Table of Contents

Calculates the position of a ball at t = 1 sec, given the initial velocity of the ball.

```
v0 = 5;
theta = 45;
g = 9.81;
t = 1;
x = v0*cosd(theta)*t;
y = v0*sind(theta)*t-g*t^2/2;
```

Calculates the positions of the ball described in the last section at t = 0, 0.2, 0.4, 0.6, 0.8, and 1.0 seconds.

```
v0 = 5;
theta = 45;
g = 9.81;
t = 0:0.2:1
x= v0*cosd(theta)*t
y= v0*sind(theta)*t-g*t.^2/2
```

```
t =

         0    0.2000    0.4000    0.6000    0.8000    1.0000
```

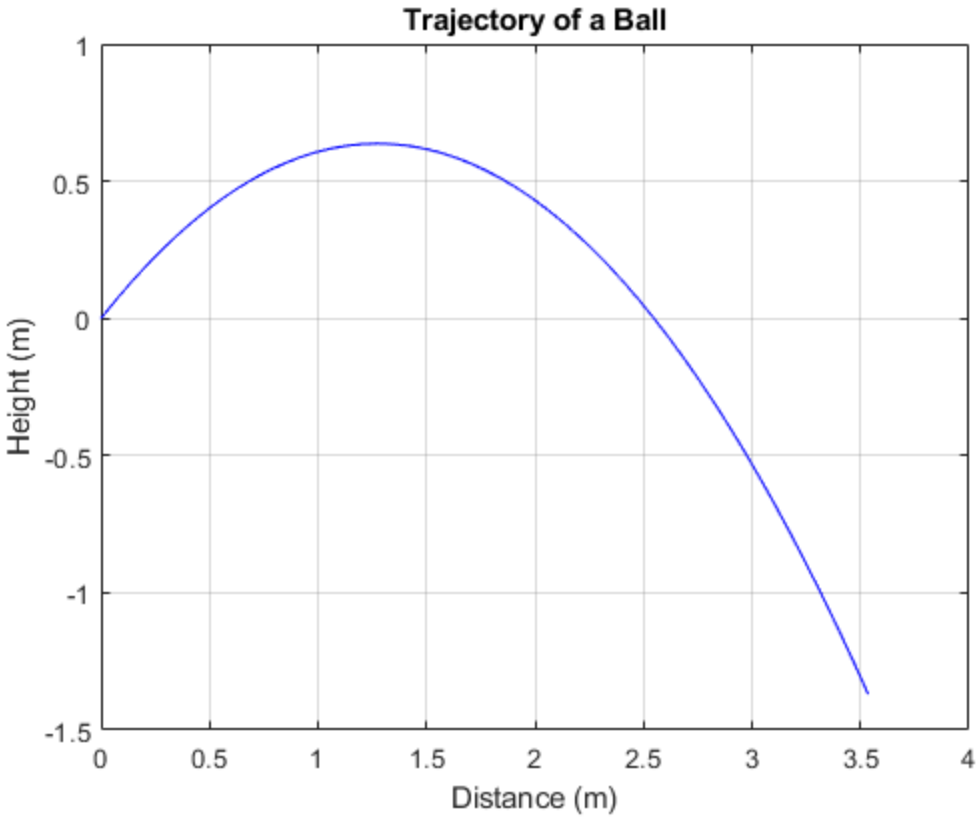
```
x =

         0    0.7071    1.4142    2.1213    2.8284    3.5355

y =

         0    0.5109    0.6294    0.3555   -0.3108   -1.3695
```

Plots a trajectory curve of the ball described before.

```
v0 = 5; theta = 45; g = 9.81;
t = 0:0.02:1
x= v0*cosd(theta)*t
y= v0*sind(theta)*t-g*t.^2/2
plot(x,y,'b'); grid;
title('Trajectory of a Ball')
xlabel('Distance (m)')
ylabel('Height (m)')


t =

  Columns 1 through 7

         0    0.0200    0.0400    0.0600    0.0800    0.1000    0.1200

  Columns 8 through 14

    0.1400    0.1600    0.1800    0.2000    0.2200    0.2400    0.2600

  Columns 15 through 21

    0.2800    0.3000    0.3200    0.3400    0.3600    0.3800    0.4000

  Columns 22 through 28

    0.4200    0.4400    0.4600    0.4800    0.5000    0.5200    0.5400

  Columns 29 through 35

    0.5600    0.5800    0.6000    0.6200    0.6400    0.6600    0.6800

  Columns 36 through 42

    0.7000    0.7200    0.7400    0.7600    0.7800    0.8000    0.8200

  Columns 43 through 49
```

```
    0.8400    0.8600    0.8800    0.9000    0.9200    0.9400    0.9600

  Columns 50 through 51

    0.9800    1.0000

x =

  Columns 1 through 7

         0    0.0707    0.1414    0.2121    0.2828    0.3536    0.4243

  Columns 8 through 14

    0.4950    0.5657    0.6364    0.7071    0.7778    0.8485    0.9192

  Columns 15 through 21

    0.9899    1.0607    1.1314    1.2021    1.2728    1.3435    1.4142

  Columns 22 through 28

    1.4849    1.5556    1.6263    1.6971    1.7678    1.8385    1.9092

  Columns 29 through 35

    1.9799    2.0506    2.1213    2.1920    2.2627    2.3335    2.4042

  Columns 36 through 42

    2.4749    2.5456    2.6163    2.6870    2.7577    2.8284    2.8991

  Columns 43 through 49

    2.9698    3.0406    3.1113    3.1820    3.2527    3.3234    3.3941

  Columns 50 through 51

    3.4648    3.5355

y =

  Columns 1 through 7

         0    0.0687    0.1336    0.1945    0.2515    0.3045    0.3536

  Columns 8 through 14

    0.3988    0.4401    0.4775    0.5109    0.5404    0.5660    0.5877

  Columns 15 through 21
```

```
  0.6054    0.6192    0.6291    0.6351    0.6371    0.6352    0.6294

Columns 22 through 28

  0.6197    0.6060    0.5884    0.5669    0.5415    0.5122    0.4789

Columns 29 through 35

  0.4417    0.4006    0.3555    0.3065    0.2537    0.1968    0.1361

Columns 36 through 42

  0.0714    0.0028   -0.0697   -0.1461   -0.2265   -0.3108   -0.3990

Columns 43 through 49

 -0.4911   -0.5872   -0.6872   -0.7911   -0.8989   -1.0107   -1.1263

Columns 50 through 51

 -1.2459   -1.3695
```



Plots a spiral curve described by the equations x =cos(#), y=sin(#), and z =# 8#, where # runs from 0 to 8#.

```
theta = 0:5:360*4;
x= cosd(theta)
y= sind(theta);
z = theta/(pi);
plot3(x,y,z,'r')
```

```
x =

  Columns 1 through 7

    1.0000    0.9962    0.9848    0.9659    0.9397    0.9063    0.8660

  Columns 8 through 14

    0.8192    0.7660    0.7071    0.6428    0.5736    0.5000    0.4226

  Columns 15 through 21

    0.3420    0.2588    0.1736    0.0872         0   -0.0872   -0.1736

  Columns 22 through 28

   -0.2588   -0.3420   -0.4226   -0.5000   -0.5736   -0.6428   -0.7071

  Columns 29 through 35

   -0.7660   -0.8192   -0.8660   -0.9063   -0.9397   -0.9659   -0.9848

  Columns 36 through 42

   -0.9962   -1.0000   -0.9962   -0.9848   -0.9659   -0.9397   -0.9063

  Columns 43 through 49

   -0.8660   -0.8192   -0.7660   -0.7071   -0.6428   -0.5736   -0.5000

  Columns 50 through 56

   -0.4226   -0.3420   -0.2588   -0.1736   -0.0872         0    0.0872

  Columns 57 through 63

    0.1736    0.2588    0.3420    0.4226    0.5000    0.5736    0.6428

  Columns 64 through 70
```

```
  0.7071    0.7660    0.8192    0.8660    0.9063    0.9397    0.9659

Columns 71 through 77

  0.9848    0.9962    1.0000    0.9962    0.9848    0.9659    0.9397

Columns 78 through 84

  0.9063    0.8660    0.8192    0.7660    0.7071    0.6428    0.5736

Columns 85 through 91

  0.5000    0.4226    0.3420    0.2588    0.1736    0.0872         0

Columns 92 through 98

 -0.0872   -0.1736   -0.2588   -0.3420   -0.4226   -0.5000   -0.5736

Columns 99 through 105

 -0.6428   -0.7071   -0.7660   -0.8192   -0.8660   -0.9063   -0.9397

Columns 106 through 112

 -0.9659   -0.9848   -0.9962   -1.0000   -0.9962   -0.9848   -0.9659

Columns 113 through 119

 -0.9397   -0.9063   -0.8660   -0.8192   -0.7660   -0.7071   -0.6428

Columns 120 through 126

 -0.5736   -0.5000   -0.4226   -0.3420   -0.2588   -0.1736   -0.0872

Columns 127 through 133

       0    0.0872    0.1736    0.2588    0.3420    0.4226    0.5000

Columns 134 through 140

  0.5736    0.6428    0.7071    0.7660    0.8192    0.8660    0.9063

Columns 141 through 147

  0.9397    0.9659    0.9848    0.9962    1.0000    0.9962    0.9848

Columns 148 through 154

  0.9659    0.9397    0.9063    0.8660    0.8192    0.7660    0.7071

Columns 155 through 161

  0.6428    0.5736    0.5000    0.4226    0.3420    0.2588    0.1736
```

Columns 162 through 168

0.0872 0 -0.0872 -0.1736 -0.2588 -0.3420 -0.4226

Columns 169 through 175

-0.5000 -0.5736 -0.6428 -0.7071 -0.7660 -0.8192 -0.8660

Columns 176 through 182

-0.9063 -0.9397 -0.9659 -0.9848 -0.9962 -1.0000 -0.9962

Columns 183 through 189

-0.9848 -0.9659 -0.9397 -0.9063 -0.8660 -0.8192 -0.7660

Columns 190 through 196

-0.7071 -0.6428 -0.5736 -0.5000 -0.4226 -0.3420 -0.2588

Columns 197 through 203

-0.1736 -0.0872 0 0.0872 0.1736 0.2588 0.3420

Columns 204 through 210

0.4226 0.5000 0.5736 0.6428 0.7071 0.7660 0.8192

Columns 211 through 217

0.8660 0.9063 0.9397 0.9659 0.9848 0.9962 1.0000

Columns 218 through 224

0.9962 0.9848 0.9659 0.9397 0.9063 0.8660 0.8192

Columns 225 through 231

0.7660 0.7071 0.6428 0.5736 0.5000 0.4226 0.3420

Columns 232 through 238

0.2588 0.1736 0.0872 0 -0.0872 -0.1736 -0.2588

Columns 239 through 245

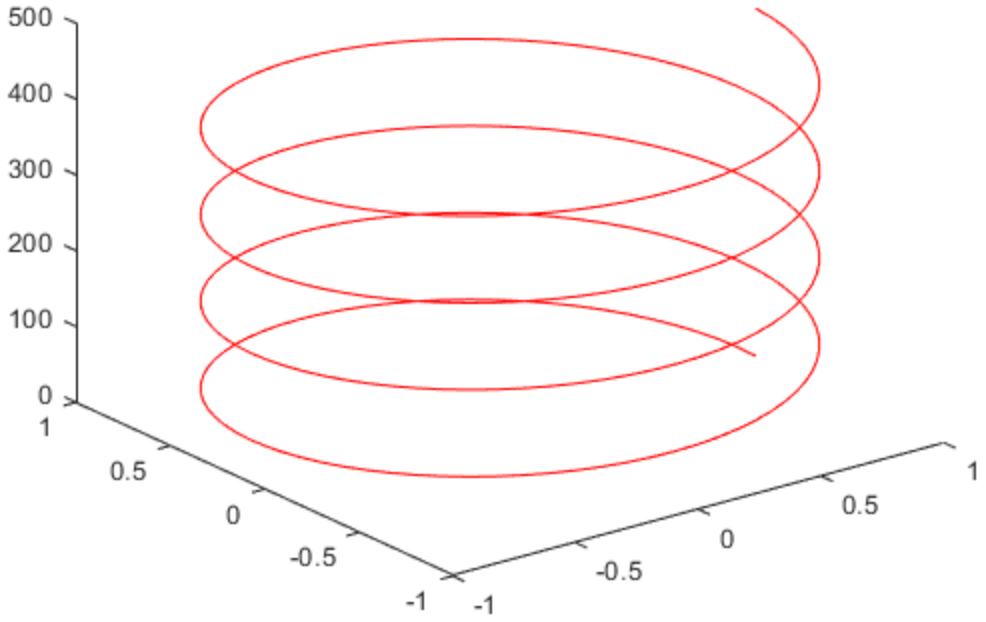
-0.3420 -0.4226 -0.5000 -0.5736 -0.6428 -0.7071 -0.7660

Columns 246 through 252

-0.8192 -0.8660 -0.9063 -0.9397 -0.9659 -0.9848 -0.9962

Columns 253 through 259

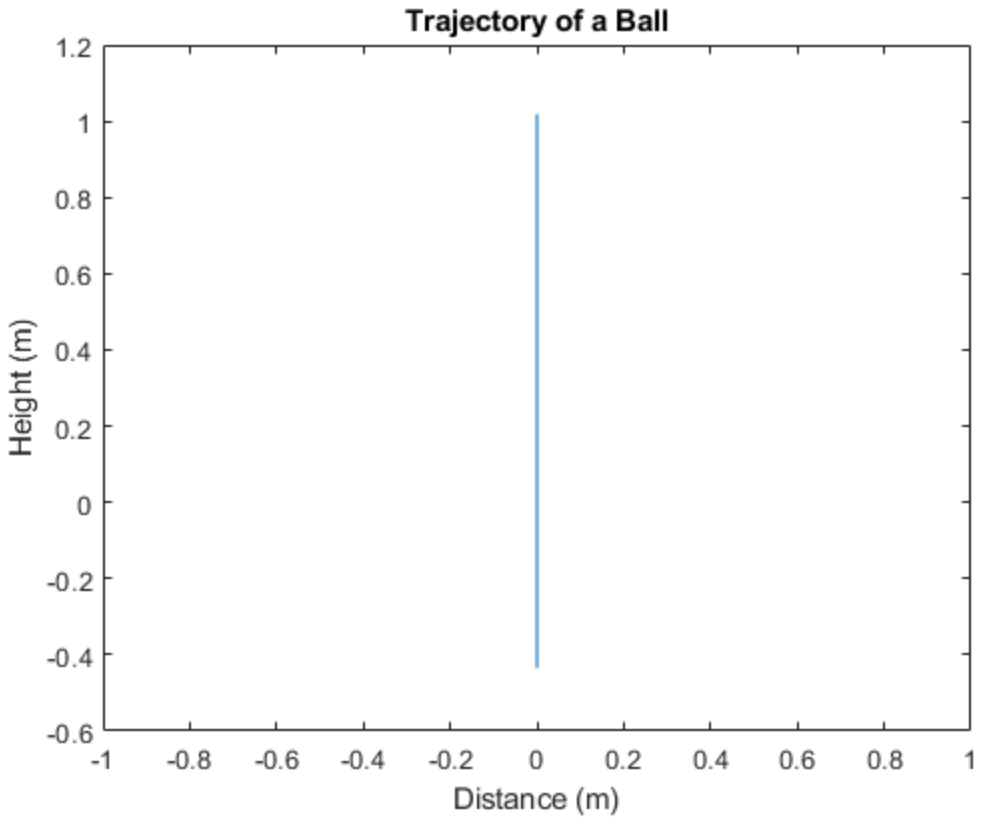
```
 -1.0000   -0.9962   -0.9848   -0.9659   -0.9397   -0.9063   -0.8660

Columns 260 through 266

 -0.8192   -0.7660   -0.7071   -0.6428   -0.5736   -0.5000   -0.4226

Columns 267 through 273

 -0.3420   -0.2588   -0.1736   -0.0872         0    0.0872    0.1736

Columns 274 through 280

  0.2588    0.3420    0.4226    0.5000    0.5736    0.6428    0.7071

Columns 281 through 287

  0.7660    0.8192    0.8660    0.9063    0.9397    0.9659    0.9848

Columns 288 through 289

  0.9962    1.0000
```



Runs the commands in the last section as a script file.

```
v0=5; theta = 360/4; g =9.81
t = 0:0.02:1
x = v0*cosd(theta)*t;
y = v0*sin(theta)*t-g*t.^2/2;
disp(x)
disp(y)
plot(x,y)
title('Trajectory of a Ball')
xlabel('Distance (m)')
ylabel('Height (m)')


g =

    9.8100


t =

  Columns 1 through 7

         0    0.0200    0.0400    0.0600    0.0800    0.1000    0.1200

  Columns 8 through 14

    0.1400    0.1600    0.1800    0.2000    0.2200    0.2400    0.2600

  Columns 15 through 21

    0.2800    0.3000    0.3200    0.3400    0.3600    0.3800    0.4000

  Columns 22 through 28

    0.4200    0.4400    0.4600    0.4800    0.5000    0.5200    0.5400

  Columns 29 through 35

    0.5600    0.5800    0.6000    0.6200    0.6400    0.6600    0.6800

  Columns 36 through 42

    0.7000    0.7200    0.7400    0.7600    0.7800    0.8000    0.8200

  Columns 43 through 49

    0.8400    0.8600    0.8800    0.9000    0.9200    0.9400    0.9600

  Columns 50 through 51
```

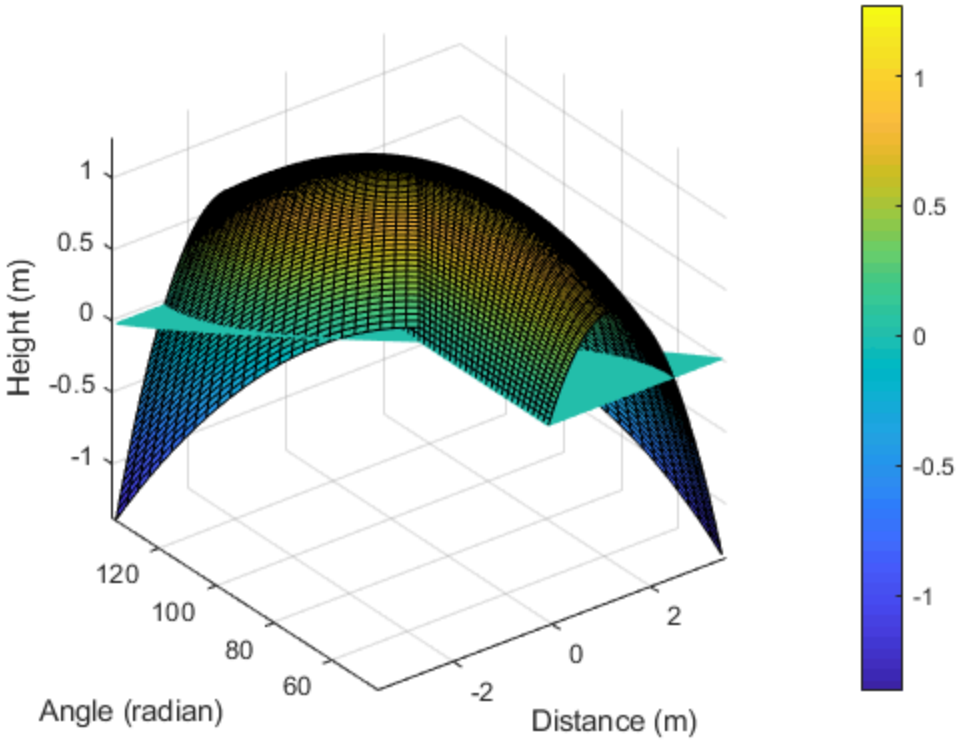
```
    0.9800    1.0000

 Columns 1 through 13

    0     0     0     0     0     0     0     0     0     0     0
0     0

 Columns 14 through 26

    0     0     0     0     0     0     0     0     0     0     0
0     0

 Columns 27 through 39

    0     0     0     0     0     0     0     0     0     0     0
0     0

 Columns 40 through 51

    0     0     0     0     0     0     0     0     0     0     0
 0

 Columns 1 through 7

         0    0.0874    0.1710    0.2505    0.3262    0.3979    0.4658

 Columns 8 through 14

    0.5297    0.5896    0.6457    0.6978    0.7460    0.7903    0.8306

 Columns 15 through 21

    0.8670    0.8995    0.9281    0.9528    0.9735    0.9903    1.0032

 Columns 22 through 28

    1.0122    1.0172    1.0183    1.0155    1.0087    0.9981    0.9835

 Columns 29 through 35

    0.9650    0.9425    0.9162    0.8859    0.8517    0.8136    0.7715

 Columns 36 through 42

    0.7255    0.6756    0.6218    0.5641    0.5024    0.4368    0.3673

 Columns 43 through 49

    0.2938    0.2164    0.1352    0.0499   -0.0392   -0.1323   -0.2293

 Columns 50 through 51

   -0.3302   -0.4350
```



Plots the trajectory curves of the ball for elevation angles # varying from # 8to 3# 8. The collection of the curves form a surface in the height-distance-# space.

```
v0=5; g =9.81;
time = 0:0.01:1; n = length(time);
theta = 45:1.8:135
m = length(theta);
time_arr = repmat(time,m,1);
theta_arr = repmat(theta',1,n);
X = v0*cosd(theta_arr).*time_arr;
Z = v0*sind(theta_arr).*time_arr-g*time_arr.^2/2;
surf(X,theta_arr,Z) % #######

hold on % ######
Z = zeros(m,n); %##51X101#matrix
mesh(X,theta_arr,Z)
xlabel('Distance (m)')
ylabel('Angle (radian)')
zlabel('Height (m)')
colorbar % #############
```

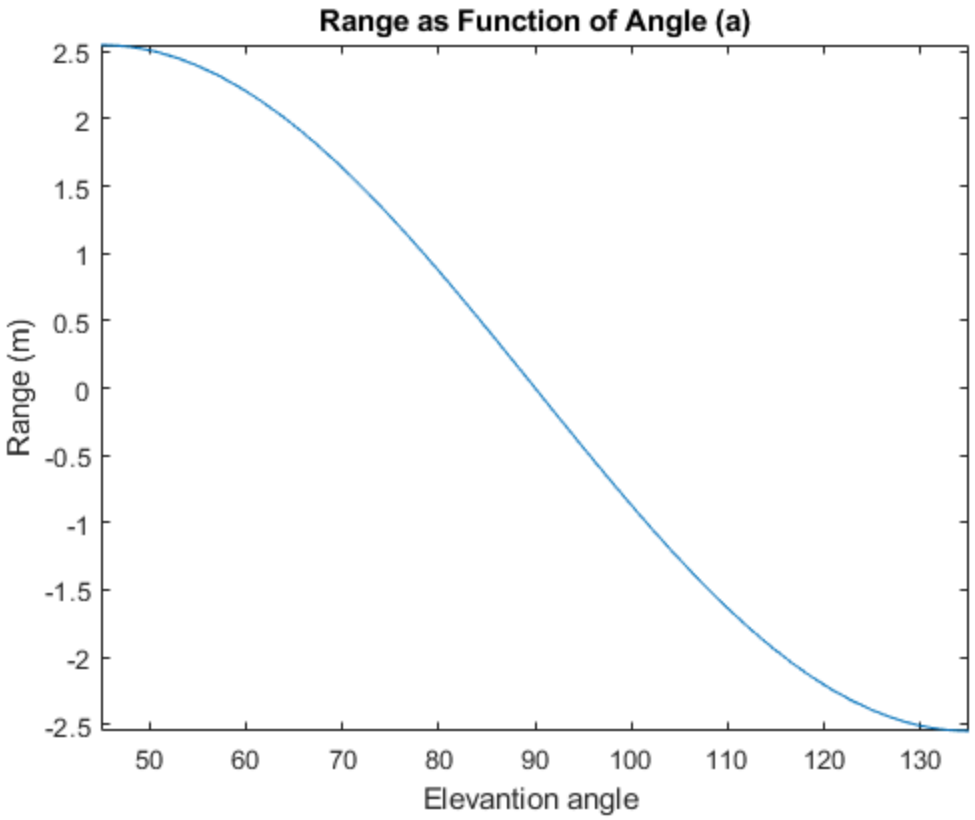
```
axis vis3d %################################

theta =

  Columns 1 through 7

   45.0000   46.8000   48.6000   50.4000   52.2000   54.0000   55.8000

  Columns 8 through 14

   57.6000   59.4000   61.2000   63.0000   64.8000   66.6000   68.4000

  Columns 15 through 21

   70.2000   72.0000   73.8000   75.6000   77.4000   79.2000   81.0000

  Columns 22 through 28

   82.8000   84.6000   86.4000   88.2000   90.0000   91.8000   93.6000

  Columns 29 through 35

   95.4000   97.2000   99.0000  100.8000  102.6000  104.4000  106.2000

  Columns 36 through 42

  108.0000  109.8000  111.6000  113.4000  115.2000  117.0000  118.8000

  Columns 43 through 49

  120.6000  122.4000  124.2000  126.0000  127.8000  129.6000  131.4000

  Columns 50 through 51

  133.2000  135.0000
```



Derives an expression for the range of the ball as a function of the elevation angle #and plots a range-versus-#curve. (a)

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

syms v0 theta g t % syms #########
x = v0*cosd(theta)*t
y = v0*sind(theta)*t-g*t^2/2
solutions = solve(y,t) % solve ######
t0 = solutions(2) % solutions(index) ##index####
range = subs(x,t,t0) % subs(S,OLD,NEW) ########S######OLD######NEW#
range = simplify(range) % ########
range = subs(range,[v0,g],[5,9.81]);
fplot(range,[360/8,360*3/8]) % fplot : ######
title('Range as Function of Angle (a)')
xlabel('Elevantion angle ')
ylabel('Range (m)')


x =
```

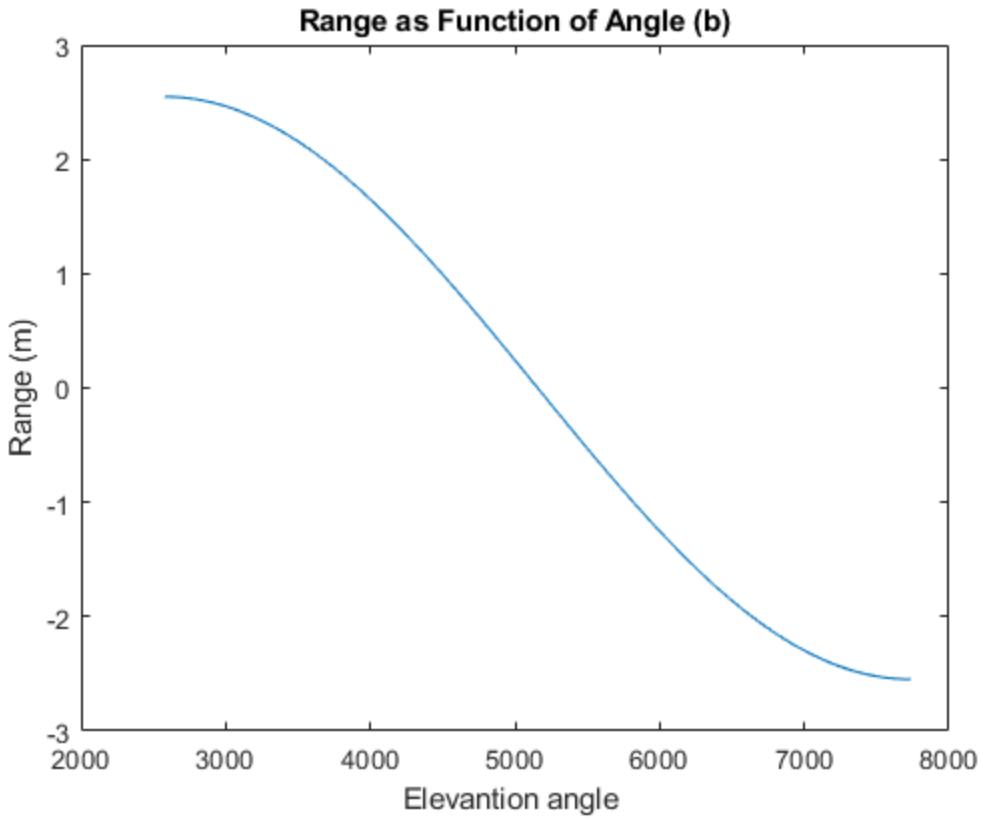
```
t*v0*cos((pi*theta)/180)

y =

t*v0*sin((pi*theta)/180) - (g*t^2)/2

solutions =

                              0
 (2*v0*sin((pi*theta)/180))/g

t0 =

(2*v0*sin((pi*theta)/180))/g

range =

(2*v0^2*cos((pi*theta)/180)*sin((pi*theta)/180))/g

range =

(v0^2*sin((pi*theta)/90))/g
```



Derives an expression for the range of the ball as a function of the elevation angle #and plots a range-versus-#curve. (b)

```
clc % ##command window
clear all % ##WorkSpace##
close all %  ######

syms v0 theta g t % syms #########
x = v0*cosd(theta)*t
y = v0*sind(theta)*t-g*t^2/2
solutions = solve(y,t) % solve ######
t0 = solutions(2) % solutions(index) ##index####
range = subs(x,t,t0) % subs(S,OLD,NEW) ########S######OLD######NEW#
range = simplify(range) % ########
range = subs(range,[v0,g],[5,9.81])
func = matlabFunction(range)
theta = [360/8:360/200:360*(3/8)];
range = func(theta);
plot(theta*180/pi,range)
title('Range as Function of Angle (b)')
xlabel('Elevantion angle ')
ylabel('Range (m)')
```

```
x =

t*v0*cos((pi*theta)/180)


y =

t*v0*sin((pi*theta)/180) - (g*t^2)/2


solutions =

                              0
 (2*v0*sin((pi*theta)/180))/g


t0 =

(2*v0*sin((pi*theta)/180))/g


range =

(2*v0^2*cos((pi*theta)/180)*sin((pi*theta)/180))/g


range =

(v0^2*sin((pi*theta)/90))/g


range =

(2500*sin((pi*theta)/90))/981


func =

  function_handle with value:

    @(theta)sin(theta.*pi.*(1.0./9.0e1)).*2.54841997961264
```



Calculates and tabulates the positions of the ball at t = 0, 0.1, 0.2, ... , 1 sec, allowing the input of an initial speed and an elevation angle.

```
disp('Enter initial speed (m/s): ');
v0 = 5
disp('Enter elevation angle: ');
theta = 45
g = 9.81; t = 0:0.1:1;
x = v0*cosd(theta)*t;
y = v0*sind(theta)*t-g*t.^2/2;
Table = [t',x',y'];
fprintf('\n time (s)    x (m)   y (m)\n')
fprintf('%10.1f %9.3f %9.3f\n',Table')
```

```
Enter initial speed (m/s):

v0 =

     5

Enter elevation angle:

theta =
```

```
   45
```

```
 time (s)    x (m)   y (m)
       0.0     0.000     0.000
       0.1     0.354     0.305
       0.2     0.707     0.511
       0.3     1.061     0.619
       0.4     1.414     0.629
       0.5     1.768     0.542
       0.6     2.121     0.356
       0.7     2.475     0.071
       0.8     2.828    -0.311
       0.9     3.182    -0.791
       1.0     3.536    -1.369
```

Creates a trajectory table, write the table to a text file, reads the table from the text file, and prints the table on the screen.

```
v0 = 5; theta = 45; g = 9.81;
t = 0:0.1:1;
x = v0*cosd(theta)*t;
y = v0*sind(theta)*t-g*t.^2/2;
Table = [t ; x ; y];
% Write to a file
file = fopen('#######/Ch1/dat/Datafile01_10.dat','w');
fprintf(file, '  Time (s)    x (m)   y (m)\n');
fprintf(file,'%10.1f %9.3f %9.3f\n',Table');
fclose(file);
% Read from the file
file = fopen('#######/Ch1/dat/Datafile01_10.dat','r');
fscanf(file, '  Time (s)    x (m)   y (m)\n');
Table = fscanf(file, '  %f %f %f\n',[3,11]);
fclose(file);
% Print on the screen
fprintf( '  Time (s)    x (m)   y (m)\n');
fprintf('%10.1f %9.3f %9.3f\n',Table')
```

```
  Time (s)    x (m)   y (m)
       0.0     0.300     0.600
       0.9     0.400     1.400
       2.5     3.500     0.500
       0.5    -0.300     0.100
       0.4     0.700     1.000
       0.7     1.768     2.828
       0.0     0.619     0.356
      -0.8     0.200     0.500
       0.8     0.000     1.061
       2.1     3.182     0.305
```

```
    0.6     0.071    -1.369
```

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