

MATH 284 Mathematical Programming
Homework 6: Due Wednesday April 4 at 1:00pm

The goal of this homework set is to provide some instruction and practice with three-dimensional plots in MATLAB. The three main functions that we will use are `plot3` for plotting curves in three-dimensional space, and `mesh` and `surf` for plotting two-dimensional surfaces in three-dimensional space.

Exercises:

1. Enter the following code into a MATLAB script file and execute the code.

```
t = 0:0.1:6*pi;
x = sqrt(t).*sin(2*t);
y = sqrt(t).*cos(2*t);
z = 0.5*t;
plot3(x,y,z,'k','linewidth',2)
grid on
xlabel('x'); ylabel('y'); zlabel('z');
```

2. Modify the code from the previous problem to plot space curves for the following parametric equations:

(a) $x = (4 + \sin(20t)) \cos(t)$, $y = (4 + \sin(20t)) \sin(t)$, $z = \cos(20t)$

(b) $x = (2 + \cos(1.5t)) \cos(t)$, $y = (2 + \cos(1.5t)) \sin(t)$, $z = \sin(1.5t)$

3. In the MATLAB command line, type `help meshgrid`. Describe in your own words what the `meshgrid` function does.
4. Enter the following code into a MATLAB script file and execute the code.

```
x = -1:0.1:3;
y = 1:0.1:4;
[X,Y] = meshgrid(x,y);
Z = X.*Y.^2./(X.^2 + Y.^2);
mesh(X,Y,Z)
xlabel('x'); ylabel('y'); zlabel('z');
```

This produces a so-called mesh plot for the function $f(x, y) = \frac{xy^2}{x^2+y^2}$.

5. Enter the following code into a MATLAB script file and execute the code.

```

x = -1:0.1:3;
y = 1:0.1:4;
[X,Y] = meshgrid(x,y);
Z = X.*Y.^2./(X.^2 + Y.^2);
surf(X,Y,Z)
xlabel('x'); ylabel('y'); zlabel('z');

```

This produces a surface plot for the function $f(x, y) = \frac{xy^2}{x^2+y^2}$.

6. Modify the code from the two previous problem to obtain mesh and surface plots for the following functions.

(a) $f(x, y) = \frac{x^2}{2} + \frac{y^2}{9}$

(b) $f(x, y) = \frac{x^2}{2} - \frac{y^2}{9}$

(c) $f(x, y) = -xye^{-x^2-y^2}$

7. For a function $z = f(x, y)$, we can obtain a mesh or surface plot for its graph together with the corresponding contour curves by using either **meshc** or **surf**. For example, execute the following code:

```

x = -1:0.1:3;
y = 1:0.1:4;
[X,Y] = meshgrid(x,y);
Z = X.*Y.^2./(X.^2 + Y.^2);
surf(X,Y,Z)
xlabel('x'); ylabel('y');

```

8. For the following functions, modify the code in the previous problem to obtain plots of the corresponding surfaces and contour curves on the same set of axes.

(a) $f(x, y) = \sin(xy)$

(b) $f(x, y) = e^x \cos(y)$

(c) $f(x, y) = \frac{x-y}{1+x^2+y^2}$