Roll No-12

M.sc. 3rd semester

Date of Assignment-02/12/2020

Date of Submission-10/12/2020

**Experiment No -09**

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

**Problem** – Consider the following sample from N(µ,) Where µ 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

Construct the UMP test for testing h0:=4 against

1. h1:>4
2. h1:<4
3. h1:≠4

Also, draw the power curve for each of the cases considering the level of significance as α=0.05

**Theory and Calculation**-

(i)From the theory of similar region we know that the CR for testing h0:=4 against h1:>4is given by

where k1 is a constant to be determined in such a way that α=0.05

⸫ P

To, find the value of a1 we use the following R-command

a1=qchisq(0.95,10,0)

a1

⸫a1=18.30704

⸫k1=4a1=73.22815

We have**,**

⸫ The S.R. is given by

Power of the test is given by

Power=1-β=P[xW1/H1]

Now, to trace the power curve we construct the following table considering different trial values of 2>4

**TABLE 1**

|  |  |  |
| --- | --- | --- |
| **Sl no** | **sigma\_1** | **power\_1** |
|  |  |  |
| **1** | 4.1 | 0.057362 |
| **2** | 4.2 | 0.06527 |
| **3** | 4.3 | 0.073707 |
| **4** | 4.4 | 0.082652 |
| **5** | 4.5 | 0.092082 |
| **6** | 4.6 | 0.10197 |
| **7** | 4.7 | 0.112289 |
| **8** | 4.8 | 0.123008 |
| **9** | 4.9 | 0.134098 |
| **10** | 5 | 0.145526 |
| **11** | 5.1 | 0.15726 |
| **12** | 5.2 | 0.169269 |
| **13** | 5.3 | 0.181521 |
| **14** | 5.4 | 0.193985 |
| **15** | 5.5 | 0.206631 |
| **16** | 5.6 | 0.219428 |
| **17** | 5.7 | 0.23235 |
| **18** | 5.8 | 0.245368 |
| **19** | 5.9 | 0.258456 |
| **20** | 6 | 0.271591 |
| **21** | 6.1 | 0.284748 |
| **22** | 6.2 | 0.297905 |
| **23** | 6.3 | 0.311043 |
| **24** | 6.4 | 0.324141 |
| **25** | 6.5 | 0.337183 |
| **26** | 6.6 | 0.350151 |
| **27** | 6.7 | 0.363031 |
| **28** | 6.8 | 0.375808 |
| **29** | 6.9 | 0.388471 |
| **30** | 7 | 0.401007 |

**Programming in R for case 1-**

library('ggplot2')

k\_1 = 73.22815

sigma\_1 = seq(from=4.1, by=0.1, length.out=30)

sigma\_1

sigma\_11 = k\_1/sigma\_1

sigma\_11

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

for(i in 1:30){

power\_1[i] = 1-pchisq(sigma\_11[i],10,0)

}

power\_1

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

Table

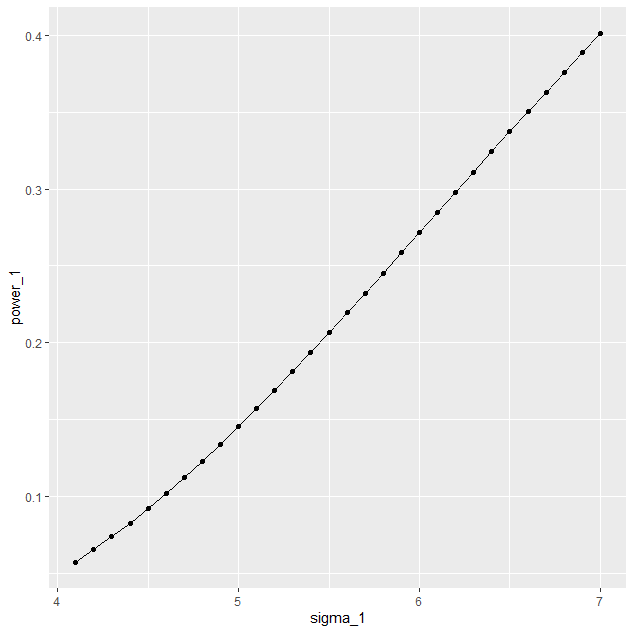
View(Table)

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

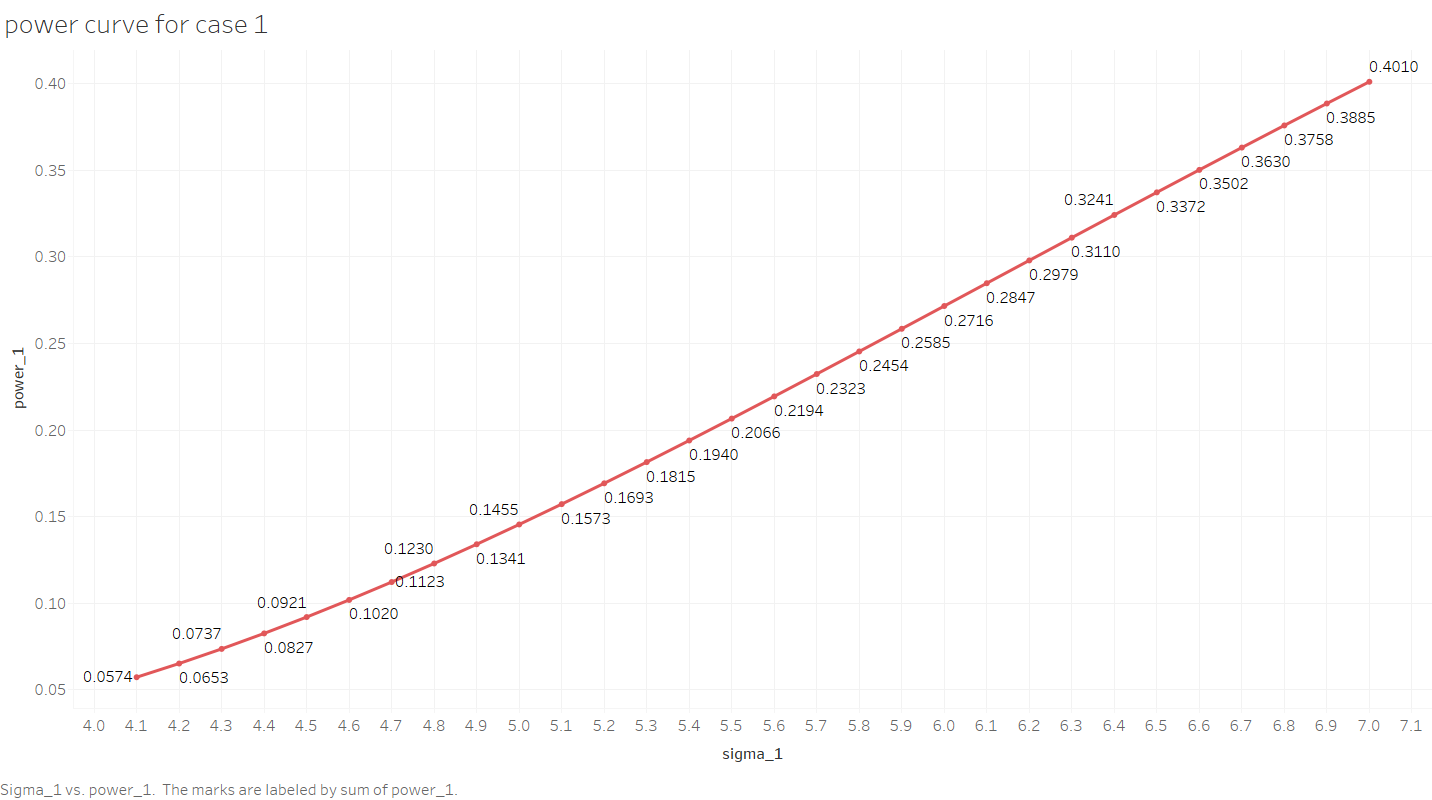
data.frame(sigma\_1)

data.frame(power\_1)

**Power curve by using ggplot 2**



**Power curve generated by using Tableau**



ii) To test h1:=4against h1:<4, is given by

where k2 is a constant to be determined in such a way that α=0.05

⸫ P

To, find the value of a2 we use the following R-command,

a2=qchisq(0.05,10,0)

a2

⸫a2=3.940299

So,k2=15.7612

⸫The similar region is given by

The power of the test is given by

1-β=P(xW2/H1)

=P[Reject H0/H1 is true]

To draw the power curve we construct the following table considering different trial values of

**TABLE 2**

|  |  |  |
| --- | --- | --- |
| **sl no** | **sigma\_2** | **power\_2** |
|  |  |  |
| **1** | 1 | 0.893325 |
| **2** | 1.1 | 0.841466 |
| **3** | 1.2 | 0.783742 |
| **4** | 1.3 | 0.723157 |
| **5** | 1.4 | 0.662226 |
| **6** | 1.5 | 0.602846 |
| **7** | 1.6 | 0.546316 |
| **8** | 1.7 | 0.493435 |
| **9** | 1.8 | 0.444615 |
| **10** | 1.9 | 0.39999 |
| **11** | 2 | 0.359501 |
| **12** | 2.1 | 0.322969 |
| **13** | 2.2 | 0.29014 |
| **14** | 2.3 | 0.260726 |
| **15** | 2.4 | 0.234423 |
| **16** | 2.5 | 0.210934 |
| **17** | 2.6 | 0.189972 |
| **18** | 2.7 | 0.171273 |
| **19** | 2.8 | 0.154589 |
| **20** | 2.9 | 0.1397 |
| **21** | 3 | 0.126403 |
| **22** | 3.1 | 0.114521 |
| **23** | 3.2 | 0.103893 |
| **24** | 3.3 | 0.094377 |
| **25** | 3.4 | 0.085848 |
| **26** | 3.5 | 0.078194 |
| **27** | 3.6 | 0.071318 |
| **28** | 3.7 | 0.065132 |
| **29** | 3.8 | 0.059561 |
| **30** | 3.9 | 0.054537 |

**Programming in R for case 2-**

library('ggplot2')

k\_2 = 15.7612

sigma\_2 = seq(from=1.0, by=0.1, length.out=30)

sigma\_2

sigma\_22 = k\_2/sigma\_2

sigma\_22

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

for(i in 1:30){

power\_2[i] = pchisq(sigma\_22[i],10,0)

}

power\_2

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

Table

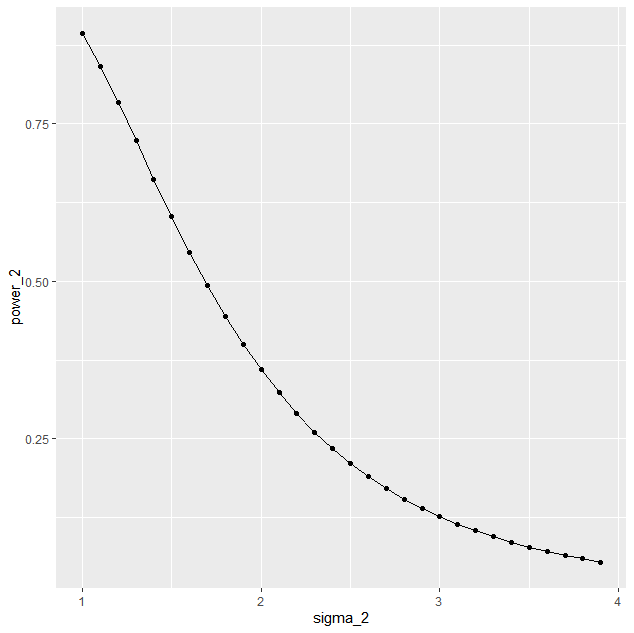
View(Table)

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

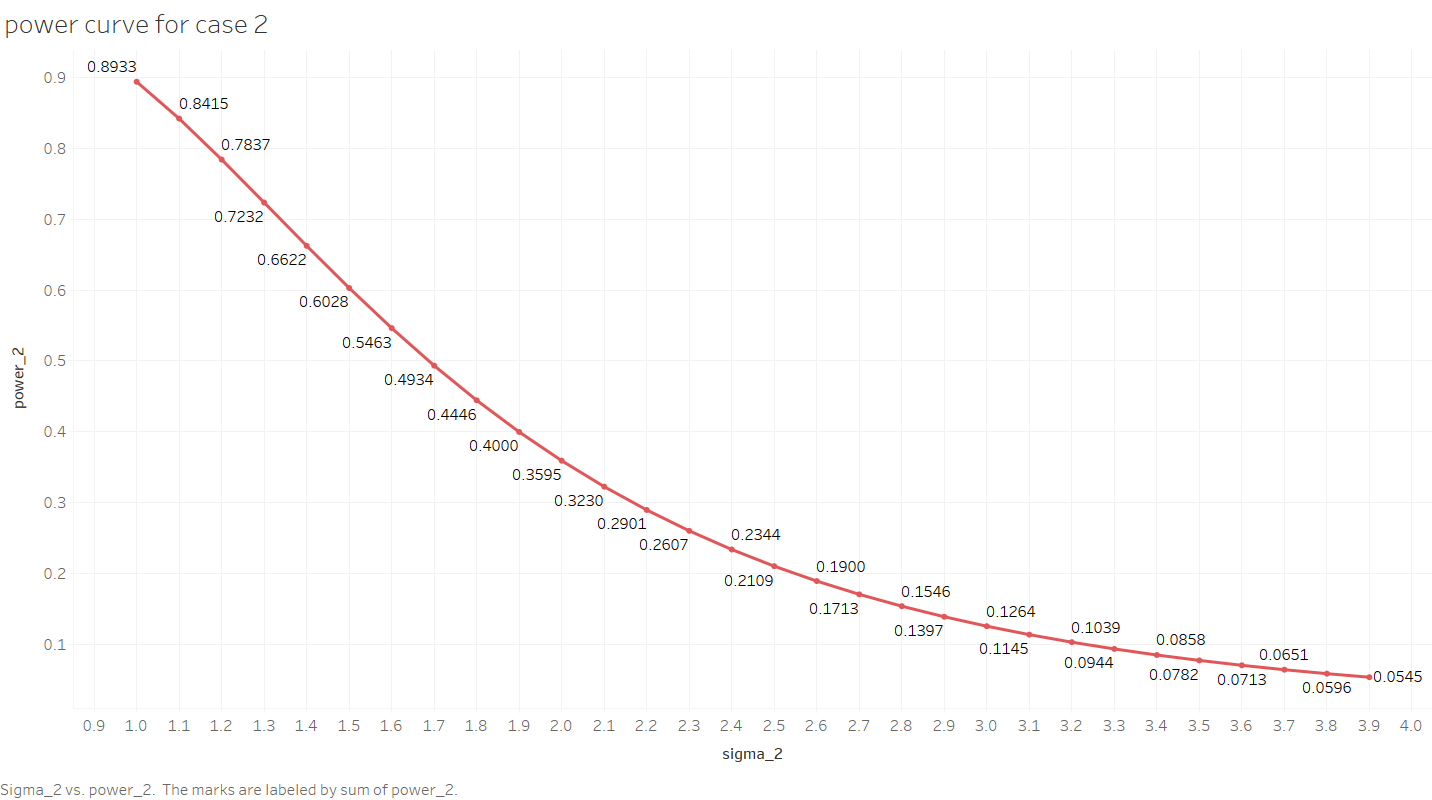
data.frame(sigma\_2)

data.frame(power\_2)

**Power curve by using ggplot 2**



**Power curve generated by using Tableau**



(iii)To test H0:=4against H1:≠4 , the best similar region is given by

Where, k3 and k4 are constants to be determined such that α=0.05

⸫ P

Assuming that the test is equitailed, we have

&

Where, a3= = and a4= =

Now to determine the values of a3 and a4 we use the following R-command:

a3=qchisq(0.025,10,0)

a3

a4=qchisq(0.975,10,0)

a4

⸫a3=3.246973 and a4=20.48318

⸫k3=12.98789 and k4=81.93271

Also ,

⸫The similar region is given by

Now, Power of the test is given by

1-β=P(xW3/H1)

=P[Reject H0/H1 is true]

To trace the power curve we construct the following table considering different trial values of 2

**TABLE 3**

|  |  |  |
| --- | --- | --- |
| **sl no** | **sigma\_3** | **power\_3** |
|  |  |  |
| **1** | 4.1 | 0.052213 |
| **2** | 4.2 | 0.055101 |
| **3** | 4.3 | 0.058642 |
| **4** | 4.4 | 0.062812 |
| **5** | 4.5 | 0.06759 |
| **6** | 4.6 | 0.07295 |
| **7** | 4.7 | 0.078868 |
| **8** | 4.8 | 0.085319 |
| **9** | 4.9 | 0.092276 |
| **10** | 5 | 0.099713 |
| **11** | 5.1 | 0.107602 |
| **12** | 5.2 | 0.115915 |
| **13** | 5.3 | 0.124625 |
| **14** | 5.4 | 0.133704 |
| **15** | 5.5 | 0.143123 |
| **16** | 5.6 | 0.152856 |
| **17** | 5.7 | 0.162874 |
| **18** | 5.8 | 0.173152 |
| **19** | 5.9 | 0.183662 |
| **20** | 6 | 0.19438 |
| **21** | 6.1 | 0.205281 |
| **22** | 6.2 | 0.21634 |
| **23** | 6.3 | 0.227536 |
| **24** | 6.4 | 0.238845 |
| **25** | 6.5 | 0.250246 |
| **26** | 6.6 | 0.26172 |
| **27** | 6.7 | 0.273248 |
| **28** | 6.8 | 0.284811 |
| **29** | 6.9 | 0.296392 |
| **30** | 7 | 0.307975 |
| **31** | 1 | 0.77565 |
| **32** | 1.1 | 0.701831 |
| **33** | 1.2 | 0.628546 |
| **34** | 1.3 | 0.558689 |
| **35** | 1.4 | 0.493973 |
| **36** | 1.5 | 0.435219 |
| **37** | 1.6 | 0.382633 |
| **38** | 1.7 | 0.33604 |
| **39** | 1.8 | 0.295045 |
| **40** | 1.9 | 0.259148 |
| **41** | 2 | 0.227813 |
| **42** | 2.1 | 0.200512 |
| **43** | 2.2 | 0.176754 |
| **44** | 2.3 | 0.156093 |
| **45** | 2.4 | 0.138133 |
| **46** | 2.5 | 0.122532 |
| **47** | 2.6 | 0.108994 |
| **48** | 2.7 | 0.097269 |
| **49** | 2.8 | 0.087149 |
| **50** | 2.9 | 0.078458 |
| **51** | 3 | 0.071053 |
| **52** | 3.1 | 0.064816 |
| **53** | 3.2 | 0.059652 |
| **54** | 3.3 | 0.055481 |
| **55** | 3.4 | 0.052242 |
| **56** | 3.5 | 0.049882 |
| **57** | 3.6 | 0.048359 |
| **58** | 3.7 | 0.047638 |
| **59** | 3.8 | 0.047689 |
| **60** | 3.9 | 0.048484 |

**Programming in R for case 3-**

library('ggplot2')

k\_3 = 12.98789

k\_4 = 81.93271

sigma\_1 = seq(from=4.1, by=0.1, length.out=30)

sigma\_1

sigma\_2 = seq(from=1.0, by=0.1, length.out=30)

sigma\_2

sigma\_3 = c(sigma\_1,sigma\_2)

sigma\_3

sigma\_31 = k\_3/sigma\_3

sigma\_31

sigma\_32 = k\_4/sigma\_3

sigma\_32

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

for(i in 1:60){

power\_3[i] = pchisq(sigma\_31[i],10,0)+1-pchisq(sigma\_32[i],10,0)

}

power\_3

Table = data.frame(sigma\_3, power\_3)

Table

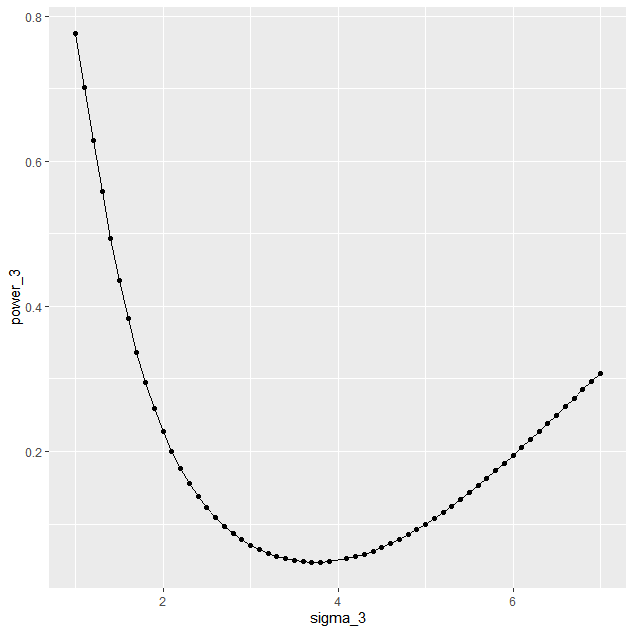
View(Table)

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

data.frame(sigma\_3)

data.frame(power\_3)

**Power curve by using ggplot 2**



**Power curve generated by using Tableau**

