

# R\_final

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```
#hide
#options(jupyter.rich_display=FALSE)
options(repr.plot.width=6,repr.plot.height=6,repr.plot.res=300)
options(max.print=1000)
library(tidyverse)

## -- Attaching packages ----- tidyverse 1.3.1 --

## v ggplot2 3.3.5      v purrr  0.3.4
## v tibble  3.1.6      v dplyr  1.0.7
## v tidyr   1.1.4      v stringr 1.4.0
## v readr   2.1.1      v forcats 0.5.1

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()     masks stats::lag()
```

## 1번

### 1-(1)

```
epsilon=rnorm(1:1000)
head(epsilon)
```

```
## [1]  0.8567065  0.4996628  1.5133864 -0.5619617 -0.3991932 -1.1486717
```

### 1-(2)

```
i=c(1:1000)
t_i=2*pi*i/1000
```

```
x_1=(sin(t_i))
x_2=(cos(4*(t_i)))
```

```
head(x_1)
```

```
## [1] 0.006283144 0.012566040 0.018848440 0.025130095 0.031410759 0.037690183
```

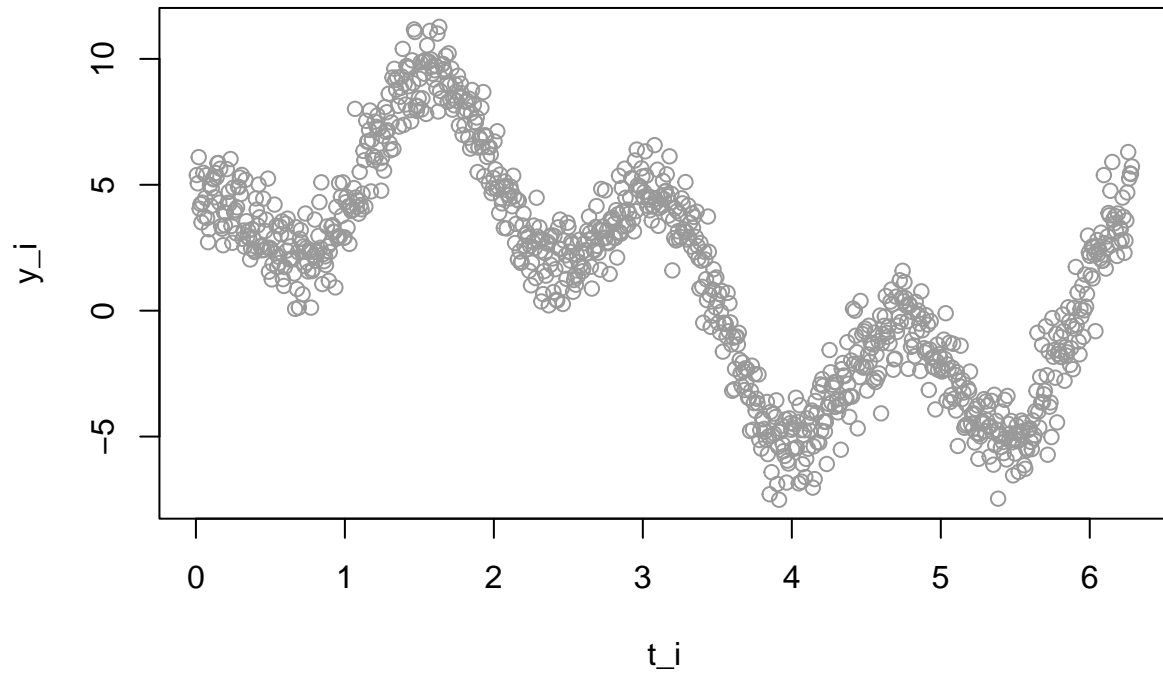
```
head(x_2)
```

```
## [1] 0.9996842 0.9987370 0.9971589 0.9949510 0.9921147 0.9886517
```

### 1-(3)

```
y_i=1.5+5*(x_1)+3*(x_2)+epsilon
```

```
plot(t_i,y_i,col='gray60')
```



1-(4)

```
X=cbind(1,x_1,x_2)
head(X)
```

```
##           x_1      x_2
## [1,]  1 0.006283144 0.9996842
## [2,]  1 0.012566040 0.9987370
## [3,]  1 0.018848440 0.9971589
## [4,]  1 0.025130095 0.9949510
## [5,]  1 0.031410759 0.9921147
## [6,]  1 0.037690183 0.9886517
```

```
dim(X)
```

```
## [1] 1000    3
```

1-(5)

```
Beta=rbind(1.5,5,3)
Beta
```

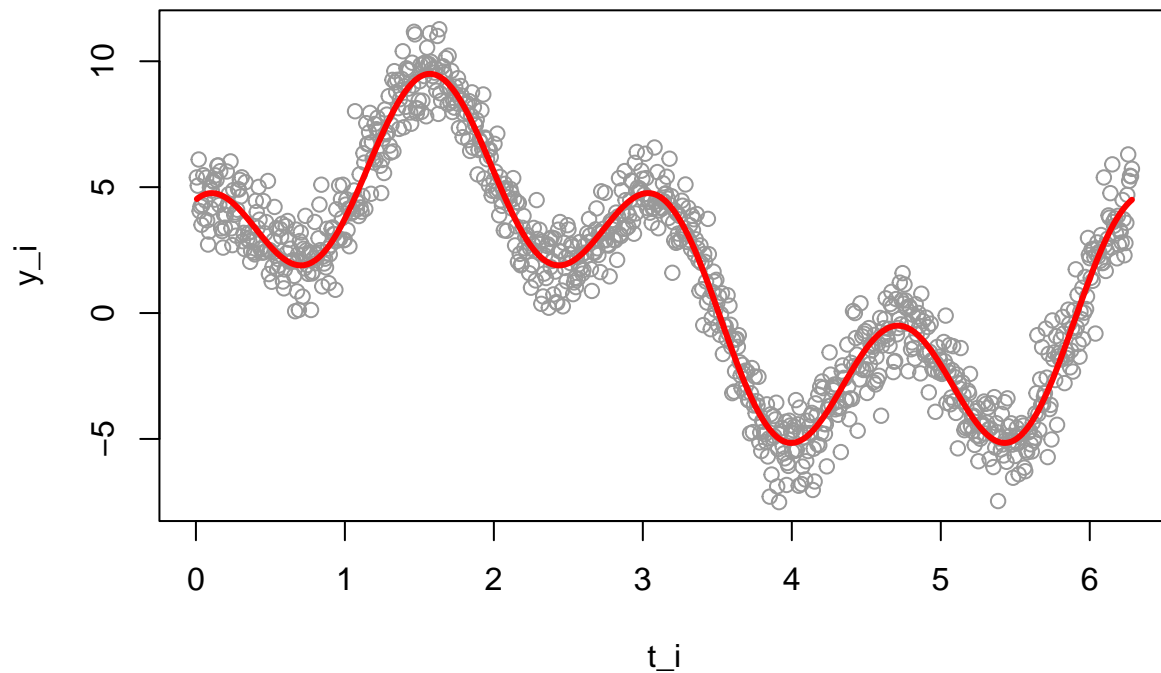
```
##      [,1]
## [1,]  1.5
## [2,]  5.0
```

```
## [3,] 3.0
```

```
B= X %%% Beta
```

```
B=c(B)
```

```
plot(t_i,y_i,col='gray60')  
lines(t_i,B,col='red',lwd=3)
```



1-(6)

```
solve(t(X) %%% X)
```

```
##                x_1      x_2  
## 1.000000e-03 -2.225759e-20 4.529710e-20  
## x_1 -2.225759e-20 2.000000e-03 4.327224e-20  
## x_2 4.529710e-20 4.327224e-20 2.000000e-03
```

```
t(X)
```

```
##      [,1]      [,2]      [,3]      [,4]      [,5]      [,6]  
## 1.000000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000  
##      [,7]      [,8]      [,9]     [,10]     [,11]     [,12]  
## 1.000000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000  
##      [,13]     [,14]     [,15]     [,16]     [,17]     [,18]     [,19]  
## 1.000000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000  
##      [,20]     [,21]     [,22]     [,23]     [,24]     [,25]     [,26]  
## 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000
```

##	[,27]	[,28]	[,29]	[,30]	[,31]	[,32]	[,33]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,34]	[,35]	[,36]	[,37]	[,38]	[,39]	[,40]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,41]	[,42]	[,43]	[,44]	[,45]	[,46]	[,47]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,48]	[,49]	[,50]	[,51]	[,52]	[,53]	[,54]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,55]	[,56]	[,57]	[,58]	[,59]	[,60]	[,61]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,62]	[,63]	[,64]	[,65]	[,66]	[,67]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,68]	[,69]	[,70]	[,71]	[,72]	[,73]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,74]	[,75]	[,76]	[,77]	[,78]	[,79]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,80]	[,81]	[,82]	[,83]	[,84]	[,85]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,86]	[,87]	[,88]	[,89]	[,90]	[,91]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,92]	[,93]	[,94]	[,95]	[,96]	[,97]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,98]	[,99]	[,100]	[,101]	[,102]	[,103]	[,104]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,105]	[,106]	[,107]	[,108]	[,109]	[,110]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,111]	[,112]	[,113]	[,114]	[,115]	[,116]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,117]	[,118]	[,119]	[,120]	[,121]	[,122]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,123]	[,124]	[,125]	[,126]	[,127]	[,128]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,129]	[,130]	[,131]	[,132]	[,133]	[,134]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,135]	[,136]	[,137]	[,138]	[,139]	[,140]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,141]	[,142]	[,143]	[,144]	[,145]	[,146]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,147]	[,148]	[,149]	[,150]	[,151]	[,152]	[,153]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,154]	[,155]	[,156]	[,157]	[,158]	[,159]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,160]	[,161]	[,162]	[,163]	[,164]	[,165]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,166]	[,167]	[,168]	[,169]	[,170]	[,171]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,172]	[,173]	[,174]	[,175]	[,176]	[,177]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,178]	[,179]	[,180]	[,181]	[,182]	[,183]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,184]	[,185]	[,186]	[,187]	[,188]	[,189]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,190]	[,191]	[,192]	[,193]	[,194]	[,195]	[,196]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

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##      [,197]      [,198]      [,199]      [,200]      [,201]      [,202]      [,203]
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##      [,204]      [,205]      [,206]      [,207]      [,208]      [,209]      [,210]
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##      [,211]      [,212]      [,213]      [,214]      [,215]      [,216]      [,217]
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##      [,218]      [,219]      [,220]      [,221]      [,222]      [,223]      [,224]
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##      [,225]      [,226]      [,227]      [,228]      [,229]      [,230]      [,231]
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##      [,232]      [,233]      [,234]      [,235]      [,236]      [,237]      [,238]
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##      [,239]      [,240]      [,241]      [,242]      [,243]      [,244]      [,245]
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##      [,246]      [,247]      [,248]      [,249] [,250]      [,251]      [,252]      [,253]
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##      [,254]      [,255]      [,256]      [,257]      [,258]      [,259]      [,260]
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##      [,261]      [,262]      [,263]      [,264]      [,265]      [,266]      [,267]
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##      [,268]      [,269]      [,270]      [,271]      [,272]      [,273]      [,274]
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##      [,275]      [,276]      [,277]      [,278]      [,279]      [,280]      [,281]
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##      [,282]      [,283]      [,284]      [,285]      [,286]      [,287]      [,288]
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##      [,289]      [,290]      [,291]      [,292]      [,293]      [,294]      [,295]
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##      [,296]      [,297]      [,298]      [,299]      [,300]      [,301]      [,302]
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##      [,303]      [,304]      [,305]      [,306]      [,307]      [,308]      [,309]
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##      [,310]      [,311]      [,312]      [,313]      [,314]      [,315]
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##      [,316]      [,317]      [,318]      [,319]      [,320]      [,321]
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##      [,322]      [,323]      [,324]      [,325]      [,326]      [,327]
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##      [,328]      [,329]      [,330]      [,331]      [,332]      [,333]
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##      [,334]      [,335]      [,336]      [,337]      [,338]      [,339]
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##      [,340]      [,341]      [,342]      [,343]      [,344]      [,345]
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##      [,346]      [,347]      [,348]      [,349]      [,350]      [,351]      [,352]
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##      [,353]      [,354]      [,355]      [,356]      [,357]      [,358]
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##      [,359]      [,360]      [,361]      [,362]      [,363]      [,364]
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##      [,365]      [,366]      [,367]      [,368]      [,369]      [,370]
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##      [,371]      [,372]      [,373]      [,374]      [,375]      [,376]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000

```

##	[,377]	[,378]	[,379]	[,380]	[,381]	[,382]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,383]	[,384]	[,385]	[,386]	[,387]	[,388]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,389]	[,390]	[,391]	[,392]	[,393]	[,394]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,395]	[,396]	[,397]	[,398]	[,399]	[,400]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,402]	[,403]	[,404]	[,405]	[,406]	[,407]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,408]	[,409]	[,410]	[,411]	[,412]	[,413]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,414]	[,415]	[,416]	[,417]	[,418]	[,419]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,420]	[,421]	[,422]	[,423]	[,424]	[,425]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,426]	[,427]	[,428]	[,429]	[,430]	[,431]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,432]	[,433]	[,434]	[,435]	[,436]	[,437]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,438]	[,439]	[,440]	[,441]	[,442]	[,443]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,445]	[,446]	[,447]	[,448]	[,449]	[,450]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,452]	[,453]	[,454]	[,455]	[,456]	[,457]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,459]	[,460]	[,461]	[,462]	[,463]	[,464]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,466]	[,467]	[,468]	[,469]	[,470]	[,471]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,473]	[,474]	[,475]	[,476]	[,477]	[,478]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,480]	[,481]	[,482]	[,483]	[,484]	[,485]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,487]	[,488]	[,489]	[,490]	[,491]	[,492]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,493]	[,494]	[,495]	[,496]	[,497]	[,498]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,499]	[,500]	[,501]	[,502]	[,503]	[,504]
##	1.000000000	1.0000000e+00	1.000000000	1.000000000	1.000000000	1.000000000
##	[,505]	[,506]	[,507]	[,508]	[,509]	[,510]
##	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000
##	[,511]	[,512]	[,513]	[,514]	[,515]	[,516]
##	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000
##	[,517]	[,518]	[,519]	[,520]	[,521]	[,522]
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
##	[,523]	[,524]	[,525]	[,526]	[,527]	[,528]
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
##	[,529]	[,530]	[,531]	[,532]	[,533]	[,534]
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
##	[,535]	[,536]	[,537]	[,538]	[,539]	[,540]
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
##	[,541]	[,542]	[,543]	[,544]	[,545]	[,546]
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000

##	[,547]	[,548]	[,549]	[,550]	[,551]	[,552]	[,553]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,554]	[,555]	[,556]	[,557]	[,558]	[,559]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,560]	[,561]	[,562]	[,563]	[,564]	[,565]	
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	
##	[,566]	[,567]	[,568]	[,569]	[,570]	[,571]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,572]	[,573]	[,574]	[,575]	[,576]	[,577]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,578]	[,579]	[,580]	[,581]	[,582]	[,583]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,584]	[,585]	[,586]	[,587]	[,588]	[,589]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,590]	[,591]	[,592]	[,593]	[,594]	[,595]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,596]	[,597]	[,598]	[,599]	[,600]	[,601]	[,602]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,603]	[,604]	[,605]	[,606]	[,607]	[,608]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,609]	[,610]	[,611]	[,612]	[,613]	[,614]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,615]	[,616]	[,617]	[,618]	[,619]	[,620]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,621]	[,622]	[,623]	[,624]	[,625]	[,626]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,627]	[,628]	[,629]	[,630]	[,631]	[,632]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,633]	[,634]	[,635]	[,636]	[,637]	[,638]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,639]	[,640]	[,641]	[,642]	[,643]	[,644]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,645]	[,646]	[,647]	[,648]	[,649]	[,650]	[,651]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,652]	[,653]	[,654]	[,655]	[,656]	[,657]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,658]	[,659]	[,660]	[,661]	[,662]	[,663]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,664]	[,665]	[,666]	[,667]	[,668]	[,669]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,670]	[,671]	[,672]	[,673]	[,674]	[,675]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,676]	[,677]	[,678]	[,679]	[,680]	[,681]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,682]	[,683]	[,684]	[,685]	[,686]	[,687]	
##	1.0000000	1.0000000	1.0000000	1.00000000	1.00000000	1.00000000	
##	[,688]	[,689]	[,690]	[,691]	[,692]	[,693]	
##	1.00000000	1.00000000	1.00000000	1.0000000	1.0000000	1.0000000	
##	[,694]	[,695]	[,696]	[,697]	[,698]	[,699]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,700]	[,701]	[,702]	[,703]	[,704]	[,705]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,706]	[,707]	[,708]	[,709]	[,710]	[,711]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	

##	[,712]	[,713]	[,714]	[,715]	[,716]	[,717]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,718]	[,719]	[,720]	[,721]	[,722]	[,723]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,724]	[,725]	[,726]	[,727]	[,728]	[,729]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,730]	[,731]	[,732]	[,733]	[,734]	[,735]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,736]	[,737]	[,738]	[,739]	[,740]	[,741]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,742]	[,743]	[,744]	[,745]	[,746]	[,747]	[,748]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,749]	[,750]	[,751]	[,752]	[,753]	[,754]	[,755]
##	1.0000000	1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,756]	[,757]	[,758]	[,759]	[,760]	[,761]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,762]	[,763]	[,764]	[,765]	[,766]	[,767]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,768]	[,769]	[,770]	[,771]	[,772]	[,773]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,774]	[,775]	[,776]	[,777]	[,778]	[,779]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,780]	[,781]	[,782]	[,783]	[,784]	[,785]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,786]	[,787]	[,788]	[,789]	[,790]	[,791]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,792]	[,793]	[,794]	[,795]	[,796]	[,797]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,798]	[,799]	[,800]	[,801]	[,802]	[,803]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,804]	[,805]	[,806]	[,807]	[,808]	[,809]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,810]	[,811]	[,812]	[,813]	[,814]	[,815]	
##	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	
##	[,816]	[,817]	[,818]	[,819]	[,820]	[,821]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,822]	[,823]	[,824]	[,825]	[,826]	[,827]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,828]	[,829]	[,830]	[,831]	[,832]	[,833]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,834]	[,835]	[,836]	[,837]	[,838]	[,839]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,840]	[,841]	[,842]	[,843]	[,844]	[,845]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,846]	[,847]	[,848]	[,849]	[,850]	[,851]	[,852]
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
##	[,853]	[,854]	[,855]	[,856]	[,857]	[,858]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,859]	[,860]	[,861]	[,862]	[,863]	[,864]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,865]	[,866]	[,867]	[,868]	[,869]	[,870]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	
##	[,871]	[,872]	[,873]	[,874]	[,875]	[,876]	
##	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	



```
##      [,877]      [,878]      [,879]      [,880]      [,881]      [,882]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,883]      [,884]      [,885]      [,886]      [,887]      [,888]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,889]      [,890]      [,891]      [,892]      [,893]      [,894]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,895]      [,896]      [,897]      [,898]      [,899]      [,900]      [,901]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,902]      [,903]      [,904]      [,905]      [,906]      [,907]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,908]      [,909]      [,910]      [,911]      [,912]      [,913]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,914]      [,915]      [,916]      [,917]      [,918]      [,919]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,920]      [,921]      [,922]      [,923]      [,924]      [,925]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,926]      [,927]      [,928]      [,929]      [,930]      [,931]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,932]      [,933]      [,934]      [,935]      [,936]      [,937]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,938]      [,939]      [,940]      [,941]      [,942]      [,943]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,944]      [,945]      [,946]      [,947]      [,948]      [,949]      [,950]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,951]      [,952]      [,953]      [,954]      [,955]      [,956]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,957]      [,958]      [,959]      [,960]      [,961]      [,962]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,963]      [,964]      [,965]      [,966]      [,967]      [,968]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,969]      [,970]      [,971]      [,972]      [,973]      [,974]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,975]      [,976]      [,977]      [,978]      [,979]      [,980]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,981]      [,982]      [,983]      [,984]      [,985]      [,986]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,987]      [,988]      [,989]      [,990]      [,991]      [,992]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,993]      [,994]      [,995]      [,996]      [,997]      [,998]
## 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
##      [,999]      [,1000]
## 1.000000000 1.0000000e+00
## [getOption("max.print") 에 도달했습니다 -- 2 행들을 생략합니다 ]
```

```
y=cbind(y_i)
head(y)
```

```
##      y_i
## [1,] 5.387175
## [2,] 5.058704
## [3,] 6.099105
## [4,] 4.048542
## [5,] 4.234205
## [6,] 3.505734
```

```
B_hat = (solve(t(X) %*% X)) %*% t(X) %*% y
B_hat
```

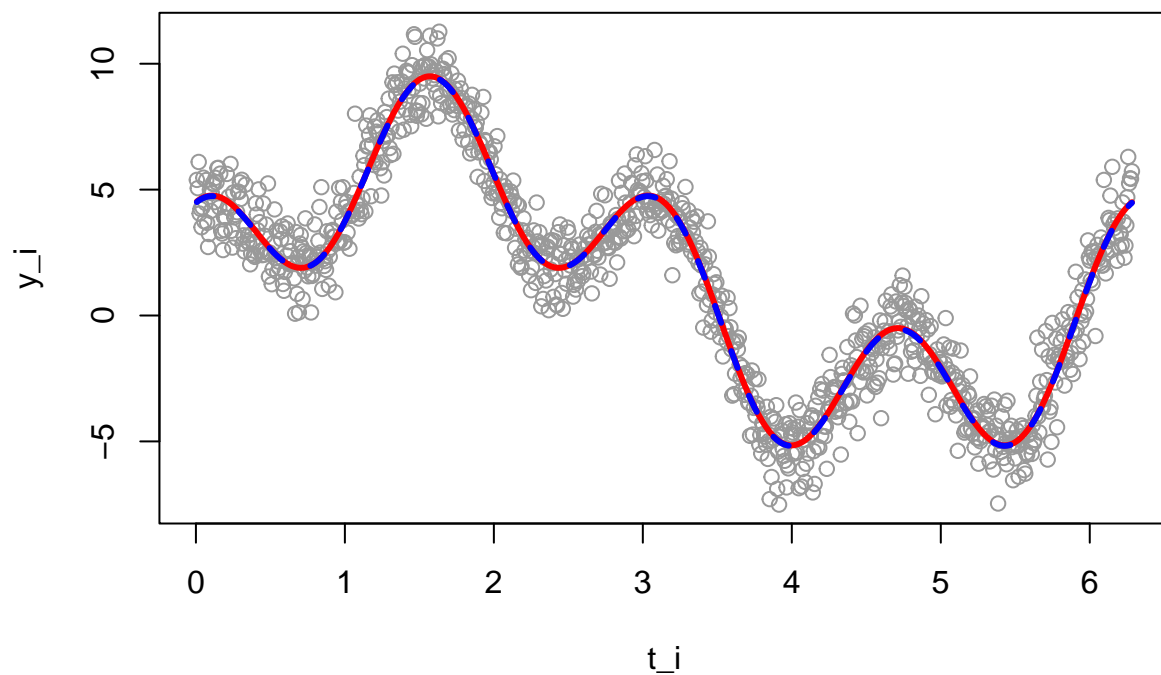
```
##          y_i
##      1.482177
## x_1 5.009633
## x_2 2.993563
```

1-(7)

```
XB_hat=X %*% B_hat
head(XB_hat)
```

```
##          y_i
## [1,] 4.506271
## [2,] 4.534910
## [3,] 4.561659
## [4,] 4.586518
## [5,] 4.609491
## [6,] 4.630583
```

```
plot(t_i,y_i,col='gray60')
lines(t_i,B,col='red',lwd=3)
lines(t_i,XB_hat,col='blue',lwd=3,lty=2)
```

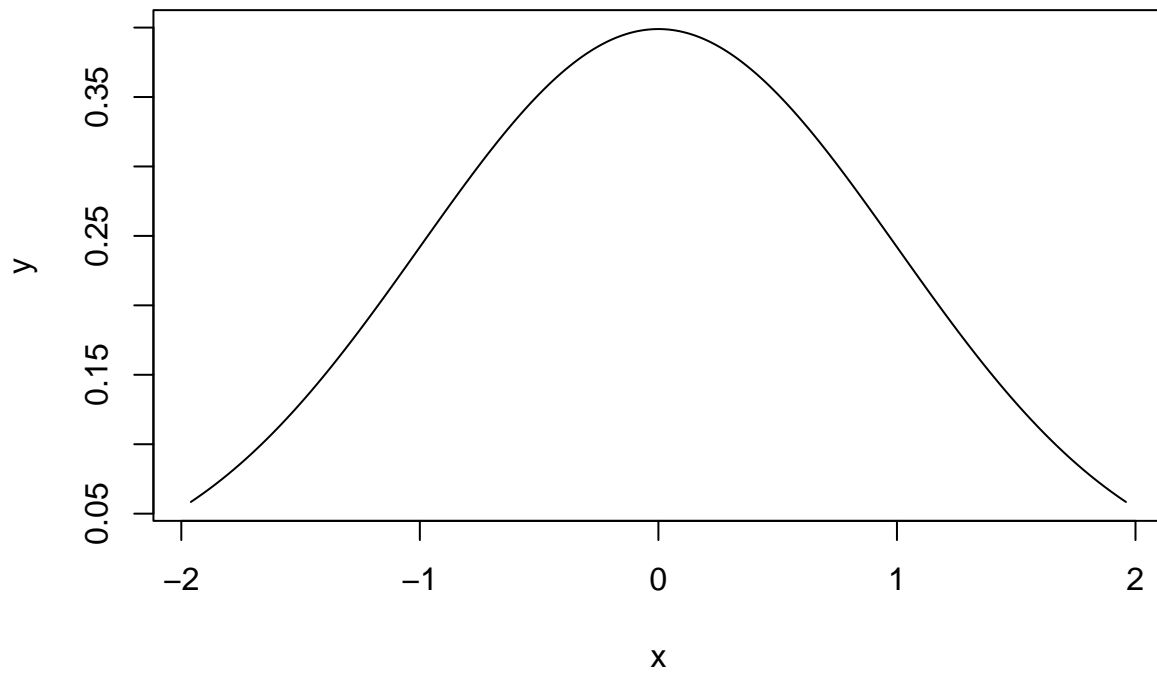


2번

2-(1)

```
x=seq(from=-1.96,to=1.96,by=0.01)
y=(1/sqrt(2*pi)*exp(-0.5*(x^2)))
```

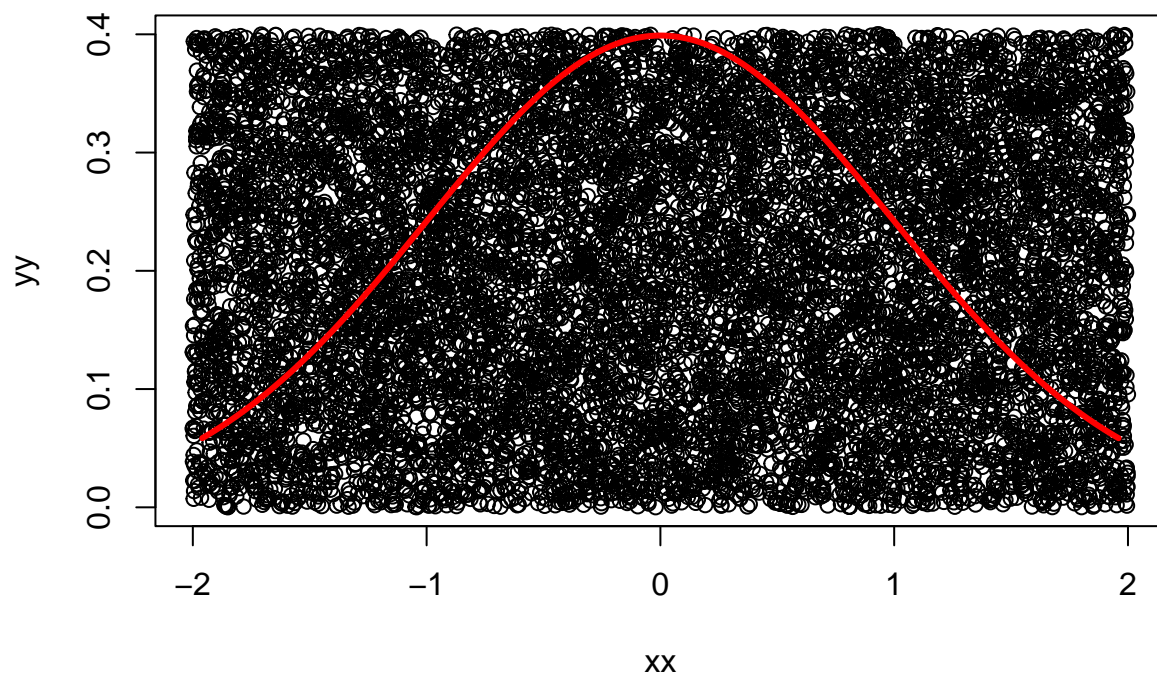
```
plot(x,y,type='l')
```



```
xx=runif(10000)
xx=xx*4-2

yy=runif(10000)*0.4
```

```
plot(xx,yy)
lines(x,y,col='red',lwd=3)
```



```
test = function(xx,yy){
  yy < (1/sqrt(2*pi))*exp((-1/2)*(xx**2))
}
```

```
print(c(xx[1],yy[1]))
```

```
## [1] -0.2375890  0.3422909
```

```
print(1/sqrt(2*pi))*exp((-1/2)*(xx[1]**2))
```

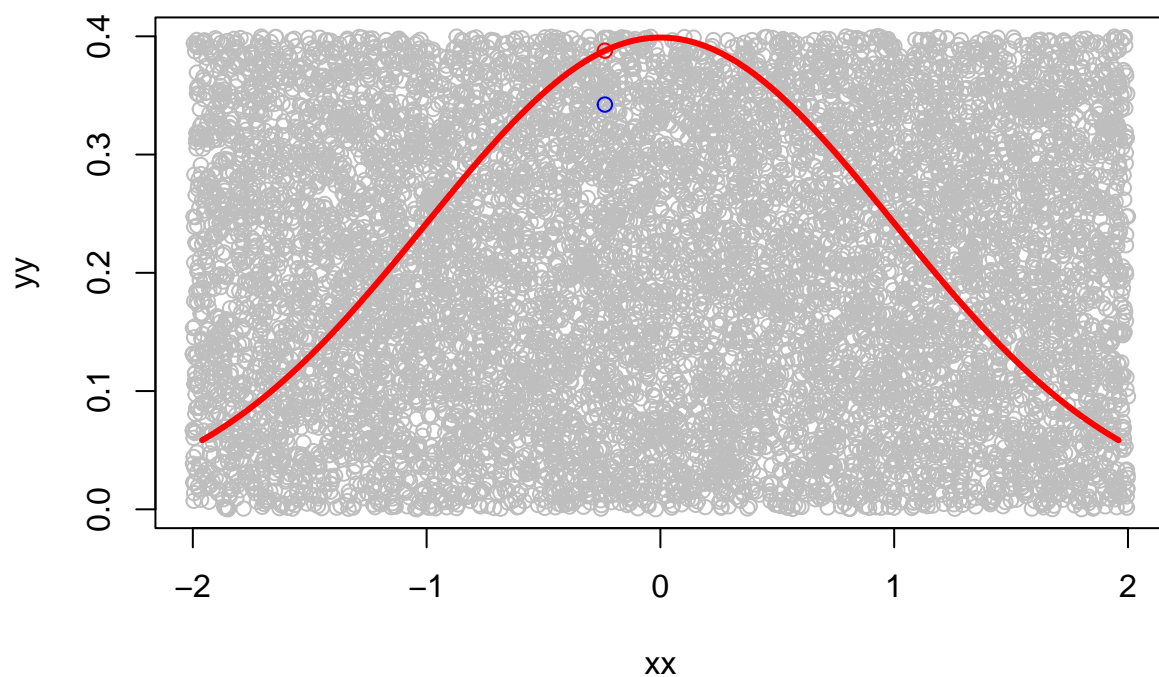
```
## [1] 0.3989423
```

```
## [1] 0.3878398
```

```
test(xx[1],yy[1])
```

```
## [1] TRUE
```

```
plot(xx,yy,col='gray')
lines(x,y,col='red',lwd=3)
points(xx[1],yy[1],col='blue')
points(xx[1],1/sqrt(2*pi)*exp(-0.5*(xx[1]^2)),col='red')
```

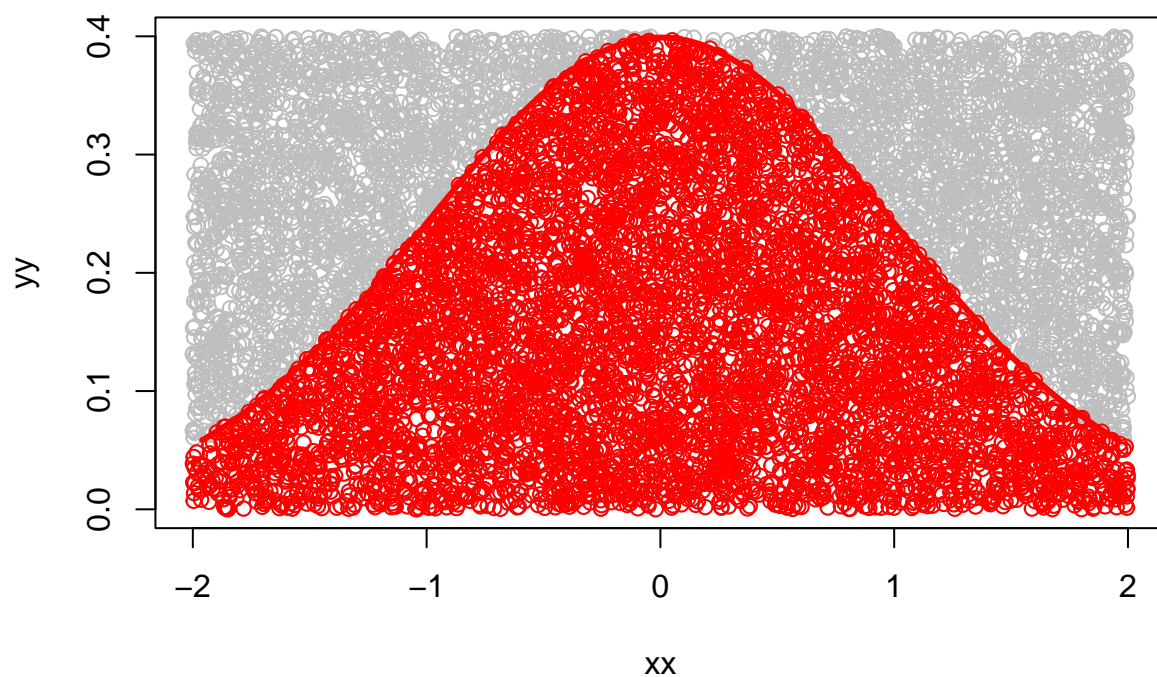


```
tst=c()
for (i in 1:10000) tst[i]=test(xx[i],yy[i])

head(tst)

## [1] TRUE FALSE FALSE FALSE TRUE FALSE

plot(xx,yy,col='gray')
lines(x,y,col='red',lwd=3)
points(xx[tst],yy[tst],col='red')
```



```
sum_tst=sum(tst)
sum_tst
```

```
## [1] 5971
```

```
w=0.4*4
```

```
sum_tst/10000*w
```

```
## [1] 0.95536
```

```
2-(2)
```

```
P=rnorm(1:1000)
```

```
length(which((P<=1.96)&P>=-1.96))
```

```
## [1] 955
```

### 3번

#### Type A

```
A_1 = sum(rbinom(1000,size=20,p=0.95)==19)
A_1
```

```
## [1] 370
```

```
A_2 = sum(rbinom(1000,size=1,p=0.5)==1)
A_2
```

```
## [1] 502
```

```
A_1 + A_2
```

```
## [1] 872
```

#### Type B

```
B_1 = sum(rbinom(1000,size=20,p=0.5)==8)
B_1
```

```
## [1] 126
```

```
B_2 = sum(rbinom(1000,size=12,p=0.95)==12)
B_2
```

```
## [1] 530
```

```
B_1 + B_2
```

```
## [1] 656
```

- 따라서 Type A의 경우에 8번 참가자가 살아남을 가능성이 더 높다.

## 4번

```
df=read_csv('https://raw.githubusercontent.com/guebin/2021IR/master/_notebooks/covid19.csv')

## Rows: 12294 Columns: 5

## -- Column specification -----
## Delimiter: ","
## chr (1): prov
## dbl (4): year, month, day, cases

##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.

head(df)

## # A tibble: 6 x 5
##   year month   day prov  cases
##   <dbl> <dbl> <dbl> <chr> <dbl>
## 1  2020     1    20 서울     0
## 2  2020     1    20 부산     0
## 3  2020     1    20 대구     0
## 4  2020     1    20 인천     1
## 5  2020     1    20 광주     0
## 6  2020     1    20 대전     0
```

### 4-(1)

```
A=df %>% filter(year==2020) %>% select(cases)
head(A)
```

```
## # A tibble: 6 x 1
##   cases
##   <dbl>
## 1     0
## 2     0
## 3     0
## 4     1
## 5     0
## 6     0
```

```
sum(A)
```

```
## [1] 60726
```

- sum(A)는 2020년의 확진자 수 총합이다.

```
B=df %>% filter(year==2021) %>% select(cases)
head(B)
```

```
## # A tibble: 6 x 1
##   cases
##   <dbl>
## 1   357
## 2    57
## 3    43
## 4    65
```



```
## 5    17
## 6    11
```

```
sum(B)
```

```
## [1] 396886
```

- sum(B)는 2021년의 확진자 수 총합이다.

#### 4-(2)

```
df %>% group_by(prov) %>% filter (year==2020 & month==2 & day<16) %>% summarise(cases_sum=sum(cases))
```

```
## # A tibble: 18 x 2
##   prov   cases_sum
##   <chr>     <dbl>
## 1 강원         0
## 2 검역         0
## 3 경기         9
## 4 경남         0
## 5 경북         0
## 6 광주         2
## 7 대구         0
## 8 대전         0
## 9 부산         0
## 10 서울         5
## 11 세종         0
## 12 울산         0
## 13 인천         0
## 14 전남         1
## 15 전북         0
## 16 제주         0
## 17 충남         0
## 18 충북         0
```

- 주어진 기간동안 가장 많은 확진자가 나온 지역은 '경기'이다.

#### 4-(3)

```
df %>% group_by(prov) %>% filter (year==2020 & month==2 & day<30 & day>15) %>% summarise(cases_sum=sum(cases))
```

```
## # A tibble: 18 x 2
##   prov   cases_sum
##   <chr>     <dbl>
## 1 강원         7
## 2 검역         0
## 3 경기        65
## 4 경남        59
## 5 경북       472
## 6 광주         7
## 7 대구       2055
## 8 대전        13
## 9 부산        75
## 10 서울        62
## 11 세종         1
## 12 울산        17
```

## 13	인천	5
## 14	전남	1
## 15	전북	4
## 16	제주	2
## 17	충남	48
## 18	충북	10

- 주어진 기간동안 가장 많은 확진자가 나온 지역은 '대구'이다.