计算方法实验报告

本文是计算方法第二次实验报告。

一、实验原理

最小二乘法拟合、快速傅里叶变换等。

二、实验过程

（1）环境：Matlab

（2）实验题目与核心代码

1.对于给函数$f(x)=\frac{-1}{1+25x^2}$在区间[-1，1]上取 xi=-1+0.2i(i=0,1，…，10)，试求 3 次曲线拟合

核心函数：

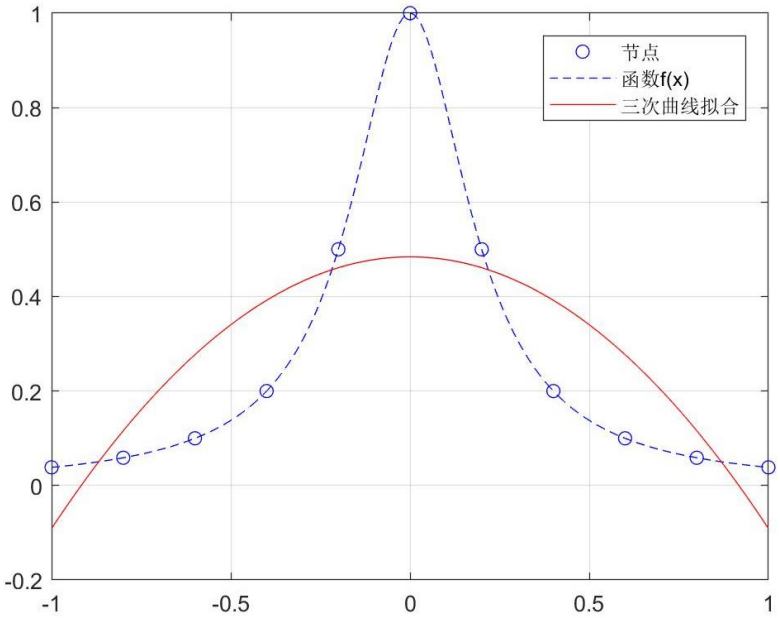
p=polyfit(x,y,n)：最小二乘法计算拟合多项式系数。x，y 为拟合数据向量，要求维度相同，n 为拟合多项式次数。返回 p 向量保存多项式系数，由最高次向最低次排列。

y=polyval(p,x)：计算多项式的函数值。返回在 x 处多项式的值，p 为多项式系数，元素按多项式降幂排序。

```
i = 0:10;
x = -1+0.2*i;
y = 1./(1+25*x.^2);
p = polyfit(x,y,3);
x1 = -1:0.01:1;
y1 = 1./(1+25*x1.^2);
y2 = polyval(p, x1);
plot(x,y,'bo', x1,y1,'b--',x1,y2,'r');
legend('½Úµã','°¯Êýf(x)','Èý´ÎÇúÏßÄâºÏ');
grid on;
```

实验结果：

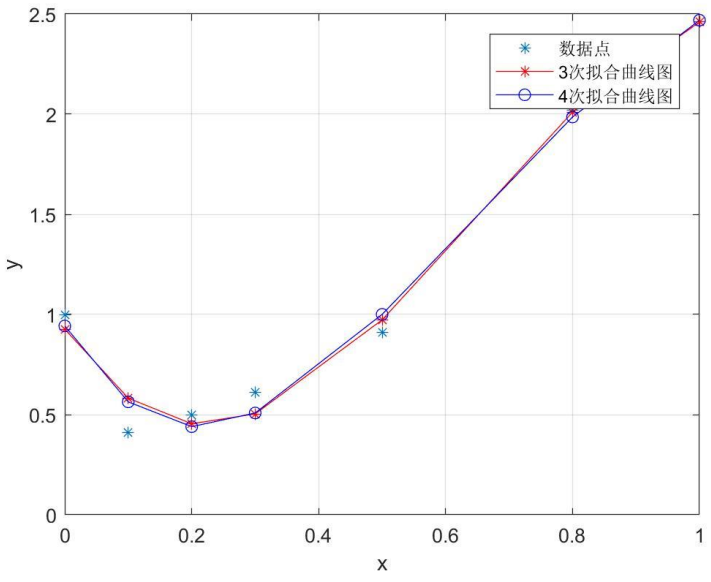
```
P=-4.4862e-17x^3 - 0.57518x^2 + 2.0447e-17x + 0.48412
```

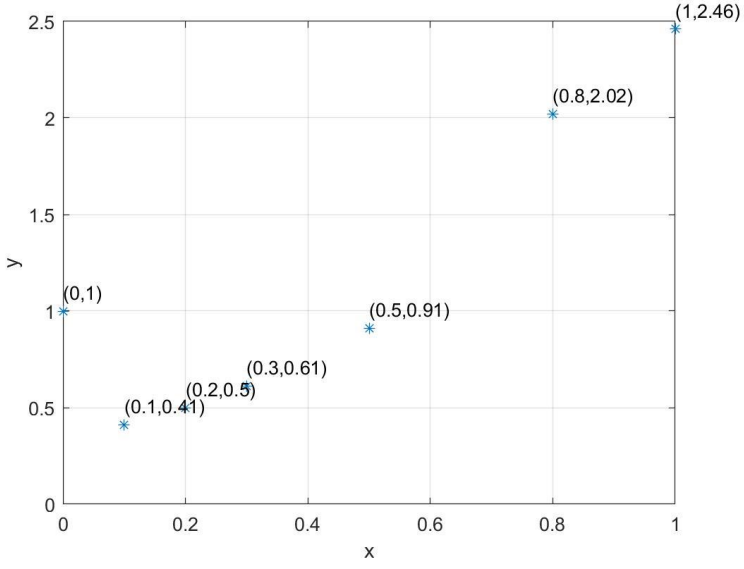


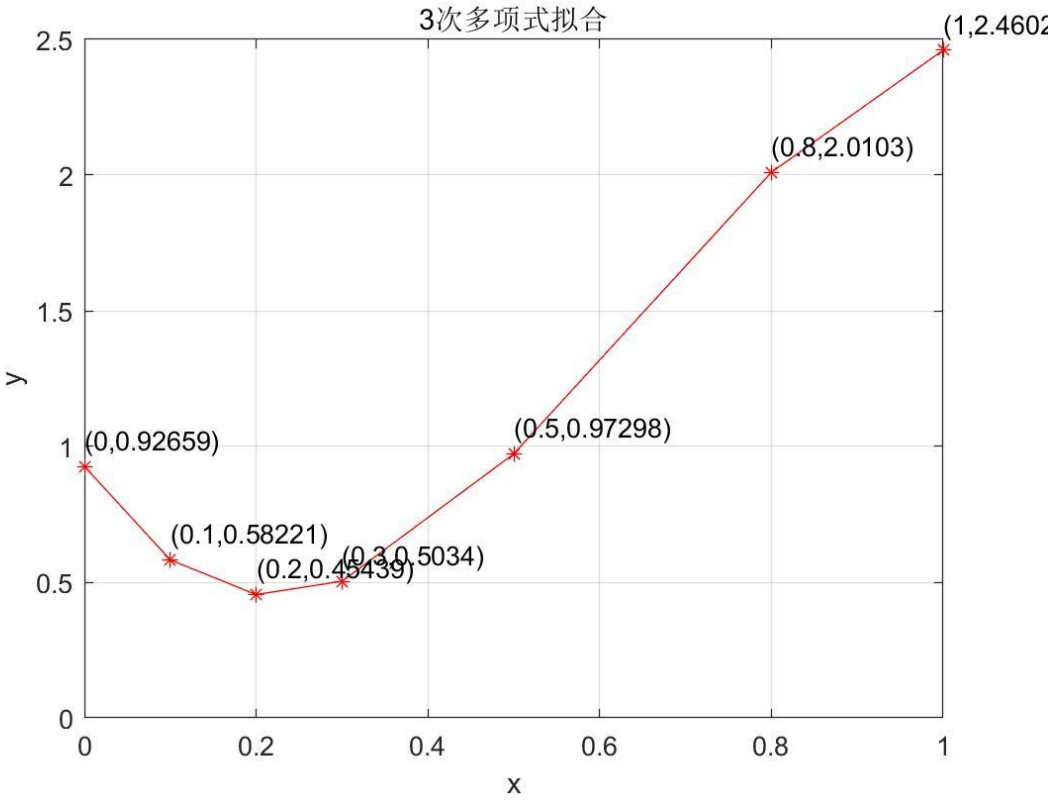
2. 根据给定点，使用 3 次、4 次多项式曲线拟合

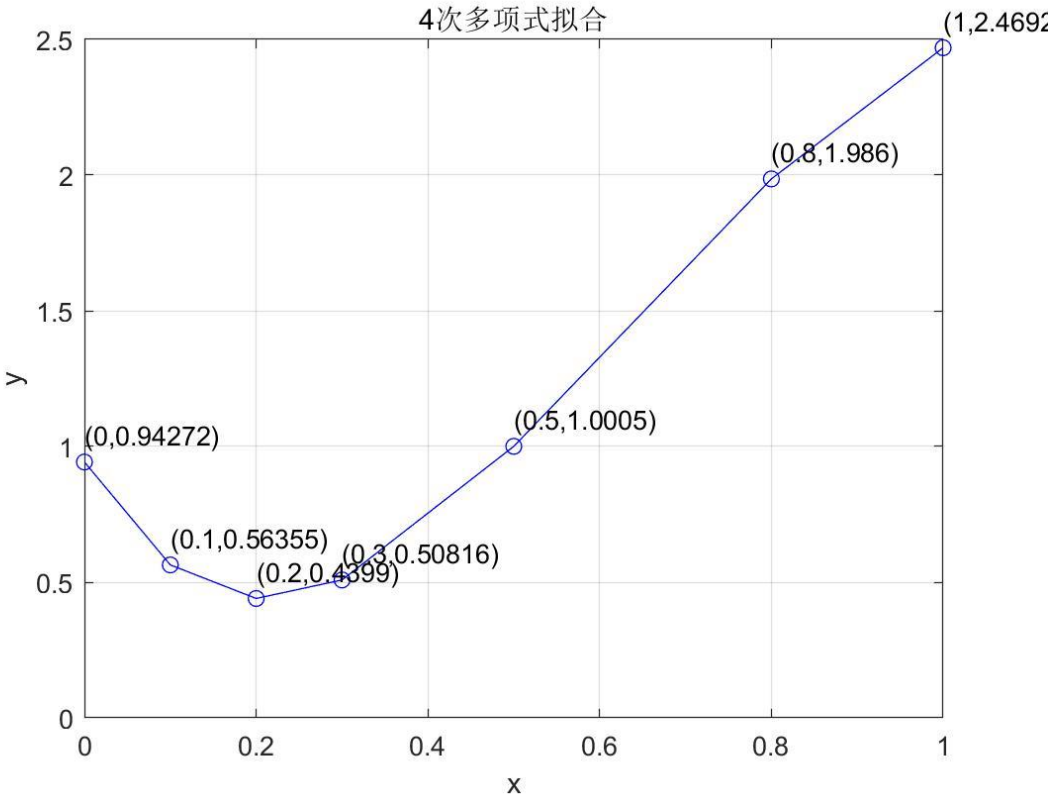
polyfit 拟合得到系数，poly2sym 由系数得到多项式，inline 转换内联函数。

```
x=[0.0 0.1 0.2 0.3 0.5 0.8 1.0];
y=[1.0 0.41 0.50 0.61 0.91 2.02 2.46];
f1=inline(poly2sym(polyfit(x,y,3)));
f2=inline(poly2sym(polyfit(x,y,4)));
plot(x,y,'*');
grid on;
for i=1:7

text(x(i),y(i)+0.1,strcat('(',num2str(x(i)),',',num2str(y
(i)),')'));
 end;
xlabel('x');
ylabel('y');
figure;
y1=f1(x);
y2=f2(x);

plot(x,y1,'-r*');
for i=1:7
text(x(i),y1(i)+0.1,strcat('(',num2str(x(i)),',',num2str(
y1(i)),')'));
end;
grid on;
title('3´Î¶àÏîÊ½Äâ°Ï');
xlabel('x');
ylabel('y');
figure;
plot(x,y2,'-bo');
for i=1:7
text(x(i),y2(i)+0.1,strcat('(',num2str(x(i)),',',num2str(
y2(i)),')'));
end;
grid on;
title('4´Î¶àÏîÊ½Äâ°Ï');
xlabel('x');
ylabel('y');
```






3次多项式拟合
(1,2.4602
(0.8,2.0103)
(0.5,0.97298)
(0,0.92659)
(0.1,0.58221)
(0.2,0.45439)
(0.3,0.5034)
y
x
0
0.5
1
1.5
2
2.5
0.2
0.4
0.6
0.8


4次多项式拟合
(1,2.4692
(0.8,1.986)
(0.5,1.0005)
(0,0.94272)
(0.1,0.56355)
(0.2,0.4399)
(0.3,0.50816)
y
x
0
0.5
1
1.5
2
2.5
0.2
0.4
0.6
0.8

3.使用快速傅里叶变换确定函数 f(x)=x^2cosx 在[-pi,pi]上 16 次三角插值

定义函数[an,bn,f]=fseries(fx,x,n,a,b)

```
function [an,bn,f]=fseries(fx,x,n,a,b)
if nargin==3
a=-pi;
b=pi;
end
l=(b-a)/2;
if a+b
fx=subs(fx,x,x+l+a);
end
an=int(fx,x,-l,l)/l;
bn=[];
f=an/2;
for ii=1:n
ann=int(fx*cos(ii*pi*x/l),x,-l,l)/l;
bnn=int(fx*sin(ii*pi*x/l),x,-l,l)/l;
an=[an,ann];
bn=[bn,bnn];
f=f+ann*cos(ii*pi*x/l)+bnn*sin(ii*pi*x/l);
end
if a+b
f=subs(f,x,x-l-a);
end
```

在命令行窗口中键入：

```
>> fx = x.^2*cos(x);
>> [an,bn,f]=fseries(fx,x,16,-pi,pi)
```

输出：

```
an =

[ -4, pi^2/3 + 1/2, -20/9, 5/8, -68/225, 13/72, -148/1225,
25/288, -260/3969, 41/800, -404/9801, 61/1800, -580/20449,
85/3528, -788/38025, 113/6272, -1028/65025]


bn =

[ 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]


f =

(5*cos(3*x))/8 - (20*cos(2*x))/9 - (68*cos(4*x))/225 +
```

```
(13*cos(5*x))/72 - (148*cos(6*x))/1225 +
(25*cos(7*x))/288 - (260*cos(8*x))/3969 +
(41*cos(9*x))/800 - (404*cos(10*x))/9801 +
(61*cos(11*x))/1800 - (580*cos(12*x))/20449 +
(85*cos(13*x))/3528 - (788*cos(14*x))/38025 +
(113*cos(15*x))/6272 - (1028*cos(16*x))/65025 +
cos(x)*(pi^2/3 + 1/2) - 2
```

三、实验结论

Matlab 可以非常方便地进行复杂数据的处理，使我们免于重复而枯燥的劳动。