9.a. 2D Hyperplane

$w = [-1, 2]^T$

$b = 2$

$w_1x + w_2y + b = 0$

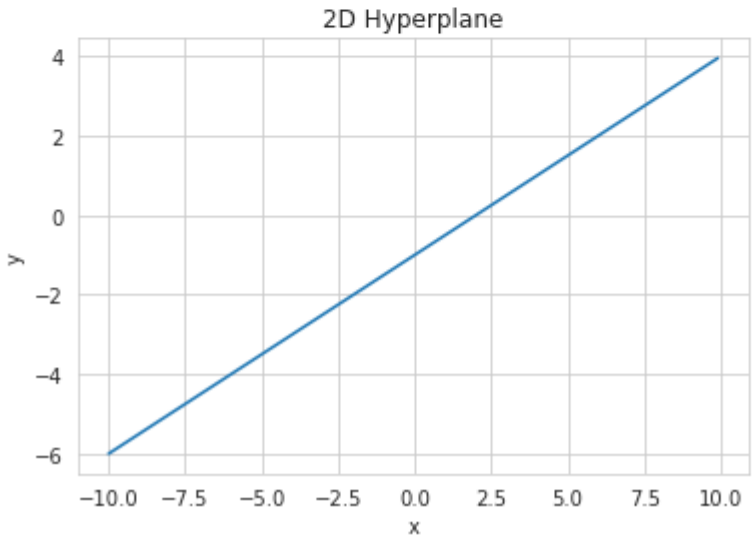
$-x + 2y + 2 = 0$

$y = (1/2)x - 1$

[6]:
```
x = np.arange(-10,10,0.1)
y = 0.5 * x -1
```

[15]:
```
plt.plot(x,y)
plt.xlabel("x")
plt.ylabel("y")
plt.title("2D Hyperplane")
```

[15]:
```
Text(0.5, 1.0, '2D Hyperplane')
```



9.b. 3D Hyperplane

$w = [1,1,1]^T$

$b = 0$

$w_1x + w_2y + w_3z + b = 0$

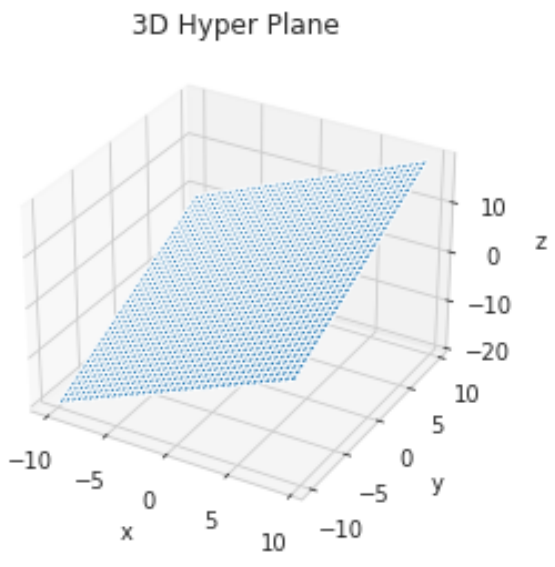
$x + y + z = 0$

[17]:
```
x = np.arange(-10,10,0.5)
y = np.arange(-10,10,0.5)
X, Y = np.meshgrid(x,y)
Z = X + Y
```

[19]:
```
ax = plt.axes(projection="3d")
ax.plot_surface(X,Y,Z)
ax.set_xlabel("x")
ax.set_ylabel("y")
ax.set_zlabel("z")

plt.title("3D Hyper Plane")
```

[19]:
```
Text(0.5, 0.92, '3D Hyper Plane')
```



[4]:
```
import numpy as np
```

[6]:
```
A = np.array([[1, 0, 2], [3, 1, 2], [1, 2, 2]])
b = np.transpose(np.array([1, -2, 1]))
c = np.transpose(np.ones(3))
```

---

11 a. Evaluate A^{-1}

[9]:
```
InvA = np.linalg.inv(A)
```

[11]:
```
InvA
```

[11]:
```
array([[-0.25 ,  0.5  , -0.25 ],
       [-0.5  ,  0.   ,  0.5  ],
       [ 0.625, -0.25 ,  0.125]])
```

---

11 b. Computing A^{-1} b

[14]:
```
# InvA * b
print(InvA * b)
```

```
[[-0.25  -1.    -0.25 ]
 [-0.5   -0.     0.5  ]
 [ 0.625  0.5    0.125]]
```

---

11 b. Computing A^{-1} c

[17]:
```
# A * c
print(A * c)
```

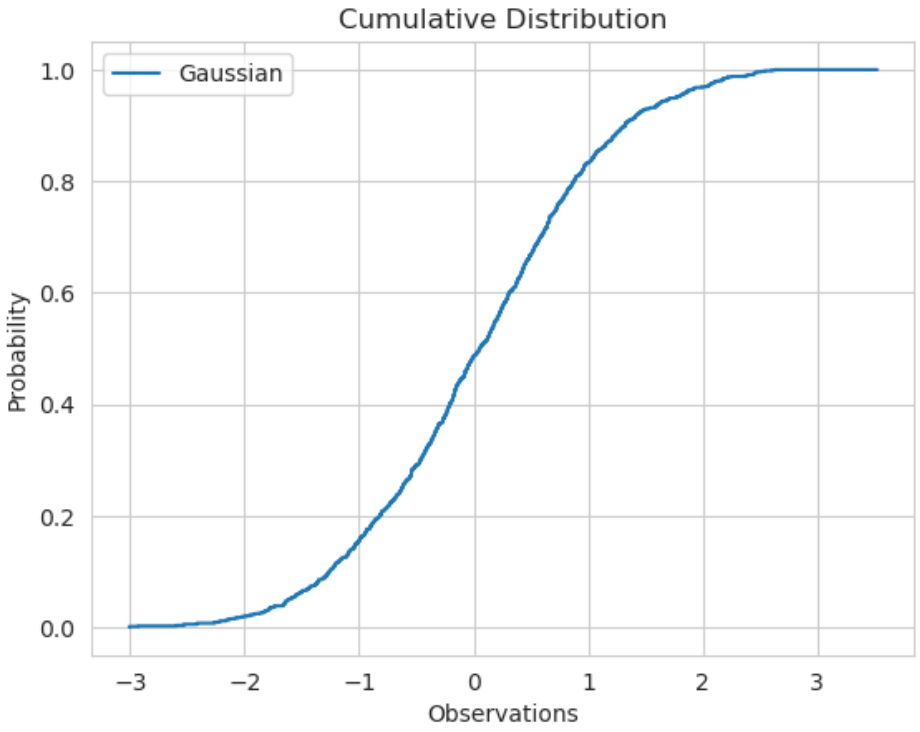
```
[[1. 0. 2.]
 [3. 1. 2.]
 [1. 2. 2.]]
```

12 a. Gaussian CDF Plot

[9]:
```
n = 1000
Z = np.random.randn(n)
```

[12]:
```
plt.step(sorted(Z), np.arange(1,n+1)/float(n), label = "Gaussian")
plt.legend()
plt.title("Cumulative Distribution")
plt.xlabel("Observations")
plt.ylabel("Probability")
```

[12]:
```
Text(0, 0.5, 'Probability')
```



12 b. Multiple CDF Plots

[17]:
```
li = [1, 8, 64, 512]
for k in li:
    sums = np.sum(np.sign(np.random.randn(n, k)) * np.sqrt(1./k), axis=1)
    plt.step(sorted(sums), np.arange(1,n+1)/float(n), label = k)

plt.step(sorted(Z), np.arange(1,n+1)/float(n), label = "Gaussian")

plt.legend()
plt.title("Cumulative Distribution")
plt.xlabel("Observations")
plt.ylabel("Probability")
```

[17]:
```
Text(0, 0.5, 'Probability')
```