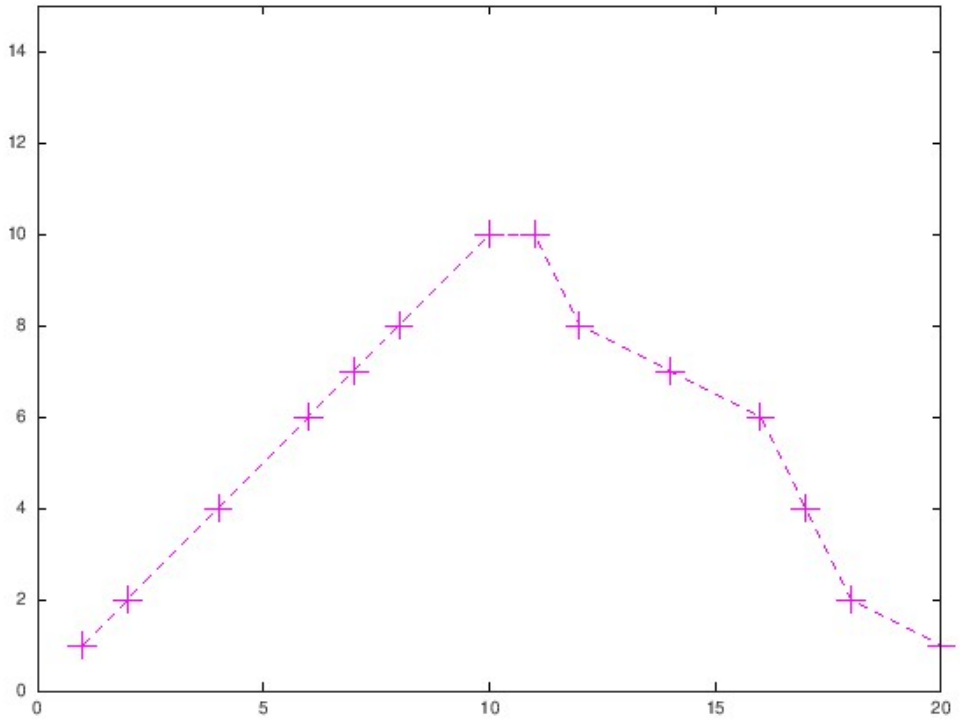
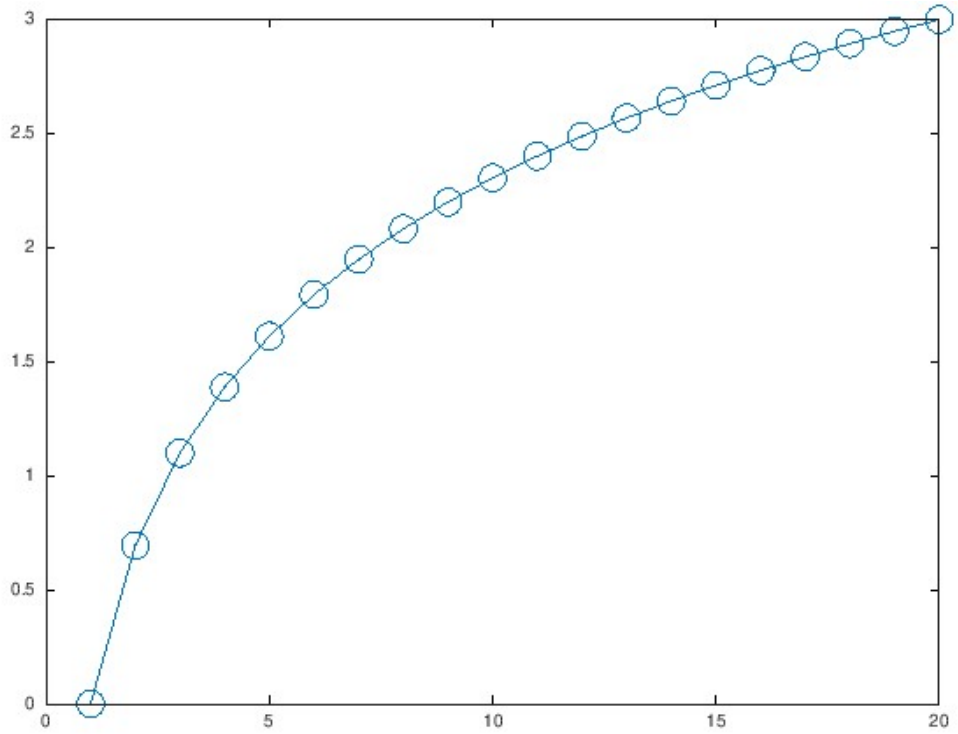
2.1 数据可视化

一元函数图像 - plot

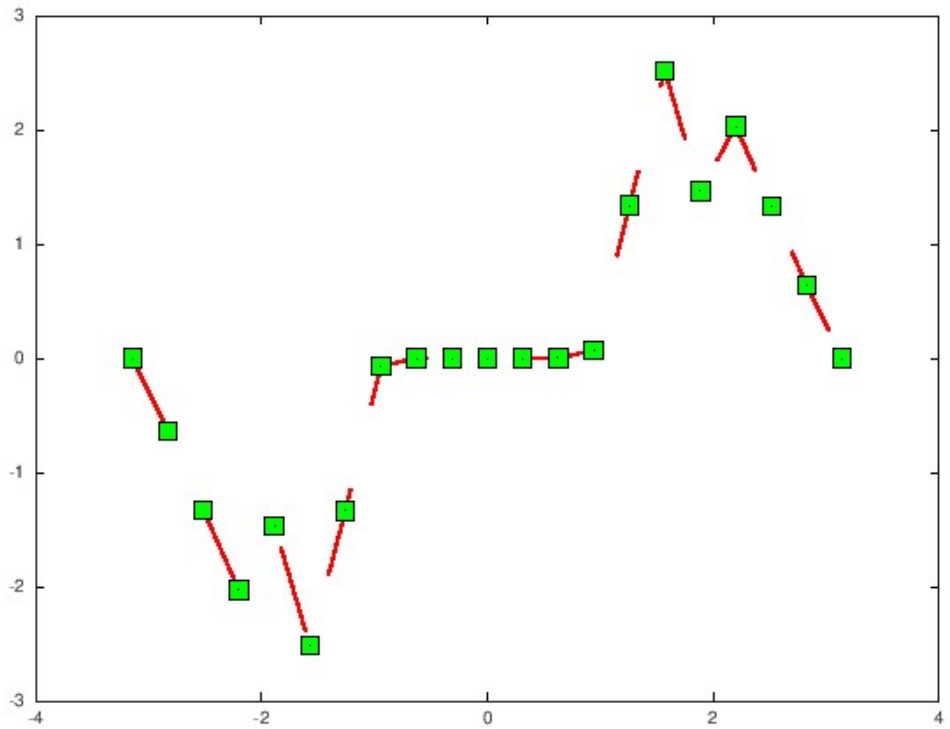
In [12]:
```
X1 = [1,2,4,6,7,8,10,11,12,14,16,17,18,20];
Y1 = [1,2,4,6,7,8,10,10, 8, 7, 6, 4, 2, 1];
plot(X1, Y1, 'm+--','MarkerSize',15); axis([0 20 0 15])
```



In [13]:
```
X2=1:20;    Y2=log(X2); plot(X2,Y2,'o-','MarkerSize',15)
```

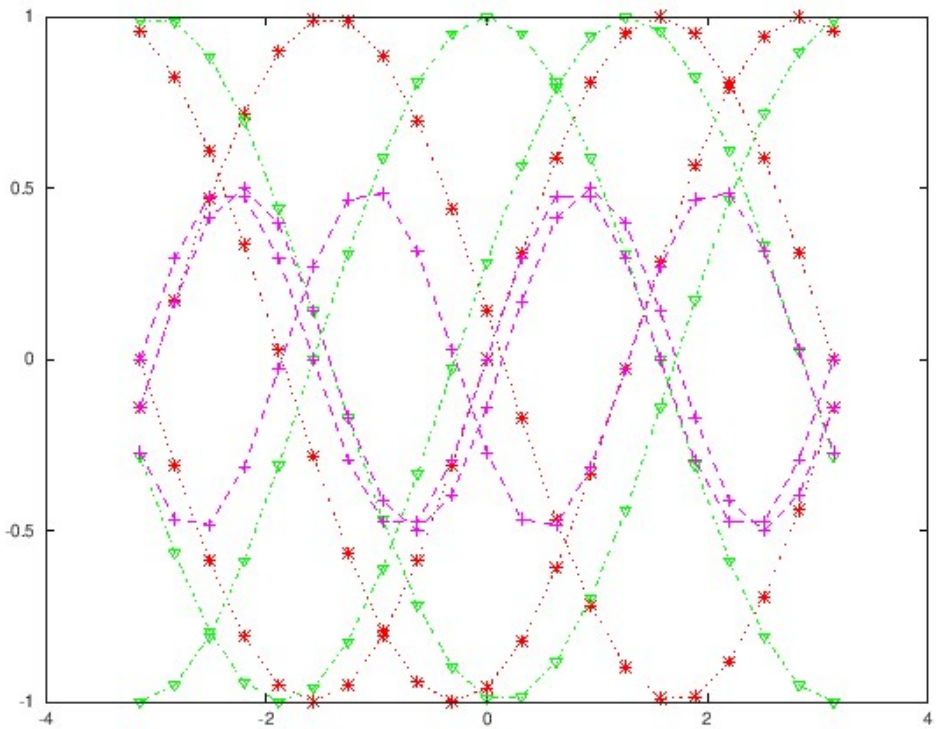


In [14]:
```
x=-pi:pi/10:pi;
y=tan(sin(x))-sin(tan(x));
% 不同的线型、尺寸等
plot(x,y,'--rs','LineWidth',5,'MarkerEdgeColor','k','MarkerFaceColor','g','MarkerSize',10);
```



In [18]:
```
x = -pi:pi/10:pi
y = [sin(x); sin(x+3); sin(x+5)]
z = [cos(x); cos(x+3); cos(x+5)];
w = y.*z;
figure; plot(x,y,'r:*',x,z,'g-.v',x,w,'m--+');
```

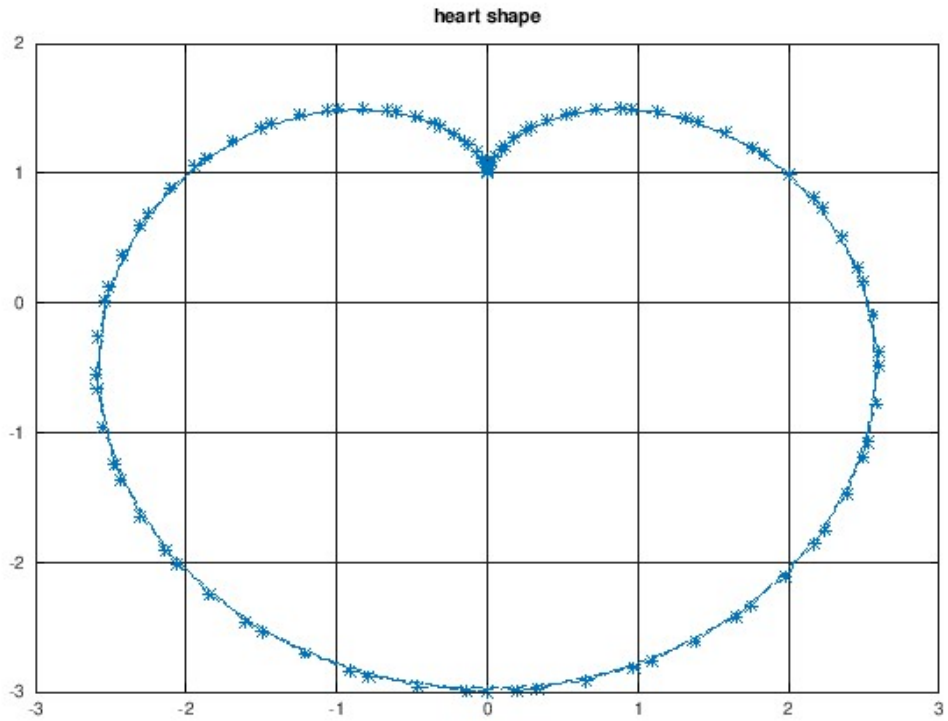
```
x =

 Columns 1 through 8:

   -3.1416   -2.8274   -2.5133   -2.1991   -1.8850   -1.5708   -1.2566   -0.9425

 Columns 9 through 16:

   -0.6283   -0.3142    0.0000    0.3142    0.6283    0.9425    1.2566    1.5708

 Columns 17 through 21:

    1.8850    2.1991    2.5133    2.8274    3.1416

y =

 Columns 1 through 8:

  -0.00000  -0.30902  -0.58779  -0.80902  -0.95106  -1.00000  -0.95106  -0.80902
  -0.14112   0.17171   0.46773   0.71797   0.89793   0.98999   0.98515   0.88387
   0.95892   0.82433   0.60905   0.33415   0.02655  -0.28366  -0.56610  -0.79313

 Columns 9 through 16:

  -0.58779  -0.30902   0.00000   0.30902   0.58779   0.80902   0.95106   1.00000
   0.69607   0.44014   0.14112  -0.17171  -0.46773  -0.71797  -0.89793  -0.98999
  -0.94252  -0.99965  -0.95892  -0.82433  -0.60905  -0.33415  -0.02655   0.28366

 Columns 17 through 21:

   0.95106   0.80902   0.58779   0.30902   0.00000
  -0.98515  -0.88387  -0.69607  -0.44014  -0.14112
   0.56610   0.79313   0.94252   0.99965   0.95892
```



In [ ]:

心形线

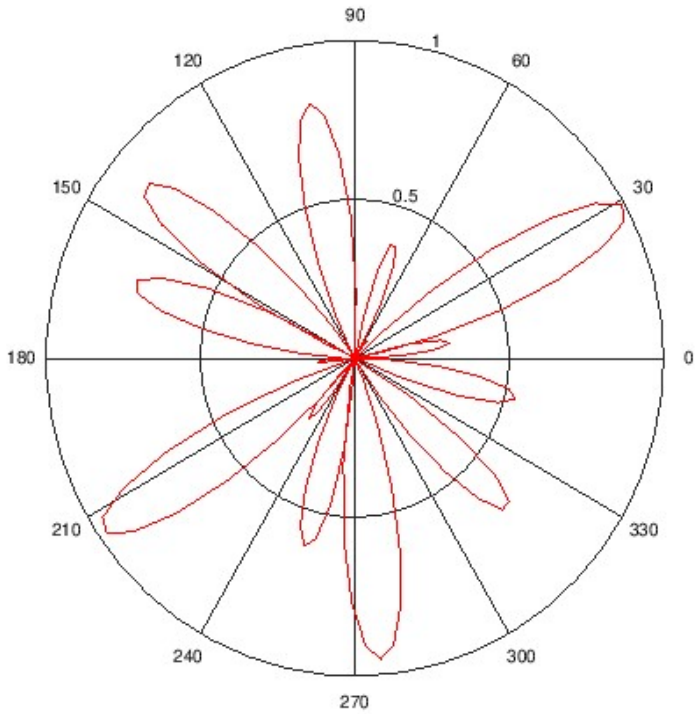
In [24]:
```
t = -3*pi:0.2:3*pi;
y = 2*cos(t) - cos(2*t);
x = 2*sin(t) - sin(2*t);
plot(x,y,'--*')
title('heart shape');
grid on
```



练习: 请绘制不同类型的心型曲线

例（极坐标图） 绘制函数$\rho=\sin(3\theta)cos(5\theta)$的图形

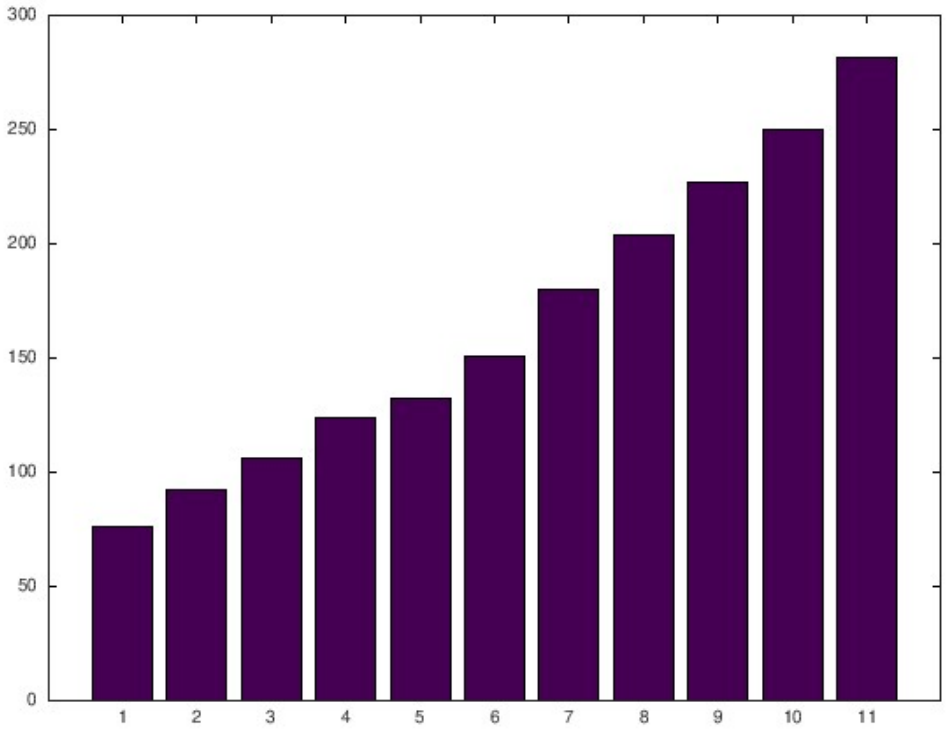
In [30]:
```
theta = 0:0.05:2*pi;
rho = sin(3*theta).*cos(5.2*theta);
polar(theta,rho,'r-');
```



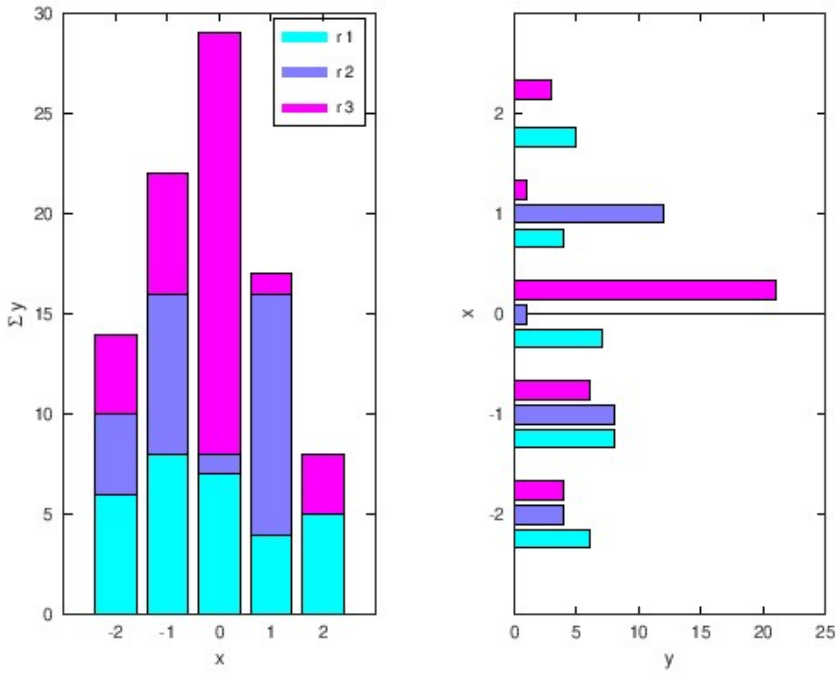
In [ ]:

统计图

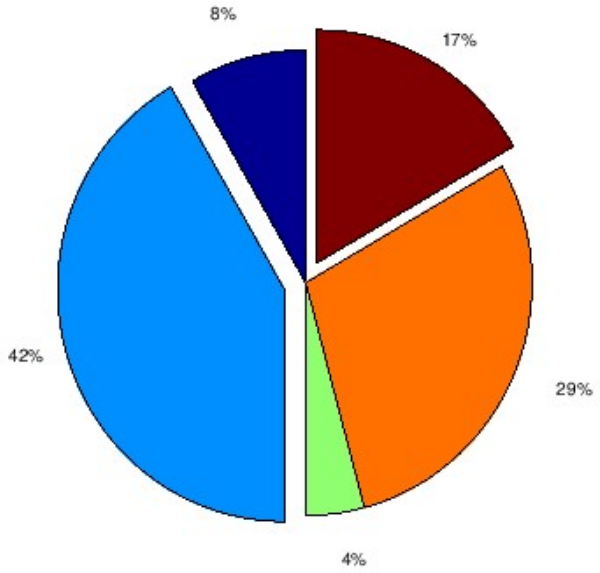
In [31]:
```
y=[75.995,91.972,105.711,123.203,131.669,150.697,179.323,203.212,226.505,249.633,28
1.422];
figure;
bar(y);
```



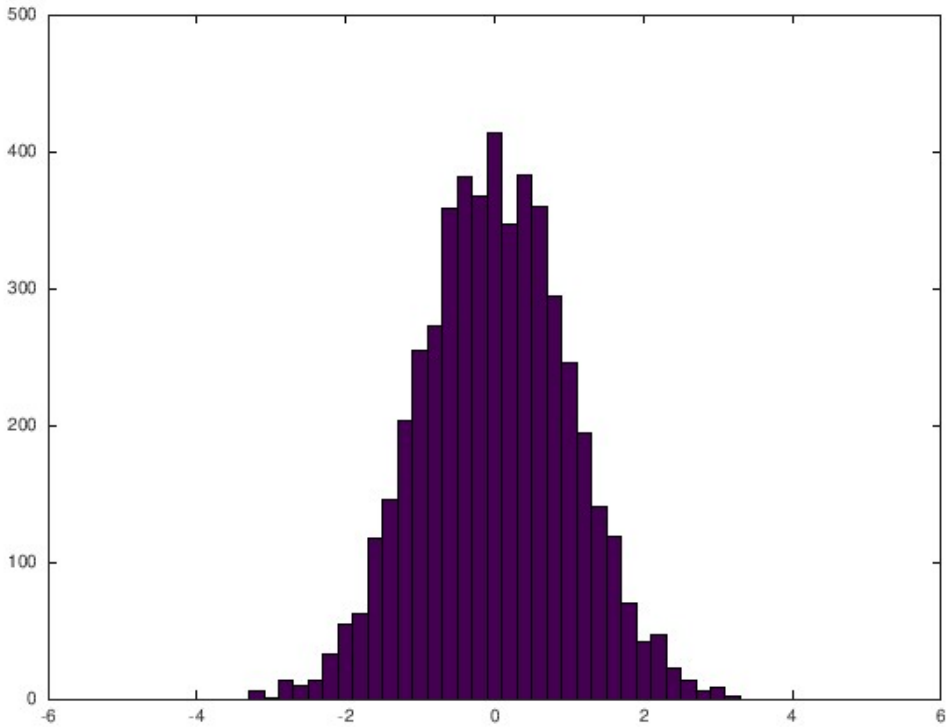
In [33]:
```
x=-2:2;
Y=[6,8,7,4,5;4,8,1,12,0;4,6,21,1,3];
subplot(1,2,1),bar(x',Y','stacked')
xlabel('x'),ylabel('\Sigma y'),colormap(cool)
legend('r 1','r 2','r 3')
subplot(1,2,2),barh(x',Y','grouped') % barh创建水平直方图
xlabel('y'),ylabel('x')
```



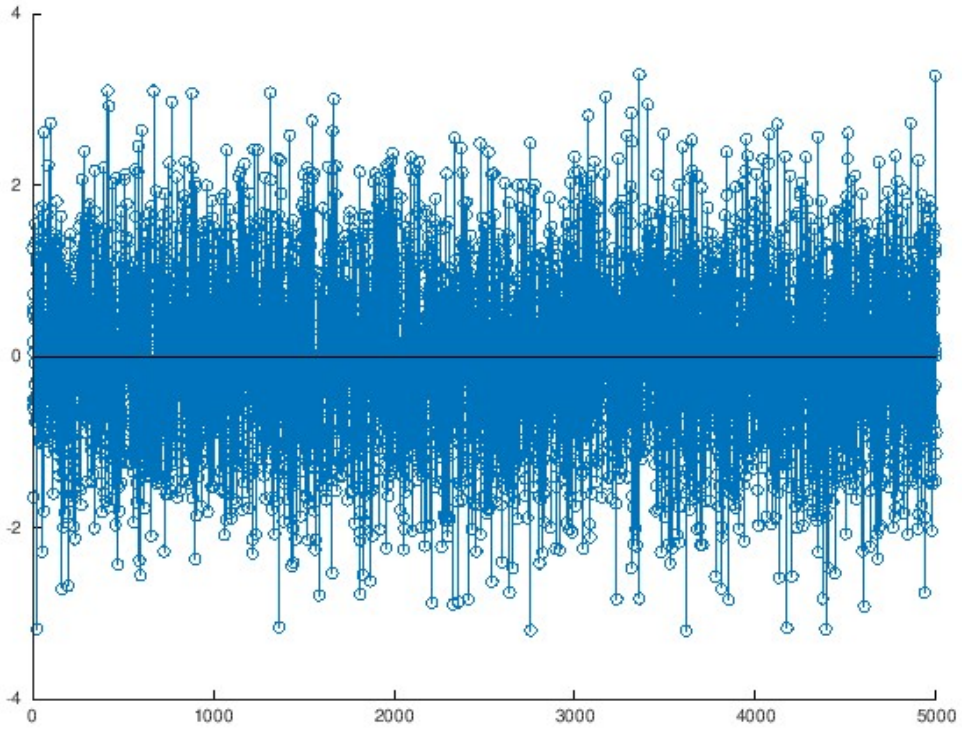
In [31]:
```
x=[1,5,0.5,3.5,2];
explode=[0,1,0,0,1];
pie(x,explode) % 饼图
%pie3(x,explode)   % this is not work for octave
colormap jet
```



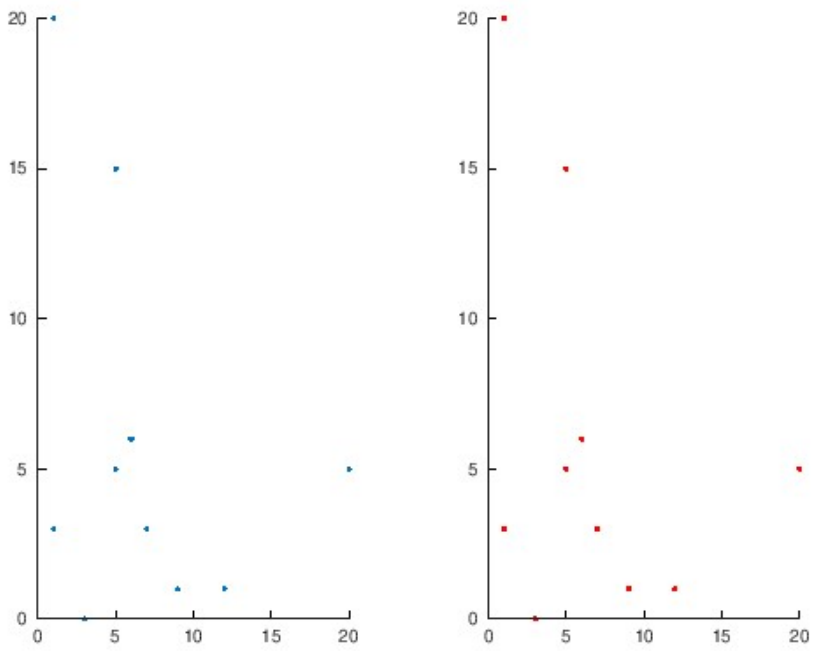
In [33]:
```
x=-4:0.2:4;
y = randn(5000,1); %% 5000个正态分布的数
hist(y,x) % 直方图
```



In [35]:
```
stem(y);    % stem3(y)
```



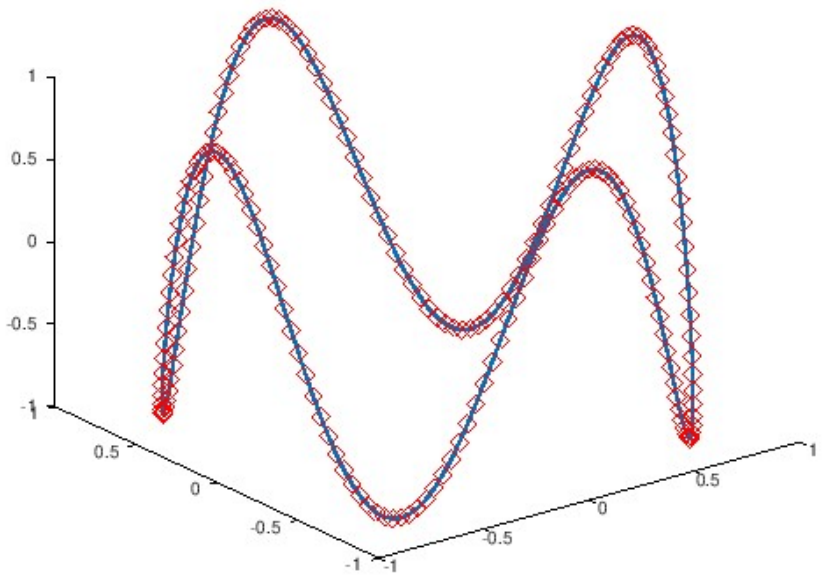
In [40]:
```
x=[1,5,6,7,9,5,1,3,12,20];
y=[20,15,6,3,1,5,3,0,1,5];
subplot(1,2,1);
scatter(x,y); % 散点图    plot(x,y,'.')
subplot(122);
scatter(x,y,[],[1,0,0],'fill');
print -depsc 'sample.eps'
```



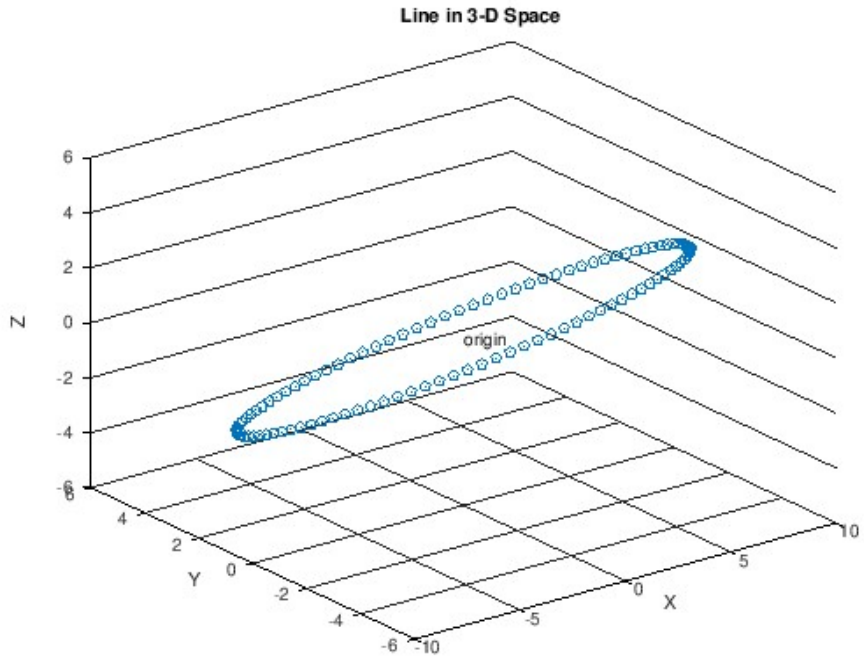
In [ ]:

三维曲线的基本函数plot3

In [44]:
```
theta = 0 : (0.01*pi) : (2*pi);
x = sin(theta); y = cos(theta); z = cos(4*theta);
plot3(x, y, z, 'LineWidth', 5, ...
      x, y, z, 'rd','MarkerSize', 10);
```



In [12]:
```
t=0:pi/50:2*pi;

x=8*cos(t);
y=4*sqrt(2)*sin(t);
z=-4*sqrt(2)*sin(t);

plot3(x,y,z,'p');

title('Line in 3-D Space');
text(0,0,0,'origin');
xlabel('X');ylabel('Y');zlabel('Z');grid;
```



练习 请在上图中加入三维空间中的螺线，并用不同的线型、颜色和粗细等，并给出图例 $$ x = \sin(2t), y = \cos(2t), z = 3t, t\in[0,5\pi] $$

In [ ]:
```

```

二元函数图像： mesh 与 surf

In [49]:
```
tx = -10 : 2.0 : 10;
ty = -10 : 4.0 : 10;
[X,Y] = meshgrid(tx, ty);
```

In [51]:
```
X
```

```
X =

   -10    -8    -6    -4    -2     0     2     4     6     8    10
   -10    -8    -6    -4    -2     0     2     4     6     8    10
   -10    -8    -6    -4    -2     0     2     4     6     8    10
   -10    -8    -6    -4    -2     0     2     4     6     8    10
   -10    -8    -6    -4    -2     0     2     4     6     8    10
   -10    -8    -6    -4    -2     0     2     4     6     8    10
```

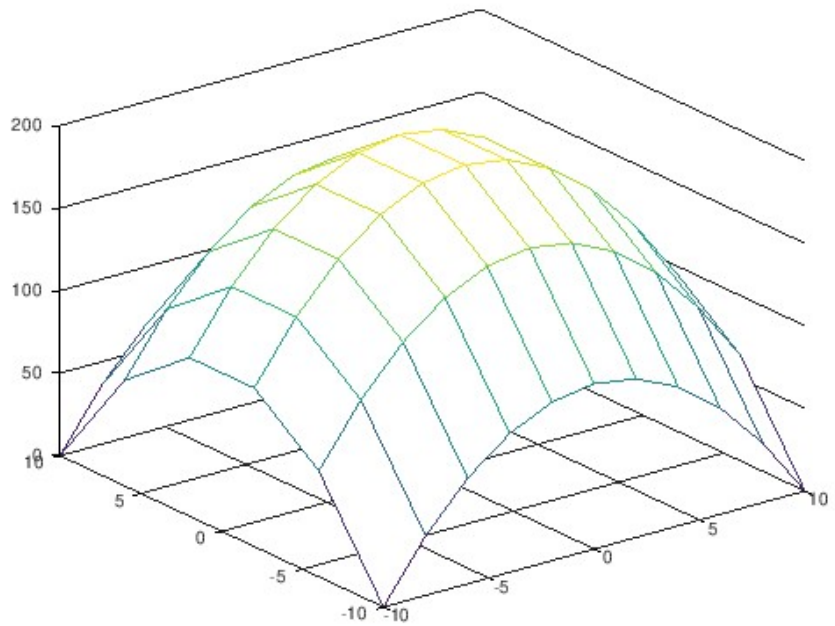
In [52]:
```
Y
```

```
Y =

   -10   -10   -10   -10   -10   -10   -10   -10   -10   -10   -10
    -6    -6    -6    -6    -6    -6    -6    -6    -6    -6    -6
    -2    -2    -2    -2    -2    -2    -2    -2    -2    -2    -2
     2     2     2     2     2     2     2     2     2     2     2
     6     6     6     6     6     6     6     6     6     6     6
    10    10    10    10    10    10    10    10    10    10    10
```

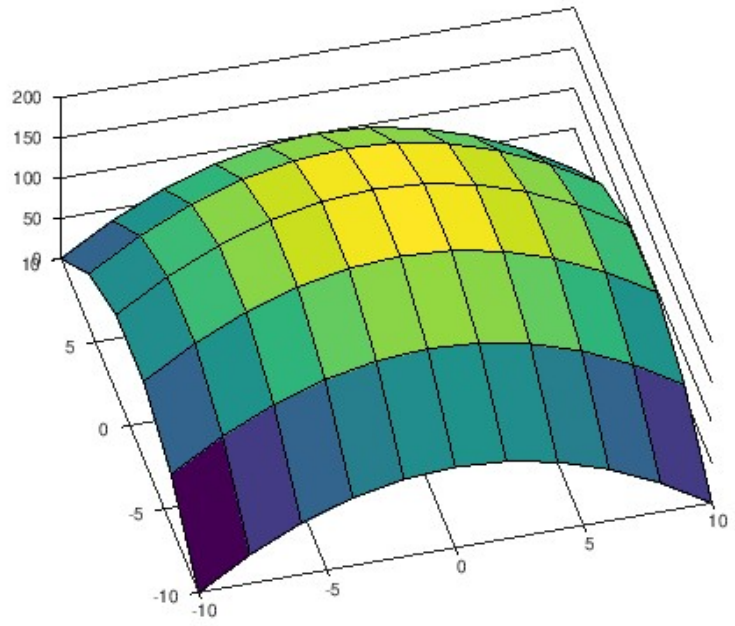
In [53]:
```
Z = - X.*X - Y.*Y + 200
```

```
Z =

     0    36    64    84    96   100    96    84    64    36     0
    64   100   128   148   160   164   160   148   128   100    64
    96   132   160   180   192   196   192   180   160   132    96
    96   132   160   180   192   196   192   180   160   132    96
    64   100   128   148   160   164   160   148   128   100    64
     0    36    64    84    96   100    96    84    64    36     0
```

In [54]:
```
mesh(X,Y,Z)
```

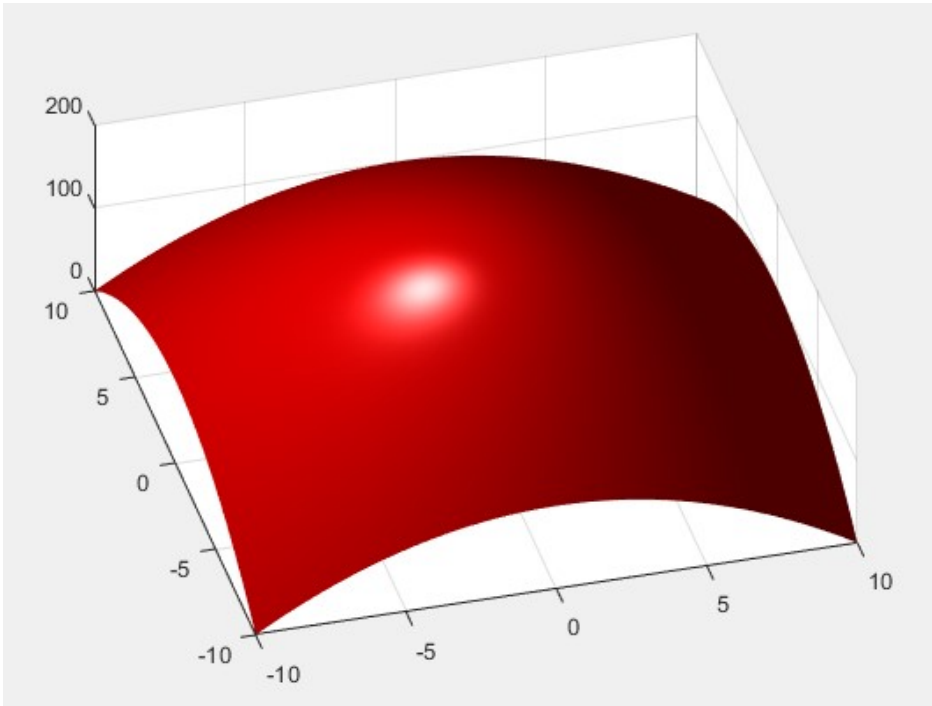


In [58]:
```
surf(X,Y,Z);    %,'FaceColor','blue','EdgeColor','black'
view(-15,65)  % 视角的角度
```



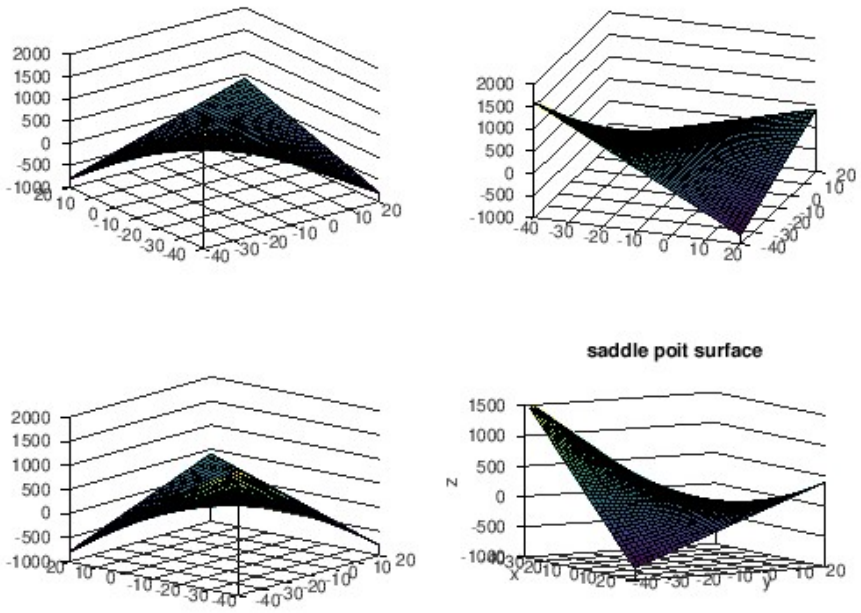
In [ ]:
```
```

In [ ]:
```
%% this is not work in octave
% camlight left; % 左侧加一个发光物体
%lighting phong % 光照模式，使图表面光滑细腻，色彩丰富
```



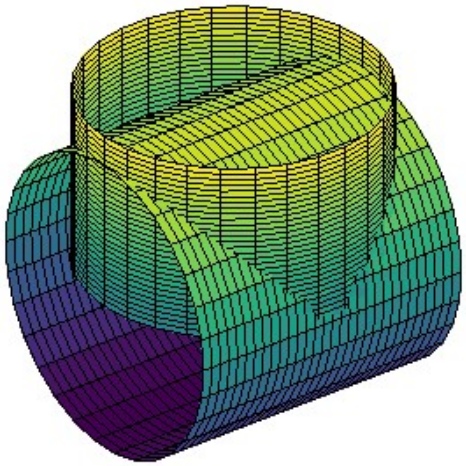
马鞍面

In [5]:
```
x1=linspace(-40,20,40);
y1=linspace(-40,20,40);
[xx1,yy1]=meshgrid(x1,y1);
zz1 = xx1.*yy1;

subplot(2,2,1), surf(xx1,yy1,zz1)
subplot(2,2,2), surf(xx1,yy1,zz1),view(20,30)
subplot(2,2,3), surf(xx1,yy1,zz1),view(-50,20)
subplot(2,2,4), surf(xx1,yy1,zz1),view(60,10)

title('saddle poit surface');
xlabel('x')
ylabel('y')
zlabel('z')
axis([-40 20 -40 20 -1000 1500])
grid on
```



练习: 绘制两个直径相等的圆管相交的图形

In [80]:

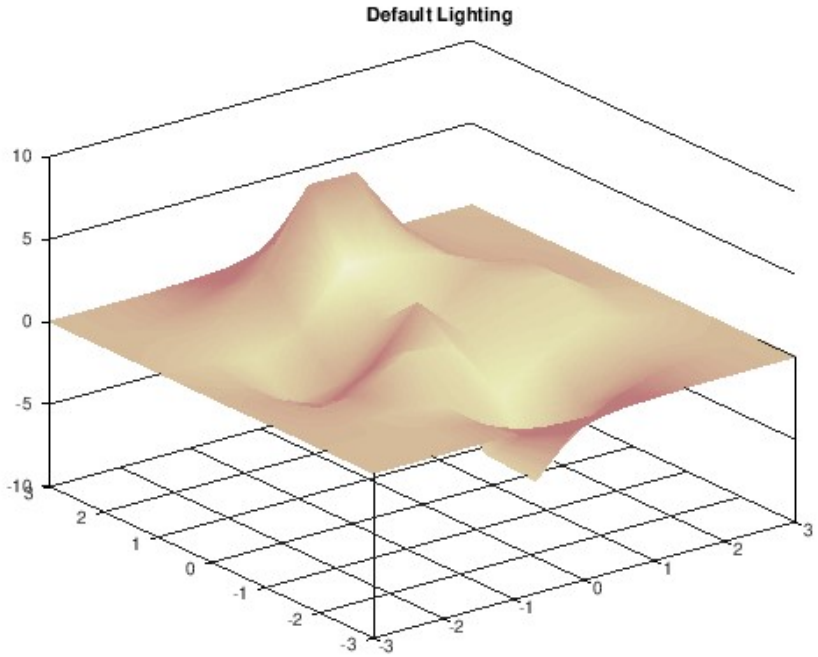


In [ ]:

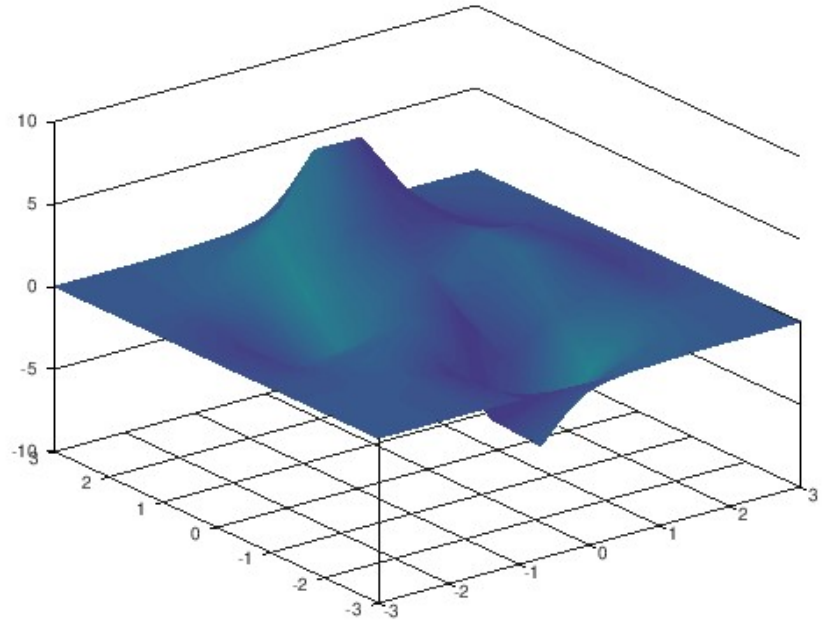
surf函数也有两个类似的函数，即具有等高线的曲面函数surfc和具有光照效果的曲面函数surfl。

In [60]:
```
[X,Y,Z] = peaks(10);
```

In [62]:
```
surfl(X,Y,Z),colormap(pink),title('Default Lighting'),shading interp
```



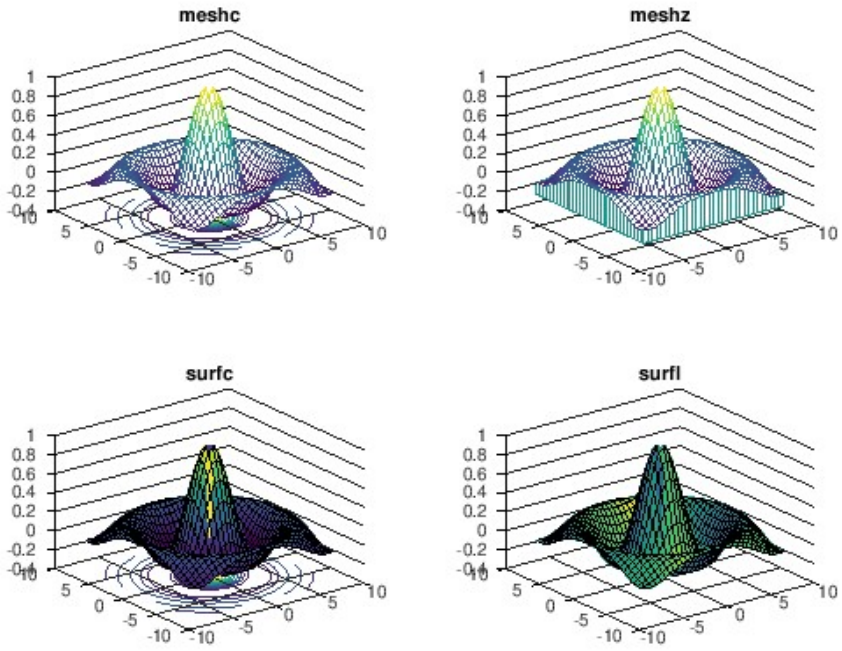
In [63]:
```
surfl(X,Y,Z,[-90,30],[.55,.6,2,10]),shading interp
```



还有两个和mesh函数相似的函数，即带等高线的三维网格曲面函数meshc和带底座的三维网格曲面函数meshz，其用法和mesh类似。不同的是，meshc还在xy平面上绘制曲面在z轴方向的等高线，meshz还在xy平面上绘制曲面的底座。

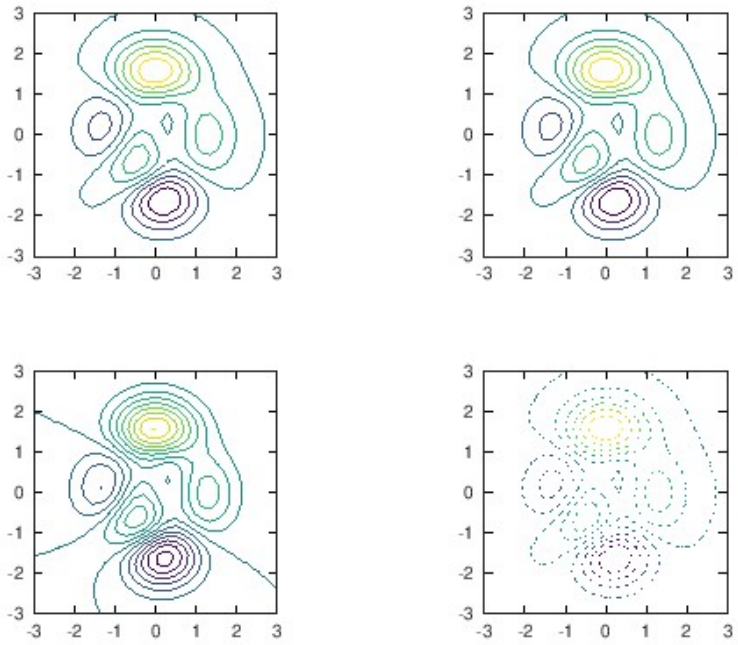
例 在xy平面内选择$[-8, 8]\times[-8, 8]$绘制函数，

In [78]:
```
[x,y] = meshgrid(-8:0.5:8);
z = sin(sqrt(x.^2+y.^2))./sqrt(x.^2+y.^2+eps);
subplot(2,2,1); meshc(x,y,z); title('meshc');
subplot(2,2,2); meshz(x,y,z); title('meshz');
subplot(2,2,3); surfc(x,y,z); title('surfc');
subplot(2,2,4); surfl(x,y,z); title('surfl');
```



等高线图

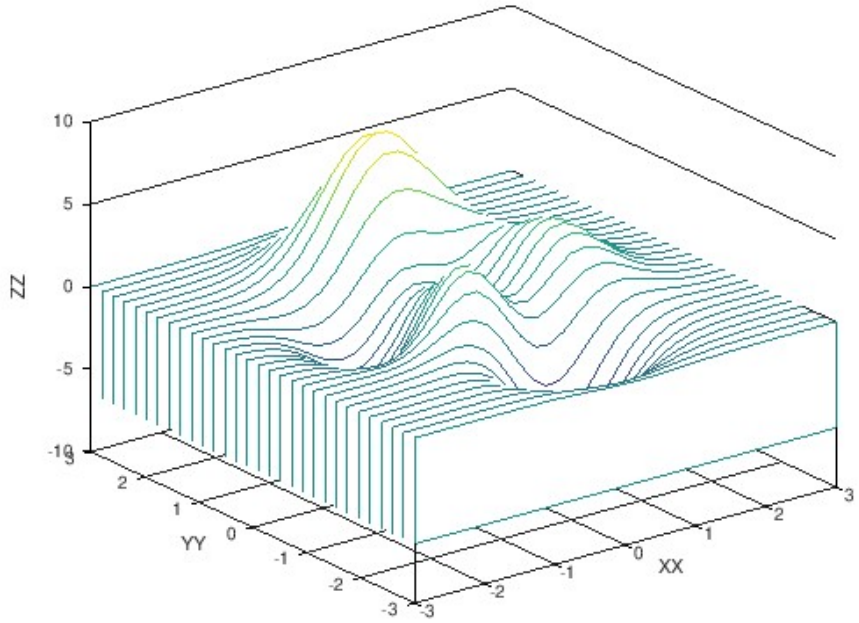
In [79]:
```
[X,Y,Z] = peaks(30);
subplot(2,2,1);contour(X,Y,Z);axis square
subplot(2,2,2);contour(X,Y,Z,10);axis square
subplot(2,2,3);contour(X,Y,Z,-10:1:10);axis square
subplot(2,2,4);contour(X,Y,Z,':');axis square
```



In [ ]:

瀑布图

In [60]:
```
waterfall(X,Y,Z);
xlabel('XX');ylabel('YY');zlabel('ZZ');
```



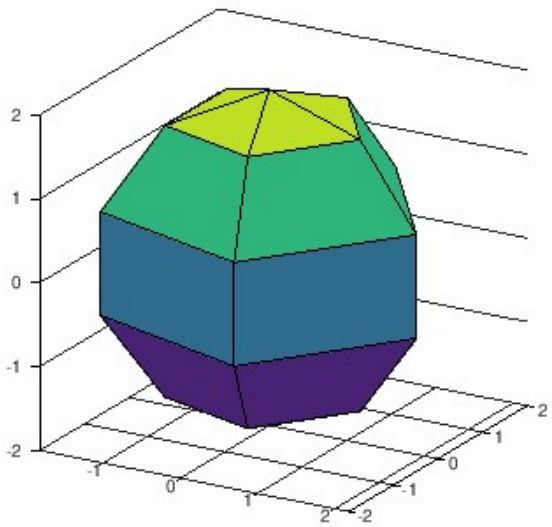
In [ ]:
```

```

封闭曲面

例 以不同的视角观察球面 x2+y2+z2=r2和圆柱面x2+y2=r*x所围区域

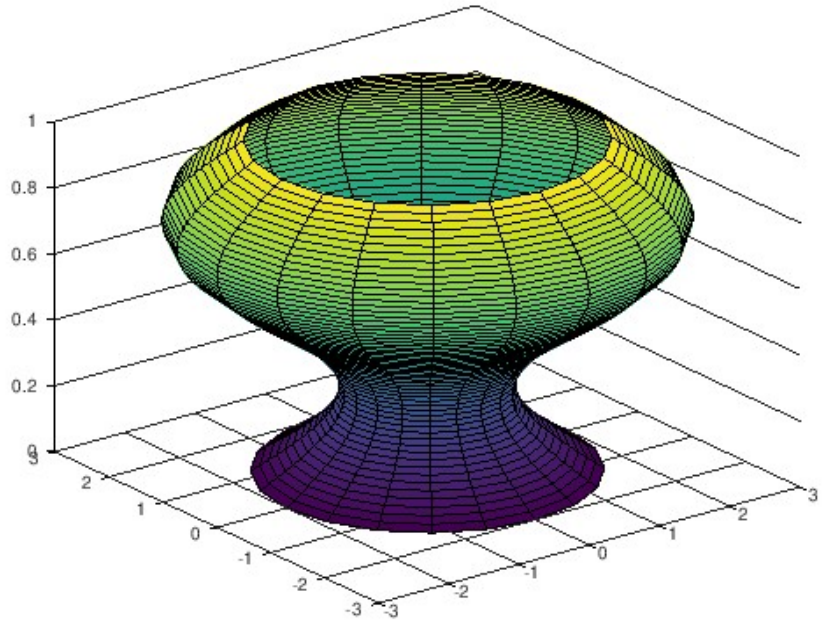
In [64]:
```
r = 2;
[x0,y0,z0] = sphere(5)
x = r*x0;
y = r*y0;
z = r*z0;
surf(x,y,z);
%%
%hold on;
%p = @(x,y)x.^2+y.^2-r*x;
%ezsurf(p,[-1.5,2.5],[-2,1.5]);
axis equal;
view(30,20);
```

```
x0 =

   6.1230e-17   1.8921e-17  -4.9536e-17  -4.9536e-17   1.8921e-17   6.1230e-17
   5.8779e-01   1.8164e-01  -4.7553e-01  -4.7553e-01   1.8164e-01   5.8779e-01
   9.5106e-01   2.9389e-01  -7.6942e-01  -7.6942e-01   2.9389e-01   9.5106e-01
   9.5106e-01   2.9389e-01  -7.6942e-01  -7.6942e-01   2.9389e-01   9.5106e-01
   5.8779e-01   1.8164e-01  -4.7553e-01  -4.7553e-01   1.8164e-01   5.8779e-01
   6.1230e-17   1.8921e-17  -4.9536e-17  -4.9536e-17   1.8921e-17   6.1230e-17

y0 =

   0.00000   0.00000   0.00000  -0.00000  -0.00000  -0.00000
   0.00000   0.55902   0.34549  -0.34549  -0.55902  -0.00000
   0.00000   0.90451   0.55902  -0.55902  -0.90451  -0.00000
   0.00000   0.90451   0.55902  -0.55902  -0.90451  -0.00000
   0.00000   0.55902   0.34549  -0.34549  -0.55902  -0.00000
   0.00000   0.00000   0.00000  -0.00000  -0.00000  -0.00000

z0 =

  -1.00000  -1.00000  -1.00000  -1.00000  -1.00000  -1.00000
  -0.80902  -0.80902  -0.80902  -0.80902  -0.80902  -0.80902
  -0.30902  -0.30902  -0.30902  -0.30902  -0.30902  -0.30902
   0.30902   0.30902   0.30902   0.30902   0.30902   0.30902
   0.80902   0.80902   0.80902   0.80902   0.80902   0.80902
   1.00000   1.00000   1.00000   1.00000   1.00000   1.00000
```



注： view（az，el）其中az为方位角，el为仰角，它们均以度为单位。系统默认的视点定义为方位角为-37.5度，仰角30度。

In [69]:
```
[x,y,z] = cylinder(2 + sin(-pi:0.1:pi),20);    % 给出母线
surf(x,y,z);
```

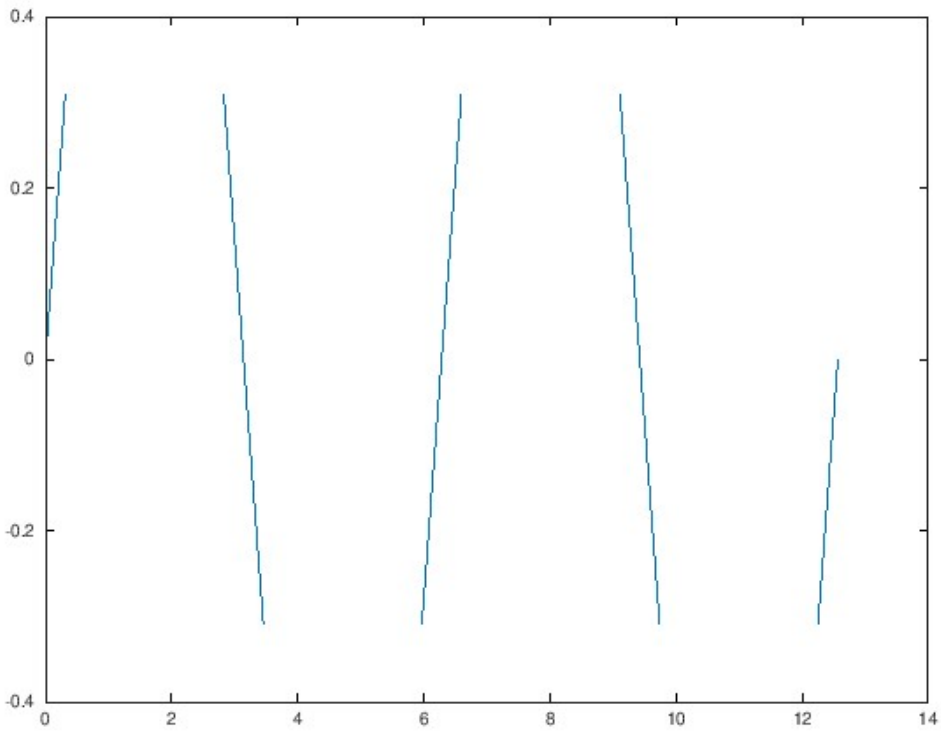


图形的裁剪处理

NaN可以用于表示那些不可使用的数据，利用这些特性，可以将图形中需要裁剪部分对应的函数值设置成NaN，这样在绘制图形时，函数值为NaN的部分将不显示出来，以达到裁剪的处理。例如：

In [73]:
```
x = 0:pi/10:4*pi;  y = sin(x);

i = find(abs(y) > 0.5)
y(i) = inf

plot(x,y);
```

```
i =

 Columns 1 through 16:

    3    4    5    6    7    8    9   13   14   15   16   17   18   19   23   24

 Columns 17 through 28:

   25   26   27   28   29   33   34   35   36   37   38   39

y =

 Columns 1 through 8:

   0.00000   0.30902       Inf       Inf       Inf       Inf       Inf       Inf

 Columns 9 through 16:

       Inf   0.30902   0.00000  -0.30902       Inf       Inf       Inf       Inf

 Columns 17 through 24:

       Inf       Inf       Inf  -0.30902  -0.00000   0.30902       Inf       Inf

 Columns 25 through 32:

       Inf       Inf       Inf       Inf       Inf   0.30902   0.00000  -0.30902

 Columns 33 through 40:

       Inf       Inf       Inf       Inf       Inf       Inf       Inf  -0.30902

 Column 41:

  -0.00000
```

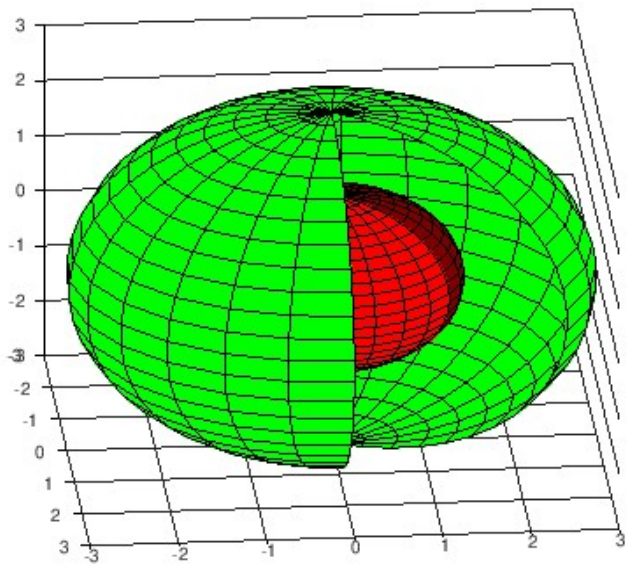


In [76]:
```
isinf(y)
```

```
ans =

 Columns 1 through 26:

  0   0   1   1   1   1   1   1   1   0   0   0   1   1   1   1   1   1   1   0   0   0   1   1   1   1

 Columns 27 through 41:

  1   1   1   0   0   0   1   1   1   1   1   1   1   0   0
```

例： 绘制两个球面，其中一个在另一个里面，将外面的球裁掉一部分，以便能看到里面的球。

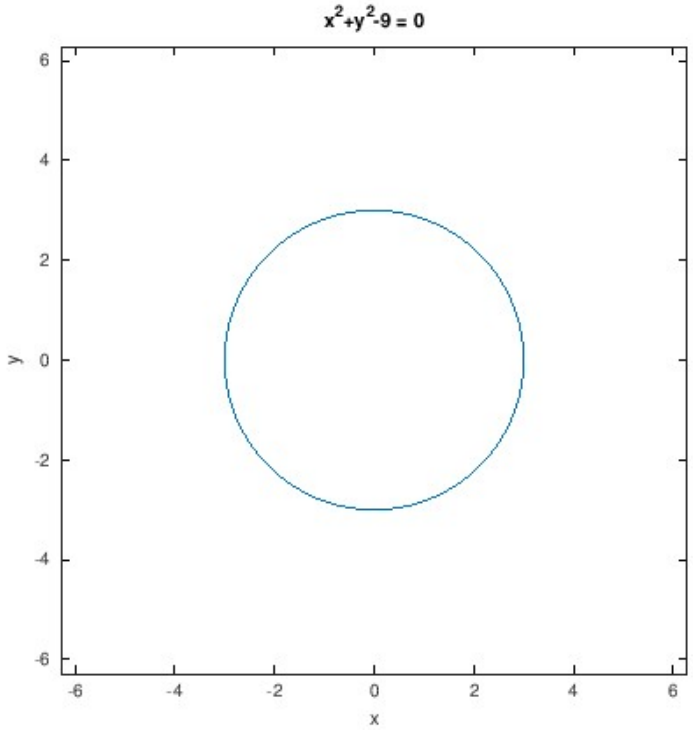
In [66]:
```
[x,y,z] = sphere(25);      %生成外面的大球

z1 = z;  z1(:, 1:4) = NaN;      %将大球裁去一部分

surf(3*x, 3*y, 3*z1, ones(size(z1)));        %生成里面的小球
hold on;

c2 = 2*ones(size(z));
c2(:,1:4) = 3*ones(size(c2(:,1:4)));
surf(1.5*x, 1.5*y, 1.5*z, c2);

view(85,30);    % 调整角度看一看
colormap([0 1 0;0.5 0 0;1 0 0]);
grid on
hold off
```



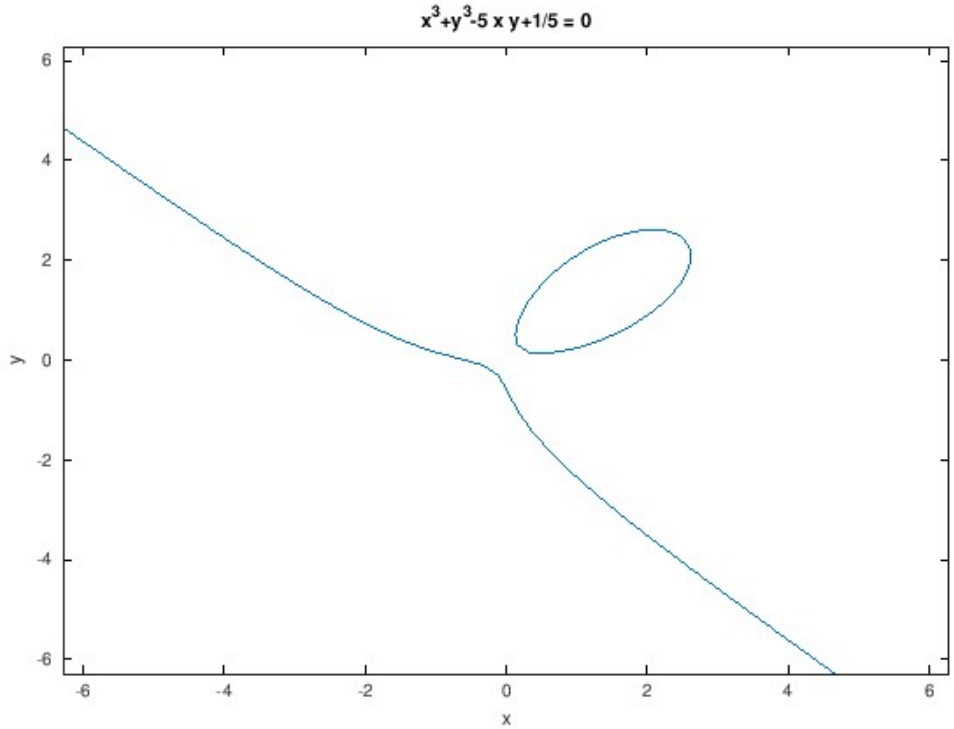
In [ ]:
```

```

隐函数作图： ezplot 和 ezplpt3

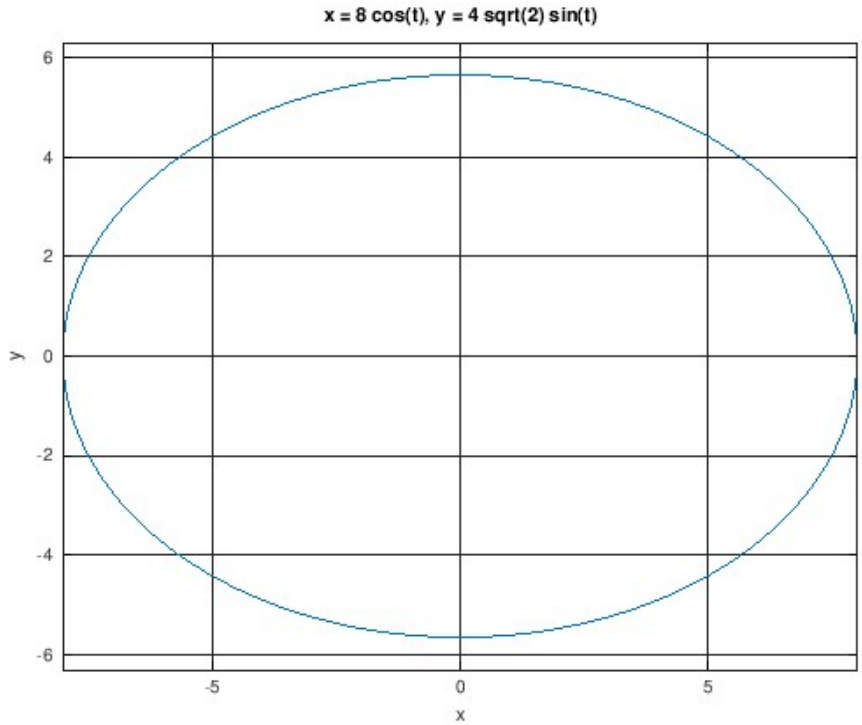
In [67]:
```
ezplot('x^2 + y^2-9');  axis equal;
```



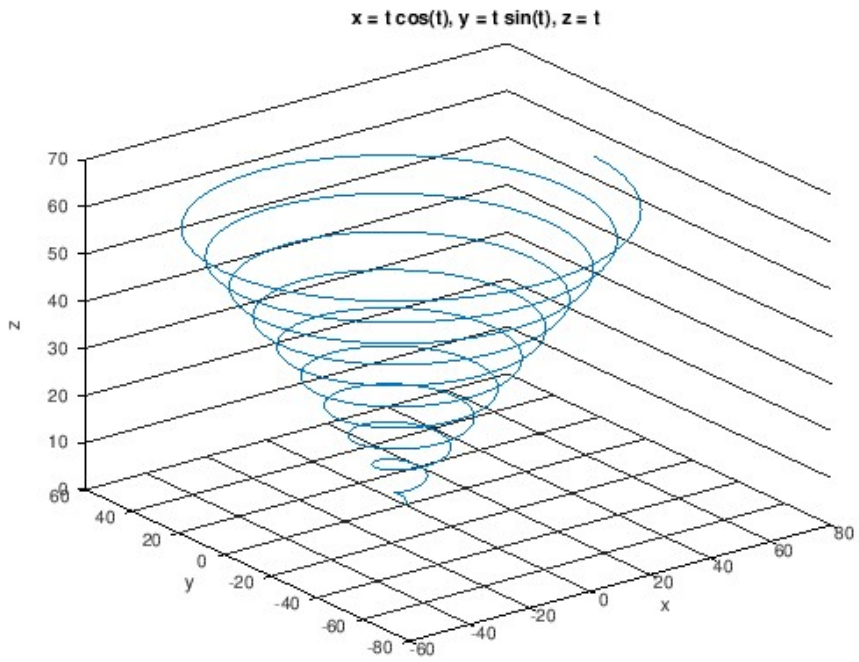
In [69]:
```
ezplot('x^3+y^3-5*x*y+1/5')   % 画出它的三维图对比下?
```



In [72]:
```
ezplot('8*cos(t)','4*sqrt(2)*sin(t)', [0,2*pi]); grid on; axis equal
```



In [68]:
```
ezplot3('t * cos(t)', 't * sin(t)', 't', [0, 20*pi])
```



其他隐函数绘图还有，ezpolar，ezcontour，ezmesh，ezmeshc，ezsurf，ezsurfc。

In [ ]:

In [ ]: