ML Lab Report 2

Name; Dheeraj Chaudhary

Roll: 17BCS009

Probability Density Function (Pdf) of values in x for normal distribution with mean and fixed deviation

In [62]:

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits import mplot3d
from scipy.stats import norm
```

Task 1: Pdf for one value in x and mean distributed in 100 parts from 0-10

In [63]:

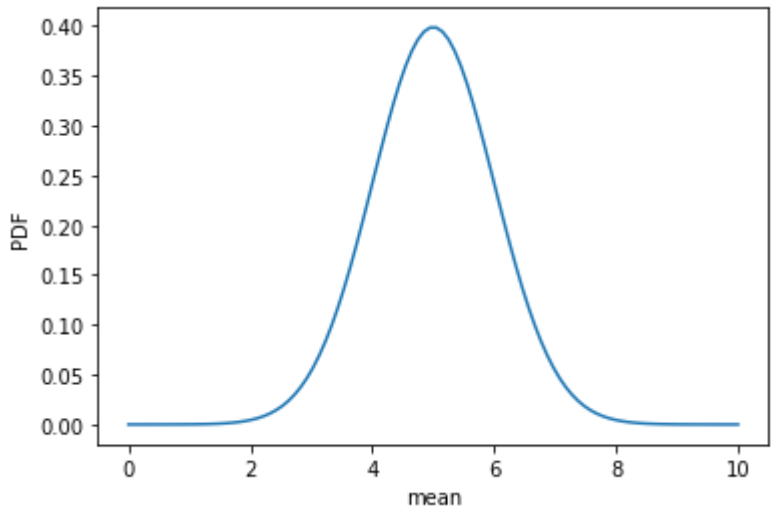
```
x = 5
m = np.linspace(0,10,100)
Y_ax = norm.pdf(x, m, 1 )
```

In [64]:

```
plt.plot(m, Y_ax)
plt.xlabel('mean')
plt.ylabel('PDF')
```

Out[64]:

```
Text(0, 0.5, 'PDF')
```



Task 2: Pdf for two value of x and rest same condition as above

In [65]:

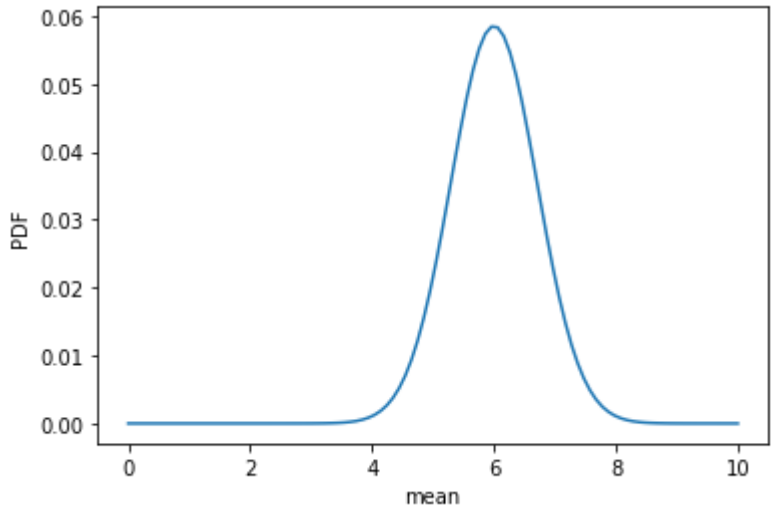
```
x = 5
x1 = 7
m = np.linspace(0,10,100)
Y_ax = norm.pdf(x, m, 1 )*norm.pdf(x1, m, 1 )
```

In [66]:

```
plt.plot(m, Y_ax)
plt.xlabel('mean')
plt.ylabel('PDF')
```

Out[66]:

```
Text(0, 0.5, 'PDF')
```



Task 3: Pdf for ten value of x and rest same condition as above

Here i'm taking 10 values of x which are randomly generated with mean 5 and deviation 1

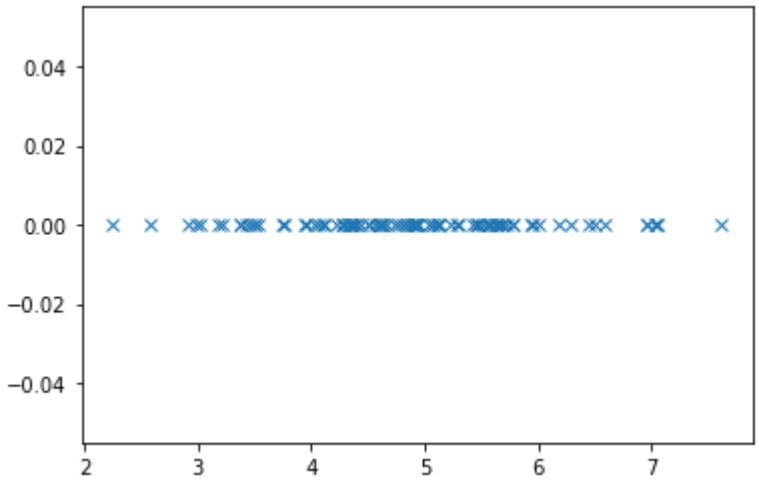
In [67]:

```
#x = [1,2,3,4,5,6,7,8,9,10]
#x = [4, 5, 7, 8, 8, 9, 10, 5, 2, 3, 5, 4, 8, 9]
x = np.random.normal(5, 1,10)
m = np.linspace(0,10,100)
```

Task 3.1: Plot of randomly generated value of x with 100 values and mean of 5 along with fixed deviation of 1

In [68]:

```
val = 0. # this is the value where you want the data to appear on the y-axis.
x = np.random.normal(5, 1,100) # just as an example array
plt.plot(x, np.zeros_like(x) + val, 'x')
plt.show()
```



Task 3.2: Plot of pdf of randomly generated value of x with 10 values and mean of 5 along with fixed deviation of 1

In [69]:

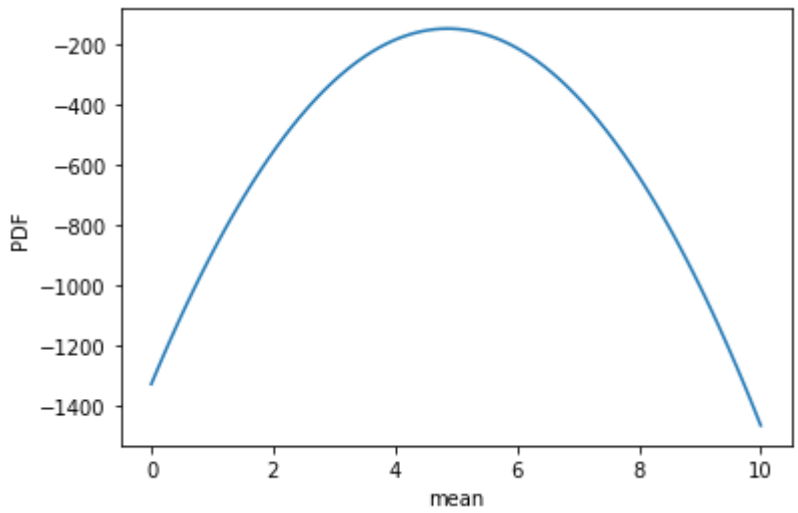
```
ll = 0
for i in x:
    ll += np.log(norm.pdf(i, m, 1))
```

In [70]:

```
plt.plot(m, ll)
plt.xlabel('mean')
plt.ylabel('PDF')
```

Out[70]:

```
Text(0, 0.5, 'PDF')
```



Plotting by directly multiplying them to get the total probability

In [71]:

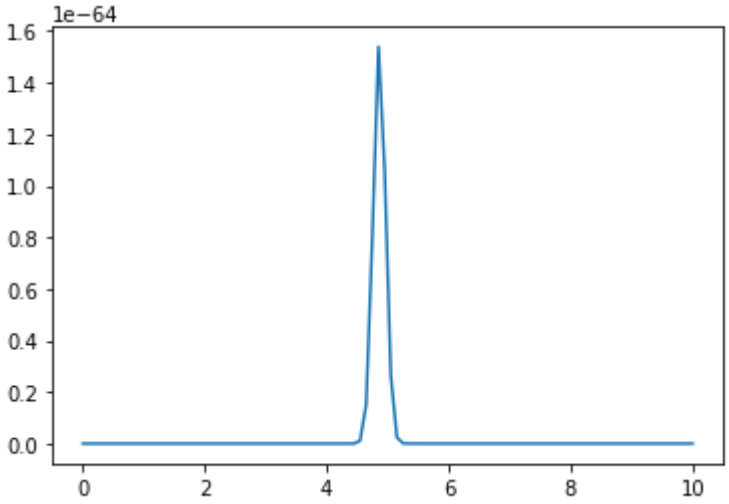
```
ll = 1
for i in x:

    ll = ll*(norm.pdf(i, m, 1))
```

In [72]:

```
plt.plot(m, ll)
```

Out[72]:

```
[<matplotlib.lines.Line2D at 0x7f89efeb4b00>]
```



Plotting likelihood function

1: Plotting without intercept

In [88]:

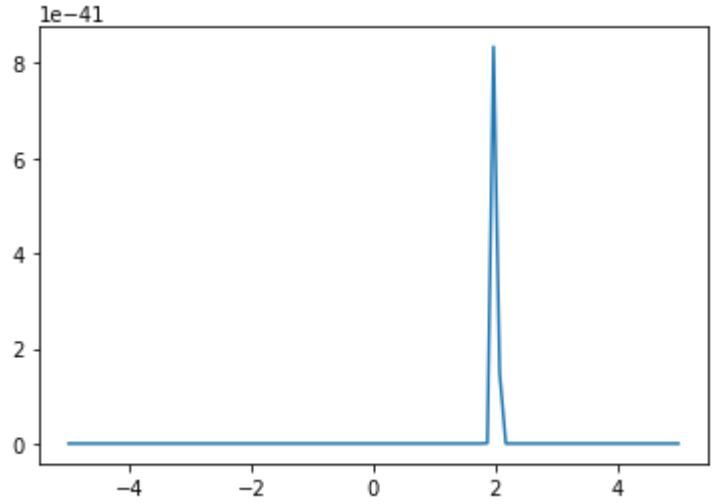
```
m = 2
x = np.linspace(-5,5,100)
y = m*x
w0 = np.linspace(-5,5,100)
def liklihood(x,u,w0):
    l = 1
    it = len(x)
    for i in range(it):
        l *= norm.pdf(w0*x[i],u[i],1)
    return l
```

In [89]:

```
plt.plot(w0,liklihood(x,y,w0))
```

Out[89]:

```
[<matplotlib.lines.Line2D at 0x7f89ee2a4160>]
```



Task2: plotting with intercept

In [91]:

```
# with intercept
y1 = m*x + c
w0 = np.linspace(-10,10,100)
w1 = np.linspace(-10,10,100)
W0 , W1 = np.meshgrid(w0,w1)
```

In [76]:

```
def in_liklhood(x,u,W0,W1):                                    #function 1
    l = 1
    it = len(x)
    for i in range(it):
        l *= norm.pdf(W1*x[i]+W0,u[i],1)
    return l
def log_in_liklhood(x,u,W0,W1):                                 #function 2
    l = 0
    it = len(x)
    for i in range(it):
        l += np.log(norm.pdf(W1*x[i]+W0,u[i],1))
    return l
```

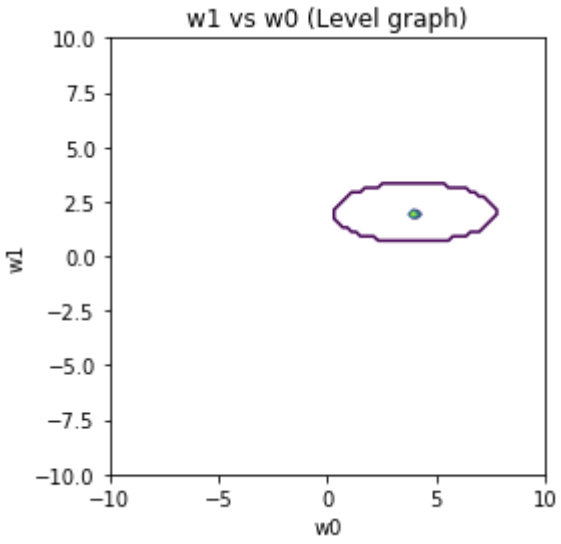
contour with function 1 from above

In [92]:

```
plt.gca().set_aspect('equal',adjustable = 'box')
plt.draw()
plt.xlabel('w0')
plt.ylabel('w1')
plt.title('w1 vs w0 (Level graph)')
plt.contour(W0,W1,in_liklhood(x,y1,W0,W1))                    #considering function
```

Out[92]:

```
<matplotlib.contour.QuadContourSet at 0x7f89ee1f9e10>
```



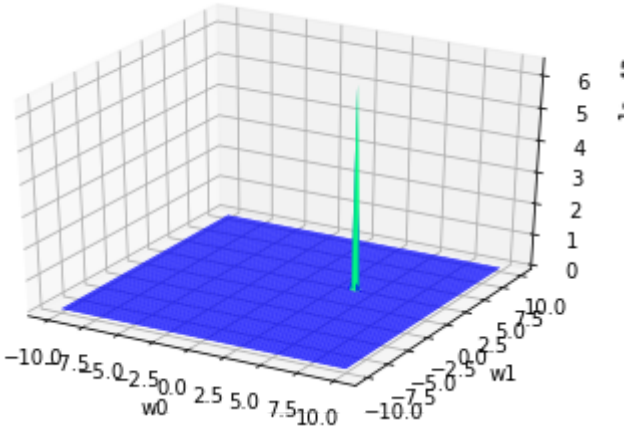
Surface plot while considering 1nd function

In [93]:

```
fig = plt.figure()
ax = plt.axes(projection='3d')
plt.xlabel('w0')                                              #considering function 1
plt.ylabel('w1')
ax.plot_surface(W0, W1,in_liklhood(x,y1,W0,W1) , cmap='winter', rstride=1, cstride=
```

Out[93]:

```
<mpl_toolkits.mplot3d.art3d.Poly3DCollection at 0x7f89eeadb438>
```



contour with function 2 which is defined above

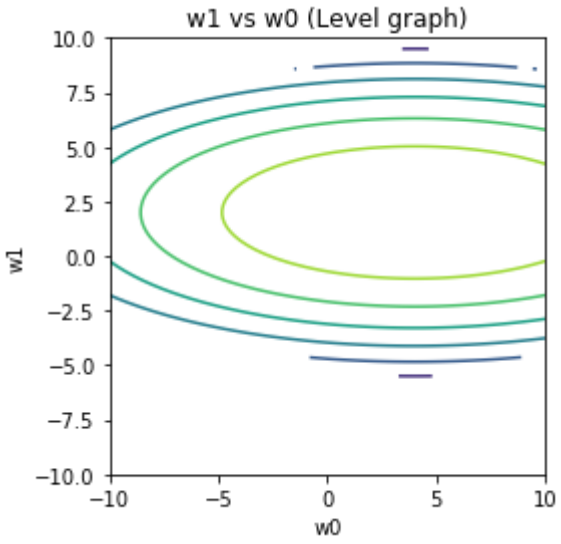
In [79]:

```
plt.gca().set_aspect('equal',adjustable = 'box')
plt.draw()
plt.xlabel('w0')
plt.ylabel('w1')
plt.title('w1 vs w0 (Level graph)')
plt.contour(W0,W1,log_in_liklhood(x,y1,W0,W1))                    #considering functi
```

```
/home/dheeraj/my_projects/my_project_env/lib/python3.6/site-packages/i
pykernel_launcher.py:12: RuntimeWarning: divide by zero encountered in
log
  if sys.path[0] == '':
```

Out[79]:

```
<matplotlib.contour.QuadContourSet at 0x7f89ef459b00>
```



Surface plot while considering 2nd function

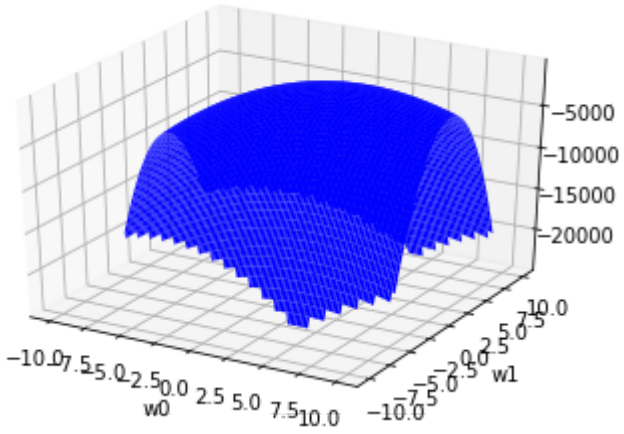
In [80]:

```
fig = plt.figure()
ax = plt.axes(projection='3d')
plt.xlabel('w0')
plt.ylabel('w1')                                        #considering function 2
ax.plot_surface(W0, W1,log_in_liklhood(x,y1,W0,W1) , cmap='winter', rstride=1, cstr
```

```
/home/dheeraj/my_projects/my_project_env/lib/python3.6/site-packages/i
pykernel_launcher.py:12: RuntimeWarning: divide by zero encountered in
log
  if sys.path[0] == '':
```

Out[80]:

```
<mpl_toolkits.mplot3d.art3d.Poly3DCollection at 0x7f89efdbf3c8>
```



Now plot for error function with the same inputs

In [81]:

```
def error(W1,W0,y1):
    l = 0
    it = len(x)
    for i in range(it):
        l += (W1*x[i] + W0 - y1[i])**2
    return l
```

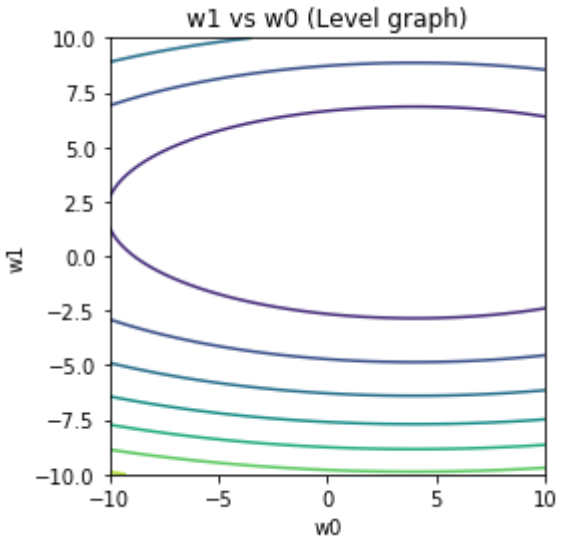
Contour curve considering error function

In [82]:

```
plt.gca().set_aspect('equal',adjustable = 'box')
plt.draw()
plt.xlabel('w0')
plt.ylabel('w1')
plt.title('w1 vs w0 (Level graph)')
plt.contour(W0,W1,error(W1,W0,y1))
```

Out[82]:

```
<matplotlib.contour.QuadContourSet at 0x7f89ef1aa710>
```



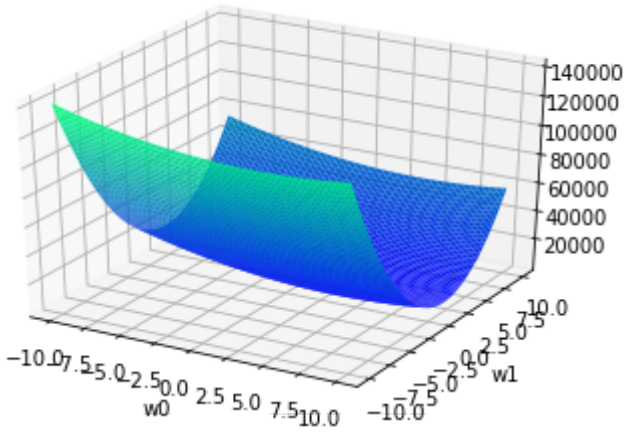
Surface plot of error function

In [95]:

```
fig = plt.figure()
ax = plt.axes(projection='3d')
plt.xlabel('w0')
plt.ylabel('w1')
ax.plot_surface(W0, W1,error(W1,W0,y1) , cmap='winter', rstride=1, cstride=1, edgec
```

Out[95]:

```
<mpl_toolkits.mplot3d.art3d.Poly3DCollection at 0x7f89ec96a4a8>
```



Comparing both likelihood plot (of with 2nd function defined above) with error function

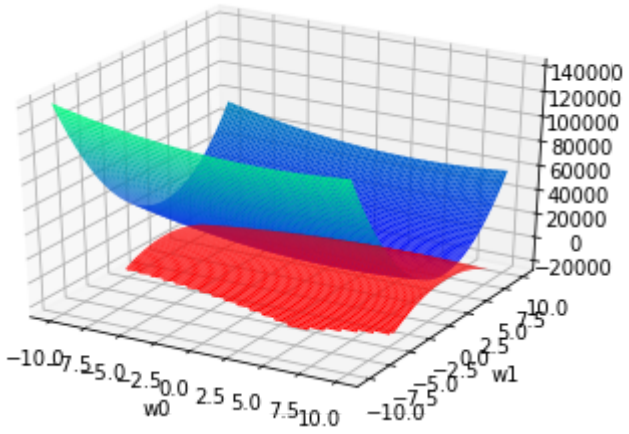
In [97]:

```
fig = plt.figure()
ax = plt.axes(projection='3d')
plt.xlabel('w0')
plt.ylabel('w1')
ax.plot_surface(W0, W1,error(W1,W0,y1) , cmap='winter', rstride=1, cstride=1, edgec
ax.plot_surface(W0, W1,log_in_liklhood(x,y1,W0,W1) , cmap='autumn', rstride=1, cstr
```

```
/home/dheeraj/my_projects/my_project_env/lib/python3.6/site-packages/i
pykernel_launcher.py:12: RuntimeWarning: divide by zero encountered in
log
  if sys.path[0] == '':
```

Out[97]:

```
<mpl_toolkits.mplot3d.art3d.Poly3DCollection at 0x7f89eb78bfd0>
```



Combined Contour for both error and likelihood function

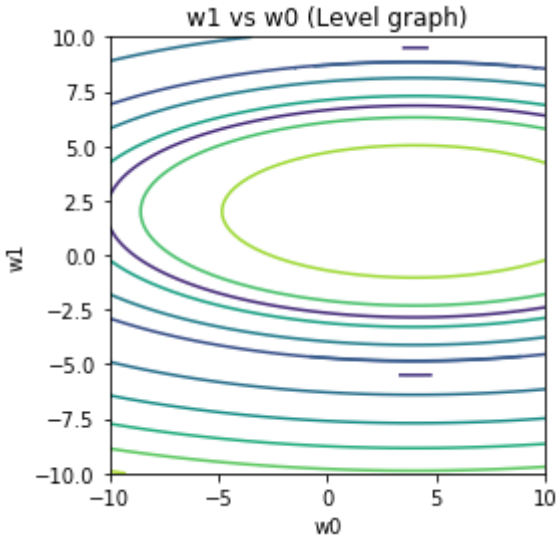
In [87]:

```
plt.gca().set_aspect('equal',adjustable = 'box')
plt.draw()
plt.xlabel('w0')
plt.ylabel('w1')
plt.title('w1 vs w0 (Level graph)')
plt.contour(W0,W1,error(W1,W0,y1))
plt.contour(W0,W1,log_in_liklhood(x,y1,W0,W1))
```

```
/home/dheeraj/my_projects/my_project_env/lib/python3.6/site-packages/i
pykernel_launcher.py:12: RuntimeWarning: divide by zero encountered in
log
  if sys.path[0] == '':
```

Out[87]:

```
<matplotlib.contour.QuadContourSet at 0x7f89ed3e5400>
```



In [ ]: