ASSIGNMENT-4

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1. Compute and interpret separately with Karl Pearson and Spearman correlation coefficient for the ing advertising cost and product sales (in lakhs) of 8 companies are selected at random:

Advertising cost	15	20	28	12	80	20	60	40
Product sales	40	30	50	30	60	30	10	20

CODE:

```
#21BCE7727
#M Gyanada Chowdary
#x=advertising cost
#y=Product sales
x<- c(15, 20, 28, 12, 80, 20, 60, 40)
y <- c(40, 30, 50, 30, 60, 30, 10, 20)
xy<-x*y
#Pearson correlation coefficient
meanx <- mean(x)
meany <- mean(y)
meanxy<-mean(xy)
sdx <- sd(x)
sdy <- sd(y)
covxy <- mean(xy)-(meanx*meany)
coxy
r_pearson <- covxy/ (sdx * sdy)
```

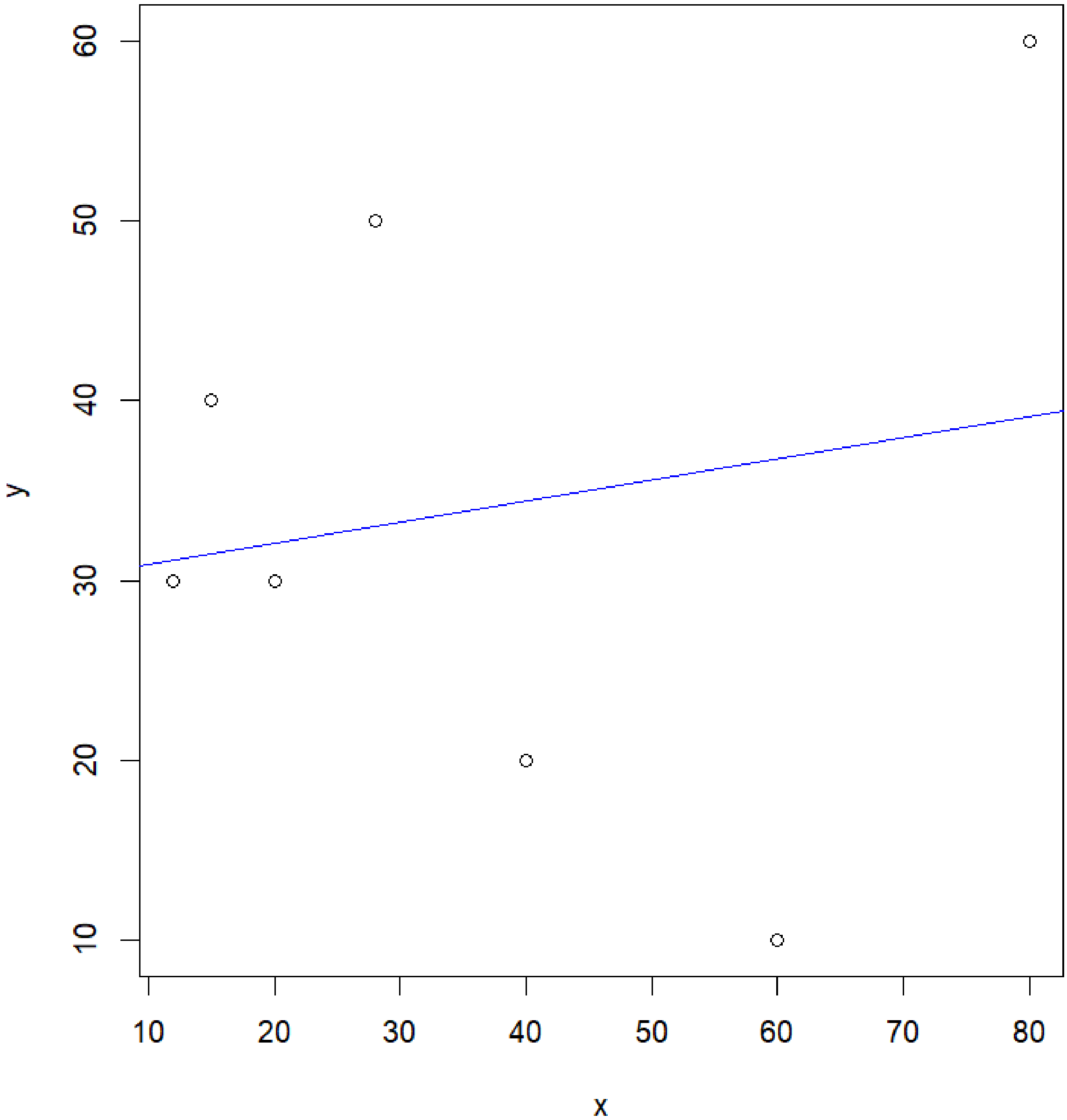
```
r_pearson
#Spearman correlation coefficient
rankx <- rank(x)
ranky <- rank(y)
d <- rankx -ranky
n <- length(x)
s=(6 * sum(d^2)) / (n * (n^2 - 1))
r_spearman <- 1-s
r_spearman
df=data.frame(c(x,meanx),c(y,meany),c(xy,meanxy))
df
df2=data.frame(x,y,rankx,ranky,d)
df2
plot(x,y)
abline(lm(y ~ x, data = df), col = "blue")
```

```r
#21BCE7727
#M Gyanada Chowdary
#x=advertising cost
#y=Product sales
x<- c(15, 20, 28, 12, 80, 20, 60, 40)
y <- c(40, 30, 50, 30, 60, 30, 10, 20)
xy<-x*y
#Pearson correlation coefficient
meanx <- mean(x)
meany <- mean(y)
meanxy<-mean(xy)
sdx <- sd(x)
sdy <- sd(y)
covxy <- mean(xy)-(meanx*meany)
coxy
r_pearson <- covxy/ (sdx * sdy)
r_pearson
#Spearman correlation coefficient
rankx <- rank(x)
ranky <- rank(y)
d <- rankx -ranky
n <- length(x)
s=(6 * sum(d^2)) / (n * (n^2 - 1))
r_spearman <- 1-s
r_spearman
df=data.frame(c(x,meanx),c(y,meany),c(xy,meanxy))
df
df2=data.frame(x,y,rankx,ranky,d)
df2
plot(x,y)
abline(lm(y ~ x, data = df), col = "red")
```

Output:

```
> #21BCE7727
> #M Gyanada Chowdary
> #x=advertising cost
> #y=Product sales
> x<- c(15, 20, 28, 12, 80, 20, 60, 40)
> y <- c(40, 30, 50, 30, 60, 30, 10, 20)
> xy<-x*y
> #Pearson correlation coefficient
> meanx <- mean(x)
> meany <- mean(y)
> meanxy<-mean(xy)
> sdx <- sd(x)
> sdy <- sd(y)
> covxy <- mean(xy)-(meanx*meany)
> covxy
[1] 59.84375
> r_pearson <- covxy/ (sdx * sdy)
> r_pearson
[1] 0.1547421
> #Spearman correlation coefficient
> rankx <- rank(x)
> ranky <- rank(y)
> d <- rankx -ranky
> n <- length(x)
> s=(6 * sum(d^2)) / (n * (n^2 - 1))
> r_spearman <- 1-s
> r_spearman
[1] 0.0297619
> df=data.frame(c(x,meanx),c(y,meany),c(xy,meanxy))
> df
  c.x..meanx. c.y..meany. c.xy..meanxy.
1      15.000       40.00           600
2      20.000       30.00           600
3      28.000       50.00          1400
4      12.000       30.00           360
5      80.000       60.00          4800
6      20.000       30.00           600
7      60.000       10.00           600
8      40.000       20.00           800
9      34.375       33.75          1220

> df2=data.frame(x,y,rankx,ranky,d)
> df2
   x  y rankx ranky    d
1 15 40   2.0     6 -4.0
2 20 30   3.5     4 -0.5
3 28 50   5.0     7 -2.0
4 12 30   1.0     4 -3.0
5 80 60   8.0     8  0.0
6 20 30   3.5     4 -0.5
7 60 10   7.0     1  6.0
8 40 20   6.0     2  4.0
> plot(x,y)
> abline(lm(y ~ x, data = df), col = "red")
>
```

GRAPH:



X

2. IC chips production (in thousands) and electricity consumption (in KW/day) for a particular week of the company are given as follows:

IC chips production	451	358	431	506	499	529	564
Electricity consumption	248	226	247	277	305	583	299

(a) Estimate the linear regression line.
(b) Estimate the quadratic regression curve.
(c) Estimate the electricity consumption for the day that company produces $4,95,000$ IC chips.
(d) Draw the scattered plot with line and curve.

CODE:

```
x <- c(451, 358, 431, 506, 499, 529, 564)
y <- c(248, 226, 247, 277, 305, 583, 299)

# (a) Linear regression using formula
n <- length(x)
slope <- (n * sum(x*y) - sum(x) * sum(y)) / (n * sum(x^2) - sum(x)^2)
intercept <- mean(y) - slope * mean(x)
cat("Linear Regression Equation: y =", round(slope, 3), "* x +", round(intercept, 3),
"\n")

# (b) Quadratic regression using formula
x2 <- x^2
x3 <- x^3
x4 <- x^4
sx <- sum(x)
sx2 <- sum(x2)
sx3 <- sum(x3)
sx4 <- sum(x4)
sy <- sum(y)
```

```
sxy <- sum(x*y)

sx2y <- sum(x2*y)

a <- matrix(c(n, sx, sx2, sx, sx2, sx3, sx2, sx3, sx4), ncol = 3)

b <- c(sy, sxy, sx2y)

coefficients <- solve(a, b)

cat("Quadratic Regression Equation: y =", round(coefficients[3], 3), "* x^2 +",
round(coefficients[2], 3), "* x +", round(coefficients[1], 3), "\n")


# (c) Estimate electricity consumption for 495000 IC chips production

x_new <- 495

y_lin <- slope * x_new + intercept

y_quad <- coefficients[3] * x_new^2 + coefficients[2] * x_new + coefficients[1]

cat("Electricity consumption for 495000 IC chips production (linear regression):",
round(y_lin, 3), "\n")

cat("Electricity consumption for 495000 IC chips production (quadratic regression):",
round(y_quad, 3), "\n")


# (d) Scatter plot with linear regression line and quadratic regression curve

plot(x, y)

abline(slope, intercept, col = "red")

curve(coefficients[3] * x^2 + coefficients[2] * x + coefficients[1], add = TRUE, col =
"blue")


quad_coef <- lm(y ~ poly(x, 2, raw=TRUE))$coefficients

a <- quad_coef[1]

b <- quad_coef[2]

c <- quad_coef[3]


# Prediction for 495000 IC chips production

x_pred <- 495

y_pred_linear <- slope * x_pred + intercept
```

y_pred_quad <- a * x_pred^2 + b * x_pred + c

abline(intercept, slope, col="red")

curve(a*x^2 + b*x + c, col="blue", add=TRUE)

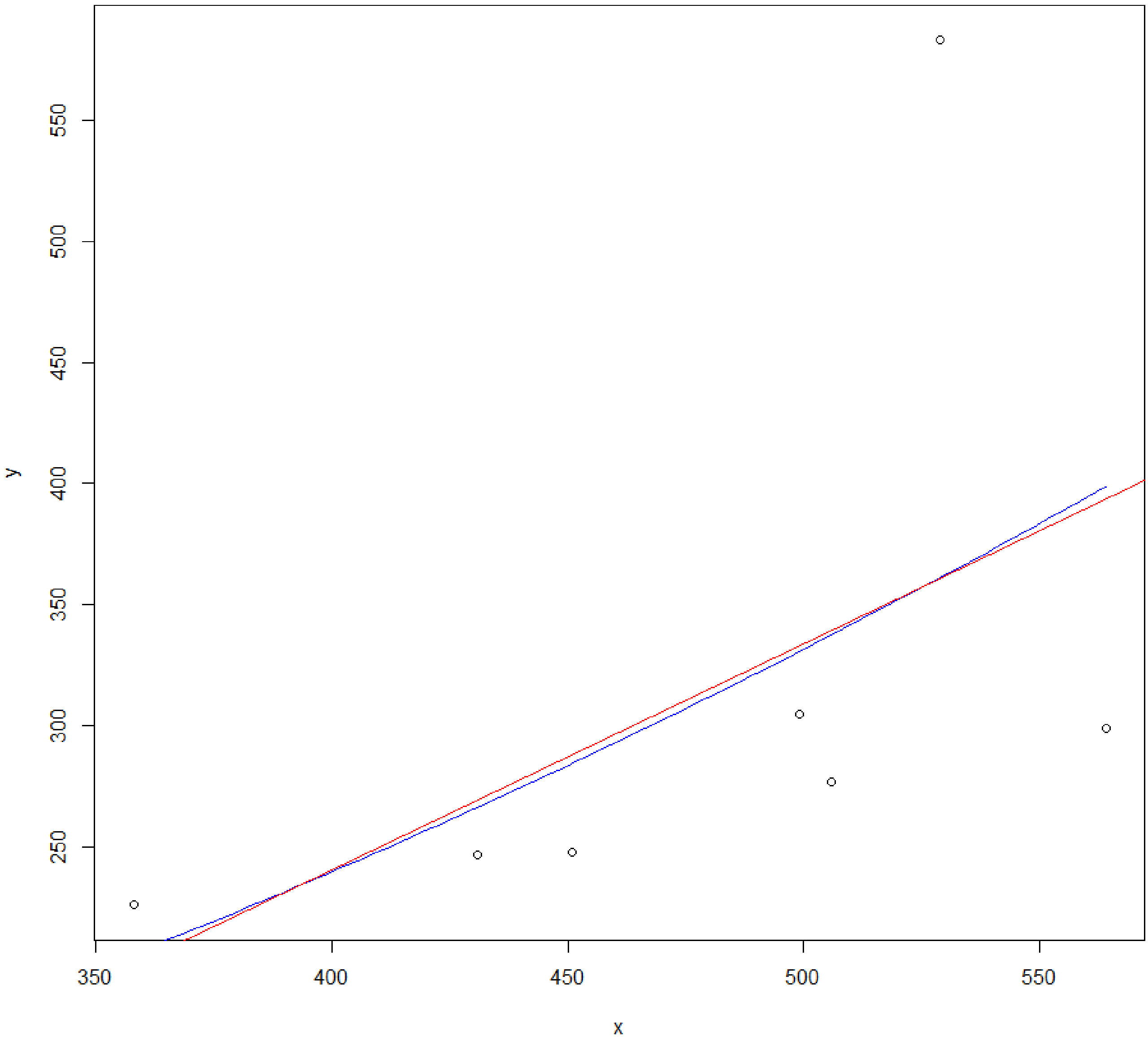
OUTPUT:

```
#21BCE7727
#M Gyanada Chowdary

x <- c(451, 358, 431, 506, 499, 529, 564)
y <- c(248, 226, 247, 277, 305, 583, 299)

# (a) Linear regression using formula
n <- length(x)
slope <- (n * sum(x*y) - sum(x) * sum(y)) / (n * sum(x^2) - sum(x)^2)
intercept <- mean(y) - slope * mean(x)
cat("Linear Regression Equation: y =", round(slope, 3), "* x +", round(intercept, 3), "\n")

# (b) Quadratic regression using formula
x2 <- x^2
x3 <- x^3
x4 <- x^4
sx <- sum(x)
sx2 <- sum(x2)
sx3 <- sum(x3)
sx4 <- sum(x4)
sy <- sum(y)
sxy <- sum(x*y)
sx2y <- sum(x2*y)
a <- matrix(c(n, sx, sx2, sx, sx2, sx3, sx2, sx3, sx4), ncol = 3)
b <- c(sy, sxy, sx2y)
coefficients <- solve(a, b)
cat("Quadratic Regression Equation: y =", round(coefficients[3], 3), "* x^2 +", round(coefficients[2], 3), "* x +", round(coefficients[1], 3), "

# (c) Estimate electricity consumption for 495000 IC chips production
x_new <- 495
y_lin <- slope * x_new + intercept
y_quad <- coefficients[3] * x_new^2 + coefficients[2] * x_new + coefficients[1]
cat("Electricity consumption for 495000 IC chips production (linear regression):", round(y_lin, 3), "\n")
cat("Electricity consumption for 495000 IC chips production (quadratic regression):", round(y_quad, 3), "\n")

# (d) Scatter plot with linear regression line and quadratic regression curve
plot(x, y)
abline(slope, intercept, col = "red")
curve(coefficients[3] * x^2 + coefficients[2] * x + coefficients[1], add = TRUE, col = "blue")

quad_coef <- lm(y ~ poly(x, 2, raw=TRUE))$coefficients
a <- quad_coef[1]
b <- quad_coef[2]
c <- quad_coef[3]

# Prediction for 495000 IC chips production
x_pred <- 495
y_pred_linear <- slope * x_pred + intercept
y_pred_quad <- a * x_pred^2 + b * x_pred + c
data.frame(c(x,sx),c(x2,sx2),c(x3,sx3),c(x4,sx4))
abline(intercept, slope, col="red")
curve(a*x^2 + b*x + c, col="blue", add=TRUE)
```

```
> #21BCE7727
> #M Gyanada Chowdary
>
> x <- c(451, 358, 431, 506, 499, 529, 564)
> y <- c(248, 226, 247, 277, 305, 583, 299)
>
> # (a) Linear regression using formula
> n <- length(x)
> slope <- (n * sum(x*y) - sum(x) * sum(y)) / (n * sum(x^2) - sum(x)^2)
> intercept <- mean(y) - slope * mean(x)
> cat("Linear Regression Equation: y =", round(slope, 3), "* x +", round(intercept, 3), "\n")
Linear Regression Equation: y = 0.934 * x + -133.47
>
> # (b) Quadratic regression using formula
> x2 <- x^2
> x3 <- x^3
> x4 <- x^4
> sx <- sum(x)
> sx2 <- sum(x2)
> sx3 <- sum(x3)
> sx4 <- sum(x4)
> sy <- sum(y)
> sxy <- sum(x*y)
> sx2y <- sum(x2*y)
> a <- matrix(c(n, sx, sx2, sx, sx2, sx3, sx2, sx3, sx4), ncol = 3)
> b <- c(sy, sxy, sx2y)
> coefficients <- solve(a, b)
> cat("Quadratic Regression Equation: y =", round(coefficients[3], 3), "* x^2 +", round(coefficients[2], 3), "* x +", round(coefficients[1], 3), "\n")
Quadratic Regression Equation: y = 0.001 * x^2 + 0.199 * x + 32.324
>
> # (c) Estimate electricity consumption for 495000 IC chips production
> x_new <- 495
> y_lin <- slope * x_new + intercept
> y_quad <- coefficients[3] * x_new^2 + coefficients[2] * x_new + coefficients[1]
> cat("Electricity consumption for 495000 IC chips production (linear regression):", round(y_lin, 3), "\n")
Electricity consumption for 495000 IC chips production (linear regression): 329.097
> cat("Electricity consumption for 495000 IC chips production (quadratic regression):", round(y_quad, 3), "\n")
Electricity consumption for 495000 IC chips production (quadratic regression): 326.584
>
> # (d) Scatter plot with linear regression line and quadratic regression curve
> plot(x, y)
> abline(slope, intercept, col = "red")
> curve(coefficients[3] * x^2 + coefficients[2] * x + coefficients[1], add = TRUE, col = "blue")
>
> quad_coef <- lm(y ~ poly(x, 2, raw=TRUE))$coefficients
> a <- quad_coef[1]
> b <- quad_coef[2]
> c <- quad_coef[3]
```

```
>
> # Prediction for 495000 IC chips production
> x_pred <- 495
> y_pred_linear <- slope * x_pred + intercept
> y_pred_quad <- a * x_pred^2 + b * x_pred + c
> data.frame(c(x,sx),c(x2,sx2),c(x3,sx3),c(x4,sx4))
  c.x..sx. c.x2..sx2. c.x3..sx3.   c.x4..sx4.
1      451     203401   91733851  41371966801
2      358     128164   45882712  16426010896
3      431     185761   80062991  34507149121
4      506     256036  129554216  65554433296
5      499     249001  124251499  62001498001
6      529     279841  148035889  78310985281
7      564     318096  179406144 101185065216
8     3338    1620300  798927302 399357108612
> abline(intercept, slope, col="red")
> curve(a*x^2 + b*x + c, col="blue", add=TRUE)
>
```

GRAPH:



y
250
300
350
400
450
500
550
350
400
450
500
550
x

X_0