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**HW1: 1,2,4,6,7,8,9,12,14**

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PROBLEM#1: A study was conducted at Virginia Tech to determine

if certain static arm-strength measures have

an influence on the “dynamic lift” characteristics of an

individual. Twenty-five individuals were subjected to

strength tests and then were asked to perform a weightlifting

test in which weight was dynamically lifted overhead.

(a) Estimate β0 and β1 for the linear regression curve

μY |x = β0 + β1x.

(b) Find a point estimate of μY |30.

(c) Plot the residuals versus the x’s (arm strength).

Comment.

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

Data is

x = Arm Strength

y = Dynamic lift

x y

[1,] 17.3 71.7

[2,] 19.3 48.3

[3,] 19.5 88.3

[4,] 19.7 75.0

[5,] 22.9 91.7

[6,] 23.1 100.0

[7,] 26.4 73.3

[8,] 26.8 65.0

[9,] 27.6 75.0

[10,] 28.1 88.3

[11,] 28.2 68.3

[12,] 28.7 96.7

[13,] 29.0 76.7

[14,] 29.6 78.3

[15,] 29.9 60.0

[16,] 29.9 71.7

[17,] 30.3 85.0

[18,] 31.3 85.0

[19,] 36.0 88.3

[20,] 39.5 100.0

[21,] 40.4 100.0

[22,] 44.3 100.0

[23,] 44.6 91.7

[24,] 50.4 100.0

[25,] 55.9 71.7

n = 25

x^2 =

[1] 299.29 372.49 380.25 388.09 524.41 533.61 696.96 718.24 761.76

[10] 789.61 795.24 823.69 841.00 876.16 894.01 894.01 918.09 979.69

[19] 1296.00 1560.25 1632.16 1962.49 1989.16 2540.16 3124.81

xy =

[1] 1240.41 932.19 1721.85 1477.50 2099.93 2310.00 1935.12 1742.00 2070.00

[10] 2481.23 1926.06 2775.29 2224.30 2317.68 1794.00 2143.83 2575.50 2660.50

[19] 3178.80 3950.00 4040.00 4430.00 4089.82 5040.00 4008.03

Sum(x) =

778.7

Sum(y) =

2050

Sum(xy) =

65164.04

Sum(x^2) =

26591.63

b0 =

64.52916

b1 =

0.5608978

Hence the fitted regression curve y = β0 + β1x is as follows: y = 64.52916 + 0.5608978 x

STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

The point estimate of μY |30 is: y = 64.52916 + 0.5608978 (30) = 81.35609

STARTING R SOLUTION BELOW FOR PART C:--------------------------------------

Gathering fitted values for y (using the built in lm() function in R) as the following:

1 2 3 4 5 6 7 8

74.23269 75.35448 75.46666 75.57884 77.37372 77.48589 79.33686 79.56122

9 10 11 12 13 14 15 16

80.00993 80.29038 80.34647 80.62692 80.79519 81.13173 81.30000 81.30000

17 18 19 20 21 22 23 24

81.52436 82.08526 84.72148 86.68462 87.18943 89.37693 89.54520 92.79840

25

95.88334

Now for the residuals:

1 2 3 4 5 6

-2.5326874 -27.0544830 12.8333375 -0.5788421 14.3262850 22.5141054

7 8 9 10 11 12

-6.0368573 -14.5612164 -5.0099346 8.0096165 -12.0464733 16.0730778

13 14 15 16 17 18

-4.0951915 -2.8317302 -21.2999996 -9.5999996 3.4756413 2.9147435

19 20 21 22 23 24

3.5785239 13.3153816 12.8105736 10.6230722 2.1548029 7.2015957

25

-24.1833422

A close up of a mans face

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End of Problem 1 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #2: The grades of a class of 9 students on a midterm

report (x) and on the final examination (y) are as follows:

x 77 50 71 72 81 94 96 99 67

y 82 66 78 34 47 85 99 99 68

(a) Estimate the linear regression line.

(b) Estimate the final examination grade of a student

who received a grade of 85 on the midterm report.

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

Sum(x) =

707

Sum(y) =

658

Sum(xy) =

53258

Sum(x^2) =

57557

b0 =

12.06232

b1 =

0.7771416

Hence the fitted regression curve y = β0 + β1x is as follows: y = 12.06232 + 0.7771416 x

STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

The point estimate of μY |30 is: y = 12.06232 + 0.7771416 (85) = 78.11936

End of Problem 2 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #4: The following data were collected to determine

the relationship between pressure and the corresponding

scale reading for the purpose of calibration.

Pressure, x (lb/sq in.) Scale Reading, y

10 13

10 18

10 16

10 15

10 20

50 86

50 90

50 88

50 88

50 92

(a) Find the equation of the regression line.

(b) The purpose of calibration in this application is to

estimate pressure from an observed scale reading.

Estimate the pressure for a scale reading of 54 using

ˆx = (54 − b0)/b1.

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

Sum(x) =

300

Sum(y) =

526

Sum(xy) =

23020

Sum(x^2) =

13000

b0 =

-1.7

b1 =

1.81

Hence the fitted regression curve y = β0 + β1x is as follows: y = -1.7 + 1.81 x

STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

Estimated pressure for a scale reading of 54 is: (54- b0)/b1 = 30.77348

End of Problem 4 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #6: In a certain type of metal test specimen, the normal

stress on a specimen is known to be functionally

related to the shear resistance. The following is a set

of coded experimental data on the two variables:

Normal Stress, x Shear Resistance, y

26.8 26.5

25.4 27.3

28.9 24.2

23.6 27.1

27.7 23.6

23.9 25.9

24.7 26.3

28.1 22.5

26.9 21.7

27.4 21.4

22.6 25.8

25.6 24.9

(a) Estimate the regression line μY |x = β0 + β1x.

(b) Estimate the shear resistance for a normal stress of

24.5.

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

Sum(x) =

311.6

Sum(y) =

297.2

Sum(xy) =

7687.76

Sum(x^2) =

8134.26

b0 =

42.5818

b1 =

-0.6860771

Hence the fitted regression curve y = β0 + β1x is as follows: y = 42.5818 + -0.6860771 x

STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

The shear resistance for a normal stress of24.5.: y = 42.5818 + -0.6860771 (24.5) = 25.77291

End of Problem 6 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #7: The following is a portion of a classic data set

called the “pilot plot data” in Fitting Equations to

Data by Daniel and Wood, published in 1971. The

response y is the acid content of material produced by

titration, whereas the regressor x is the organic acid

content produced by extraction and weighing.

y x | y x

76 123 70 109

62 55 37 48

66 100 82 138

58 75 88 164

88 159 43 28

(a) Plot the data; does it appear that a simple linear

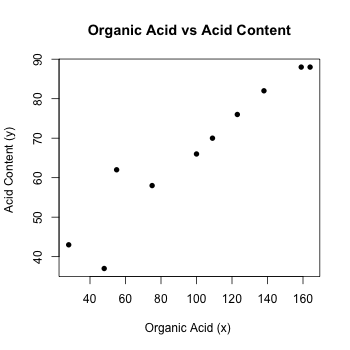
regression will be a suitable model?

(b) Fit a simple linear regression; estimate a slope and

intercept.

(c) Graph the regression line on the plot in (a).

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------



A linear regression model will be suitable for this

STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

Sum(x) =

999

Sum(y) =

670

Sum(xy) =

74058

Sum(x^2) =

119969

b0 =

31.70866

b1 =

0.3532667

Hence the fitted regression curve y = β0 + β1x is as follows: y = 31.70866 + 0.3532667 xnull A screenshot of a cell phone

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End of Problem 7 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #8: A mathematics placement test is given to all entering

freshmen at a small college. A student who receives

a grade below 35 is denied admission to the regular

mathematics course and placed in a remedial class.

The placement test scores and the final grades for 20

students who took the regular course were recorded.

(a) Plot a scatter diagram.

(b) Find the equation of the regression line to predict

course grades from placement test scores.

(c) Graph the line on the scatter diagram.

(d) If 60 is the minimum passing grade, below which

placement test score should students in the future

be denied admission to this course?

Placement Test Course Grade

50 53

35 41

35 61

40 56

55 68

65 36

35 11

60 70

90 79

35 59

90 54

80 91

60 48

60 71

60 71

40 47

55 53

50 68

65 57

50 79

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

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STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

Sum(x) =

1110

Sum(y) =

1173

Sum(xy) =

67690

Sum(x^2) =

67100

b0 =

32.50591

b1 =

0.4710646

Hence the fitted regression curve y = β0 + β1x is as follows: y = 32.50591 + 0.4710646 x

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STARTING R SOLUTION BELOW FOR PART C:--------------------------------------

60 is the minimum passing grade: (54- b0)/b1 = 58.36585

End of Problem 8 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #9: A study was made by a retail merchant to determine

the relation between weekly advertising expenditures

and sales.

Advertising Costs ($) Sales ($)

40 385

20 400

25 395

20 365

30 475

50 440

40 490

20 420

50 560

40 525

25 480

50 510

(a) Plot a scatter diagram.

(b) Find the equation of the regression line to predict

weekly sales from advertising expenditures.

(c) Estimate the weekly sales when advertising costs

are $35.

(d) Plot the residuals versus advertising costs. Comment.

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

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STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

Sum(x) =

410

Sum(y) =

5445

Sum(xy) =

191325

Sum(x^2) =

15650

b0 =

343.7056

b1 =

3.220812

Hence the fitted regression curve y = β0 + β1x is as follows: y = 343.7056 + 3.220812 x

STARTING R SOLUTION BELOW FOR PART C:--------------------------------------

The point estimate of μY |35 is: y = 343.7056 + 3.220812 (35) = 456.434

STARTING R SOLUTION BELOW FOR PART D:--------------------------------------

1 2 3 4 5 6 7 8

472.5381 408.1218 424.2259 408.1218 440.3299 504.7462 472.5381 408.1218

9 10 11 12

504.7462 472.5381 424.2259 504.7462

Now for the residuals:

1 2 3 4 5 6 7

-87.538071 -8.121827 -29.225888 -43.121827 34.670051 -64.746193 17.461929

8 9 10 11 12

11.878173 55.253807 52.461929 55.774112 5.253807

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PROBLEM#12 A study was done to study the effect of ambient

temperature x on the electric power consumed by

a chemical plant y. Other factors were held constant,

and the data were collected from an experimental pilot

plant.

y (BTU) x (◦F) y (BTU) x (◦F)

250 27 265 31

285 45 298 60

320 72 267 34

295 58 321 74

(a) Plot the data.

(b) Estimate the slope and intercept in a simple linear

regression model.

(c) Predict power consumption for an ambient temperature

of 65

◦

F.

STARTING R SOLUTION BELOW FOR PART A:--------------------------------------

A close up of a map

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STARTING R SOLUTION BELOW FOR PART B:--------------------------------------

Sum(x) =

401

Sum(y) =

2301

Sum(xy) =

118652

Sum(x^2) =

22495

b0 =

218.2548

b1 =

1.383945

Hence the fitted regression curve y = β0 + β1x is as follows: y = 218.2548 + 1.383945 x

STARTING R SOLUTION BELOW FOR PART C:--------------------------------------

The point estimate of μY |65 is: y = 218.2548 + 1.383945 (65) = 308.2112

End of Problem 12 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

PROBLEM #14: A professor in the School of Business in a university

polled a dozen colleagues about the number of

professional meetings they attended in the past five

years (x) and the number of papers they submitted

to refereed journals (y) during the same period. The

summary data are given as follows:

n = 12, ¯x = 4, ¯y = 12,

n

i=1

x2i

= 232,

n

i=1

xiyi = 318.

Fit a simple linear regression model between x and y by

finding out the estimates of intercept and slope. Comment

on whether attending more professional meetings

would result in publishing more papers.

STARTING R SOLUTION BELOW :--------------------------------------

Sum(x) =

401

Sum(y) =

2301

Sum(xy) =

318

Sum(x^2) =

232

b0 =

-2.571331

b1 =

5.815102

Hence the fitted regression curve y = β0 + β1x is as follows: y = -2.571331 + 5.815102 x