Informatics Institute of Technology

Artificial Intelligence & Data Science

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Module CM1606 Computational Mathematics

Assignement : Individual Coursework

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Acknowledge

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Question 1

1) According to the theory always the total of probabilities should be equal to 1. Therefore the value 1 can be obtained by adding the total values of the 'Y'.

(1/3 + 1/6 + p + 2p) = 1

½ + 3p = 1

3p = 1 – ½

3p/3 = 1/2/3

P = 1/6

Therefore value of p is = 1/6

2)

E(X) = 2(1/3) + 4(1/6) + 6(1/6) + 8(1/3)

= 5

Var(X) = $E(X^2) - [E(X)]^2$

= 4(1/3) + 16(1/6) + 36(1/6) + 6(1/3)

= 4/3 + 8/3 + 6 + 64/3

= 82/3 + 4

= 93/3 + 1 = 94/3 – $(5)^2$

= 19/3

= 6.333

Therefore E(X) = 5 and Var(X) = 6.333

3)

Given that Y = X – 2

Therefore when Y,

P(X = 2) = P(Y = 0)

P(X = 4) = P(Y = 2)

P(X = 6) = P(Y = 4)

P(X = 8) = P(Y = 6)

Y	**0**	**2**	**4**	**6**
Probability	1/3	1/6	1/6	2/6

4)

Range of Y	**∞ < y<0**	**0<y<2**	**2<y<4**	**4<y<6**	**8 <= y< = ∞**
P(Y <= y)	0	1/3	1/2	2/3	1

5)

P(Y = 4) = 2/3 – 1/2

= 1/6

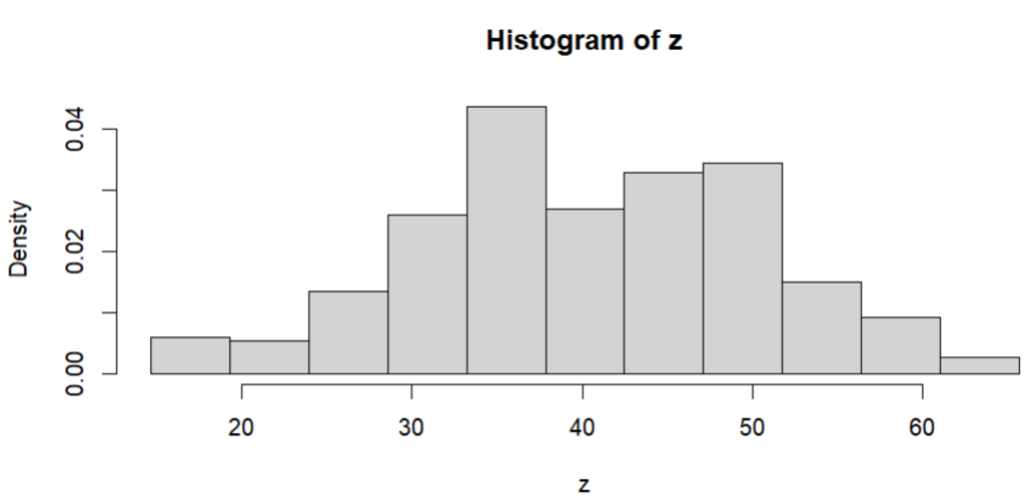
Therefore P(Y = 4) will be 1/6

Question 2

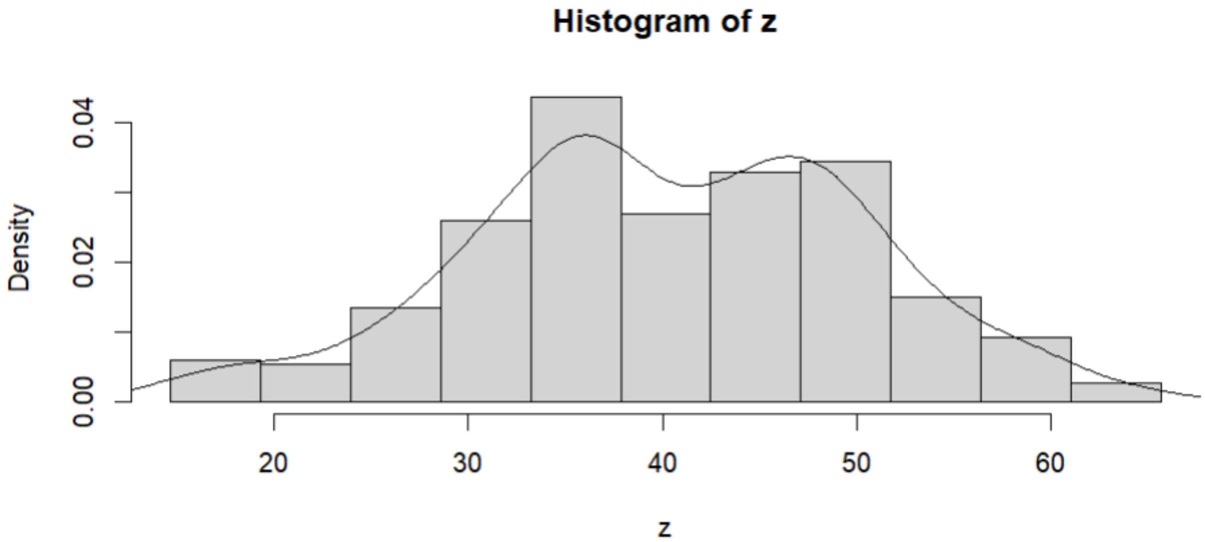
1) > z < - rnorm(400,40,10)

```
> z <- rnorm(400,40,10)
> z
  [1] 35.88096 46.26713 43.69134 27.02367 45.68311 33.05285 31.17448 59.37672 55.44354 37.84476 19.37883
 [12] 40.07634 33.83355 41.01362 42.31651 59.69089 47.59550 57.66703 28.01881 28.10186 36.91245 47.49598
 [23] 51.00707 28.07059 30.35405 31.64365 25.89748 31.24742 49.29527 52.52909 36.71384 48.15479 30.42878
 [34] 48.50105 34.67954 36.17370 34.72554 27.67244 28.71053 47.82896 43.78109 63.19375 45.81821 50.53467
 [45] 35.58936 25.56275 32.33189 37.27607 35.42942 47.38715 56.64129 28.61428 37.69704 44.37320 57.99959
 [56] 14.95383 25.00258 54.37510 44.13792 35.37190 43.02648 49.66285 29.92977 41.74730 59.62247 50.84195
 [67] 43.62050 46.55956 25.02402 34.02327 34.45447 41.94672 45.69703 46.60268 34.93325 32.14448 36.39115
 [78] 50.00919 32.88456 53.18103 39.93235 33.82124 28.74421 29.80138 30.25388 26.87999 49.52735 44.88270
 [89] 49.09307 53.54227 33.50362 36.53166 37.40017 28.86018 39.54655 24.78859 33.26602 47.51575 48.42271
[100] 59.33915 48.53746 45.60125 49.76402 40.91844 27.93731 53.64851 36.79792 45.26172 36.94450 55.37752
[111] 56.77536 35.04086 36.41072 49.00757 64.65127 36.88786 36.12802 35.19529 14.65877 37.76768 30.83747
[122] 45.10469 49.73086 41.97154 46.38777 52.76580 46.37859 29.71850 46.45251 41.34943 45.36635 35.72055
[133] 32.79251 18.41107 34.86626 50.60256 50.26154 36.99370 36.73661 50.41615 21.67974 44.16746 45.47855
[144] 46.76054 37.12572 35.82798 35.29067 35.18127 25.13385 40.97508 48.95117 30.08913 38.05231 54.20121
[155] 31.53632 31.72049 39.31301 46.23675 35.06846 34.91433 14.85908 37.89136 20.54032 40.03145 45.32594
[166] 38.16260 42.98967 18.92190 48.51564 34.79366 22.19490 58.78626 53.76357 37.05172 50.61434 37.57290
[177] 42.00656 58.89694 59.44590 52.41351 32.43968 38.90783 36.80750 24.73003 44.42731 39.53316 49.89398
[188] 32.92901 49.39945 47.14695 43.93002 44.66248 31.17591 48.39326 38.10505 28.45903 51.24161 45.42398
[199] 54.59049 48.87428 43.73213 30.64225 49.62013 37.25343 32.61207 27.07301 47.14485 41.95231 58.46779
[210] 40.74919 53.98462 53.42303 45.48679 51.97173 35.87610 16.11544 63.28898 33.18765 30.39269 48.43903
[221] 43.14824 24.92996 48.20140 44.17384 51.62180 56.55807 37.41553 40.62412 25.86661 43.15377 36.33482
[232] 54.76573 44.32979 58.79515 48.98989 40.72227 45.88845 35.29735 38.32217 35.61700 53.84619 65.67874
[243] 46.00673 34.68543 29.44435 29.92914 45.14649 49.20676 41.11323 46.35956 42.72547 35.09082 41.88705
[254] 43.25103 52.43713 38.62201 31.63456 42.09911 47.54025 37.67809 38.12183 48.92720 36.69917 34.14596
[265] 35.53542 31.56934 28.13845 40.38169 41.43439 22.92695 21.66343 34.72627 36.54746 32.34666 44.65987
[276] 44.57928 59.13544 35.40570 43.02121 52.51761 38.00235 35.01286 38.86266 38.16979 48.80248 47.50196
[287] 45.31213 46.43054 49.87390 40.99768 16.00345 32.69377 43.29744 31.42322 19.60456 43.97713 36.53380
[298] 56.04457 59.91490 18.18228 17.45368 40.96449 48.35836 32.86738 45.86280 37.31650 41.38985 48.79898
[309] 38.94998 50.62109 41.32882 54.35900 36.98625 33.72585 18.31078 30.52765 30.03518 51.81074 15.22012
[320] 32.09275 50.13495 35.24164 41.78626 47.50697 50.21812 37.55326 37.93591 46.70958 49.80927 36.84345
[331] 53.77932 53.43592 51.46639 48.47571 31.05242 24.09217 35.12807 37.40775 40.82964 34.13557 51.59673
[342] 35.98684 58.45895 45.30422 43.04957 29.94508 43.70176 44.35816 47.46467 35.57962 19.76473 31.51691
[353] 52.24151 37.09400 46.44119 25.10467 32.24646 34.08307 39.18459 39.58555 44.81118 47.71939 47.14055
[364] 38.96361 33.37528 45.47511 32.70539 34.11958 32.48332 34.02420 28.03484 41.73174 37.10859 45.76638
[375] 40.79540 43.04649 39.07774 49.25487 43.41594 48.57106 27.57852 48.42127 55.88065 47.55440 32.30716
[386] 24.75571 48.15484 38.19265 47.16442 34.49563 37.08654 19.52367 51.97223 23.17039 48.59779 27.56932
[397] 55.37116 61.90714 34.67778 28.92387
```

2) breaks < - seq (from = min(z), to = max(z), length = 12)
hist (z, breaks = breaks , freq = F)



3) lines (density(z,))



4) By observing the histogram, it is clear that the plotted histogram has a symmetrical shape. The curve of the graph too has a bell-shaped symmetrical line from the data that were generated.

Question 3

$(1 - 0.3) = 0.7$

1) $p(y= 0) = {}^{n}C_{y}\, p^{y}\, q^{(n-y)}$

$= {}^{10}C_{0}\,(0.3)^{0}\,(0.7)^{10-0}$

$= (0.7)^{10}$

$p(y <= 1) = {}^{n}C_{y}\, p^{y}\, q^{(n-y)}$

$= {}^{10}C_{1}\,(0.3)^{1}\,(0.7)^{10-1}$

$= 0.121060821$

2) For ($Y \leq 5$),
> pbinom (5, 10, 0.3) = 0.952651

P(Y > 8)
> 1 - pbinom (7, 10, 0.3) = 0.001590386

```
> pbinom(5, 10, 0.3)
[1] 0.952651
> 1 - pbinom(7, 10, 0.3)
[1] 0.001590386
>
```

3) E(Y) = np = (10)(0.3) = 3

Var(Y) = npq = (3)(0.7) = 2.1

4) > pbinom (3, 10, 0.3)
[1] 0.6496107

```
> pbinom(3,10,0.3)
[1] 0.6496107
>
```

Question 4

1)

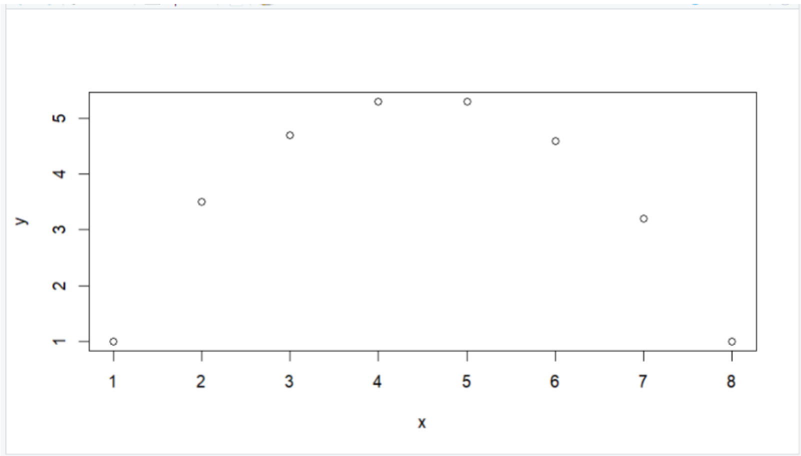
> x <-c(1,2,3,4,5,6,7,8)

> y <-c(1, 3.5, 4.7, 5.3, 5.3, 4.6, 3.2, 1)

> plot(x, y)

> cor(x, y, method="pearson")

[1] -0.02982897



2) When looking at the graph the y values are slightly increasing but once after it reaches the 5th value tit starts to decrease even though the x values keep increasing. The reason for the y value to decrease after some point is because it no longer has a strong linear relationship.

3)

> p < - x[1:5]

> q < - y[1:5]

> cor (p, q, method="pearson")

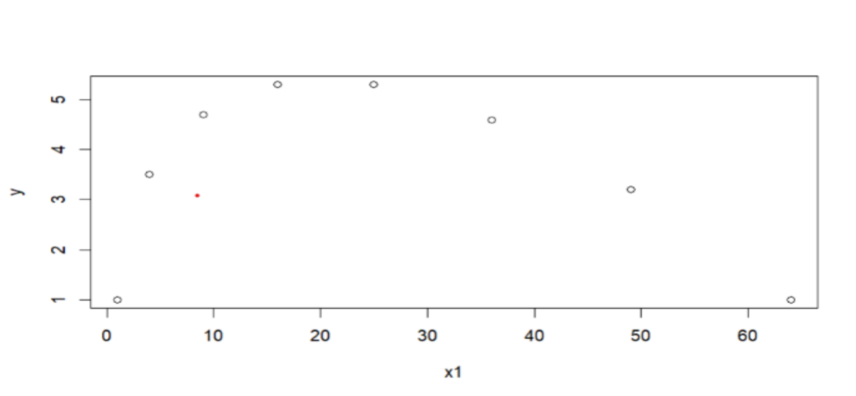
[1] 0.9082363

4) Though the y values are same there will be a slight relationship between r_{xy} and $r_{x1}y$ because the linear relationship of $r_{x1}y$ will be less than $r_{xy..}$ Since the value of x_1 is squared by it's number a slight curve can be seen in the graph.

When considering the relationships between r_{xy} and $r_{x2}y$, a linear relationship can be identified because the y value is constant always.

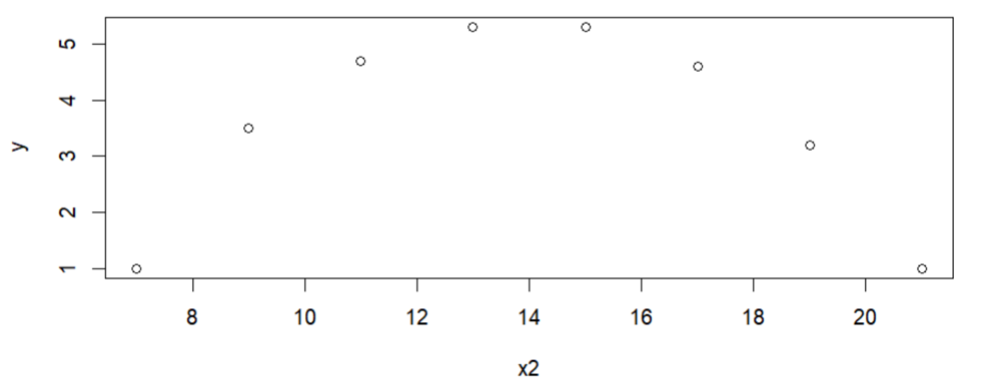
5) > x1 < -x^2

> plot(x1, y)



> x2 < -(2*x) + 5

> plot(x2, y)



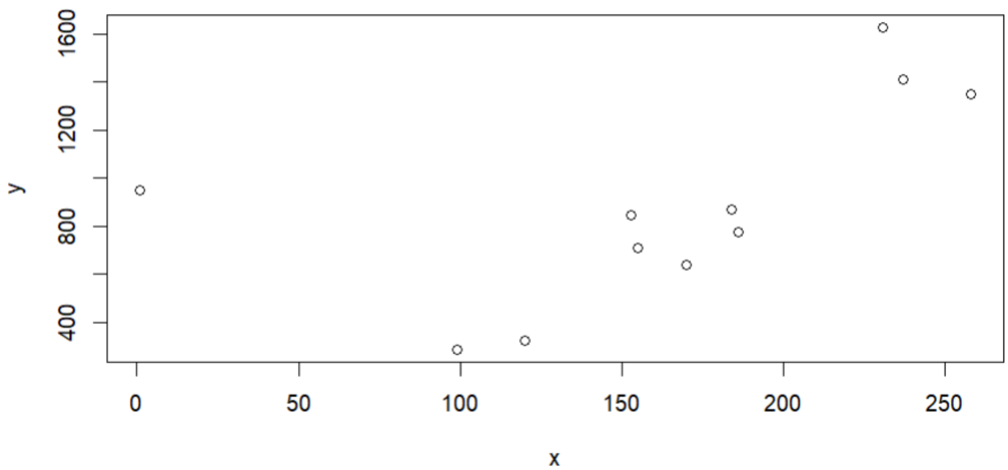
Question 5

1)

x <-c(237, 184, 99, 258, 231, 186, 155, 153, 170, 120, 179)

y <-c(1412, 872, 288, 1351, 1627, 775, 711, 849, 642, 324, 950)

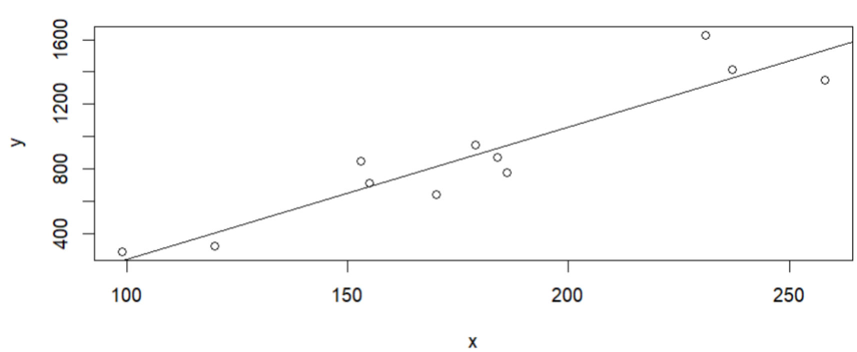
plot(x, y)



2)

> fit <-lm(y~x)

> abline(fit)



3) Gradient of the plotted graph = 8.192

- Therefore, the upkeep expenditure increase per $1000 increase in home value is = $8.192

4)

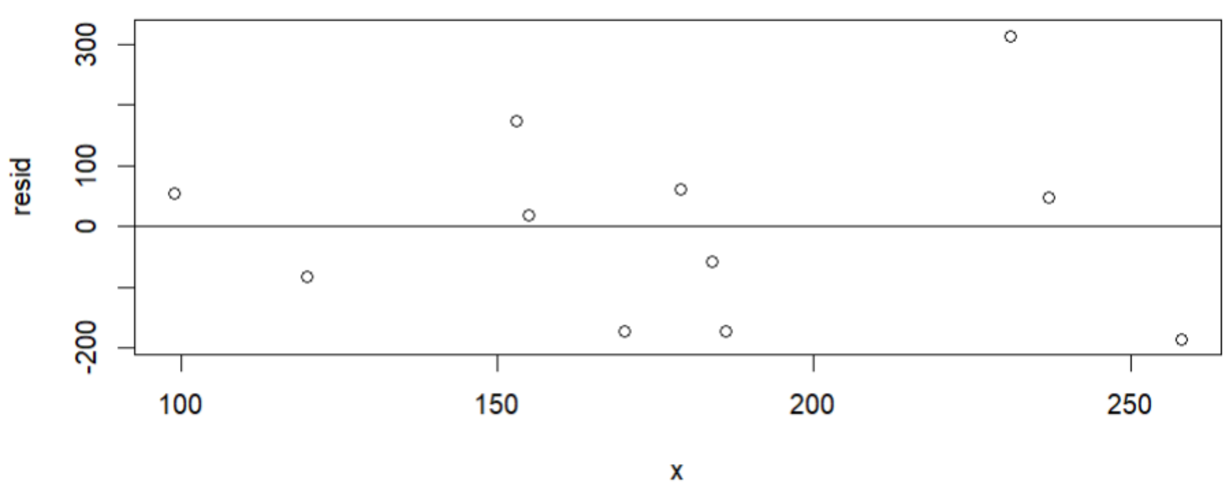
> resid < -residuals(fit)

```
> resid <-residuals(fit)
> resid
         1          2          3          4          5          6          7 
  48.17383  -57.71962   54.48899 -184.83065  312.31797 -171.10100   18.81037 
         8          9         10         11 
 173.19175 -173.04997  -81.51549   61.23382 
> 
```

> plot(x, resid, ylim= c(-190, 320))

>abline(0,0)

```
> plot(x, resid, ylim = c(-190,320))
> abline(0,0)
> 
```



Comment:

By observing the graph we can say that the residuals versus x is horizontal

5) > newExp <-data.frame(x=c(140,225))

> predict(fit, newExp)

```
> newExp <-data.frame(x=c(140,225))
> predict(fit, newExp)
        1         2
 569.3293 1265.5379
>
```

Question 6

> x < -numeric(1000)

> for(y in 1:1000)

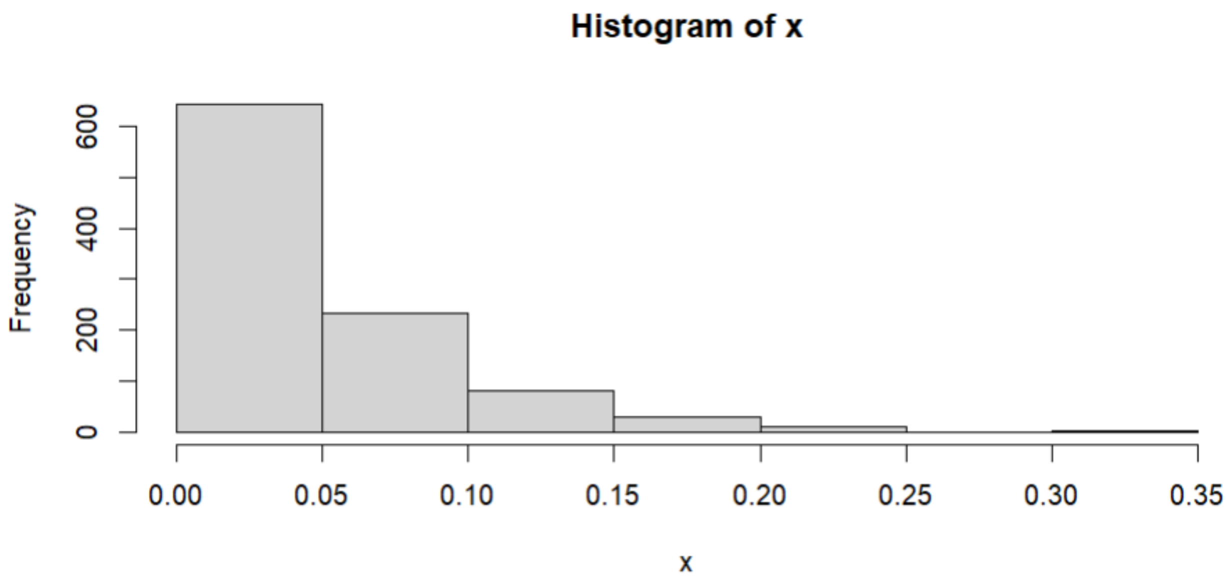
+ {ssize < - runif(20)

+ X[y] < - min(ssize)}

> ssize

```
> x<-numeric(1000)
> for(y in 1:1000)
+ {ssize<-runif(20)
+ x[y]<-min(ssize)}
> ssize
 [1] 0.99630617 0.95962812 0.09945093 0.57548555 0.74834726 0.23824970 0.20254348
 [8] 0.92568460 0.88978570 0.80857183 0.86811557 0.61657433 0.09938638 0.05300325
[15] 0.98834298 0.43041775 0.27547345 0.92521976 0.45613498 0.43355806
> hist(x)
```

> hist(x)




```
> qqnorm(x)
>
```