年级、专业＿＿＿＿＿＿ 姓名＿＿＿＿＿ 学号＿＿＿＿＿ **名单序号**（勿换行）＿＿＿＿

选课时间（打√）：周一 **56**、周三 **56** 节 ☐＿＿＿＿　　周一 **78**、周三 **78** 节 ☐＿＿＿＿

实验时间＿2019 年　4 月　　日＿　　使用软件版本＿MATLAB＿＿＿

实验报告：实验 2　数据建模——插值与拟合

1. 编写一个自定义函数实现 Lagrangian 插值。

```
function y=lagrange1(x0,y0,x);
n=length(x0);m=length(x);
for i=1:m
    z=x(i);
    s=0.0;
    for k=1:n
        p=1.0;
        for j=1:n
            if j~=k
                p=p*(z-x0(j))/(x0(k)-x0(j));
            end
        end
        s=p*y0(k)+s;
    end
    y(i)=s;
end
```

```
% 1
x=linspace(1,10,10)
```

```
x = 1×10
     1     2     3     4     5     6     7     8     9    10
```

```
y=sin(x)
```

```
y = 1×10
    0.8415    0.9093    0.1411   -0.7568   -0.9589   -0.2794    0.6570    0.9894
```

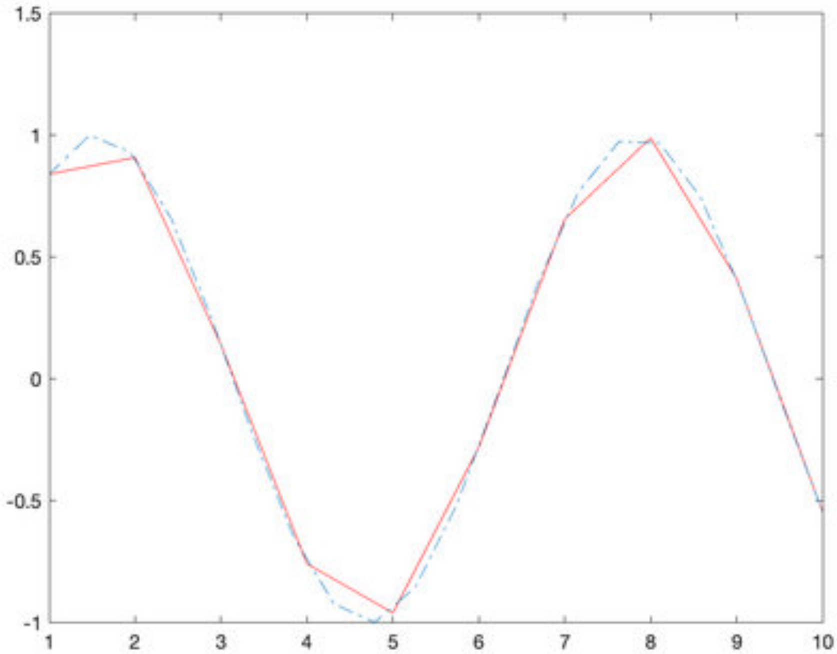
```
x2=linspace(1,10,20)
```

```
x2 = 1×20
    1.0000    1.4737    1.9474    2.4211    2.8947    3.3684    3.8421    4.3158
```

```
y2=lagrange1(x,y,x2)
```

```
y2 = 1×20
    0.8415    1.0015    0.9303    0.6587    0.2442   -0.2246   -0.6445   -0.9225
```

```
plot(x,y,"-r",x2,y2,"-.")
```



2. 在下面的函数中选择两个，在n个结点上（n不要太大，如5～11）分别用Lagrangian、分段线性、三次样条插值三种插值方法，计算m个插值点的函数值 (m要适中，如50～100)。通过数值和图形输出，将三种插值结果与精确值进行比较。适当增加n, 再做比较，由此做初步分析。

$$(1)\ y=\sqrt{1-x^2}, -1 \le x \le 1 \tag{1}$$

$$(2)\ y=\sin^6 x, -\pi \le x \le \pi \tag{2}$$

$$(3)\ y=e^{-x^2}, -2 \le x \le 2 \tag{3}$$

由 Xnip 截图

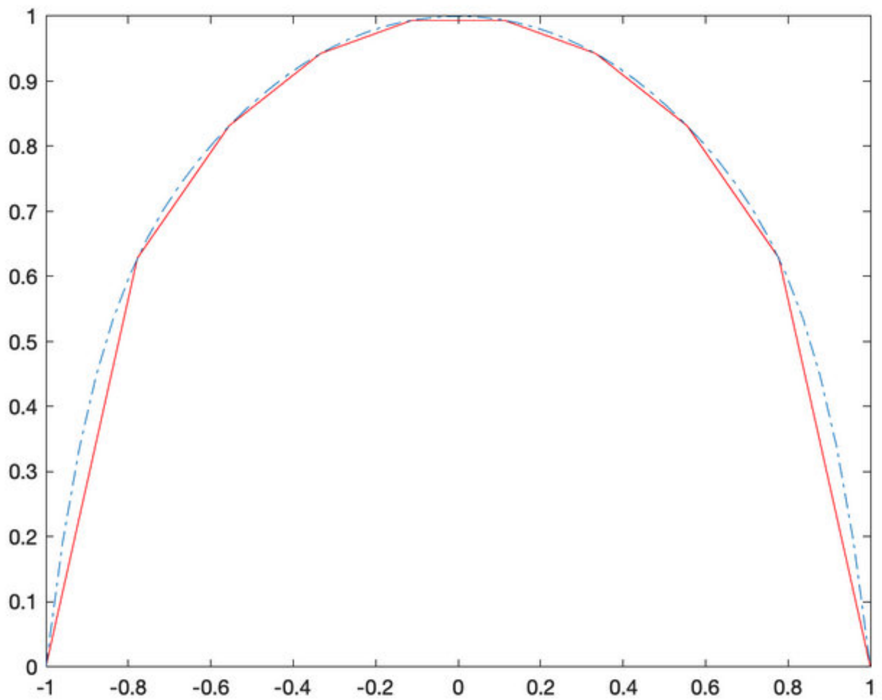
```
% 2

a=-1;
b=1;
x=linspace(a,b,10);
x2=linspace(a,b,50);
y=f1(x)
```

```
y = 1×10
        0    0.6285    0.8315    0.9428    0.9938    0.9938  ...
```

```
y1=lagrange1(x,y,x2)
```

```
y1 = 1×50
        0    0.1920    0.3376    0.4488    0.5349    0.6028  ...
```

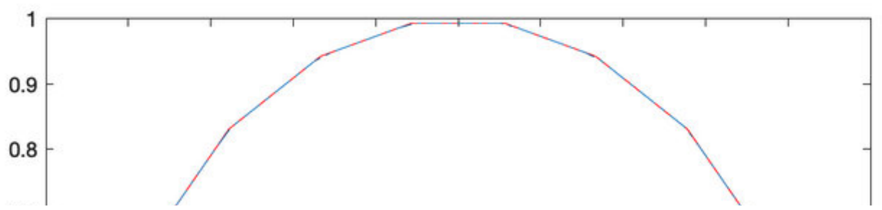
```
plot(x,y,"-r",x2,y1,"-.")
```

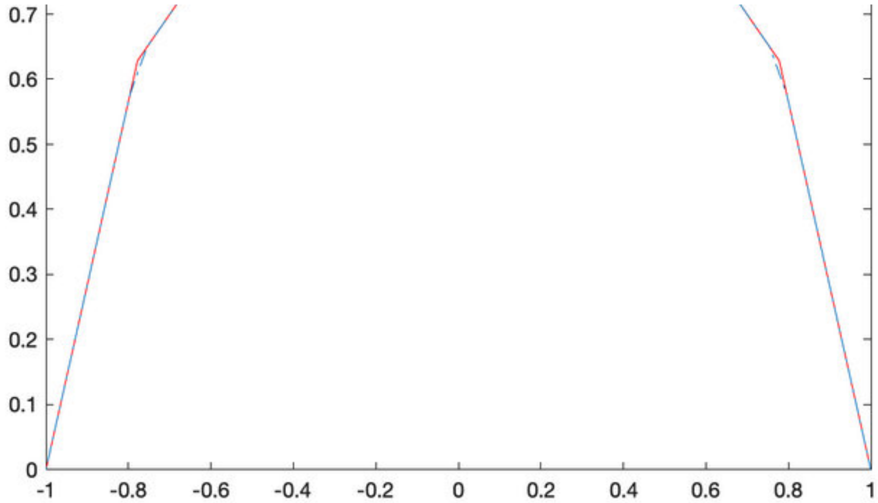



```
y2=interp1(x,y,x2,"liner")
```

```
y2 = 1×50
        0    0.1154    0.2309    0.3463    0.4618    0.5772  ...
```

```
plot(x,y,"-r",x2,y2,"-.")
```

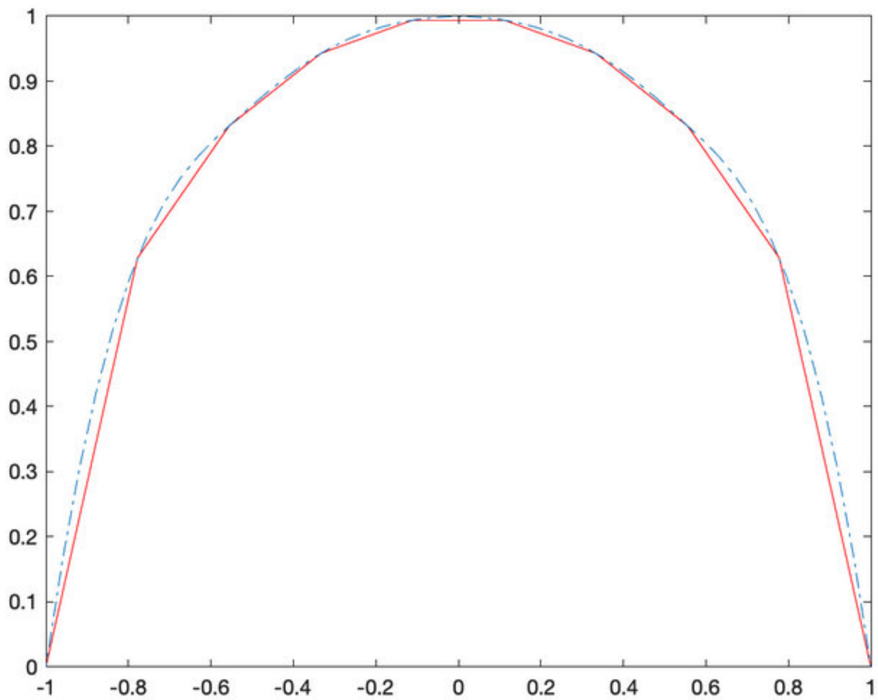




```
y3=interp1(x,y,x2,"spline")
```

```
y3 = 1×50
         0    0.1661    0.3065    0.4237    0.5203    0.5988  ...
```

```
plot(x,y,"-r",x2,y3,"-.")
```



```
clear;
a=-pi;
b=pi;
x=linspace(a,b,10);
x2=linspace(a,b,50);
y=f2(x)
```

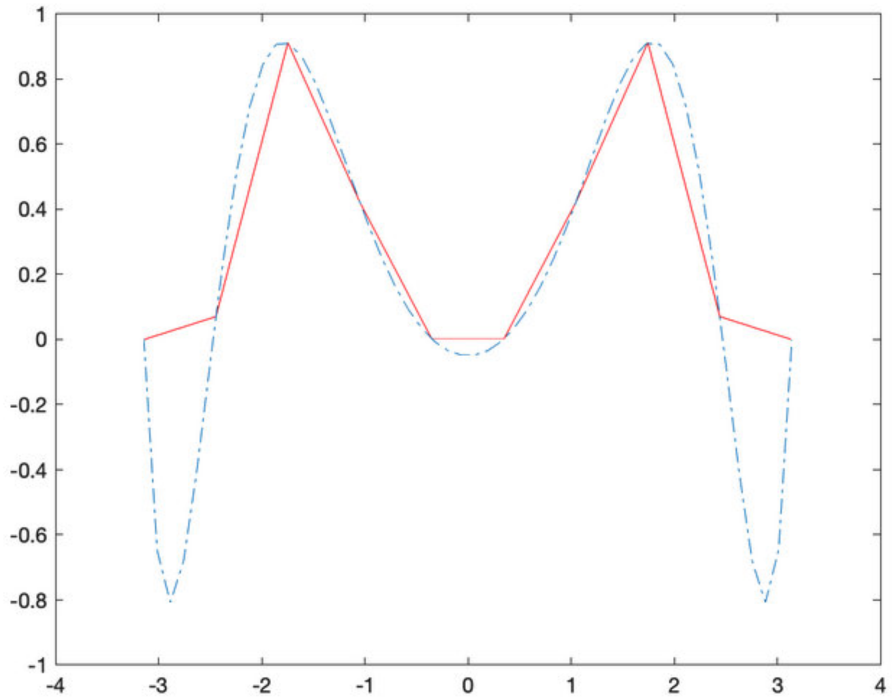
```
y = 1×10
    0.0000    0.0705    0.9122    0.4219    0.0016    0.0016  ...
```

```
0.0000    0.0705    0.9122    0.4219    0.0016    0.0016  ...
```

```
y1=lagrange1(x,y,x2)
```

```
y1 = 1×50
    0.0000   -0.6461   -0.8080   -0.6806   -0.4039   -0.0749  ...
```

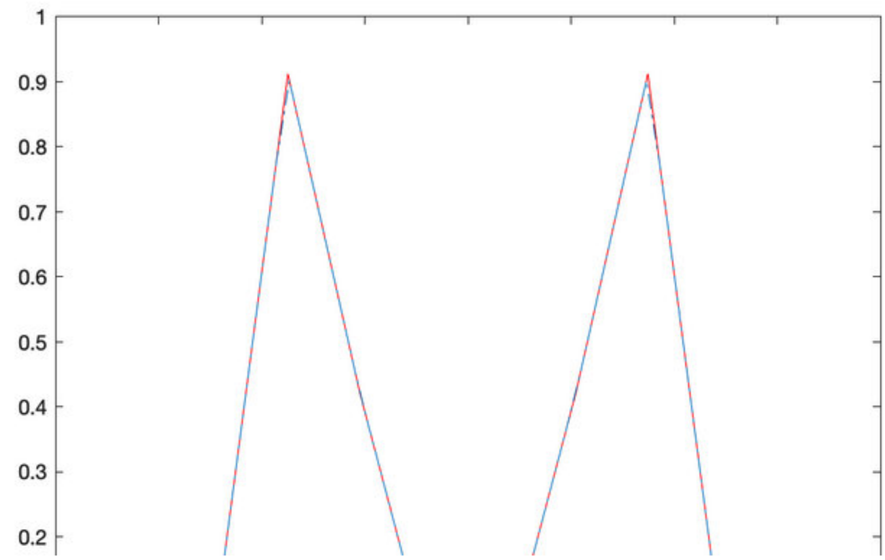
```
plot(x,y,"-r",x2,y1,"-.")
```

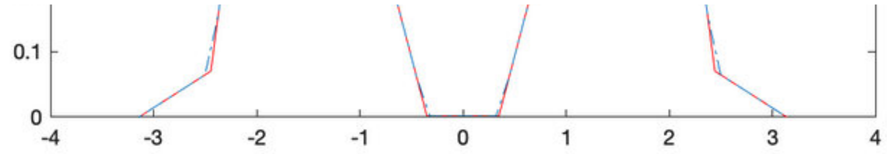



```
y2=interp1(x,y,x2,"liner")
```

```
y2 = 1×50
    0.0000    0.0130    0.0259    0.0389    0.0518    0.0648  ...
```

```
plot(x,y,"-r",x2,y2,"-.")
```

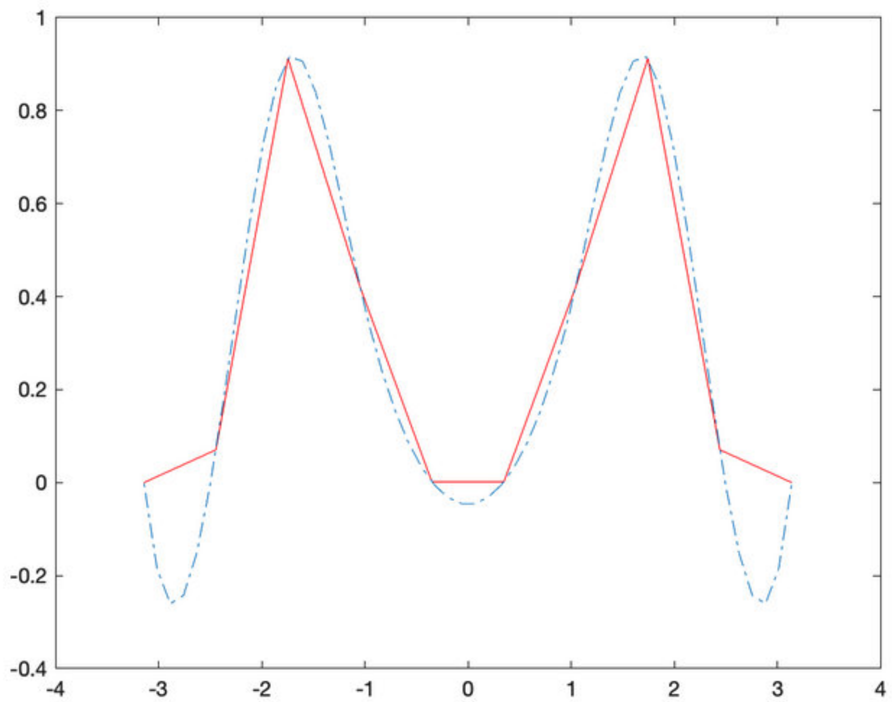





```
y3=interp1(x,y,x2,"spline")
```

```
y3 = 1×50
      0.0000   -0.1860   -0.2604   -0.2424   -0.1512   -0.0062 ...
```

```
plot(x,y,"-r",x2,y3,"-.")
```



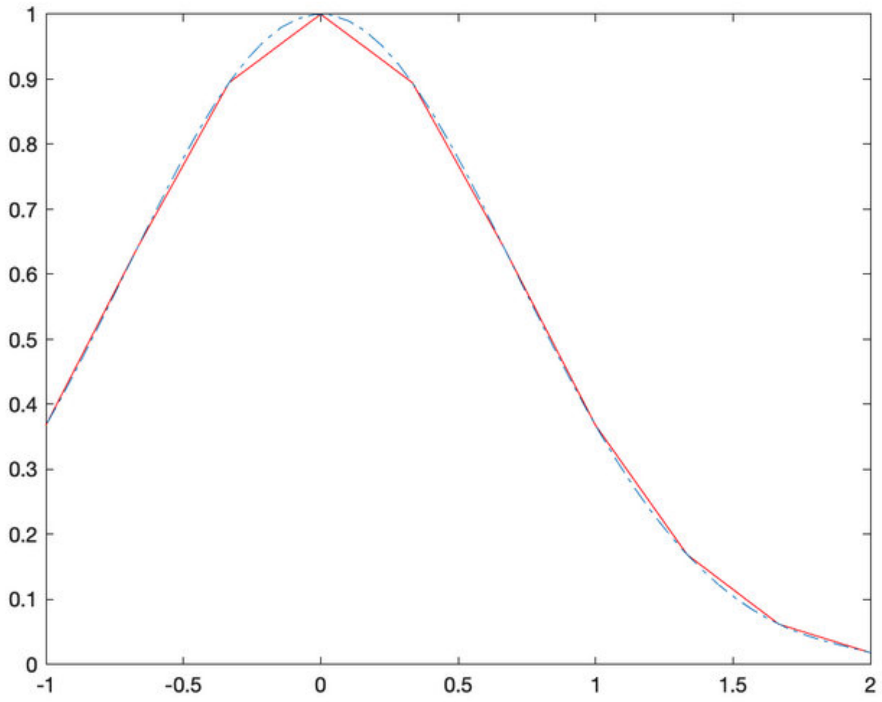

```
clear;

a=-1;
b=2;
x=linspace(a,b,10);
x2=linspace(a,b,50);
y=f3(x)
```

```
y = 1×10
      0.3679    0.6412    0.8948    1.0000    0.8948    0.6412 ...
```

```
y1=lagrange1(x,y,x2)
```

```
y1 = 1×50
      0.3679    0.4142    0.4629    0.5136    0.5655    0.6179 ...
```

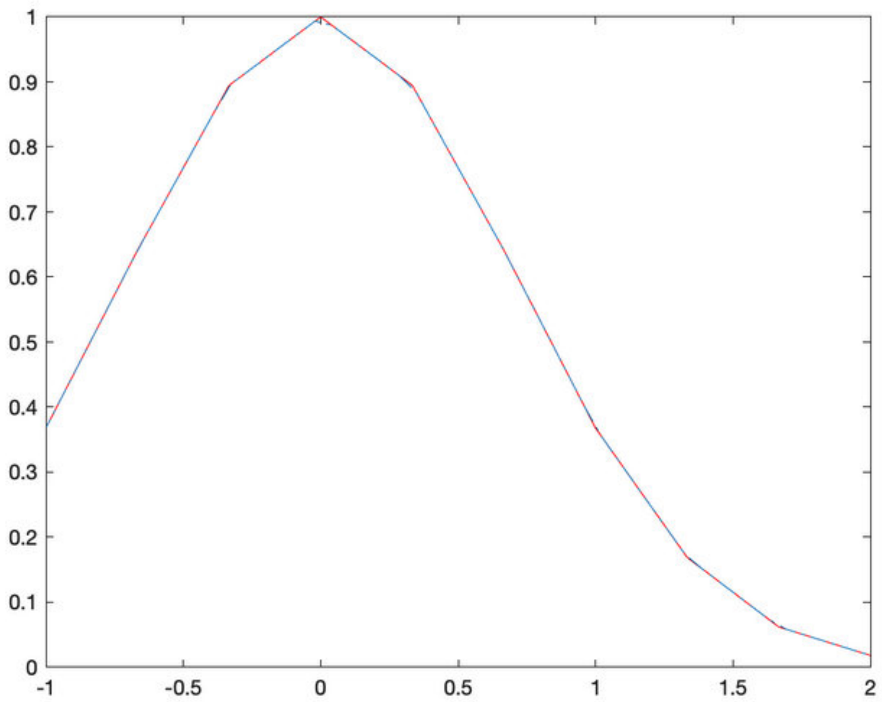
```
plot(x,y,"-r",x2,y1,"-.")
```




```
y2=interp1(x,y,x2,"liner")
```

```
y2 = 1×50
       0.3679    0.4181    0.4683    0.5185    0.5687    0.6189  ...
```

```
plot(x,y,"-r",x2,y2,"-.")
```

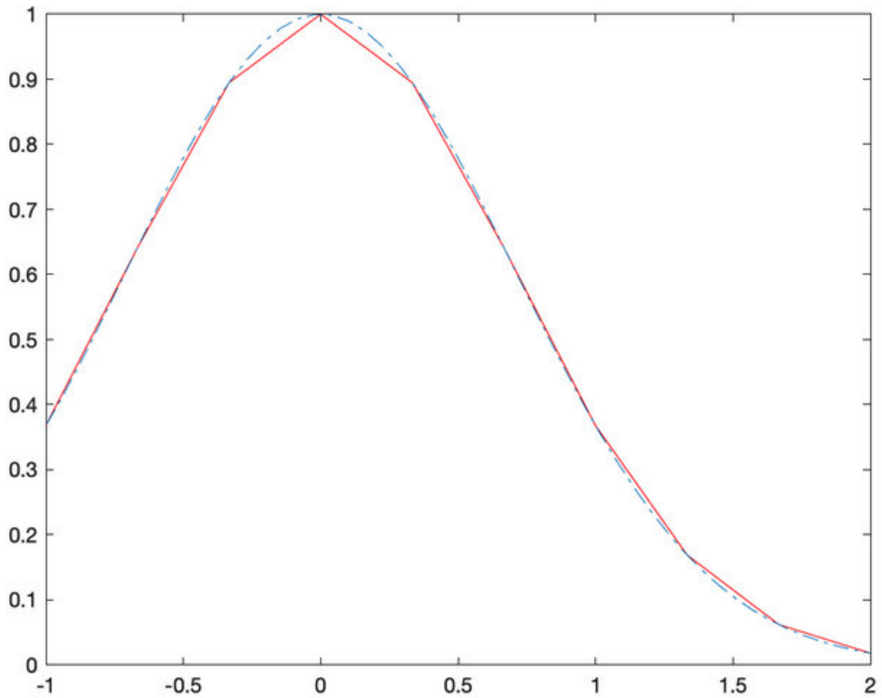



```
y3=interp1(x,y,x2,"spline")
```

```
y3 = 1×50
```

```
y3 = 1×50
      0.3679      0.4132      0.4617      0.5126      0.5649      0.6177   ...
```

```
plot(x,y,"-r",x2,y3,"-.")
```



3. 某天的气温变化如第 3 题数据表，试用最小二乘法找出这一天的气温变化规律。

第 3 题数据表（工作表：气温变化）

时刻 t(h)	0	1	2	3	4	5	6	7	8	9	10	11	12
温度 T(℃)	15	14	14	14	14	15	16	18	20	22	23	25	28
时刻 t(h)	13	14	15	16	17	18	19	20	21	22	23	24	
温度 T(℃)	31	32	31	29	27	25	24	22	20	18	17	16	

```
% 3
t= linspace(0,24,25)
```

```
t = 1×25
     0     1     2     3     4     5     6     7     8     9    10
```

```
y=[15    14         14         14         14         15         16         18
```

```
y = 1×25
    15    14    14    14    14    15    16    18    20    22    23
```

```
p = polyfit(t,y,5)
```

```
p = 1×6
    0.0001   -0.0037    0.0450    0.0157   -0.8304   15.0539
```

```
y1 = polyval(p,25)
```

```
y1 = 19.6326
```

4. 用电压 V=10v 的电池给电容器充电，电容器上 t 时刻的电压为 $u(t)=V-(V-V_0)e^{-t/\tau}$，其中 V_0 是电容器的初始电压，τ 是充电常数。试由第 4 题数据表中的一组 t, $U(t)$ 数据确定 V_0 和 τ。

第 4 题数据表（工作表：电容器）

t(s)	0.5	1	2	3	4	5	7	9
U(t)	6.4	6.5	7.3	8.2	8.7	9	9.4	9.6

```
% 4
% v(t) = V - (V - V0)e^(-t/T) => ln(V-v) = ln(V - V0) - t/T
% y = ln(V - v),x1 = -1/T,x2 = ln(V-V0)
% y = x1t + x2
% T = -1/x1,V0 = V - e^x2

V = 10;
t = [0.5,1,2,3,4,5,7,9];
v = [6.4,6.4,7.3,8.2,8.6,8.9,9.4,9.6];
y = log(V - v);
x = polyfit(t,y,1)
```

```
x = 1×2
    -0.2732    1.4690
```

```
T = 1/x(1)
```

```
T = -3.6609
```

```
V0 = V - exp(x(2))
```

```
V0 = 5.6551
```

5. 给定数据见第 5 题数据表：

第 5 题数据表（工作表：三次样条）

x	0.25	0.30	0.39	0.45	0.53
y	0.5000	0.5477	0.6245	0.6708	0.7280

分别就下列边界条件求三次样条函数 $S(x)$ 并作图。

（1） $S'(0.25)=1, S'(0.53)=0.6868;$

（2） $S''(0.25)=S''(0.53)=0.$

由 Xnip 截图

```
% 5
x=[0.25 0.2 0.29 0.45 0.53]
```

```
x = 1×5
    0.2500    0.2000    0.2900    0.4500    0.5300
```

```
y=[0.5 0.5477 0.6245 0.6708 0.7280]
```

```
y = 1×5
    0.5000    0.5477    0.6245    0.6708    0.7280
```

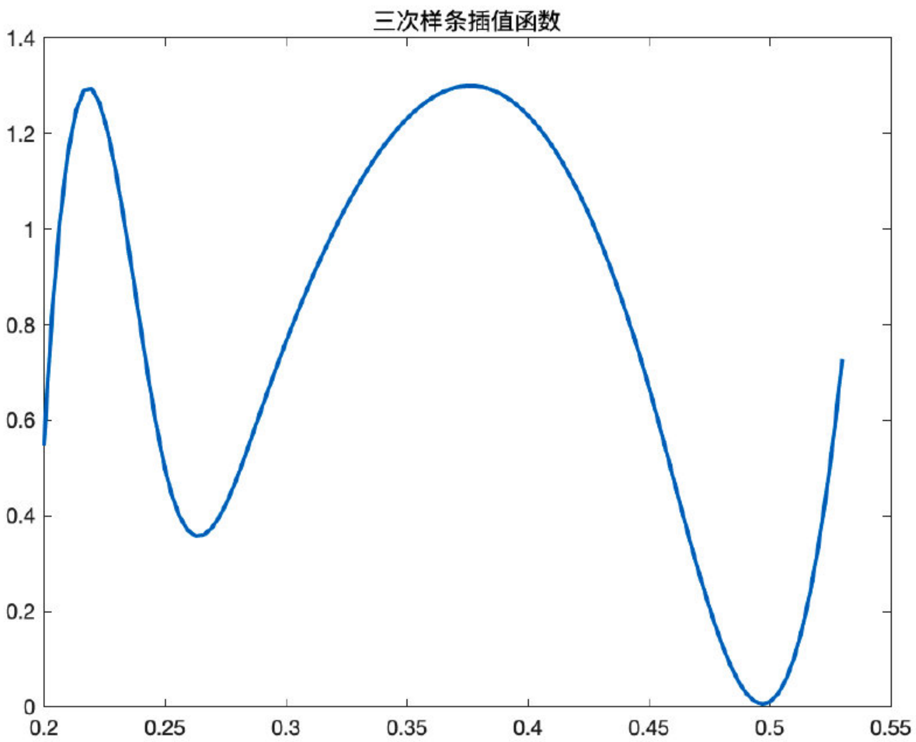
```
pp=csape(x,y,'complete','[1 0.6868]')
```

```
pp = 包含以下字段的 struct:
      form: 'pp'
    breaks: [0.2000 0.2500 0.2900 0.4500 0.5300]
     coefs: [4×4 double]
    pieces: 4
     order: 4
       dim: 1
```

```
pp.coefs
```

```
ans = 4×4
10^4 ×
    2.8243   -0.3251    0.0091    0.0001
   -0.8746    0.0985   -0.0022    0.0001
   -0.0154   -0.0064    0.0015    0.0001
    0.4637   -0.0138   -0.0018    0.0001
```

```
fnplt(pp)
title("三次样条插值函数");
```



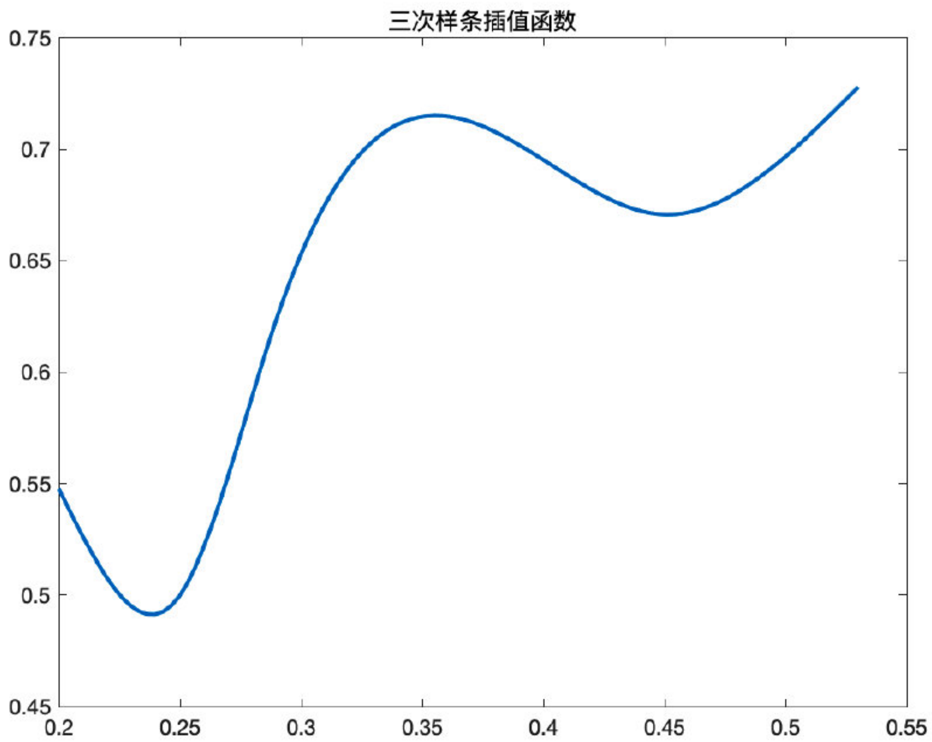

```
pp=csape(x,y,'variational','[0 0]')
```

```
pp = 包含以下字段的 struct:
      form: 'pp'
    breaks: [0.2000 0.2500 0.2900 0.4500 0.5300]
     coefs: [4×4 double]
    pieces: 4
     order: 4
       dim: 1
```

```
pp.coefs
```

```
ans = 4×4
  502.7368         0   -2.2108    0.5477
 -914.7533   75.4105    1.5597    0.5000
  100.9861  -34.3599    3.2017    0.6245
  -58.8060   14.1134   -0.0377    0.6708
```

```
fnplt(pp)
title("三次样条插值函数")
```



6. 用模型 $P = ae^{bt}$ 拟合以下数据，求出拟合系数 a,b.要求用两种方法：

（1）直接法

（2）通过变换，化成线性拟合问题

t	7	14	21	28	35	42
P	8	41	133	250	280	297

由 Xnip 截图

```
% 6
t=[7 14 21 28 35 42 ]
```

```
t = 1×6
     7    14    21    28    35    42
```

```
P =[8 41 133 250 280 297]
```

```
P = 1×6
     8    41   133   250   280   297
```

```
pp=polyfit(t,p,1)
```

```
pp = 1×2
       0.2970   -4.8959
```

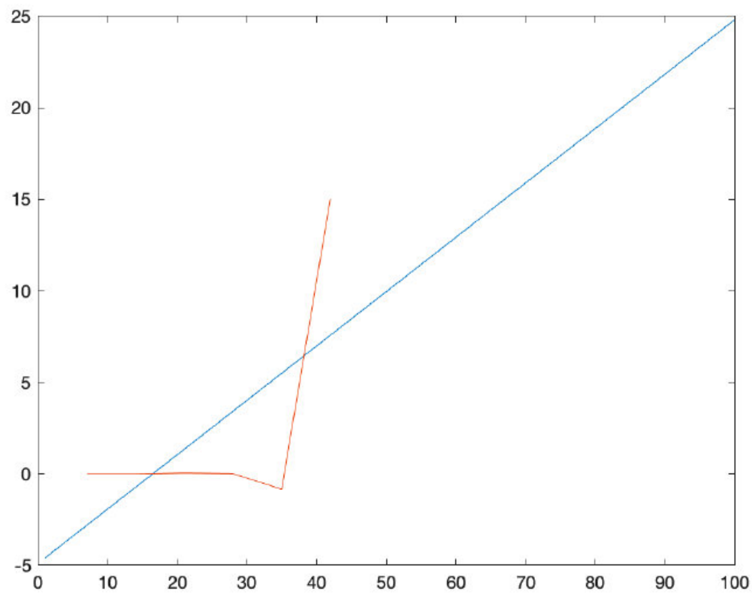
```
x=linspace(1,100,100)
```

```
x = 1×100
     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16
```

```
y=polyval(pp,x)
```

```
y = 1×100
   -4.5989   -4.3019   -4.0049   -3.7079   -3.4110   -3.1140   -2.8170   -2.5200   -2.2231   -1.9
```

```
plot(x,y,t,p)
```




```
pp=polyfit(t,p,4)
```

```
pp = 1×5
       0.0002   -0.0128    0.3680   -4.1779   15.3236
```

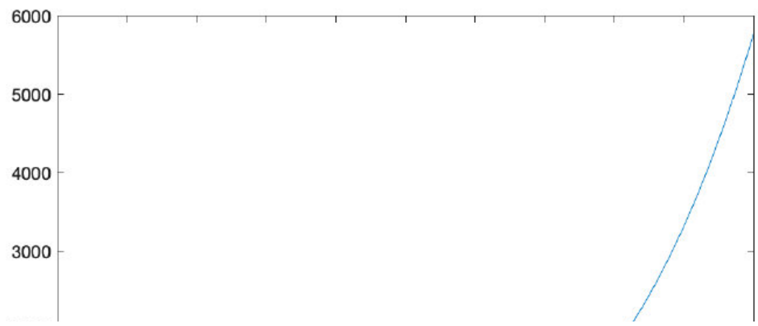
```
x=linspace(1,100,100)
```

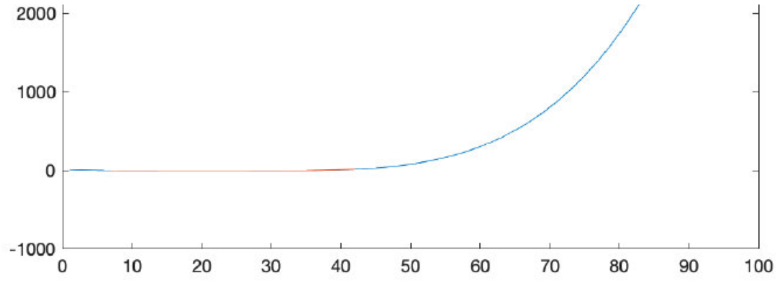
```
x = 1×100
     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16
```

```
y=polyval(pp,x)
```

```
y = 1×100
10^3 ×
       0.0115    0.0083    0.0058    0.0037    0.0021    0.0009    0.0001   -0.0005   -0.0008   -0.0
```

```
plot(x,y,t,p)
```




2000
1000
0
-1000
0
10
20
30
40
50
60
70
80
90
100