e162.m

```
syms k
A=[1-k -2 4;2 3-k 1;1 1 1-k];
D=det(A)
factor(D)
```

结果显示如下：

```
D =
   -6*k+5*k^2-k^3
ans =
    -k*(k-2)*(-3+k)
```

从而得到：当 k=0、k=2 或 k=3 时，原方程组有非 0 解。

e181_1.m

```
A=[1   1   -3   -1;3   -1   -3   4;1   5   -9   -8];
b=[1 4 0]';
B=[A b];
n=4;
R_A=rank(A)
R_B=rank(B)
format rat
if R_A==R_B&R_A==n
   X=A\b
elseif R_A==R_B&R_A<n
   X=A\b
   C=null(A,'r')
else X='Equation has no solves'
end
```

结果显示为：

```
R_A =
     2
R_B =
     2
Warning: Rank deficient, rank = 2   tol =    8.8373e-015.
> In D:\Matlab\pujun\lx0723.m at line 11
X =
   0
   0
   -8/15
```

3/5

C =

3/2	-3/4
3/2	7/4
1	0
0	1

所以原方程组的通解为

$$X=k_1\begin{pmatrix}3/2\\3/2\\1\\0\end{pmatrix}+k_2\begin{pmatrix}-3/4\\7/4\\0\\1\end{pmatrix}+\begin{pmatrix}0\\0\\-8/15\\3/5\end{pmatrix}$$

e181_2.m

```
A=[1   1   -3   -1;3   -1   -3   4;1   5   -9   -8];
b=[1 4 0]';
B=[A b];
 C=rref(B)
```

结果显示为：

C =

1	0	-3/2	3/4	5/4
0	1	-3/2	-7/4	-1/4
0	0	0	0	0

对应齐次方程组的基础解系为：

$$\xi_1=\begin{pmatrix}3/2\\3/2\\1\\0\end{pmatrix},\qquad \xi_2=\begin{pmatrix}-3/4\\7/4\\0\\1\end{pmatrix}$$

非齐次方程组的特解为：

$$\eta^*=\begin{pmatrix}5/4\\-1/4\\0\\0\end{pmatrix}$$

所以，原方程组的通解为：

$$X=k_1\xi_1+k_2\xi_2+\eta^*$$

e193.m

```
A=[0 1 1 -1;1 0 -1 1;1 -1 0 1;-1 1 1 0];
[P,D]=schur(A)
syms y1 y2   y3 y4
y=[y1;y2;y3;y4];
X=vpa(P,2)*y
f=[y1 y2 y3 y4]*D*y
```

运行后结果显示如下：

```
P =
    780/989        780/3691        1/2         -390/1351
    780/3691       780/989        -1/2          390/1351
    780/1351      -780/1351       -1/2          390/1351
        0              0           1/2         1170/1351
D =
        1              0            0             0
        0              1            0             0
        0              0           -3             0
        0              0            0             1
X =
      [ .79*y1+.21*y2+.50*y3-.29*y4]
      [ .21*y1+.79*y2-.50*y3+.29*y4]
      [ .56*y1-.56*y2-.50*y3+.29*y4]
      [                .50*y3+.85*y4]
f =
      y1^2+y2^2-3*y3^2+y4^2
```

e1105.m

```
load west0479
S=west0479;
p=colmmd(S);
subplot(2,2,1),spy(S)
subplot(2,2,2),spy(S(:,p))
subplot(2,2,3),spy(lu(S))
subplot(2,2,4),spy(lu(S(:,p)))
```

结果如图：

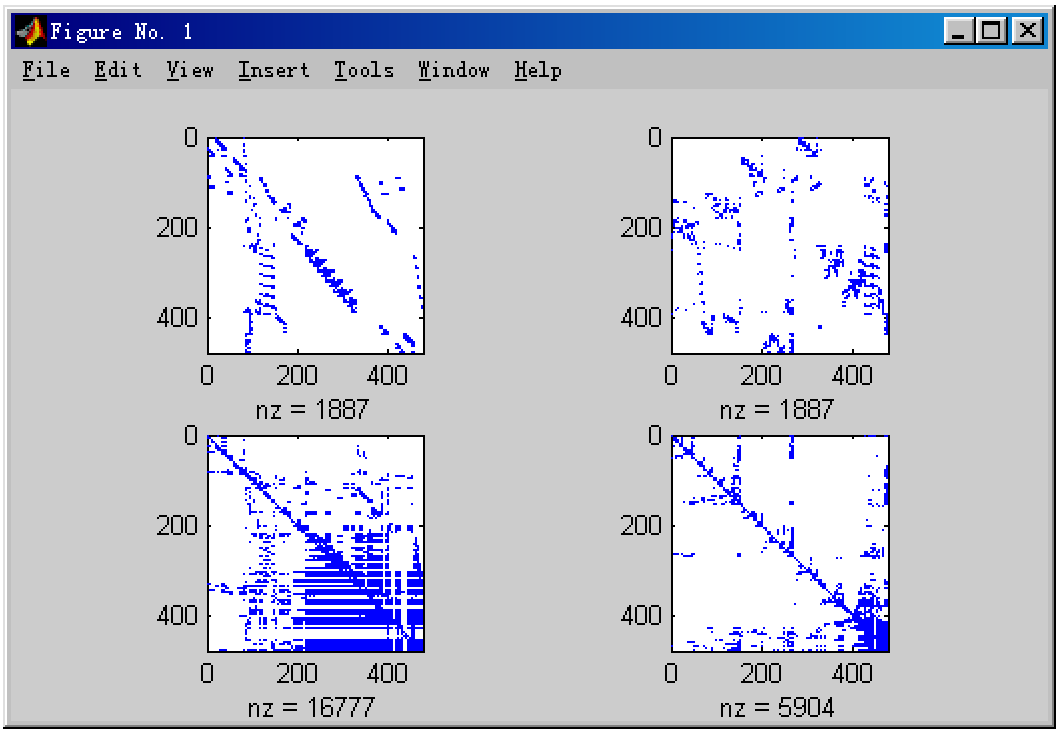


图 1.5　稀疏矩阵的排序图

e232.m

```
year = 1900:10:2010;
product = [75.995   91.972   105.711   123.203   131.669   150.697   179.323   203.212
     226.505   249.633   256.344   267.893 ];
p1995 = interp1(year,product,1995)
x = 1900:1:2010;
y = interp1(year,product,x,'pchip');
plot(year,product,'o',x,y)
```

结果为：

```
p1995 =
        252.9885
```

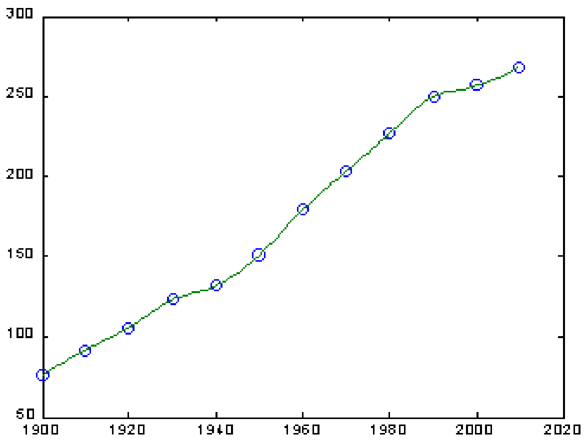


图 2-16　离散数据的一维插值图

e236.m

```
x = [0 2 4 5 8 12 12.8 17.2 19.9 20];    y = exp(x).*sin(x);
xx = 0:.25:20;
yy = spline(x,y,xx);
plot(x,y,'o',xx,yy)
```

插值图形结果为：

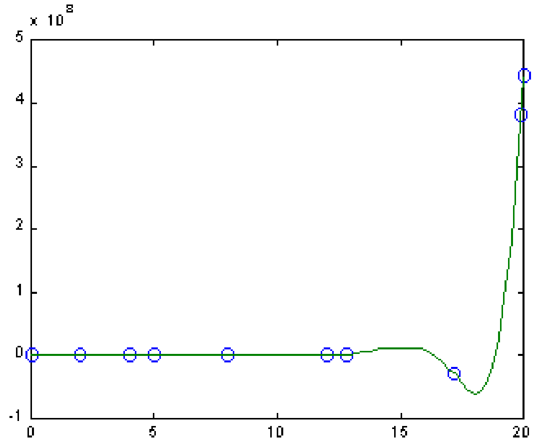


图 2-19　三次样条插值

e244.m

```
f = inline('exp(-x.^2/2).*sin(x.^2+y)','x','y');
xlower = inline('-sqrt(1-y.^2)','y'); xupper = inline('sqrt(1-y.^2)','y');
Q = quad2dggen(f, xlower,xupper,-1,1,1e-4)
```

计算结果为：

```
Q =
      0.5368603818
```

e245.m

先编写函数文件：verderpol.m：

```
function xprime = verderpol(t,x)
global MU
xprime = [x(2);MU*(1-x(1)^2)*x(2)-x(1)];
```

再编写 M 文件：e245.m

```
global MU
MU = 7;
Y0=[1;0]
[t,x] = ode45('verderpol',0,40,Y0);
x1=x(:,1);x2=x(:,2);
plot(t,x1,t,x2)
```

图形结果为：

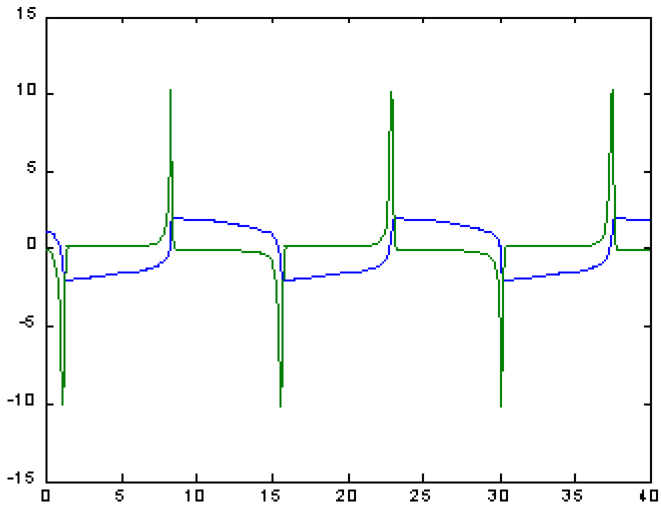


图 2-20　Ver der Pol 微分方程图

e330.m

```
syms x y
f = (1-x)^2*exp(-(x^2)-(y+1)^2)-5*(x/5-x^3-y^5)*sin(-x^2-y^2)-1/3*exp(-(x+1)^2-y^2);
ezcontourf(f,[-3,3],64)
```

图形结果为：

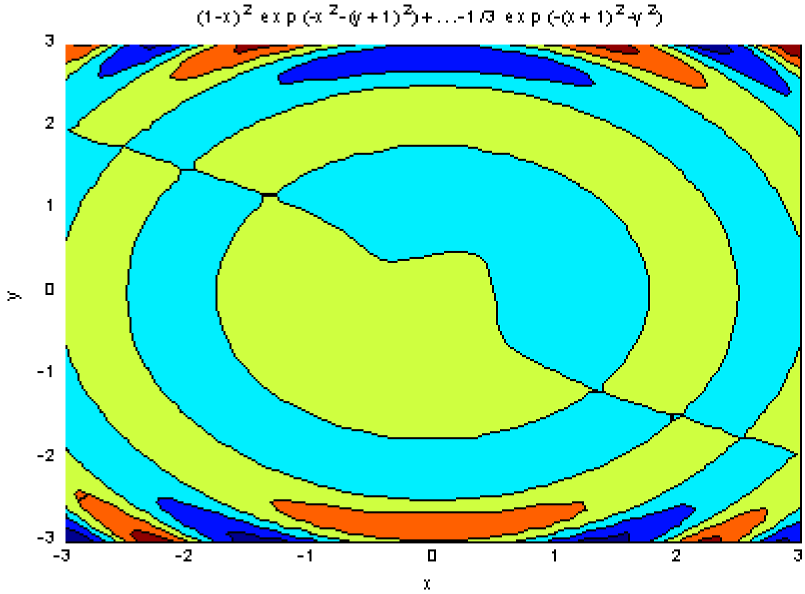


图 3-5　等高线填充图

e342.m

```
syms a s t u v x
        f = exp(x/s^2);
        IL1 = ilaplace(f)
        g = 1/(t-a)^2;
        IL2 = ilaplace(g)
        k = 1/(u^2-a^2);
        IL3 = ilaplace(k,x)
        y = s^3*v/(s^2+v^2);
        IL4 = ilaplace(y,v,x)
```

计算结果为：

```
IL1 =
        ilaplace(exp(x/s^2),s,t)
IL2 =
        x*exp(a*x)
IL3 =
       1/(-a^2)^(1/2)*sin((-a^2)^(1/2)*x)
IL4 =
       s^3*cos((s^2)^(1/2)*x)
```

e348.m

```
syms x y z u v w
        w = [x*y*z; y; x+z];
        v = [x,y,z];
        R = jacobian(w,v)
        b = jacobian(x+u, v)
```

计算结果为：

R =

```
[ y*z,   x*z, x*y]
[     0,      1,      0]
[     1,      0,      1]
```

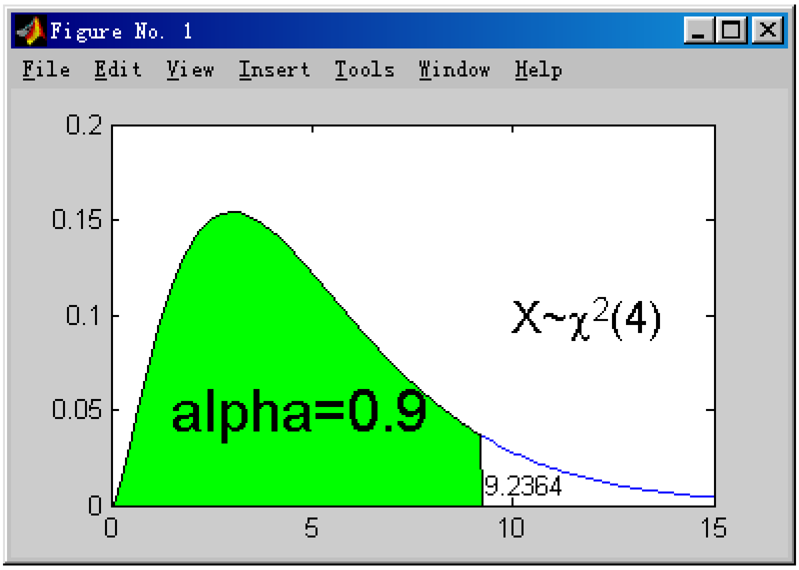
b =

```
[ 1, 0, 0]
```

e429.m

```
n=5; a=0.9;
x_a=chi2inv(a,n);
x=0:0.1:15; yd_c=chi2pdf(x,n);
plot(x,yd_c,'b'), hold on
xxf=0:0.1:x_a; yyf=chi2pdf(xxf,n);
fill([xxf,x_a], [yyf,0], 'g')
text(x_a*1.01,0.01, num2str(x_a))
text(10,0.10, ['\fontsize{16}X~{\chi}^2(4)'])
text(1.5,0.05, '\fontsize{22}alpha=0.9' )
```

结果显示如下：



e440.m

```
X=[-2 -1 0 1 2];
p=[0.3 0.1 0.2 0.1 0.3];
EX=sum(X.*p)
Y=X.^2-1
EY=sum(Y.*p)
```

运行后结果如下：

EX =

0

Y =

3 0 -1 0 3

EY =

1.6000

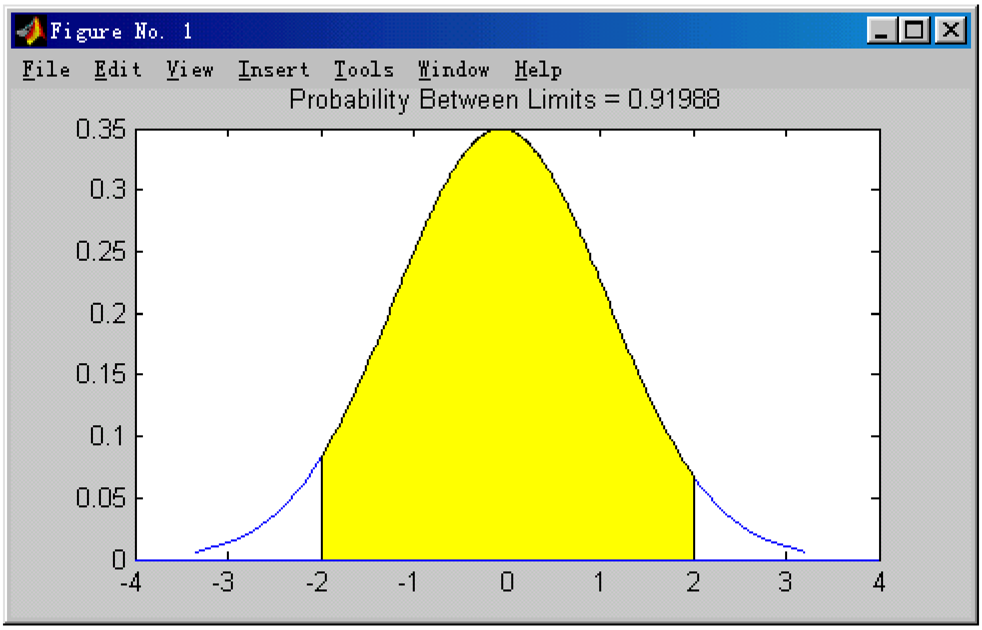
e458.m

```
data=normrnd (0,1,30,1);
p=capaplot(data,[-2,2])
```

结果为：

p =

0.9199



e463.m

```
X=[6.683 6.681 6.676 6.678 6.679 6.672];
Y=[6.661 6.661 6.667 6.667 6.664];
[mu,sigma,muci,sigmaci]=normfit(X,0.1)
[MU,SIGMA,MUCI,SIGMACI]=normfit(Y,0.1)
```

运行后结果显示如下：

mu =

6.6782

sigma =

0.0039

muci =

6.6750

6.6813

sigmaci =

0.0026
0.0081
MU =
6.6640
SIGMA =
0.0030
MUCI =
6.6611
6.6669
SIGMACI =
0.0019
0.0071

由上可知，金球测定的μ估计值为 6.6782，置信区间为[6.6750，6.6813]；
σ的估计值为 0.0039，置信区间为[0.0026，0.0081]。
泊球测定的μ估计值为 6.6640，置信区间为[6.6611，6.6669]；
σ的估计值为 0.0030，置信区间为[0.0019，0.0071]。

e476.m

```
X=[78.1   72.4   76.2   74.3   77.4   78.4   76.0   75.5   76.7   77.3];
Y=[79.1   81.0   77.3   79.1   80.0   79.1   79.1   77.3   80.2   82.1];
[h,sig,ci]=ttest2(X,Y,0.05,-1)
```

结果显示为：

```
h =
     1
sig =
  2.1759e-004        %说明两个总体均值相等的概率很小
ci =
     -Inf    -1.9083
```

结果表明：H=1 表示在水平α＝0.05 下，应该拒绝原假设，即认为建议的新操作方法提高了得率，因此，比原方法好。

e481.m

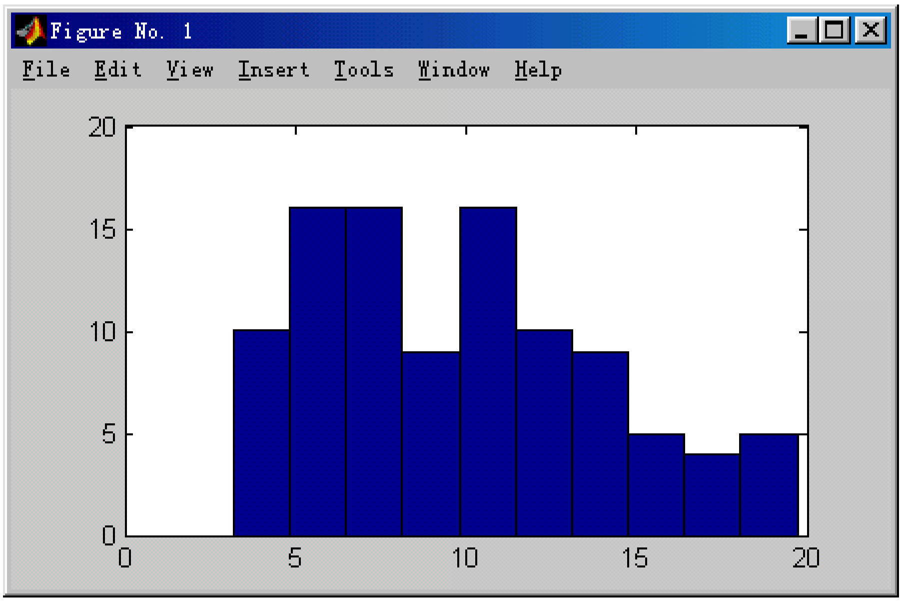
```
  Y=chi2rnd(10,100,1);
  [h,p,l,cv]=lillietest(Y)
  hist(Y)
```

结果为

```
h =
     1
p =
    0.0175
l =
    0.1062
cv =
```

0.0886

说明：h=1 表示拒绝正态分布的假设；p = 0.0175 表示服从正态分布的概率很小；统计量的值 l = 0.1062 大于接受假设的临界值 cv =0.0886，因而拒绝假设(测试水平为 5%)。



从图中看出，数据 Y 不服从正态分布。

e482.m

```
x=weibrnd(1,2,100,1);
[H1,p1,ksstat1,cv1]=kstest(x,[x weibcdf(x,1,2)],0.05)
[H2,p2,ksstat2,cv2]=kstest(x,[x expcdf(x,1)],0.05)
[H3,p3,ksstat3,cv3]=kstest(x,[ ],0.05)
```

结果为：

H1 =

0

p1 =

0.3022

ksstat1 =

0.0959

cv1 =

0.1340

说明：H1=0 表示接受原假设，统计量 ksstat 小于临界值表示接受原假设。

H2 =

1

p2 =

0.0073

ksstat2 =

0.1653

cv2 =

0.1340

说明：H2=1 表明拒绝服从指数分布的假设。

```
H3 =
     1
p3 =
   3.1285e-026
ksstat3 =
    0.5380
cv3 =
    0.1340
```

说明：H3=1 表明不服从标准正态分布。

e485.m

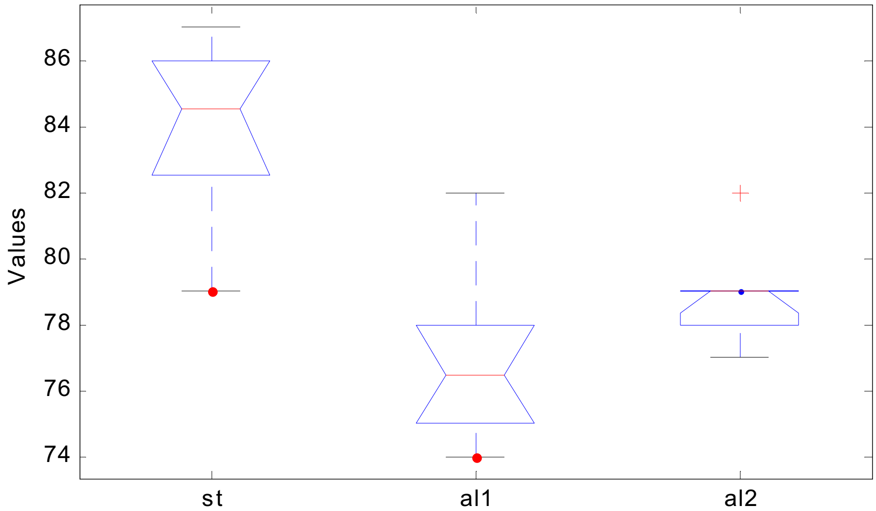
```
strength = [82 86 79 83 84 85 86 87 74 82 78 75 76 77 79 79 77 78 82 79];
alloy = {'st','st','st','st','st','st','st','st', 'al1','al1','al1','al1','al1','al1',...
        'al2','al2','al2','al2','al2','al2'};
[p,table,stats] = anova1(strength,alloy,'on')
```

结果为

```
p =
   1.5264e-004
table =
    'Source'    'SS'          'df'    'MS'         'F'          'Prob>F'
    'Groups'    [184.8000]    [ 2]    [92.4000]    [15.4000]    [1.5264e-004]
    'Error'     [102.0000]    [17]    [ 6.0000]           [ ]              [ ]
    'Total'     [286.8000]    [19]          [ ]           [ ]              [ ]
stats =
    gnames: {3x1 cell}
         n: [8 6 6]
    source: 'anova1'
     means: [84 77 79]
        df: 17
         s: 2.4495
```

ANOVA Table

Source	SS	df	MS	F	Prob>F
Groups	184.8	2	92.4	15.4	0.0002
Error	102	17	6		
Total	286.8	19			



说明：p 值显示，3 种合金是明显不同的，盒图显示钢横梁的挠度大于另两种合金横梁的挠度。

e506.m

先在建立非线性约束函数文件：mycon.m

```
function   [c, ceq]=mycon (x)
c=(x(1)-1)^2-x(2);
ceq=[ ];
```

然后，建立 M 文件：e506.m

```
fun='x(1)^2+x(2)^2-x(1)*x(2)-2*x(1)-5*x(2)';
x0=[0 1];
A=[-2 3];
b=6;
Aeq=[ ];
beq=[ ];
lb=[ ];
ub=[ ];
[x,fval,exitflag,output,lambda,grad,hessian]
   =fmincon(fun,x0,A,b,Aeq,beq,lb,ub,@mycon)
```

则结果为

```
x =
      3        4
fval =
   -13
exitflag =          %解收敛
      1
output =
          iterations: 2
```

```
            funcCount: 9
             stepsize: 1
            algorithm: 'medium-scale: SQP, Quasi-Newton, line-search'
    firstorderopt: [ ]
     cgiterations: [ ]
lambda =
             lower: [2x1 double]     %x 下界有效情况，通过 lambda.lower 可查看。
             upper: [2x1 double]     %x 上界有效情况，为 0 表示约束无效。
             eqlin: [0x1 double]      %线性等式约束有效情况，不为 0 表示约束有效。
          eqnonlin: [0x1 double]      %非线性等式约束有效情况。
           ineqlin: 2.5081e-008      %线性不等式约束有效情况。
        ineqnonlin: 6.1938e-008      %非线性不等式约束有效情况。
grad =          %目标函数在最小值点的梯度
   1.0e-006 *
    -0.1776
          0
hessian =       %目标函数在最小值点的 Hessian 值
      1.0000    -0.0000
     -0.0000     1.0000
```

e510.m

先建立非线性约束和半无限约束函数文件，并保存为 mycon.m：

```
function [C,Ceq,K1,K2,S] = mycon(X,S)
if   isnan(S(1,1)),
     S = [0.2   0; 0.2   0];
end
w1 = 1:S(1,1):100;
w2 = 1:S(2,1):100;
K1 = sin(w1*X(1)).*cos(w1*X(2)) - 1/1000*(w1-50).^2 -sin(w1*X(3))-X(3)-1;
K2 = sin(w2*X(2)).*cos(w2*X(1)) - 1/1000*(w2-50).^2 -sin(w2*X(3))-X(3)-1;
C = [ ]; Ceq=[ ];
plot(w1,K1,'-',w2,K2,':'),title('Semi-infinite constraints')
```

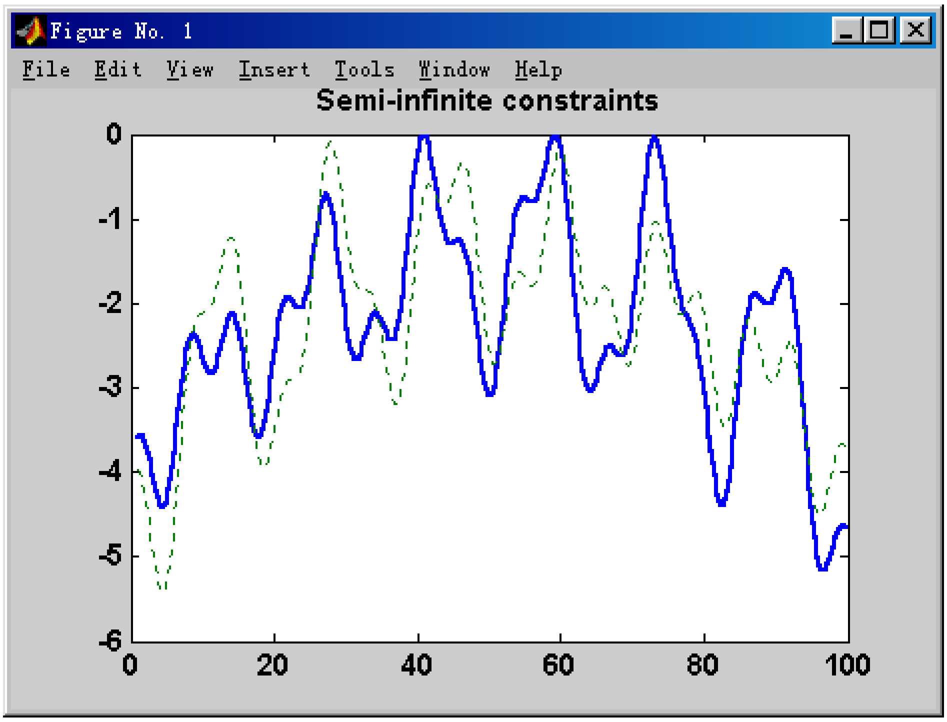
然后建立 M 文件：**e510.m**

```
fun = 'sum((x-0.5).^2)';
x0 = [0.5; 0.2; 0.3];          % Starting guess
[x,fval] = fseminf(fun,x0,2,@mycon)
[C,Ceq,K1,K2] = mycon (x,NaN);
K1_m=max(K1)
K2_m=max(K2)
```

结果为：

```
      x =
      0.6673
      0.3013
```

0.4023
fval =
0.0770
k1_m =
-0.0017
k2_m =
-0.0845



e511.m

先建立非线性和半无限约束函数文件，并保存为 mycon1.m

```
function [C,Ceq,K1,S] = mycon1(X,S)

if   isnan(S(1,1)),
     S = [2 2];
end

w1x = 1:S(1,1):100;
w1y = 1:S(1,2):100;
[wx, wy] = meshgrid(w1x,w1y);

K1 = sin(wx*X(1)).*cos(wx*X(2))-1/1000*(wx-50).^2 -sin(wx*X(3))-X(3)+...
sin(wy*X(2)).*cos(wx*X(1))-1/1000*(wy-50).^2-sin(wy*X(3))-X(3)-1.5;

C = [ ]; Ceq=[ ];

m = surf(wx,wy,K1,'edgecolor','none','facecolor','interp');
```

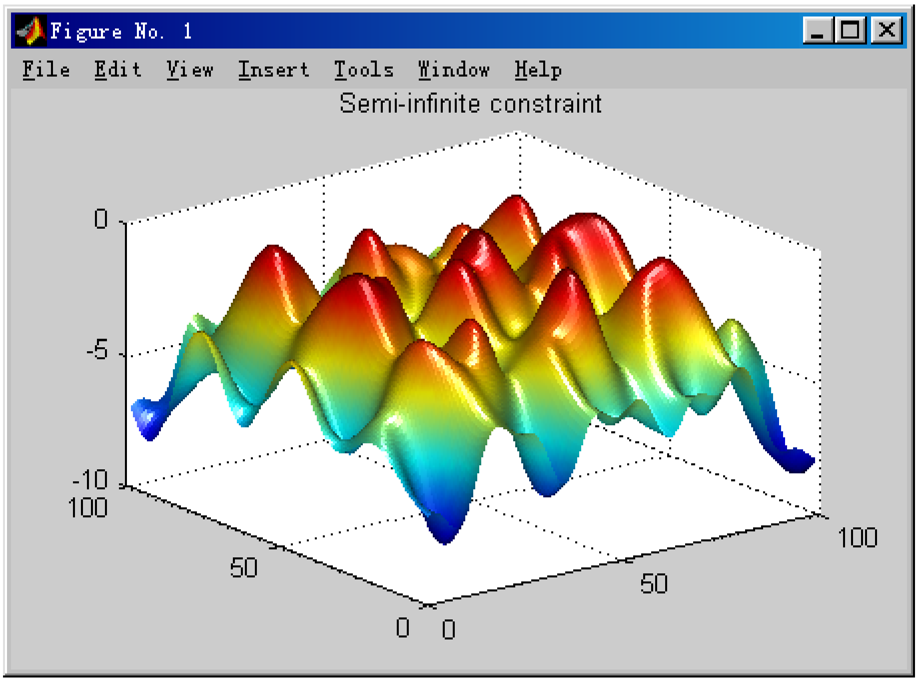
```
camlight headlight
title('Semi-infinite constraint')
drawnow
```

然后键 M 文件：e511.m

```
fun = 'sum((x-0.2).^2)';
x0 = [0.25, 0.25, 0.25];
[x,fval] = fseminf(fun,x0,1,@mycon1)
[C,Ceq,K1] = mycon1(x,[0.5,0.5]);
K1_m=max(max(K1))
```

结果为（如图）

```
Optimization terminated successfully:
 Magnitude of directional derivative in search direction
  less than 2*options.TolFun and maximum constraint violation
  is less than options.TolCon
Active Constraints:
    18
x =
    0.2926    0.1874    0.2202
fval =
    0.0091
K1_m =
   -0.0027
```



e516.m

解：先建立拟合函数文件，并保存为 myfun.m

```
function F = myfun(x,xdata)
F = x(1)*xdata.^2 + x(2)*sin(xdata) + x(3)*xdata.^3;
```

然后给出数据 xdata 和 ydata 并建立 M 文件： **e516.m**

```
xdata = [3.6 7.7 9.3 4.1 8.6 2.8 1.3 7.9 10.0 5.4];
ydata = [16.5 150.6 263.1 24.7 208.5 9.9 2.7 163.9 325.0 54.3];
x0 = [10, 10, 10];
[x,resnorm] = lsqcurvefit(@myfun,x0,xdata,ydata)
```

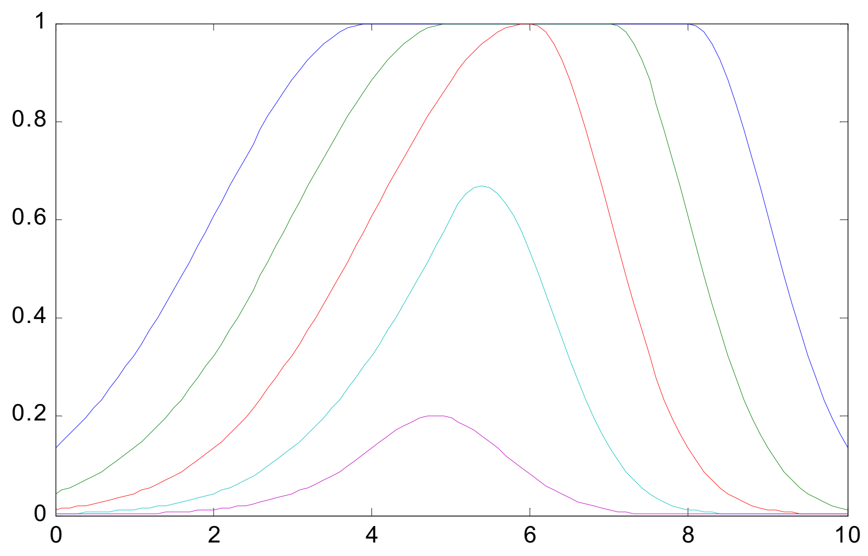
结果为：

```
Optimization terminated successfully:
Relative function value changing by less than OPTIONS.TolFun
x =
0.2269       0.3385       0.3021
resnorm =
       6.2950
```

e602.m

```
x = (0:0.1:10)';
y1 = gauss2mf(x, [2 4 1 8]);
y2 = gauss2mf(x, [2 5 1 7]);
y3 = gauss2mf(x, [2 6 1 6]);
y4 = gauss2mf(x, [2 7 1 5]);
y5 = gauss2mf(x, [2 8 1 4]);
plot(x, [y1 y2 y3 y4 y5]);
set(gcf, 'name', 'gauss2mf', 'numbertitle', 'off');
```

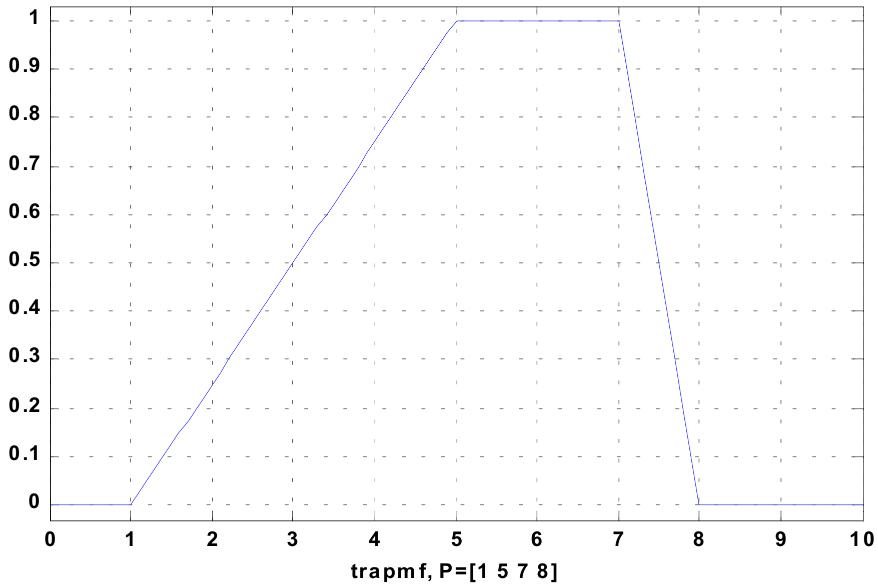
结果为



e612.m

```
x=0:0.1:10;
y=trapmf(x,[1 5 7 8]);
plot(x,y)
xlabel('trapmf, P=[1 5 7 8]')
```

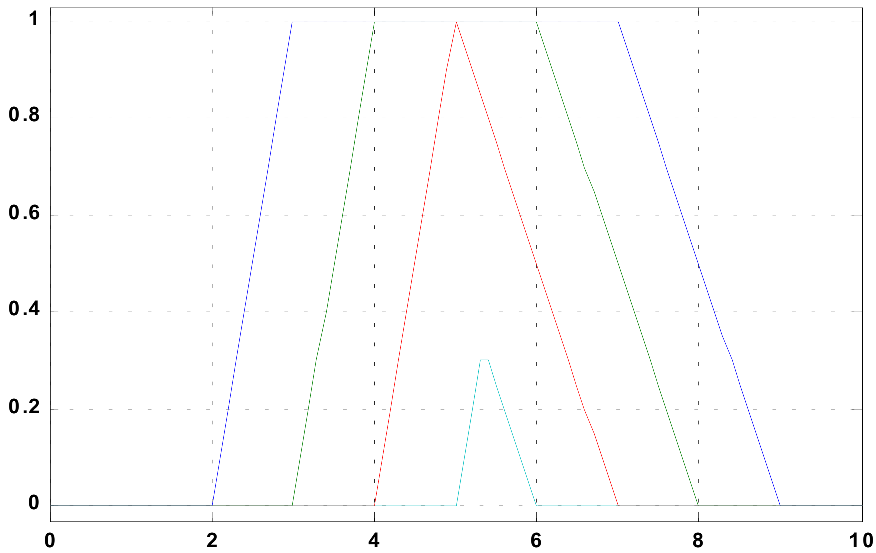
结果为



e613.m

```
x = (0:0.1:10)';
y1 = trapmf(x,[2 3 7 9]);
y2 = trapmf(x,[3 4 6 8]);
y3 = trapmf(x,[4 5 5 7]);
y4 = trapmf(x,[5 6 4 6]);
plot(x,[y1  y2  y3  y4]);
```

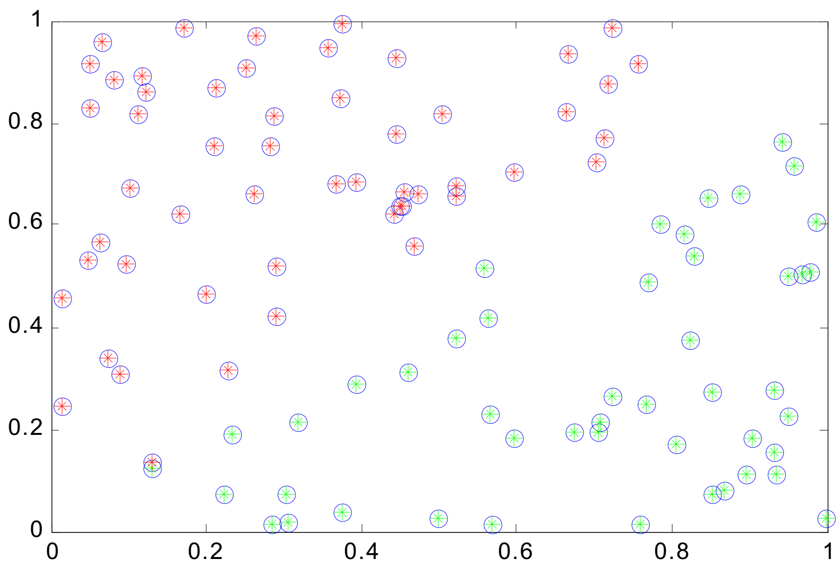
结果为



e623.m

```
data = rand(100, 2);
[center,U,obj_fcn] = fcm(data, 2);
plot(data(:,1), data(:,2),'o');
maxU = max(U);
index1 = find(U(1,:) == maxU);
index2 = find(U(2, :) == maxU);
line(data(index1,1), data(index1, 2), 'linestyle', 'none', 'marker', '*', 'color', 'g');
line(data(index2,1), data(index2, 2), 'linestyle', 'none', 'marker', '*', 'color', 'r');
```

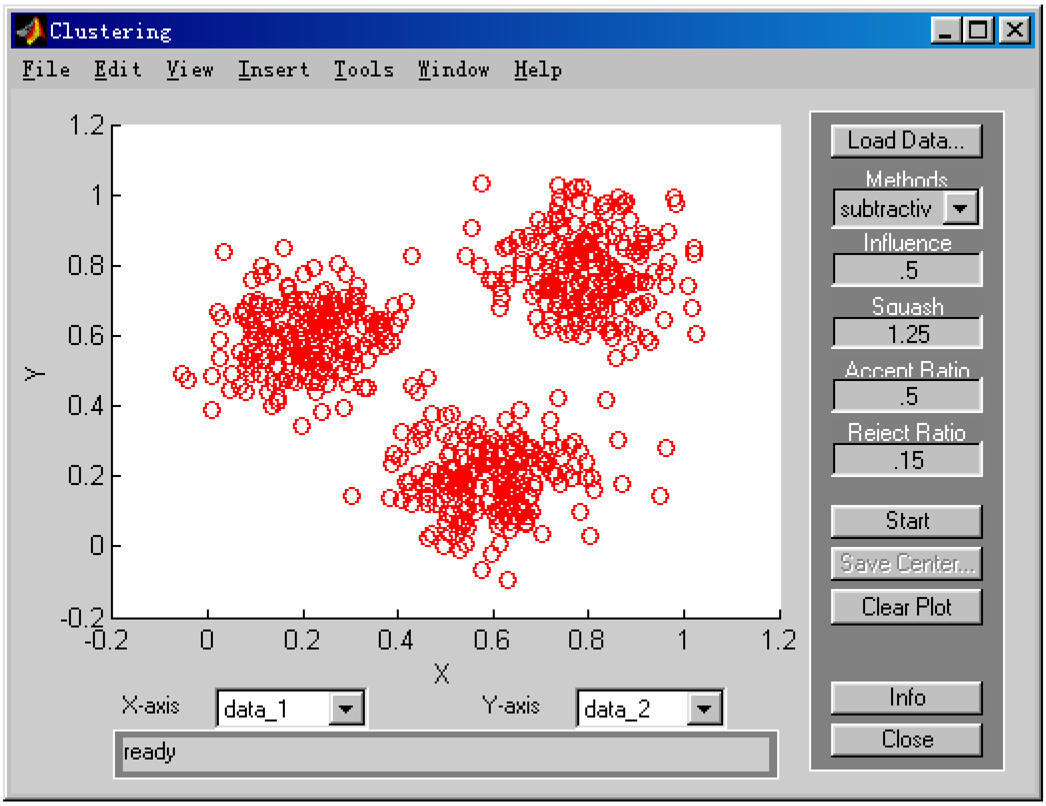
结果为



e624.m

```
findcluster('clusterdemo.dat')
```

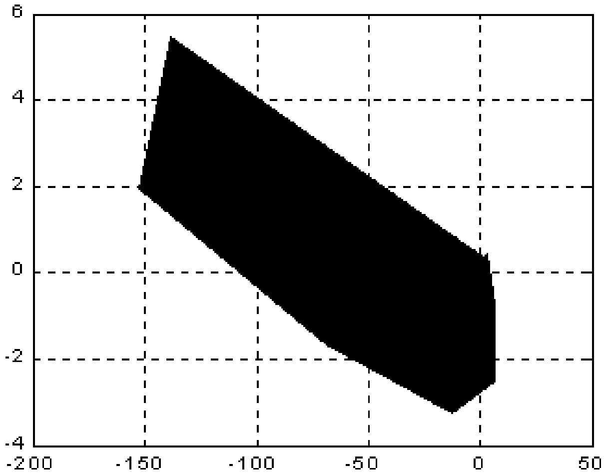
结果为



e706.m

```
t = (1/16:1/8:1)'*2*pi;
x = exp(t).*sin(t);
y = t.*cos(t);
fill(x,y,'k')
grid on
```

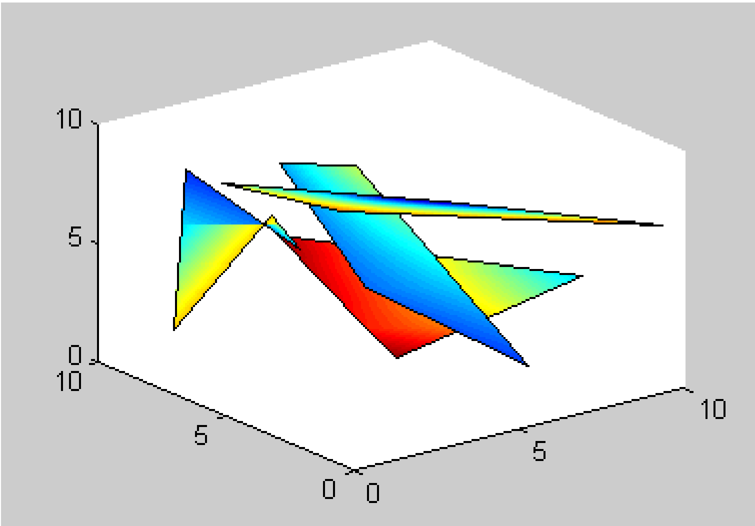
图形结果为：



e725.m

```
X = 10*rand(4);Y=10*rand(4);Z=10*rand(4);
C = rand(4);
fill3(X,Y,Z,C)
```

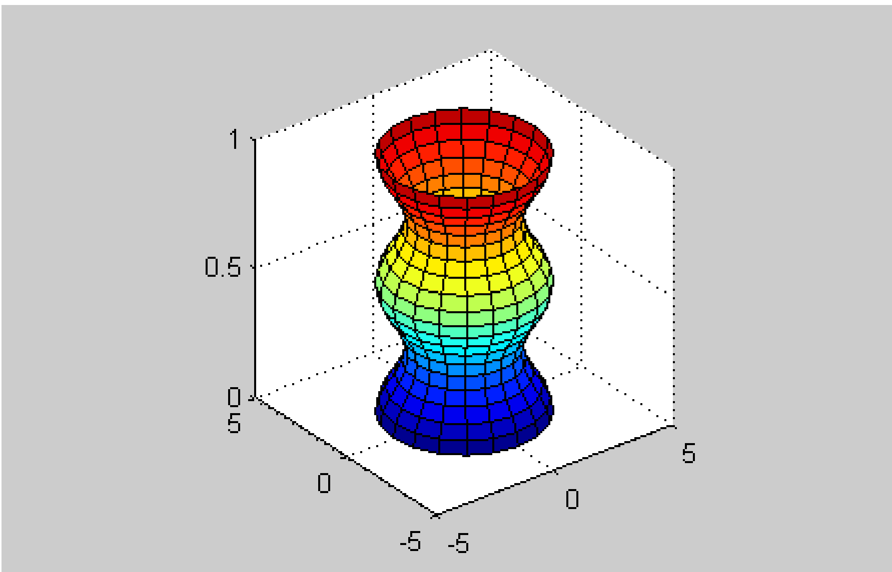
图形结果可能为：



e736.m

```
t = 0:pi/10:2*pi;
[X,Y,Z] = cylinder(2+(cos(t)).^2);
surf(X,Y,Z); axis square
```

图形结果为：



e748.m

```
line(rand(4,2),rand(4,2),rand(4,1))
line(rand(1,4),rand(1,4),rand(1,4))
line(rand(4,1),rand(4,1),rand(4,1))
line(rand(2,4),rand(2,4),rand(1,4))
line(rand(4,2),rand(4,2),rand(4,1))
```

生成图形为：

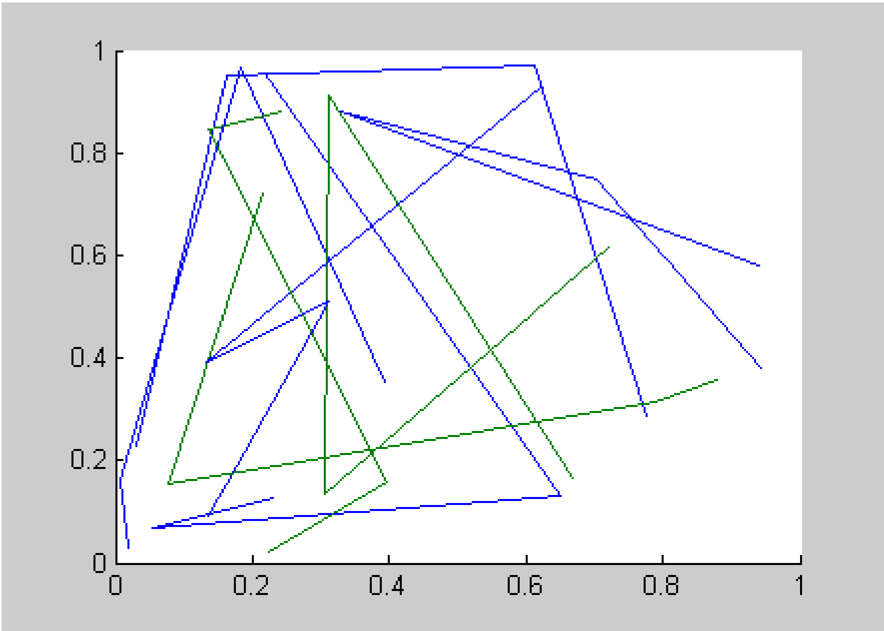


图 3。随机直线图