# P1

November 12, 2018

## 1 Regresión Lineal con 1 Variable

### 1.1 Imports:

```
In [1]: import pandas as pd
        import matplotlib.pyplot as plt #importar biblioteca y renombrarla a plt
        import numpy as np
```

### 1.2 Lector de CSV

```
In [2]: def readCsv(nombre):
            valores = pd.read_csv(nombre, header = None).values
            return valores.astype(float)
```

### 1.3 Regresion Lineal

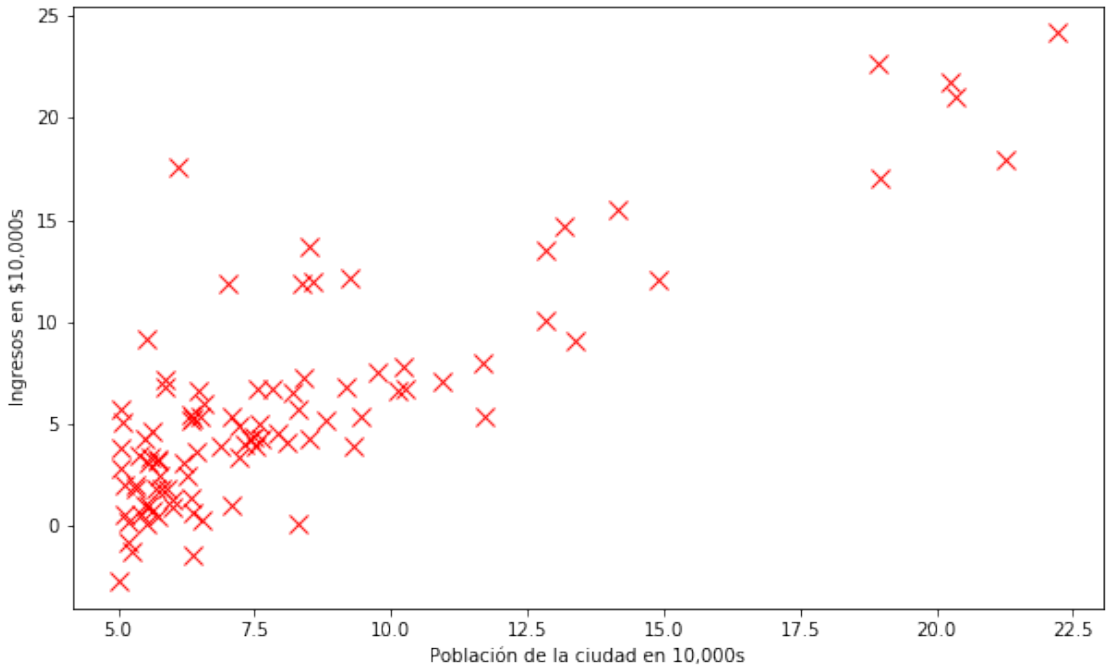
```
In [3]: def LinearRegression(valores):
            #Formar la matriz X y el vector Y
            X = np.transpose(np.array(valores[:-1]))
            x = np.transpose(np.array(X[:-1]))
            y = np.transpose(np.array(X[-1:]))
            m = y.size # numero de casos de entrenamiento
            #Insertar la columna de 1s en la matriz X
            x = np.insert(x,0,1,axis=1)
            return x,y,m
```

### 1.4 Grafica

```
In [4]: def PlotData(X,y):


            plt.figure(figsize=(10,6))
            plt.plot(X[:,1],y[:,0],'rx',markersize=10)
            plt.ylabel('Ingresos en $10,000s')
            plt.xlabel('Población de la ciudad en 10,000s')
```

## 2 Dibujado de gráfica con datos de entrenamiento

```
In [5]: datos = readCsv("ex1data1.csv")
        X,y,m=LinearRegression(datos)
        PlotData(X,y)
        iterations = 1500
        alpha = 0.01
```




### 2.1 Coste de la funcion

```
In [6]: def h(theta,X):
            return np.dot(X,theta)

        def computeCost(mytheta,X,y):
            return float((1./(2*m)) * np.dot((h(mytheta,X)-y).T,(h(mytheta,X)-y)))

        initial_theta = np.zeros((X.shape[1],1)) #(theta es un vector con n filas y 1 columna)
```

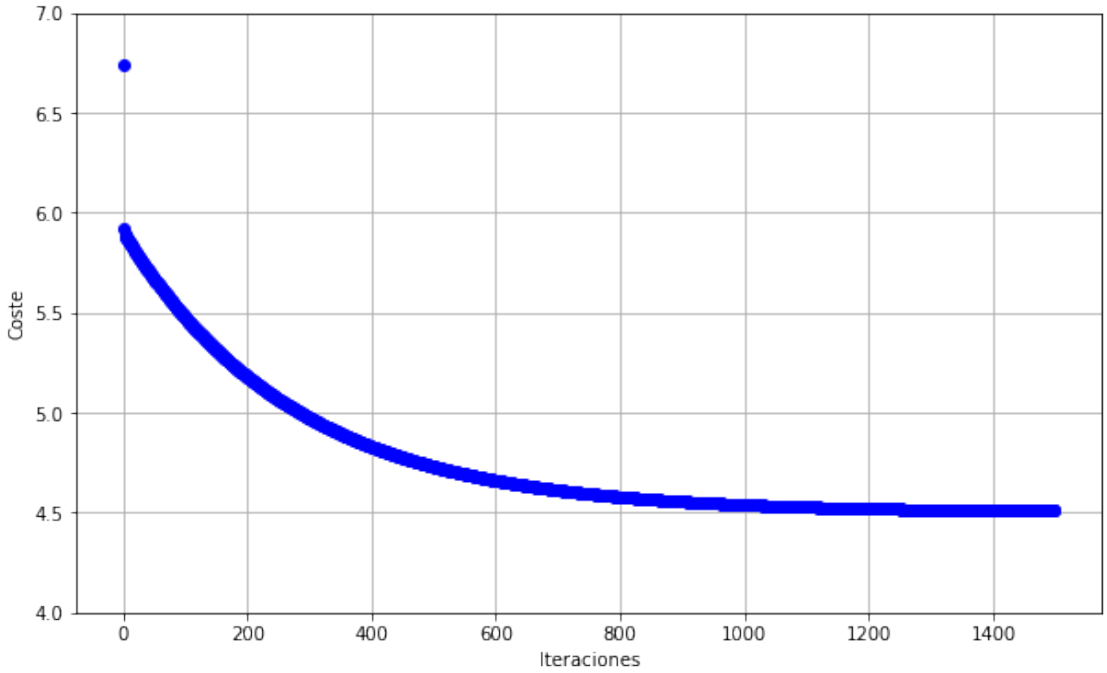
### 2.2 Descenso de Gradiente

```
In [7]: def descendGradient(X, theta_start = np.zeros(2)):
            theta = theta_start
            jvec = []
            thetahistory = []
            for meaninglessvariable in range(iterations):
```

```
            tmptheta = theta
            jvec.append(computeCost(theta,X,y))
            thetahistory.append(list(theta[:,0]))
            for j in range(len(tmptheta)):
                tmptheta[j] = theta[j] - (alpha/m)*np.sum((h(initial_theta,X) - y)*np.array
            theta = tmptheta
        return theta, thetahistory, jvec
```

### 2.3 Grafica de Coste

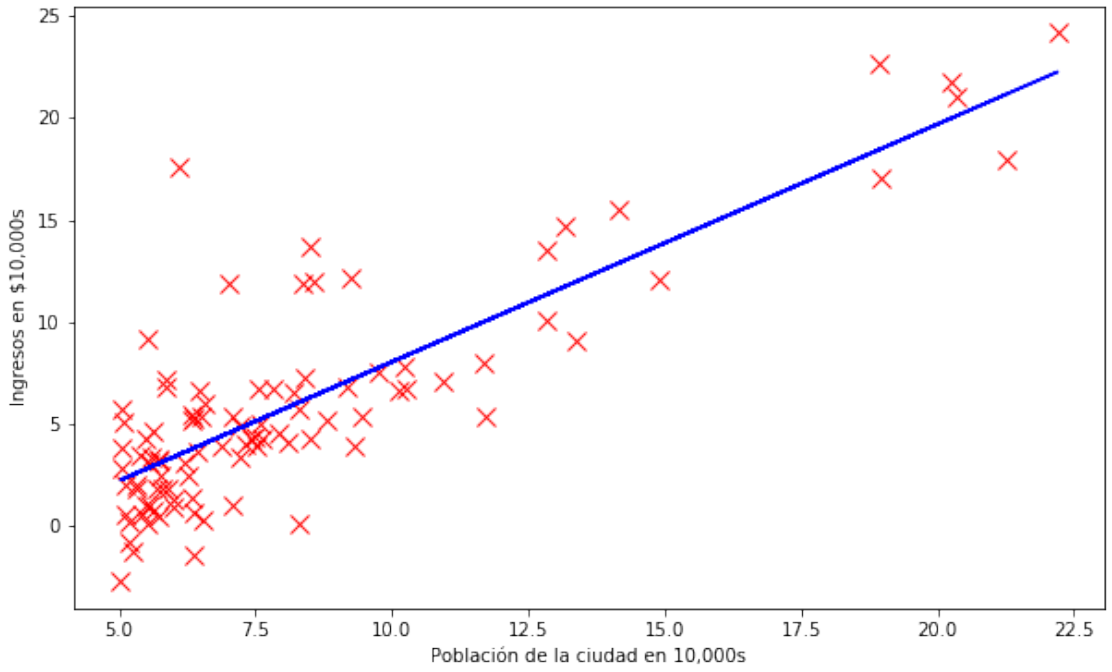
```
In [8]: initial_theta = np.zeros((X.shape[1],1))
        theta, thetahistory, jvec = descendGradient(X,initial_theta)

        #Plot the convergence of the cost function
        def plotConvergence(jvec):
            plt.figure(figsize=(10,6))
            plt.plot(range(len(jvec)),jvec,'bo')
            plt.grid(True)
            plt.xlabel("Iteraciones")
            plt.ylabel("Coste")
            a = plt.xlim([-0.05*iterations,1.05*iterations])


        plotConvergence(jvec)
        a = plt.ylim([4,7])
```



## 2.4 Grafica encima de los datos de aprendizaje

```
In [9]: def myfit(xval):
            return theta[0] + theta[1]*xval
        plt.figure(figsize=(10,6))
        plt.plot(X[:,1],y[:,0],'rx',markersize=10)
        plt.plot(X[:,1],myfit(X[:,1]),'b-')
        plt.ylabel('Ingresos en $10,000s')
        plt.xlabel('Población de la ciudad en 10,000s')
```

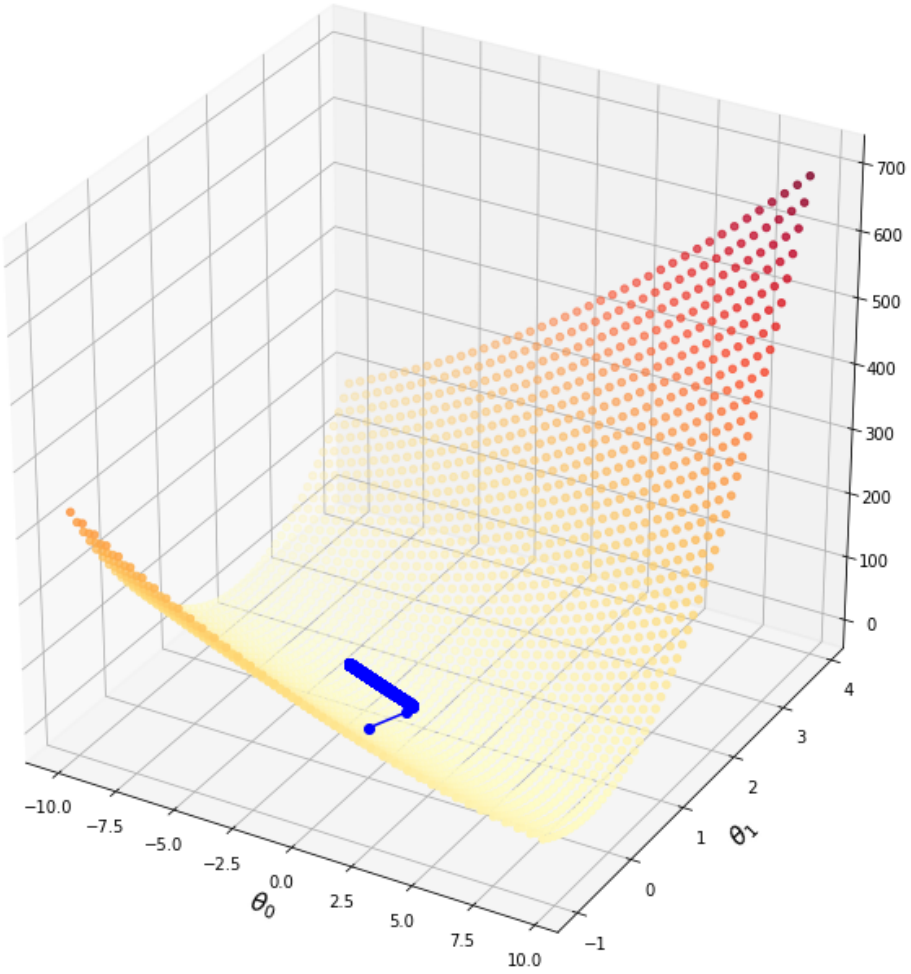
```
Out[9]: Text(0.5,0,'Población de la ciudad en 10,000s')
```




## 2.5 Visualizar J($\theta$)

```
In [10]: from mpl_toolkits.mplot3d import axes3d, Axes3D
         from matplotlib import cm
         import itertools

         fig = plt.figure(figsize=(12,12))
         ax = fig.gca(projection='3d')

         xvals = np.arange(-10,10,.5)
         yvals = np.arange(-1,4,.1)
         myxs, myys, myzs = [], [], []
         for x1 in xvals:
             for y1 in yvals:
```

```
            myxs.append(x1)
            myys.append(y1)
            myzs.append(computeCost(np.array([[x1], [y1]]),X,y))

scat = ax.scatter(myxs,myys,myzs,c=np.abs(myzs),cmap=plt.get_cmap('YlOrRd'))

plt.xlabel(r'$\theta_0$',fontsize=15)
plt.ylabel(r'$\theta_1$',fontsize=15)
plt.plot([x[0] for x in thetahistory],[x[1] for x in thetahistory],jvec,'bo-')
plt.show()
```



# 3 Regresión Lineal con Varias Variables

## 3.1 Lectura de datos

```
In [11]: datos2 = readCsv("ex1data2.csv")
         X,y,m=LinearRegression(datos2)
```

## 3.2 Normalizar

```
In [12]: stored_feature_means, stored_feature_stds = [], []
         Xnorm = X.copy()
         for icol in range(Xnorm.shape[1]):
             stored_feature_means.append(np.mean(Xnorm[:,icol]))
             stored_feature_stds.append(np.std(Xnorm[:,icol]))
             if not icol: continue
             Xnorm[:,icol] = (Xnorm[:,icol] - stored_feature_means[-1])/stored_feature_stds[-1]
```

## 3.3 Descenso de gradiente

```
In [13]: initial_theta = np.zeros((Xnorm.shape[1],1))
         theta, thetahistory, jvec = descendGradient(Xnorm,initial_theta)
```

## 3.4 Probamos el valor (1650,3) para ver que precio deduce

```
In [14]: print ("Precio deducido para una casa de 1650 metros cuadrados y 3 habitaciones")
         ytest = np.array([1650.,3.])
         ytestscaled = [(ytest[x]-stored_feature_means[x+1])/stored_feature_stds[x+1] for x in
         ytestscaled.insert(0,1)
         print ("$%0.2f" % float(h(theta,ytestscaled)))
```

```
Precio deducido para una casa de 1650 metros cuadrados y 3 habitaciones
$292817.57
```

### 3.4.1 Ecuación normal/directa

```
In [15]: from numpy.linalg import inv
         def normEqtn(X,y):
             return np.dot(np.dot(inv(np.dot(X.T,X)),X.T),y)
```

```
In [16]: print ("Predicción para una casa de 1650 metros cuadrados y 3 habitaciones")
         print ("$%0.2f" % float(h(normEqtn(X,y),[1,1650.,3])))
```

```
Predicción para una casa de 1650 metros cuadrados y 3 habitaciones
$292798.87
```