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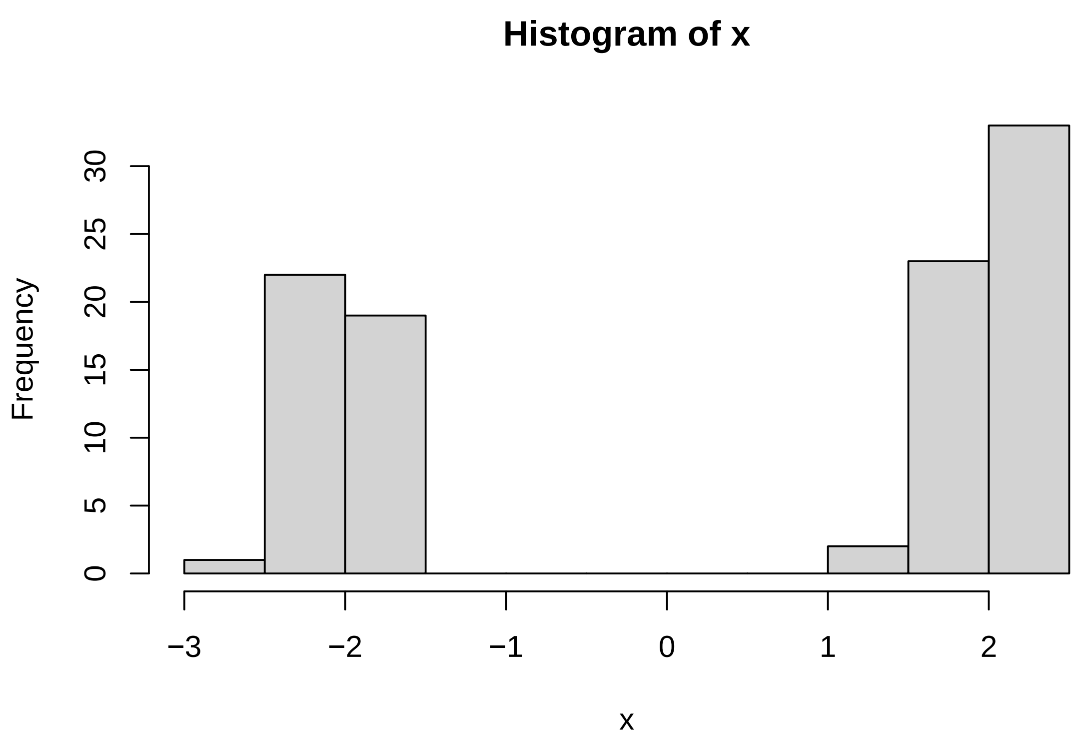
1. 1.Since there are 6 types of birds, we choose to use Kruskal-Wallis test to see whether 6 sample medians are the same or not

H0:M1=M2=M3=M4=M5=M6(the length of eggs are related to the host birds) v.s. H1: at least two medians are different

```
##
##  Kruskal-Wallis rank sum test
##
## data:  data1
## Kruskal-Wallis chi-squared = 35.04, df = 5, p-value = 1.477e-06
```

We can see the p-value<0.05. So we reject the null. The length of eggs are related to the host birds



2.

```
## [1] 0.3226837
```

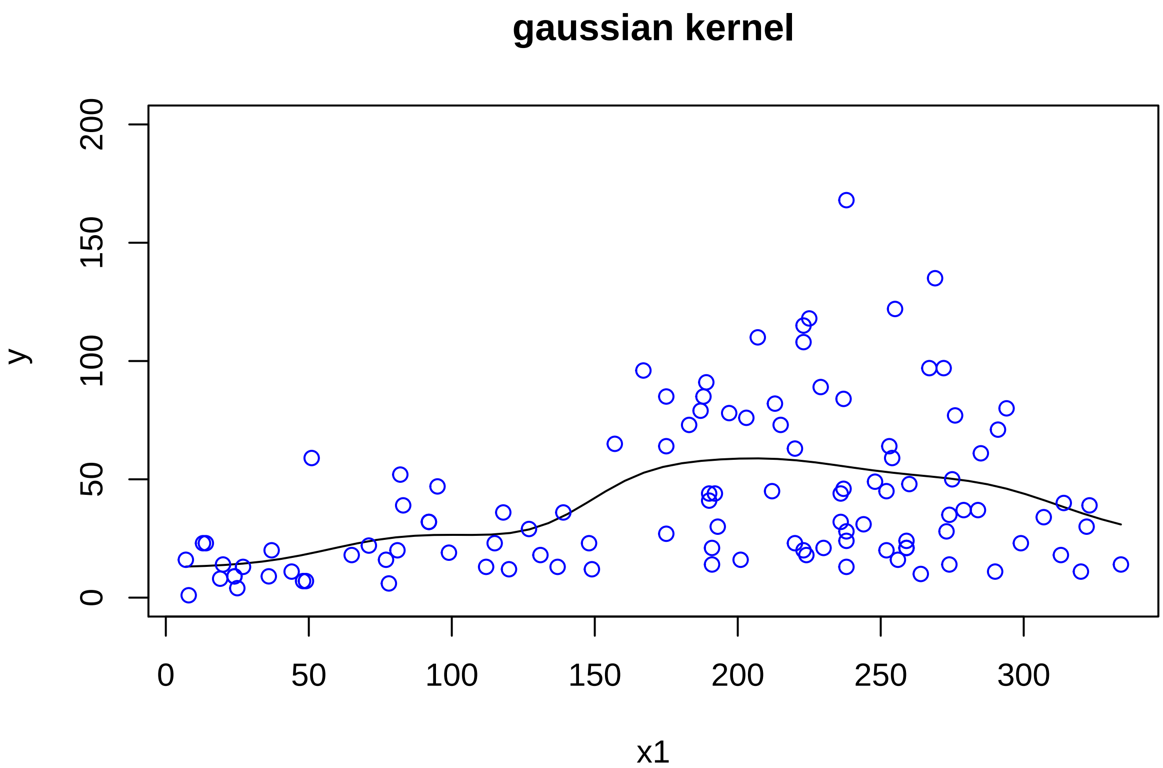
```
## [1] 1.746594
```

```
## [1] 4.018356
```

Estimations of E(X),median(X) and var(X) are 0.323, 1.75, 4.02 respectively.

3. We choose two different types of kernel each for x1,x2 and x3 to compare the result.

```
## Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 /Multistart 1 of 1 |Multis
```

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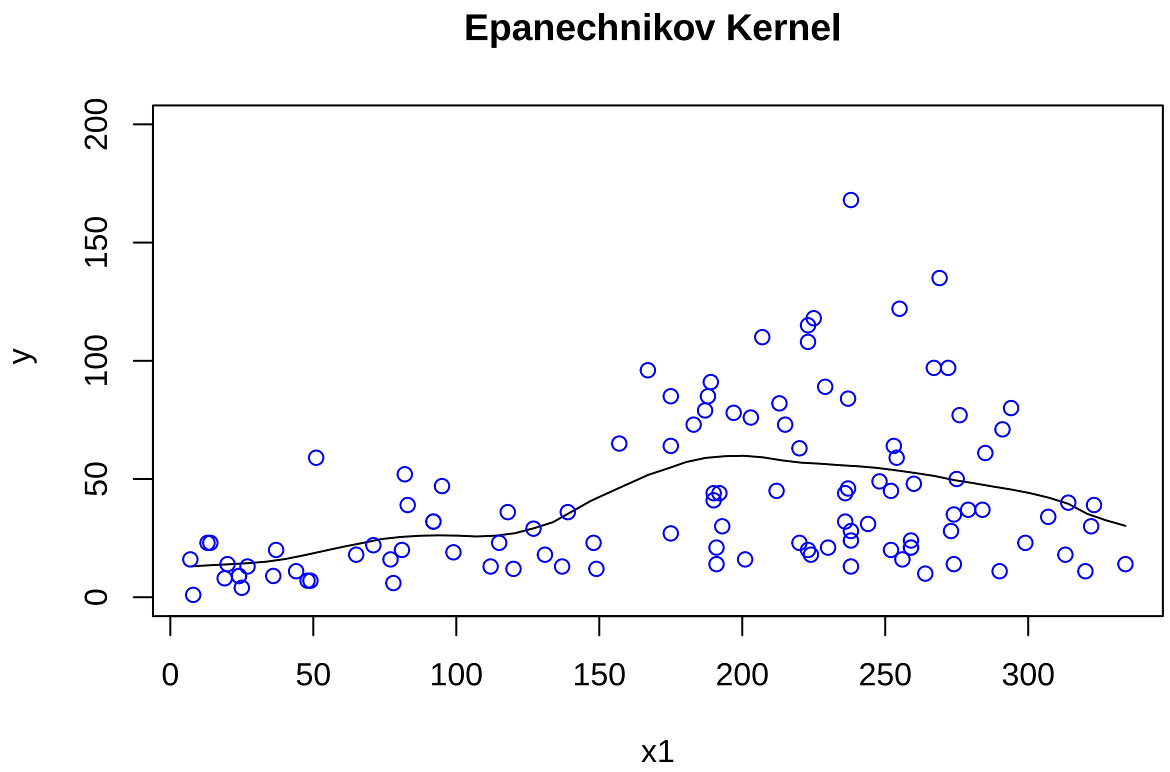
## Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 /Multistart 1 of 1 |Multis
```

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## Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 /Multistart 1 of 1 |Multis
```
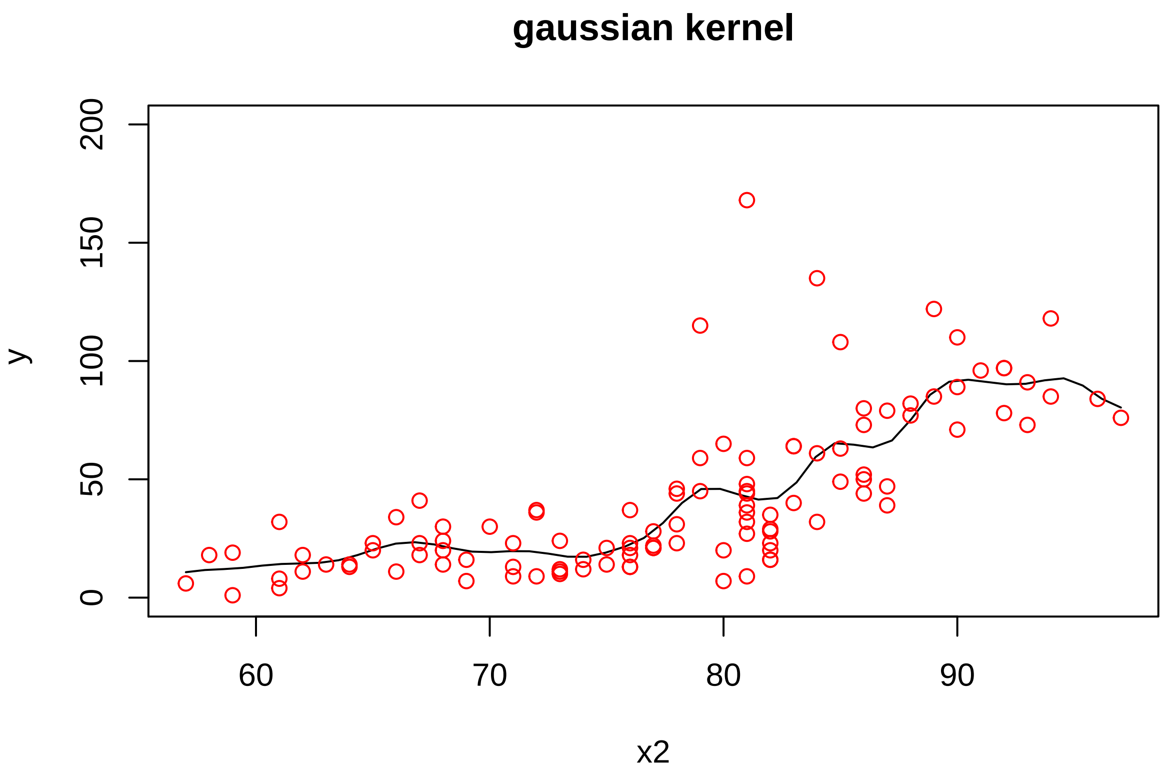
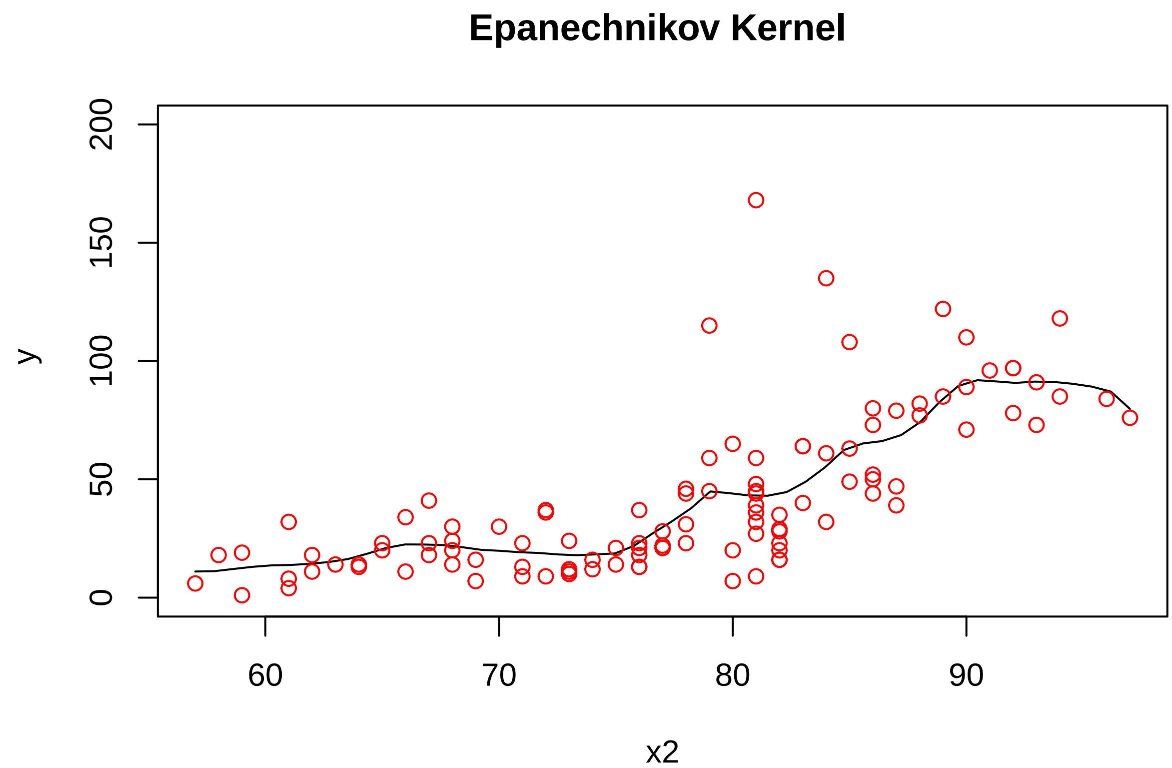
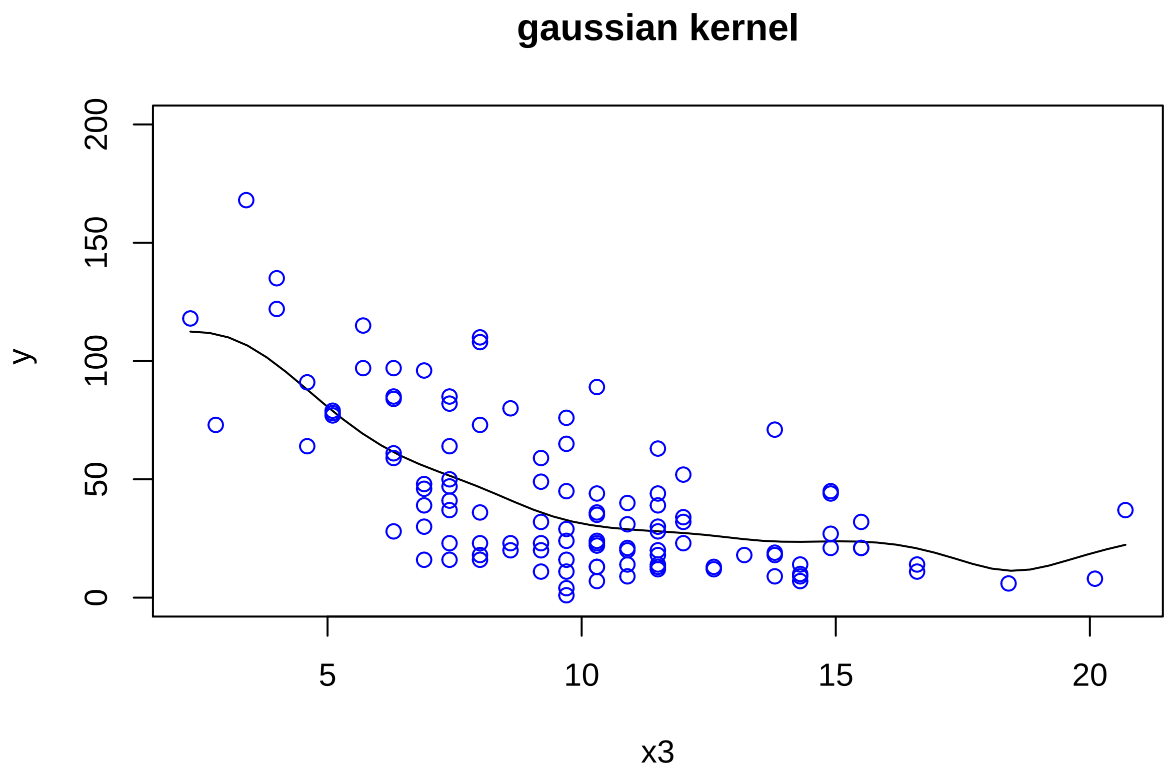



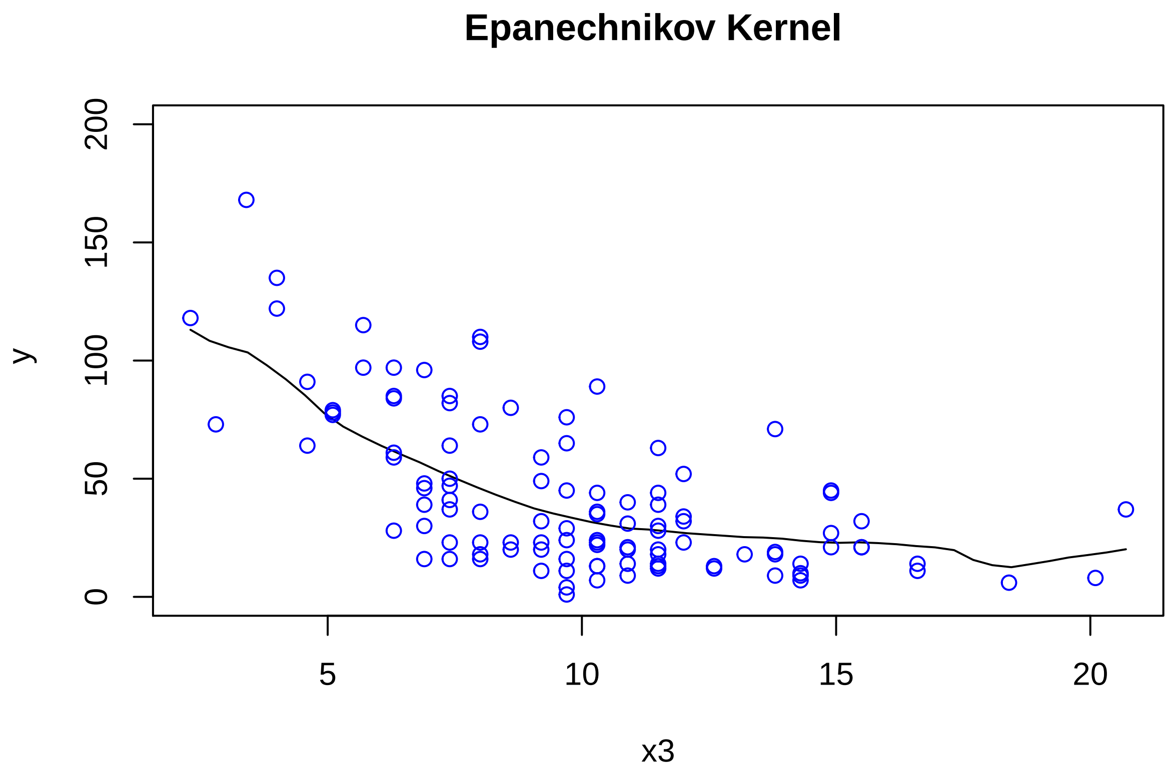

```
## Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 /Multistart 1 of 1 -Multis
```




```
## Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 /Multistart 1 of 1 |Multis
```




```
## Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 |Multistart 1 of 1 /Multistart 1 of 1 |Multis
```



We can see from the plot that the plot of two types of kernel are very similar.

Besides, when radiation increases and is in (0,200), ozone concentration also increases. When radiation is greater than 200 and increases, ozone concentration decreases.

When temperature is less than 90 and increases, the ozone concentration also increases. When temperature is greater than 90 and increases, the ozone concentration starts to decrease.

When wind speed increase, the ozone concentration increases.

4. (a).

```
##
##  Pearson's product-moment correlation
##
## data:  x1 and r1
## t = 137.83, df = 98, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.9961769 0.9982735
## sample estimates:
##       cor
## 0.9974306
```

```
##
##  Pearson's product-moment correlation
##
## data:  x2 and r2
## t = 12.757, df = 98, p-value < 2.2e-16
```

```
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.7026453 0.8539371
## sample estimates:
##       cor
## 0.7900296
```

```
##
##  Pearson's product-moment correlation
##
## data:  x3 and r3
## t = 40.534, df = 98, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.9577849 0.9807326
## sample estimates:
##       cor
## 0.9714481
```

```
##
##  Pearson's product-moment correlation
##
## data:  x4 and r4
## t = 34.522, df = 98, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.9428603 0.9738124
## sample estimates:
##       cor
## 0.9612583
```

We can see from the output that the sample correlation coefficient is 0.9974,0.7900,0.9714,0.9613 for the three distributions respectively.

(b).

```
##
##  Pearson's product-moment correlation
##
## data:  x1[-100] and r1[-1]
## t = 0.19397, df = 97, p-value = 0.8466
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.1784143  0.2162622
## sample estimates:
##        cor
## 0.01969107
```

```
##
##  Pearson's product-moment correlation
##
## data:  x2[-100] and r2[-1]
## t = -0.3655, df = 97, p-value = 0.7155
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.2327928  0.1615090
## sample estimates:
```

```
##         cor
## -0.03708528
```

```
##
##  Pearson's product-moment correlation
##
## data:  x3[-100] and r3[-1]
## t = -1.4942, df = 97, p-value = 0.1384
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.33741458  0.04886496
## sample estimates:
##        cor
## -0.1499938
```

```
##
##  Pearson's product-moment correlation
##
## data:  x4[-100] and r4[-1]
## t = -0.81365, df = 97, p-value = 0.4178
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.2752707  0.1169802
## sample estimates:
##         cor
## -0.08233299
```

(c).

```
##
##  Pearson's product-moment correlation
##
## data:  x1[-1] and r1[-100]
## t = 0.13936, df = 97, p-value = 0.8895
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.1837768  0.2109709
## sample estimates:
##        cor
## 0.01414835
```

```
##
##  Pearson's product-moment correlation
##
## data:  x2[-1] and r2[-100]
## t = -1.2294, df = 97, p-value = 0.2219
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.31360709  0.07539168
## sample estimates:
##        cor
## -0.1238636
```

```
##
##  Pearson's product-moment correlation
##
## data:  x3[-1] and r3[-100]
```

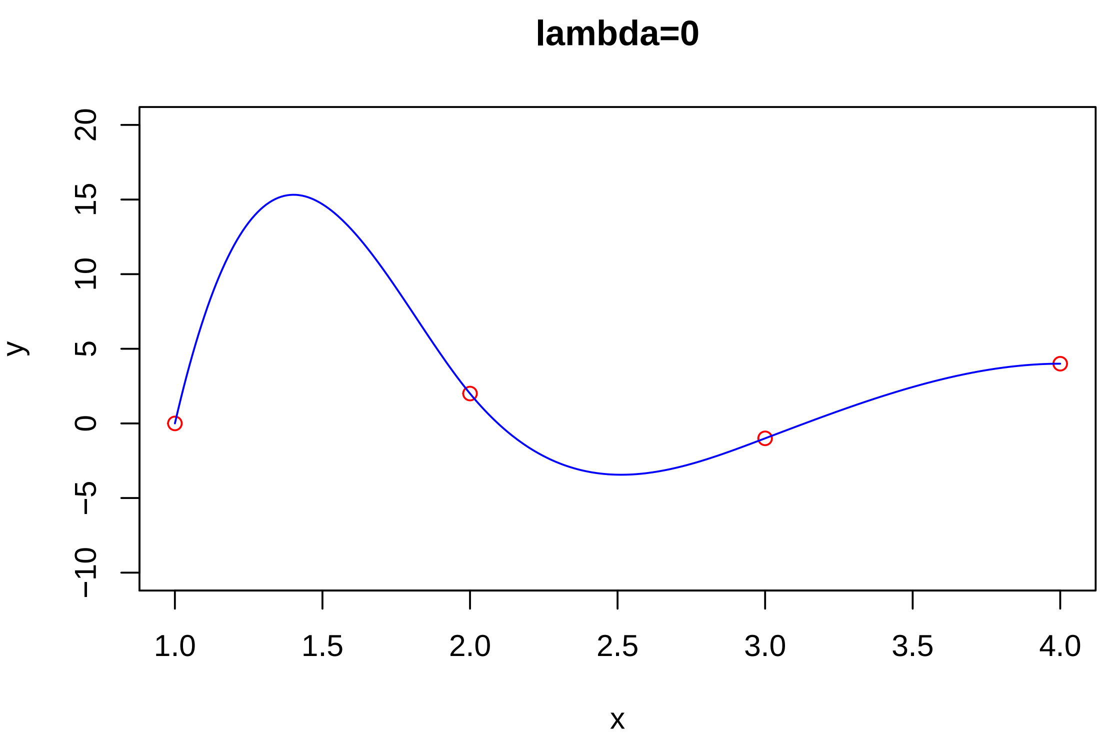
```
## t = -2.0375, df = 97, p-value = 0.04433
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.384613481 -0.005386849
## sample estimates:
##        cor
## -0.2025832
```

```
##
##  Pearson's product-moment correlation
##
## data:  x4[-1] and r4[-100]
## t = -1.6092, df = 97, p-value = 0.1108
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.34759736  0.03735027
## sample estimates:
##        cor
## -0.1612505
```

Results:

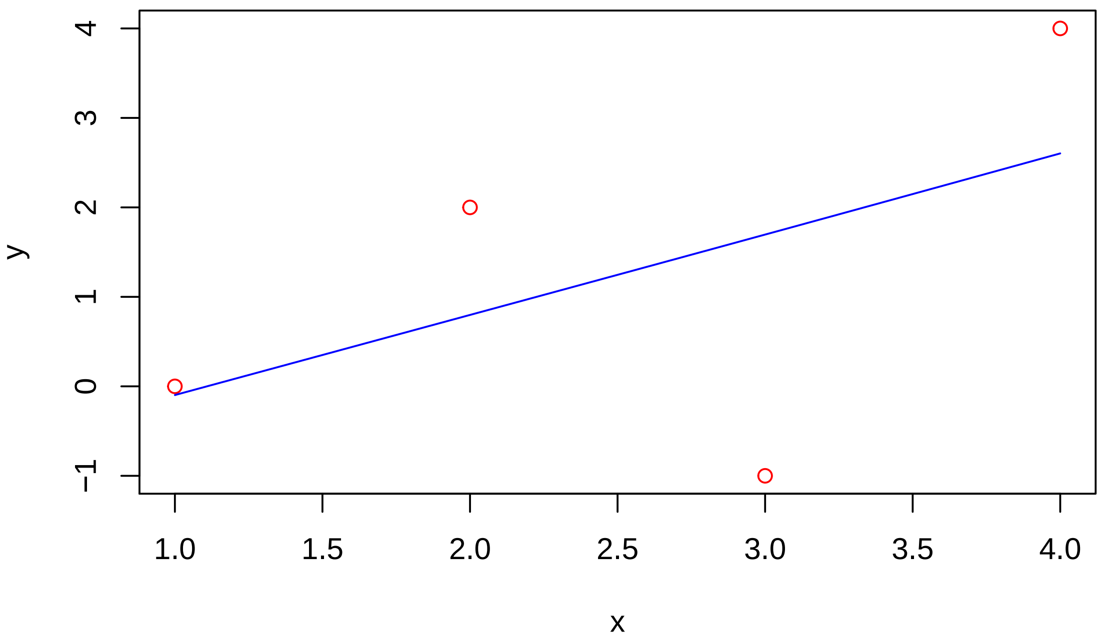
(a). the sample correlation coefficients are very high, meaning they are highly correlated. So ranks contain much information about the original data.

(b) and (c). the absolute values of sample correlation coefficients are all less than 0.1,meaning that there are almost no correlation. Since the Xi are independent of Xi+1 , This result makes sense.

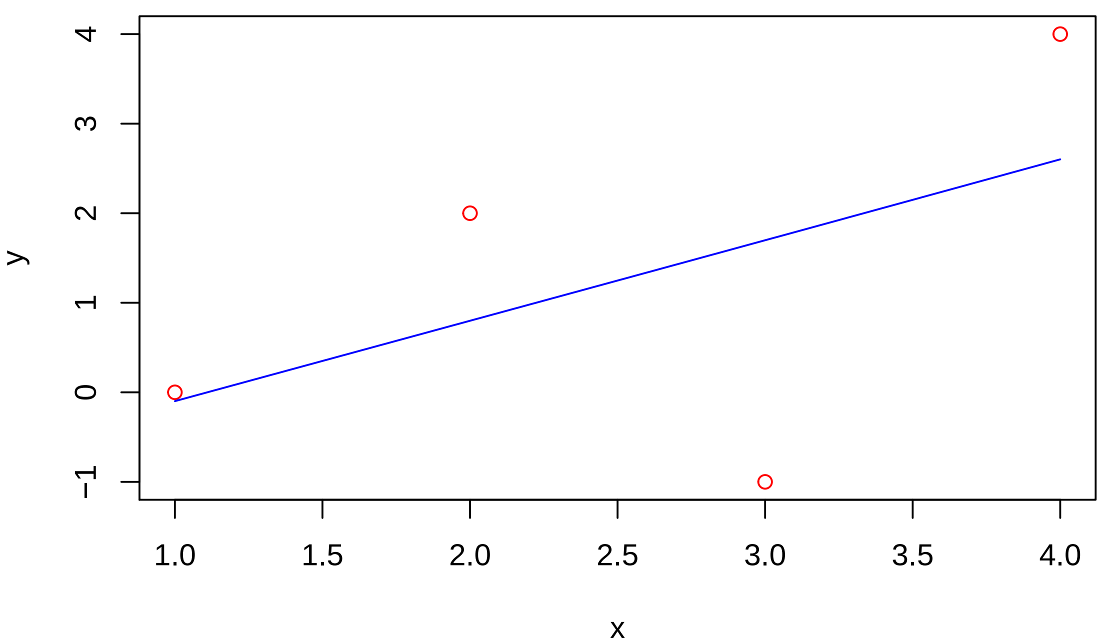


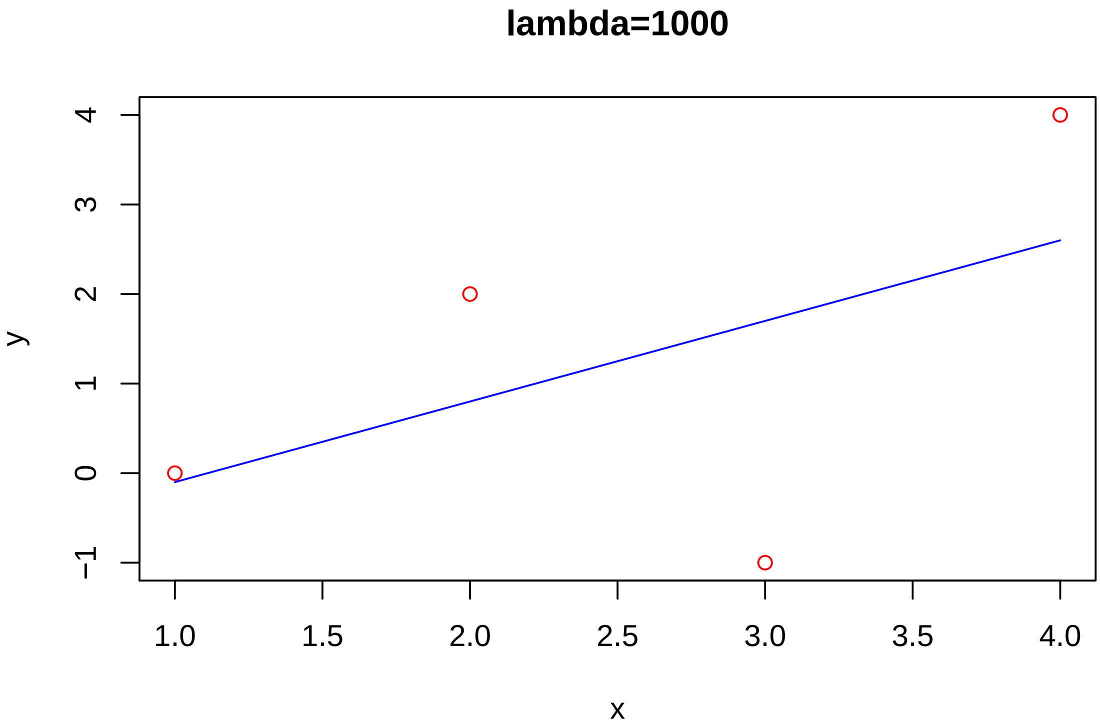
5.

lambda=1



lambda=2




lambda=1000
y
4
3
2
1
0
−1
1.0
1.5
2.0
2.5
3.0
3.5
4.0
x