**PRACTICAL: 2**

*Fitting of Polynomial using Principle of Least Square (e.g.: y=a+bx, y=a+bx+cx2, and y=eax+b or beax)*

**FORMULA USED:**

1. **NORMAL EQUATIONS OF:**
   1. **Y=A+BX**
   2. **Y=A+BX+CX2**
   3. **Y=eAX+B  orY=BeAX**

Where v=log(y).

* 1. **Y=AXB**

Where u=log (x) and v=log(y).

**QUESTION 1:** Fit the data of height and weight of the students of your class using linear regression. (y=a+bx)

**ANSWER:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | HEIGHT(X) | WEIGHT(Y) | XY | X^2 |
| 1 | 120 | 45 | 5400 | 14400 |
| 2 | 118 | 59 | 6962 | 13924 |
| 3 | 119 | 55 | 6545 | 14161 |
| 4 | 135 | 50 | 6750 | 18225 |
| 5 | 110 | 51 | 5610 | 12100 |
| 6 | 111 | 43 | 4773 | 12321 |
| 7 | 123 | 47 | 5781 | 15129 |
| 8 | 124 | 58 | 7192 | 15376 |
| 9 | 123 | 49 | 6027 | 15129 |
| 10 | 110 | 47 | 5170 | 12100 |
| 11 | 119 | 45 | 5355 | 14161 |
| 12 | 118 | 43 | 5074 | 13924 |
| 13 | 117 | 54 | 6318 | 13689 |
| 14 | 123 | 43 | 5289 | 15129 |
| 15 | 112 | 65 | 7280 | 12544 |
| 16 | 119 | 45 | 5355 | 14161 |
| 17 | 111 | 34 | 3774 | 12321 |
| 18 | 123 | 54 | 6642 | 15129 |
| 19 | 124 | 45 | 5580 | 15376 |
| 20 | 110 | 45 | 4950 | 12100 |
| 21 | 117 | 59 | 6903 | 13689 |
| 22 | 123 | 50 | 6150 | 15129 |
| 23 | 112 | 51 | 5712 | 12544 |
| 24 | 119 | 58 | 6902 | 14161 |
| 25 | 110 | 49 | 5390 | 12100 |
| 26 | 117 | 47 | 5499 | 13689 |
| 27 | 123 | 54 | 6642 | 15129 |
| 28 | 123 | 45 | 5535 | 15129 |
| 29 | 124 | 34 | 4216 | 15376 |
| 30 | 110 | 49 | 5390 | 12100 |
| 31 | 117 | 47 | 5499 | 13689 |
| 32 | 123 | 45 | 5535 | 15129 |
| 33 | 118 | 43 | 5074 | 13924 |
| 34 | 135 | 54 | 7290 | 18225 |
| 35 | 110 | 43 | 4730 | 12100 |
| 36 | 123 | 65 | 7995 | 15129 |
| 37 | 119 | 45 | 5355 | 14161 |
| 38 | 123 | 45 | 5535 | 15129 |
| 39 | 123 | 58 | 7134 | 15129 |
| 40 | 112 | 54 | 6048 | 12544 |
| 41 | 123 | 45 | 5535 | 15129 |
| 42 | 123 | 55 | 6765 | 15129 |
| 43 | 119 | 50 | 5950 | 14161 |
| 44 | 110 | 58 | 6380 | 12100 |
| 45 | 119 | 47 | 5593 | 14161 |
| 46 | 124 | 43 | 5332 | 15376 |
| 47 | 110 | 45 | 4950 | 12100 |
| 48 | 117 | 34 | 3978 | 13689 |
| 49 | 123 | 51 | 6273 | 15129 |
| 50 | 117 | 49 | 5733 | 13689 |
| 51 | 117 | 47 | 5499 | 13689 |
| 52 | 112 | 34 | 3808 | 12544 |
| 53 | 126 | 49 | 6174 | 15876 |
| 54 | 134 | 46 | 6164 | 17956 |
| 55 | 136 | 56 | 7616 | 18496 |
| 56 | 118 | 65 | 7670 | 13924 |
| 57 | 120 | 43 | 5160 | 14400 |
|  | **6798** | **2789** | **332941** | **813152** |

**CALCULATIONS:**

**Normal Equations formed upon putting values are :**

2789-57a-6798b=0 – (1)

332941-6798a-813152b=0 – (2)

**Upon solving these two equations:**

**Value of a= 33.231**

**Value of b= 0.1316**

**Hence, the line of best fit is given as follows:**

**Y=33.231+0.1316X**

**SCATTER PLOT:**

**QUESTION 2: For the following data find regression equation of the form y=a+bx+cx2.**

|  |  |
| --- | --- |
| X | Y |
| 1 | 2 |
| 1 | 7 |
| 2 | 7 |
| 2 | 10 |
| 3 | 8 |
| 3 | 12 |
| 4 | 10 |
| 5 | 14 |
| 6 | 11 |
| 7 | 14 |

**ANSWER:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| X | Y | X^2 | X^3 | X^4 | X^2Y | XY |
| 1 | 2 | 1 | 1 | 1 | 2 | 2 |
| 1 | 7 | 1 | 1 | 1 | 7 | 7 |
| 2 | 7 | 4 | 8 | 16 | 28 | 14 |
| 2 | 10 | 4 | 8 | 16 | 40 | 20 |
| 3 | 8 | 9 | 27 | 81 | 72 | 24 |
| 3 | 12 | 9 | 27 | 81 | 108 | 36 |
| 4 | 10 | 16 | 64 | 256 | 160 | 40 |
| 5 | 14 | 25 | 125 | 625 | 350 | 70 |
| 6 | 11 | 36 | 216 | 1296 | 396 | 66 |
| 7 | 14 | 49 | 343 | 2401 | 686 | 98 |
| 34 | **95** | **154** | **820** | **4774** | **1849** | **377** |

**CALCULATION:**

**Normal Equations after putting values:**

1849-4774c-820b-154a=0

377-820c-154b-34a=0

95-154c-34b-10a=0

**Upon solving the equations we get:**

**Value of a=1.8022**

**Value of b=3.842**

**Value of c=-0.269**

**Hence the equation we get is :**

**Y=-0.269x2+3.842x+1.8022**

**SCATTER PLOT:**

**QUESTION 3: Fit the following data using both the equations of exponential curve:**

|  |  |
| --- | --- |
| X | Y |
| 1 | 1 |
| 2 | 1.2 |
| 3 | 1.8 |
| 4 | 2.5 |
| 5 | 3.6 |
| 6 | 4.7 |
| 7 | 6.6 |
| 8 | 9.1 |

**ANSWER:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| USING EQUATION Y=AX^B | | | | | |
| X | **Y** | **U=LOG X** | **V=LOG Y** | **UV** | **U^2** |
| 1 | 1 | 0 | 0 | 0 | 0 |
| 2 | 1.2 | 0.693147181 | 0.182321557 | 0.126375673 | 0.480453 |
| 3 | 1.8 | 1.098612289 | 0.587786665 | 0.645749653 | 1.206949 |
| 4 | 2.5 | 1.386294361 | 0.916290732 | 1.270248675 | 1.921812 |
| 5 | 3.6 | 1.609437912 | 1.280933845 | 2.061583494 | 2.59029 |
| 6 | 4.7 | 1.791759469 | 1.547562509 | 2.772859779 | 3.210402 |
| 7 | 6.6 | 1.945910149 | 1.887069649 | 3.672067982 | 3.786566 |
| 8 | 9.1 | 2.079441542 | 2.208274414 | 4.591977551 | 4.324077 |
| 36 | **30.5** | **10.6046029** | **8.61023937** | **15.14086281** | **17.52055** |
|  |  | **10.605** | **8.61** | **15.141** | **17.521** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| USING EQUATION Y=AE^BX | | | | |
| X | Y | V=LOG Y | VX | X^2 |
| 1 | 1 | 0 | 0 | 1 |
| 2 | 1.2 | 0.182322 | 0.364643 | 4 |
| 3 | 1.8 | 0.587787 | 1.76336 | 9 |
| 4 | 2.5 | 0.916291 | 3.665163 | 16 |
| 5 | 3.6 | 1.280934 | 6.404669 | 25 |
| 6 | 4.7 | 1.547563 | 9.285375 | 36 |
| 7 | 6.6 | 1.88707 | 13.20949 | 49 |
| 8 | 9.1 | 2.208274 | 17.6662 | 64 |
| 36 | **30.5** | **8.610239** | **52.35889** | **204** |

**CALCULATIONS:**

**Normal Equations for Y=AXB after putting values:**

8.61-8a-10.605b=0 – (1)

15.141-10.605a-17.521b=0 – (2)

**Upon solving the two equations we get:**

**Value of a =0.704**

**Value of b=1.076**

**Hence the equation we get is as follows:**

**Y=0.704x1.076**

**Normal Equations for after putting values:**

8.61-8a-36b=0 – (1)

52.36-36-204=0 – (2)

**Upon solving the two equations we get:**

**Value of a =** **0.6822**

**Value of b=0.3241**

**Hence the equation we get is as follows:**

**Y=0.6822e0.3241x**

**SCATTER PLOT:**

**INFERENCE:**

We have drawn various curves to fit the various scenarios with all the possible curves/lines available. The fitting of polynomials is used to estimate the value of a variable where no data is available. We can infer that the exponential curves fit the situations best in comparison to other fittings.