แบบฝึกหัด 6 LEAST-SQUARES REGRESSION

1. LINEAR REGRESSION

x	10	15	20	30	40	50	60	70	80
f(x)	5	9	15	18	22	30	35	38	43

1.1 จงใช้ LINEAR REGRESSION ในการคำนวณหา $f(x) = a_0 + a_1x_1$ และค่า f(65)

1.2 จงเขียน code

2. POLYNOMIAL REGRESSION

x	10	15	20	30	40	50	60	70	80
f(x)	5	9	15	18	22	30	35	38	43

2.1 จงใช้ POLYNOMIAL REGRESSION order m = 2 ในการสร้างสมการ $f(x) = a_0 + a_1x + a_2x^2$

2.2 จงเขียน code

3. MULTIPLE LINEAR REGRESSION

x_1	x_2	x_3	Y
1	0	1	4
0	1	3	-5
2	4	1	-6
3	2	2	0
4	1	5	-1
2	3	3	-7
1	6	4	-20

3.1 จงใช้ MULTIPLE LINEAR REGRESSION ในการสร้างสมการ $f(x) = a_0 + a_1x_1 + a_2x_2 + a_3x_3$

3.2 จงเขียน code

1. LINEAR REGRESSION

x	10	15	20	30	40	50	60	70	80
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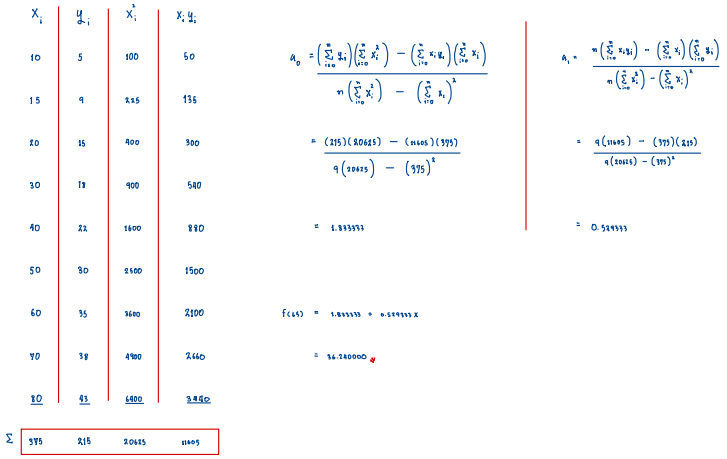
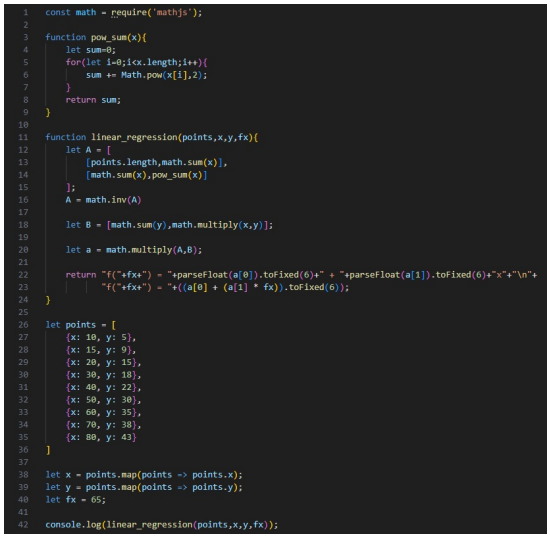
1.1 จงใช้ LINEAR REGRESSION ในการคำนวณหา f(x) = $a_0 + a_1x_1$ และค่า f(65)

1.2 จงเขียน code





```
const math = require('mathjs');

function pow_sum(x){
    let sum=0;
    for(let i=0;i<x.length;i++){
        sum += Math.pow(x[i],2);
    }
    return sum;
}

function linear_regression(points,x,y,fx){
    let A = [
        [points.length,math.sum(x)],
        [math.sum(x),pow_sum(x)]
    ];
    A = math.inv(A)

    let B = [math.sum(y),math.multiply(x,y)];

    let a = math.multiply(A,B);

    return "f("+fx+") = "+parseFloat(a[0]).toFixed(6)+" + "+parseFloat(a[1]).toFixed(6)+"x"+"\n"+
           "f("+fx+") = "+((a[0] + (a[1] * fx)).toFixed(6));
}

let points = [
    {x: 10, y: 5},
    {x: 15, y: 9},
    {x: 20, y: 15},
    {x: 30, y: 18},
    {x: 40, y: 22},
    {x: 50, y: 30},
    {x: 60, y: 35},
    {x: 70, y: 38},
    {x: 80, y: 43}
]

let x = points.map(points => points.x);
let y = points.map(points => points.y);
let fx = 65;

console.log(linear_regression(points,x,y,fx));
```

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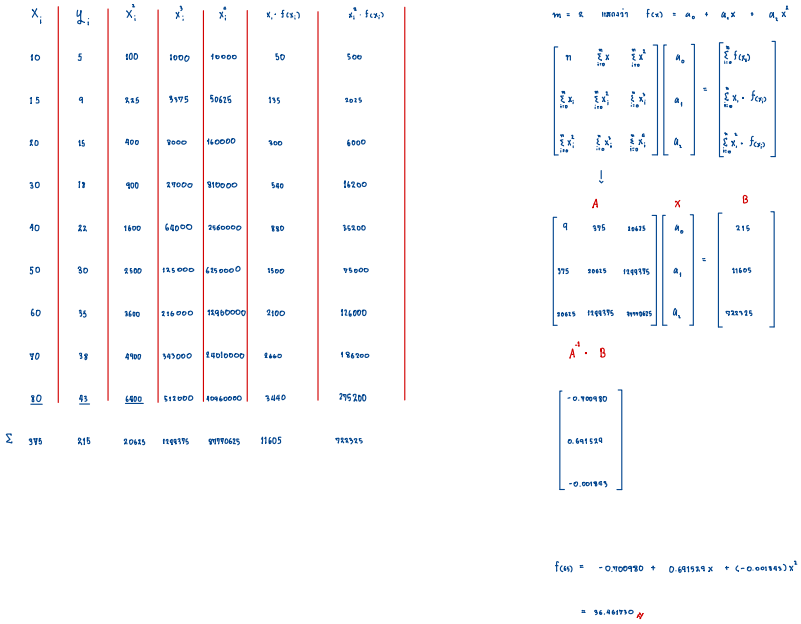
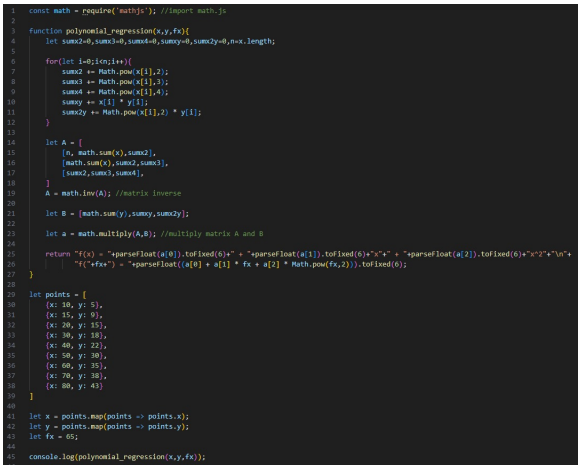
2. POLYNOMIAL REGRESSION

x	10	15	20	30	40	50	60	70	80
f(x)	5	9	15	18	22	30	35	38	43

2.1 จงใช้ POLYNOMIAL REGRESSION order m = 2 ในการสร้างสมการ f(x) = $a_0 + a_1x + a_2X^2$

2.2 จงเขียน code





```
const math = require('mathjs'); //import math.js

function polynomial_regression(x,y,fx){
    let sumx2=0,sumx3=0,sumx4=0,sumxy=0,sumx2y=0,n=x.length;

    for(let i=0;i<n;i++){
        sumx2 += Math.pow(x[i],2);
        sumx3 += Math.pow(x[i],3);
        sumx4 += Math.pow(x[i],4);
        sumxy += x[i] * y[i];
        sumx2y += Math.pow(x[i],2) * y[i];
    }

    let A = [
        [n, math.sum(x),sumx2],
        [math.sum(x),sumx2,sumx3],
        [sumx2,sumx3,sumx4],
    ]
    A = math.inv(A); //matrix inverse

    let B = [math.sum(y),sumxy,sumx2y];

    let a = math.multiply(A,B); //multiply matrix A and B

    return "f(x) = "+parseFloat(a[0]).toFixed(6)+" + "+parseFloat(a[1]).toFixed(6)+"x"+" + "+parseFloat(a[2]).toFixed(6)+"x^2"+"\n"+
           "f("+fx+") = "+parseFloat((a[0] + a[1] * fx + a[2] * Math.pow(fx,2))).toFixed(6);
}

let points = [
    {x: 10, y: 5},
    {x: 15, y: 9},
    {x: 20, y: 15},
    {x: 30, y: 18},
    {x: 40, y: 22},
    {x: 50, y: 30},
    {x: 60, y: 35},
    {x: 70, y: 38},
    {x: 80, y: 43}
]

let x = points.map(points => points.x);
let y = points.map(points => points.y);
let fx = 65;

console.log(polynomial_regression(x,y,fx));
```

3. MULTIPLE LINEAR REGRESSION

x_1	x_2	x_3	Y	x_1x_1	x_2x_2	x_3x_3	x_1x_2	x_1x_3	x_2x_3	x_1y	x_2y	x_3y
1	0	1	4	1	0	1	0	1	0	4	0	4
0	1	3	-5	0	1	9	0	0	3	0	-5	-15
2	4	1	-6	4	16	1	8	2	4	-12	-24	-6
3	2	2	0	9	4	4	6	6	4	0	0	0
4	1	5	-1	16	1	25	4	20	5	-4	-1	-5
2	3	3	-7	4	9	9	6	6	9	-14	-21	-21
1	6	4	-20	1	36	16	6	4	24	-20	-120	-80
$\sum_{i=0}^{n}$	13	17	19	-35	35	67	65	30	39	49	-46	-171	-123

3.1 จงใช้ MULTIPLE LINEAR REGRESSION ในการสร้างสมการ $f(x) = a_0 + a_1x_1 + a_2x_2 + a_3x_3$

3.2 จงเขียน code

$$\begin{bmatrix} n & \sum_{i=0}^{n} x_{1i} & \sum_{i=0}^{n} x_{2i} & \sum_{i=0}^{n} x_{3i} \\ \sum_{i=0}^{n} x_{1i} & \sum_{i=0}^{n} x_{1i}x_{1i} & \sum_{i=0}^{n} x_{1i}x_{2i} & \sum_{i=0}^{n} x_{1i}x_{3i} \\ \sum_{i=0}^{n} x_{2i} & \sum_{i=0}^{n} x_{1i}x_{2i} & \sum_{i=0}^{n} x_{2i}x_{2i} & \sum_{i=0}^{n} x_{2i}x_{3i} \\ \sum_{i=0}^{n} x_{3i} & \sum_{i=0}^{n} x_{1i}x_{3i} & \sum_{i=0}^{n} x_{2i}x_{3i} & \sum_{i=0}^{n} x_{3i}x_{3i} \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ \vdots \\ a_3 \end{bmatrix} \begin{bmatrix} \sum_{i=0}^{n} y_i \\ \sum_{i=0}^{n} x_{1i}y_i \\ \sum_{i=0}^{n} x_{2i}y_i \\ \vdots \\ \sum_{i=0}^{n} x_{3i}y_i \end{bmatrix}$$

$$\begin{bmatrix} 7 & 13 & 17 & 19 \\ 13 & 35 & 30 & 39 \\ 17 & 30 & 67 & 49 \\ 19 & 39 & 49 & 65 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \end{bmatrix} \begin{bmatrix} -35 \\ -46 \\ -171 \\ -123 \end{bmatrix}$$

$A^{-1} \cdot B$

$$\begin{bmatrix} 4.000000 \\ 2.000000 \\ -3.000000 \end{bmatrix}$$

$f(x) = 4.000000 + 2.000000\,x_1 + (-3.000000)\,x_2 + (-7.000000)\,x_3$

```
const math = require('mathjs');

function multiple_linear_regression(x1,x2,x3,y,fx){
    let A = [
        [x1.length,math.sum(x1),math.sum(x2),math.sum(x3)],
        [math.sum(x1),math.multiply(x1,x1),math.multiply(x1,x2),math.multiply(x1,x3)],
        [math.sum(x2),math.multiply(x1,x2),math.multiply(x2,x2),math.multiply(x2,x3)],
        [math.sum(x3),math.multiply(x1,x3),math.multiply(x2,x3),math.multiply(x3,x3)]
    ]

    let B = [math.sum(y),math.multiply(x1,y),math.multiply(x2,y),math.multiply(x3,y)];

    A = math.inv(A); //matrix inverse

    let a = math.multiply(A,B); //multiply matrix A and B

    return "f(x) = "+parseFloat(a[0]).toFixed(6)+" + "+parseFloat(a[1]).toFixed(6)+"x1"+" + "+parseFloat(a[2]).toFixed(6)+"x2"+" + "+parseFloat(a[3]).toFixed(6)+"x3";
}

let points = [
    {x1: 1,x2: 0,x3: 1,y: 4},
    {x1: 0,x2: 1,x3: 3,y: -5},
    {x1: 2,x2: 4,x3: 1,y: -6},
    {x1: 3,x2: 2,x3: 2,y: 0},
    {x1: 4,x2: 1,x3: 5,y: -1},
    {x1: 2,x2: 3,x3: 3,y: -7},
    {x1: 1,x2: 6,x3: 4,y: -20},
]

let x1 = points.map(points => points.x1);
let x2 = points.map(points => points.x2);
let x3 = points.map(points => points.x3);
let y = points.map(points => points.y);
let fx = 65;

console.log(multiple_linear_regression(x1,x2,x3,y,fx));
```