Course: Business Mathematics and Statistics (8532)
Semester: Autumn, 2021

ASSIGNMENT No. 1

Q. 1 a construction company has bid on two contracts. The probability of winning contract A is 0.3. If the company wins contract A, then the probability of winning contract B is 0.4. If the company loses contract A, then the probability of winning contract B decreases to 0.2. Find the probability of the following events.

Let A = event of winning contract A.

Let B = event of winning contract B.

We are given the following information:

P (A) = 0.3

P (B given A) = 0.4

P (B given not A) = 0.2.

(a) Winning both contracts

The probability of winning both contracts is

P (A and B) = P (A) P (B given A) = 0.3(0.4) = 0.12.

(b) Winning exactly one contract

The probability of winning exactly one contract is

P ((A and not B) or (B and not A))

= P (A and not B) + P (B and not A)

Since the events (A and not B), (B and not A) are disjoint

= P (A) P (not B, given A) + P (not A) P (B given not A)

= 0.3(1 - 0.4) + (1 - 0.3) (0.2)

= 0.18 + 0.14

= 0.32.

(c) Winning at least one contract

The probability of winning at least one contract is

P (winning both contracts) + P (winning exactly one contract)

= 0.12 + 0.32, from parts a) and b)

= 0.44.

Alternatively, the probability of winning at least one contract is

P (A or B) = 1 - P (not A and not B), from de Morgan's law

= 1 - P (not A) P (not B, given not A)

= 1 - (1 - 0.3) (1 - 0.2)

= 1 - 0.56

= 0.44

Q. 2 The Vice President of sales for the conglomerate you work for has asked you to evaluate the sales records of two of the firm's divisions. You note that the range of monthly sales for division A over the last 2 years is Rs.50,000 and the range of division B is only Rs.30,000. You compute each division's mean monthly sales for the same time period and discover that both divisions have a mean of Rs. 110,000. Assume that is all the information you have about the division's sales records. Would you be willing to say which of the divisions has a more consistent sales record? Why or why not?

Range of monthly sales for division A over the last 2 years is Rs.50, 000 and the range of division B is only Rs.30, 000. The comparison of two independent population means is very common and provides a way to test the hypothesis that the two groups differ from each other. Is the night shift less productive than the day shift, are the rates of return from fixed asset investments different from those from common stock investments, and so on? An observed difference between two sample means depends on both the means and the sample standard deviations. Very different means can occur by chance if there is great variation among the individual samples. When we developed the hypothesis test for the mean and proportions we began with the Central Limit Theorem. We recognized that a sample mean came from a distribution of sample means, and sample proportions came from the sampling distribution of sample proportions. This made our sample parameters, the sample means and sample proportions, into random variables. It was important for us to know the distribution that these random variables came from. The Central Limit Theorem gave us the answer: the normal distribution. Our Z and t statistics came from this theorem.

Range of monthly sales for division A (2 year) = 50,000

Range of monthly sales for division B (2 year) = 30,000

Mean A = 110,000

Mean B = 110,000

Both have same mean but salary division are different so the division A is better than division B.

Q. 3

A research physician conducted an experiment to investigate the effects of various cold-water temperatures on the pulse rate of small children. The data for seven 6-year-old children are:

Child:	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Temperature of water (°F):	**68**	**65**	**70**	**62**	**60**	**55**	**58**
Decrease in pulse rate: (beats per minute)	**2**	**5**	**1**	**10**	**9**	**13**	**10**

1. Find the least squares line for the data

$X- M_x$	$Y- M_y$	$(X- M_x)^2$	$(X- M_x)(Y- M_y)$

5.4286	-5.1429	29.4694	-27.9184
2.4286	-2.1429	5.898	-5.2041
7.4286	-6.1429	55.1837	-45.6327
-0.5714	2.8571	0.3265	-1.6327
-2.5714	1.8571	6.6122	-4.7755
-7.5714	5.8571	57.3265	-44.3469
-4.5714	2.8571	20.898	-13.0612
		SS = 175.7143	**SP: -142.5714**

Sum of X = 438

Sum of Y = 50

Mean X= M_x = 62.5714

Mean Y = M_y =7.1429

Sum of squares (SS_X) = 175.7143

Sum of products (SP) = -142.5714

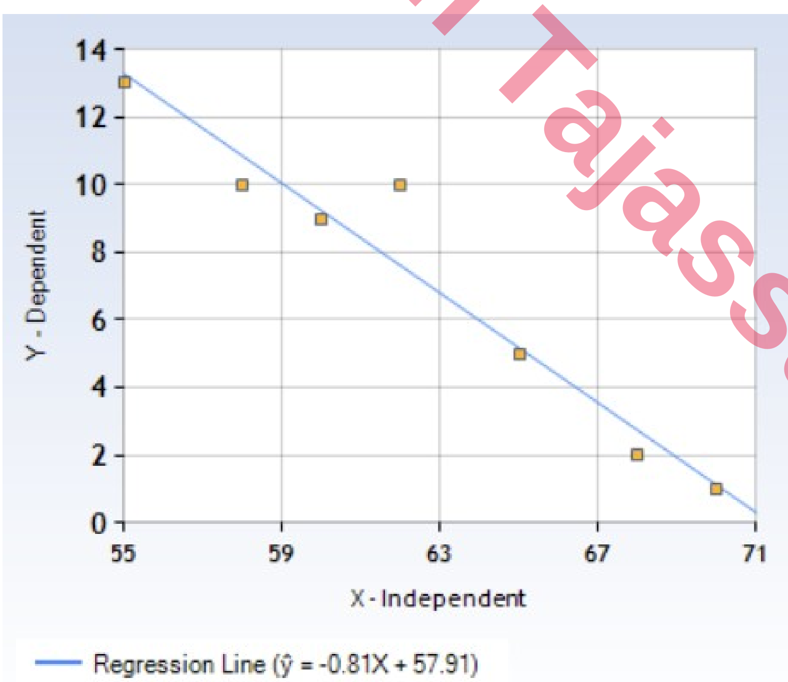
Regression Equation = $\hat{y} = a + bX$

$b = SP/SS_X = -142.57/175.71 = -0.81138$

$a = M_Y - bM_X = 7.14 - (-0.81*62.57) = 57.9122$

$\hat{y} = -0.81138X + 57.9122$

2. Plot the data and the fitted line



Q. 4 The owner of a retailing organization is interested in the relationship between price at which the commodity is offered for sale and the quantity sold. The data is given below:

Price	**25**	**45**	**30**	**50**	**35**	**40**	**65**	**75**	**70**	**60**

Quantity Sold	**118**	**105**	**112**	**100**	**111**	**108**	**95**	**88**	**91**	**96**

Find the relationship between the price and the quantity sold.

Input Data :

Data set x = 25, 45, 30, 50, 35, 40, 65, 75, 70, 60

Data set y = 118, 105, 112, 100, 111, 108, 95, 88, 91, 96

Total number of elements = 10

Xmean = (25 + 45 + 30 + 50 + 35 + 40 + 65 + 75 + 70 + 60)/10

= 495/10

Xmean = 49.5

Ymean = (118 + 105 + 112 + 100 + 111 + 108 + 95 + 88 + 91 + 96)/10

= 1024/10

Ymean = 102.4

Slope =$(\sum y)(\sum x^2)$ - $(\sum x)(\sum xy)$ / $(\sum x^2)$ - $(\sum x)^2$

$\sum y$ = 118 + 105 + 112 + 100 + 111 + 108 + 95 + 88 + 91 + 96

$\sum y$ = 1024

$\sum x^2 = (25)^2 + (45)^2 + (30)^2 + (50)^2 + (35)^2 + (40)^2 + (65)^2 + (75)^2 + (70)^2 + (60)^2$

= 625 + 2025 + 900 + 2500 + 1225 + 1600 + 4225 + 5625 + 4900 + 3600

$\sum x^2$ = 27225

$\sum x$ = 25 + 45 + 30 + 50 + 35 + 40 + 65 + 75 + 70 + 60

$\sum x$ = 495

$\sum xy$ = (25 x 118) + (45 x 105) + (30 x 112) + (50 x 100) + (35 x 111) + (40 x 108) + (65 x 95) + (75 x 88) + (70 x 91) + (60 x 96)

$\sum xy$ = 2950 + 4725 + 3360 + 5000 + 3885 + 4320 + 6175 + 6600 + 6370 + 5760

$\sum xy$ = 49145

Apply the values in above formula

Slope = ((1024 x 27225) - (495 x 49145)) / (10 x 27225) - $(495)^2$

=27878400 – 24326775 / 272250 – 245025

=3551625 / 27225

Slope = 130.4545

Intercept =n $(\sum xy)$ - $(\sum x)(\sum y)$ / n$(\sum x^2)$ - $(\sum x)^2$

=10(49145) - (495 x 1024) / (10 x 27225) - $(495)^2$

=491450 – 506880 / 272250 – 245025

=-15430 / 27225

Intercept = -0.5668

Regression equation = Intercept + Slope x

Regression equation = -0.5668 + 130.4545 x

Q. 5 Given the following data:

x	**-5**	**-2**	**-**	**3**	**4**	**7**
y	**15**	**9**	**7**	**6**	**4**	**1**

Data set x = -5, -2, 0, 3, 4, 7

Data set y = 15, 9, 7, 6, 4, 1

Total number of elements = 6

(a) the regression equation

X_{mean} = (-5 + -2 + 0 + 3 + 4 + 7)/6

= 7/6

X_{mean} = 1.1667

Y_{mean} = (15 + 9 + 7 + 6 + 4 + 1)/6

= 42/6

Y_{mean} = 7

Slope =$(\sum y)(\sum x^2) - (\sum x)(\sum xy) / n(\sum x^2) - (\sum x)^2$

$\sum y$ = 15 + 9 + 7 + 6 + 4 + 1

$\sum y$ = 42

$\sum x^2 = (-5)^2 + (-2)^2 + (0)^2 + (3)^2 + (4)^2 + (7)^2$

= 25 + 4 + 0 + 9 + 16 + 49

$\sum x^2$ = 103

$\sum x$ = -5 + -2 + 0 + 3 + 4 + 7

$\sum x$ = 7

$\sum xy$ = (-5 x 15) + (-2 x 9) + (0 x 7) + (3 x 6) + (4 x 4) + (7 x 1)

$\sum xy$ = -75 + -18 + 0 + 18 + 16 + 7

$\sum xy$ = -52

Apply the values in above formula

Slope =(42 x 103) - (7 x -52)) / (6 x 103) - $(7)^2$

=4326 - -364 / 618 – 49

=4690 / 569

Slope = 8.2425

Intercept =n $(\sum xy) - (\sum x)(\sum y) / n(\sum x^2) - (\sum x)^2$

=6(-52) - (7 x 42) / (6 x 103) - $(7)^2$

=-312 – 294 / 618 – 49

=-606 / 569

Intercept = -1.065

Regression equation = Intercept + Slope x

Regression equation = -1.065 + 8.2425 x

(b) Use regression equation to determine the predicted value of y.

Regression equation = Intercept + Slope x

Regression equation = -1.065 + 8.2425 x

y=-1.065 + 8.2425 x

(c) Calculate the residuals.

$r = n(\sum xy) - (\sum x)(\sum y) / n(\sum x^2) - (\sum x)^2$

$= 6(-52) - (7 \times 42) / (6 \times 103) - (7)^2$

=-312 – 294 / 618 – 49

=-606 / 569

r = -1.065