Plotting surfaces and curves on Mathematica

Below are some examples of plotting in Mathematica using the commands **Plot3D**, **ContourPlot3D**, and **ParametricPlot3D**. To learn more options to each command, you can go to Help, choose 'Find Selected Function', and type the command's name.

1. Surfaces
   The command **Plot3D** is used to plot surfaces that are graphs of a function $f(x, y)$, for example $z = f(x, y) = x + y,\ x^2 + y^2,\ \sin(x)y, \ldots$

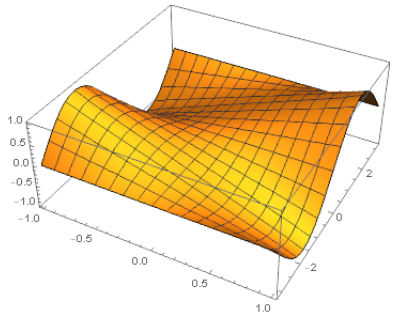
   The command **ContourPlot3D** is used to plot surfaces given by an equation, for example $x^2 + y^2 = 1$, $x + y^2 - z = 3$, $\sin(yz) = 0$,...

   The command **ParametricPlot3D** is used to plot surfaces given by parametric equations, for example $x = t\cos t$, $y = t\sin t$, $z = t$.

   You can rotate each 3D picture plotted in Mathematica by placing the mouse on the picture and drag it.

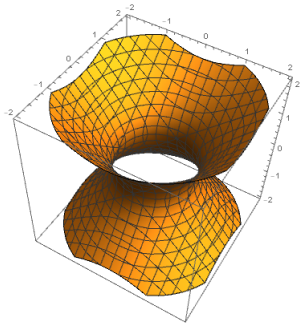
   - Plot the graph of function $f(x, y) = x\sin y$.

     ```
     Plot3D[x*Sin[y], {x, -1, 1}, {y, -Pi, Pi}]
     ```

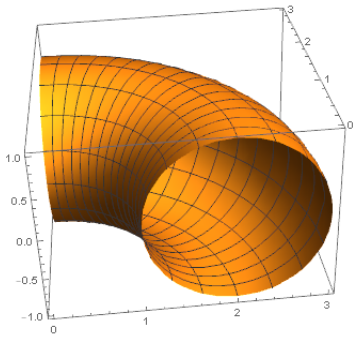
     

   - Plot the one-sheet elliptic hyperboloid $x^2 + y^2 - z^2 = 1$.

     ```
     ContourPlot3D[
      x^2 + y^2 - z^2 == 1, {x, -2, 2}, {y, -2, 2}, {z, -2, 2}]
     ```

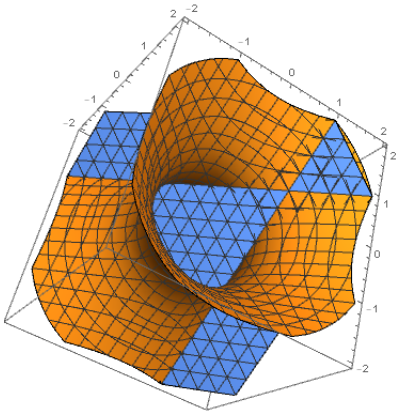
   - Plot the surface $x = (2 + \cos t)\cos s$, $y = (2 + \cos t)\sin s$, $z = \sin t$.



```
ParametricPlot3D[{(2 + Cos[t])*Cos[s], (2 + Cos[t])*
   Sin[s], Sin[t]}, {t, 0, 2*Pi}, {s, 0, Pi/2}]
```

- Plot the one-sheet elliptic hyperboloid $x^2 + y^2 - z^2 = 1$ and the plane $x + y - z = 1$ to see the trace.

```
ContourPlot3D[{x^2 + y^2 - z^2 == 1, x + y - z == 1}, {x, -2,
  2}, {y, -2, 2}, {z, -2, 2}]
```

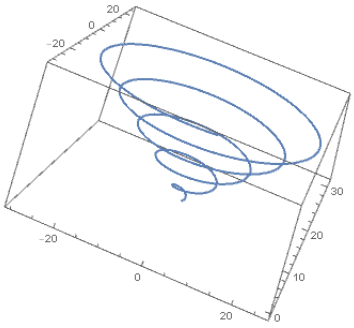


2. Curves

The command **ParametricPlot3D** is used to plot a curve given by parametric equations.

- Plot the curve $r(t) = \langle t\cos t, t\sin t, t\rangle$.

```
ParametricPlot3D[{t*Cos[t], t*Sin[t], t}, {t, 0, 30}]
```



- The parametric equations also show us how a curve is drawn. For example, consider the curve parametrized by $r(t) = \langle t\cos t, t\sin t, t\rangle$.

```
p[s_] := ParametricPlot3D[{t*Cos[t], t*Sin[t], t}, {t, 0, s},
  PlotRange -> {{-30, 30}, {-30, 30}, {0, 30}}]
Manipulate[p[s], {s, 0.1, 30}]
```