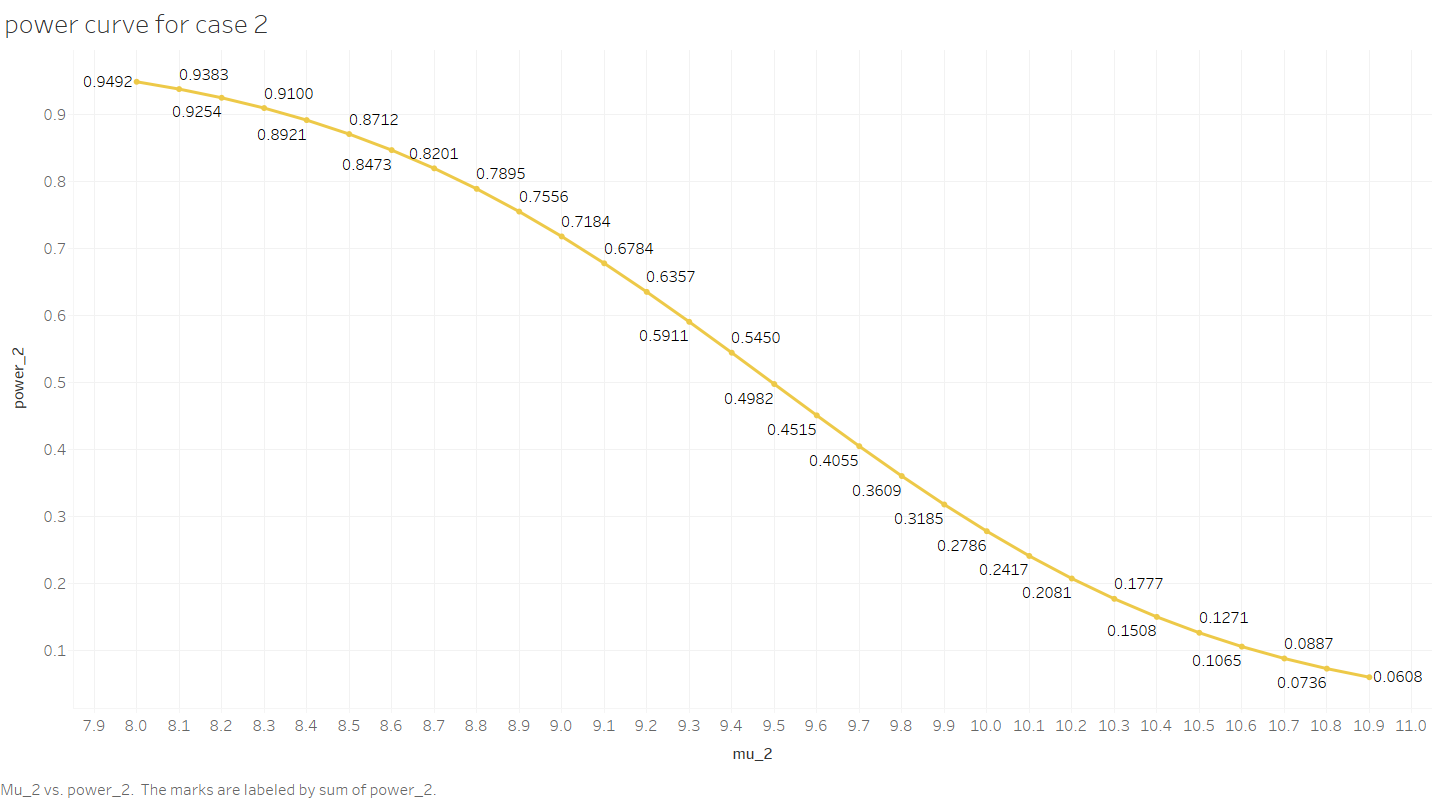
data.frame(mu\_2)

data.frame(power\_2)

**Power curve by using ggplot 2**



**Power curve generated by using Tableau**



iii) The CR for testing  against  is given by



To find out the value of  and the CR’s , we use the following R-commands

t\_tab\_3=qt((1-(0.05/2)),11-1)

t\_tab\_3

t\_tab\_4=qt((0.05/2),11-1)

t\_tab\_4

sr\_3=11+(sqs\*t\_tab\_3)/(sqrt(n))

sr\_3

sr\_4=11+(sqs\*t\_tab\_4)/(sqrt(n))

sr\_4

 sr\_3= 12.8487 and sr\_4= 9.151298

The CR is given by



And the power of the test is given by





+

+

Now, to draw the power curve, we construct the following table considering different values of 

**TABLE 3**

|  | **mu\_a** | **power\_3** |
| --- | --- | --- |
|  |  |  |
| **1** | 11.5 | 0.07647112 |
| **2** | 11.6 | 0.08887098 |
| **3** | 11.7 | 0.10406590 |
| **4** | 11.8 | 0.12226710 |
| **5** | 11.9 | 0.14367027 |
| **6** | 12.0 | 0.16843403 |
| **7** | 12.1 | 0.19665666 |
| **8** | 12.2 | 0.22835288 |
| **9** | 12.3 | 0.26343298 |
| **10** | 12.4 | 0.30168688 |
| **11** | 12.5 | 0.34277583 |
| **12** | 12.6 | 0.38623393 |
| **13** | 12.7 | 0.43148074 |
| **14** | 12.8 | 0.47784477 |
| **15** | 12.9 | 0.52459634 |
| **16** | 13.0 | 0.57098669 |
| **17** | 13.1 | 0.61628922 |
| **18** | 13.2 | 0.65983862 |
| **19** | 13.3 | 0.70106364 |
| **20** | 13.4 | 0.73951068 |
| **21** | 13.5 | 0.77485651 |
| **22** | 13.6 | 0.80691003 |
| **23** | 13.7 | 0.83560448 |
| **24** | 13.8 | 0.86098223 |
| **25** | 13.9 | 0.88317481 |
| **26** | 14.0 | 0.90238097 |
| **27** | 14.1 | 0.91884496 |
| **28** | 14.2 | 0.93283680 |
| **29** | 14.3 | 0.94463556 |
| **30** | 14.4 | 0.95451626 |
| **31** | 8.0 | 0.90238097 |
| **32** | 8.1 | 0.88317481 |
| **33** | 8.2 | 0.86098223 |
| **34** | 8.3 | 0.83560448 |
| **35** | 8.4 | 0.80691003 |
| **36** | 8.5 | 0.77485651 |
| **37** | 8.6 | 0.73951068 |
| **38** | 8.7 | 0.70106364 |
| **39** | 8.8 | 0.65983862 |
| **40** | 8.9 | 0.61628922 |
| **41** | 9.0 | 0.57098669 |
| **42** | 9.1 | 0.52459634 |
| **43** | 9.2 | 0.47784477 |
| **44** | 9.3 | 0.43148074 |
| **45** | 9.4 | 0.38623393 |
| **46** | 9.5 | 0.34277583 |
| **47** | 9.6 | 0.30168688 |
| **48** | 9.7 | 0.26343298 |
| **49** | 9.8 | 0.22835288 |
| **50** | 9.9 | 0.19665666 |
| **51** | 10.0 | 0.16843403 |
| **52** | 10.1 | 0.14367027 |
| **53** | 10.2 | 0.12226710 |
| **54** | 10.3 | 0.10406590 |
| **55** | 10.4 | 0.08887098 |
| **56** | 10.5 | 0.07647112 |
| **57** | 10.6 | 0.06665829 |
| **58** | 10.7 | 0.05924313 |
| **59** | 10.8 | 0.05406694 |
| **60** | 10.9 | 0.05101049 |

**Programming in R for case 3-**

library('ggplot2')

alfa = 0.05

n = 11

t\_tab\_3=qt((1-(0.05/2)),11-1)

t\_tab\_3

t\_tab\_4=qt((0.05/2),11-1)

t\_tab\_4

#To find out the value of similar region, we use the following R-Program

sv = c(5.2,10.8,7.1,15.4,12.5,12,10.3,10,12.7,9.7,10.5)

variance\_sv = var(sv)

variance\_sv

sqs = sqrt(variance\_sv)

sqs

sr\_3=11+(sqs\*t\_tab\_3)/(sqrt(n))

sr\_3

sr\_4=11+(sqs\*t\_tab\_4)/(sqrt(n))

sr\_4

#To find the power curve

n\_3 = 11

c = sqs

n\_4 = 11

d = sqs

mu\_3 = seq(from=11.5, by=0.1, length.out=30)

mu\_3

mu\_4 = seq(from=8.0, by=0.1, length.out=30)

mu\_4

mu\_a = c(mu\_3,mu\_4)

mu\_a

power\_3 = mat.or.vec(60,1)

for(i in 1:60){

power\_3[i] =(1-pt((t\_tab\_3-(((mu\_a[i]-n\_3)\*sqrt(n))/c)), n-1)) + pt((t\_tab\_4-(((mu\_a[i]-n\_4)\*sqrt(n))/d)), n-1)

}

power\_3

Table = data.frame(mu\_a, power\_3)

Table

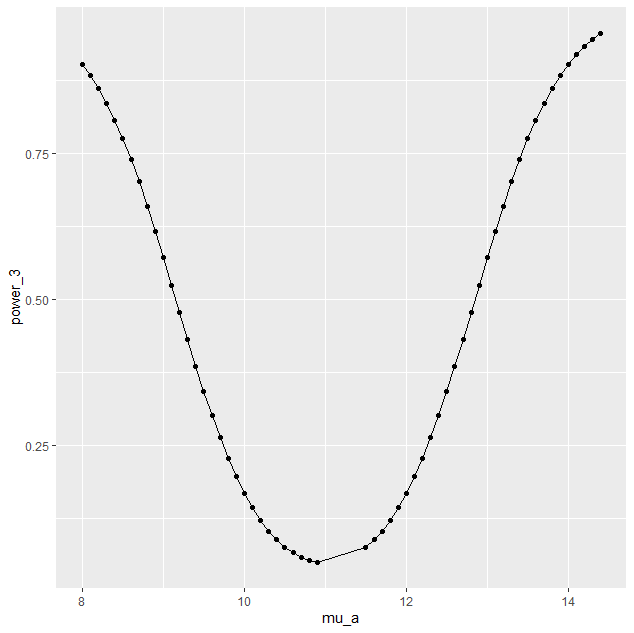
View(Table)

ggplot(data=Table,mapping=aes(x=mu\_a,y=power\_3))+geom\_point()+geom\_line()

data.frame(mu\_a)

data.frame(power\_3)

**Power curve by using ggplot 2**



**Power curve generated by using Tableau**

