Linear Regression Task 6

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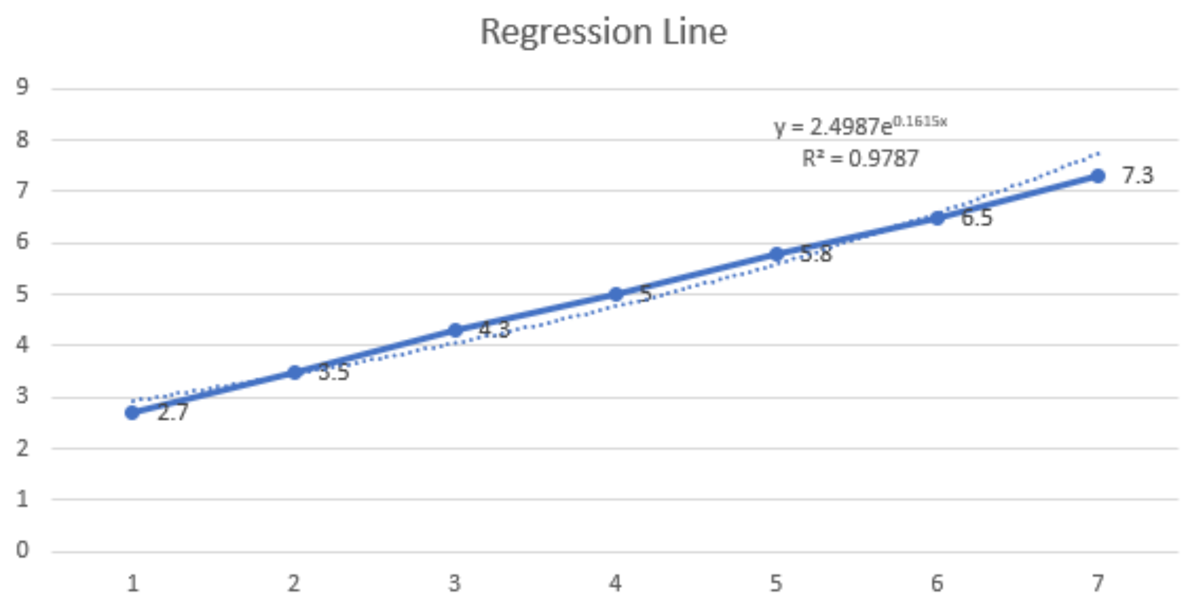
1).

Linear Regression

x	y	xy	x^2	f(x)	y - f(x)	[y - f(x)]^2
1	2.7	2.7	1	2.7321	-0.0321	0.0010
2	3.5	7	4	3.4929	0.0071	0.0001
3	4.3	12.9	9	4.2536	0.0464	0.0022
4	5	20	16	5.0143	-0.0143	0.0002
5	5.8	29	25	5.7750	0.0250	0.0006
6	6.5	39	36	6.535714286	-0.036	0.00127551
7	7.3	51.1	49	7.296428571	0.0036	1.27551E-05
28	35.1	161.7	140	35.1000	0.0000	0.0054

x bar=	4
y bar=	5.014286
b=	0.760714
a=	1.9714
SD=	0.032733

Slope	0.760714286
Y-intercept	1.971428571
y=a+bx	1.9714 + 0.7607x



Trying out python (this is not used for answer, just reference)

```python
import numpy as np
from scipy.interpolate import CubicSpline

x = np.array([1, 2, 3, 4, 5])
y = np.array([1, 3, 5, 8, 10])

cs = CubicSpline(x, y)

a = cs.c
b = (cs(x[1:]) - cs(x[:-1])) / (x[1:] - x[:-1])
c = y[:-1]
c = c.reshape(-1, 1)

for i in range(len(c)):
    print("f(x) = {}(x - {})^3 + {}(x - {})^2 + {}(x - {}) + {}".format(
        a[i], x[i], b[i], x[i], c[i], x[i], c[i]))

f_3_5 = cs(3.5)
print("Cubic spline function value at x = 3.5:", f_3_5)
```

```
f(x) = [ 0.29166667  0.29166667 -0.45833333 -0.45833333](x - 1)^3 + 2.0(x - 1)^2 + [1](x - 1) + [1]
f(x) = [-8.75000000e-01 -2.22044605e-16  8.75000000e-01 -5.00000000e-01](x - 2)^3 + 2.0(x - 2)^2 + [3](x - 2) + [3]
f(x) = [2.58333333 1.70833333 2.58333333 2.95833333](x - 3)^3 + 3.0(x - 3)^2 + [5](x - 3) + [5]
f(x) = [1. 3. 5. 8.](x - 4)^3 + 2.0(x - 4)^2 + [8](x - 4) + [8]
Cubic spline function value at x = 3.5: 6.453125
```

2. (a.)

i	0	1	2	3	4
x	1	2	3	4	5
y	1	3	5	8	10
	y_0	y_1	y_2	y_3	y_4

$k_0 = 0 \quad k_4 = 0$

$h = 1 \quad n = 4$

$i = 1 \rightarrow k_0 + 4k_1 + k_2 = 6(y_0 - 2y_1 + y_2)$

$4k_1 + k_2 = 6(1 - 2(3) + 5)$

$4k_1 + k_2 = 6(0)$

$4k_1 + k_2 = 0$ //

$i = 2 \rightarrow k_1 + 4k_2 + k_3 = 6(y_1 - 2y_2 + y_3)$

$k_1 + 4k_2 + k_3 = 6(3 - 2(5) + 8)$

$k_1 + 4k_2 + k_3 = 6(1)$

$k_1 + 4k_2 + k_3 = 6$

$i = 3 \rightarrow k_2 + 4k_3 + k_4 = 6(y_2 - 2y_3 + y_4)$

$k_2 + 4k_3 = 6(5 - 2(8) + 10)$

$k_2 + 4k_3 = 6(-1)$

$k_2 + 4k_3 = -6$

$k_2 + 4k_3 = -6 \quad \times 1$

$k_1 + 4k_2 + k_3 = 6 \quad \times 4$ −

$k_2 + 4k_3 = -6$

$4k_1 + 16k_2 + 4k_3 = 24$ −

$4k_1 + 15k_2 = 30$

$4k_1 + 15k_2 = 30$

$4k_1 + k_2 = 0$ −

$14k_2 = 30$

$k_2 = 30/14$

$= 15/7$ //

$4k_1 + k_2 = 0$

$4k_1 = -15/7$

$k_1 = -15/28$ //

$k_2 + 4k_3 = -6$

$15/7 + 4k_3 = -6$

$4k_3 = -6 - 15/7$

$k_3 = -57/28$ //

$i = 3$

$$f(3) = \frac{1}{6h}(x_3 - x)^3 k_2 + \frac{1}{6h}(x - x_2)^3 k_3 + \frac{1}{h}(x_3 - x)\left(y_2 - \frac{h^2}{6} \times k_2\right) + \frac{1}{h}(x - x_2)\left(y_3 - \frac{h^2}{6} \times k_3\right)$$

$$f(3) = \frac{1}{6}(4 - x)^3 \times \frac{15}{7} + \frac{1}{6}(x-3)^3 \times \frac{-57}{28} + 1(4-x) \times \left(5 - \frac{1}{6} \times \frac{15}{7}\right) + 1(x-3)\left(8 - \frac{1}{6} \times \frac{-57}{28}\right)$$

$$f(3) = \frac{5}{14}(4-x)^3 - \frac{19}{56}(x-3)^3 + (4-x)\frac{65}{14} + (x-3)\frac{467}{56}$$

$$f(3) = \frac{5}{14}(4-x)^3 - \frac{19}{56}(x-3)^3 + \frac{65}{14}(4-x) + \frac{467}{56}(x-3) \quad //$$

(b.) $f(3.5) = \frac{5}{14}(4 - 3.5)^3 - \frac{19}{56}(x - 3.5)^3 + \frac{65}{14}(4 - 3.5) + \frac{467}{56}(3.5 - 3)$

$= 6.4933$ //