Universidad Pólitecnica Salesiana

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Fecha: 11/05/2021

Asignatura: Simulación

In [109]:

```
import pandas as pd
import numpy as np
from datetime import datetime,timedelta
from sklearn.metrics import mean_squared_error
from scipy.optimize import curve_fit
from scipy.optimize import fsolve
from sklearn import linear_model
import matplotlib.pyplot as plt
%matplotlib inline

url = 'https://raw.githubusercontent.com/andrab/ecuacovid/master/datos_crudos/vacunas/vacunas.csv'

df = pd.read_csv(url)
df.head()
```

Out[109]:

	fecha	dosis_total	primera_dosis	segunda_dosis
0	21/01/2021	0	0	0
1	22/01/2021	108	108	0
2	27/01/2021	2982	2982	0
3	04/02/2021	6228	6228	0
4	17/02/2021	8190	6228	1962

In [110]:

```
df['index'] = df.index

df.head()
```

Out[110]:

	fecha	dosis_total	primera_dosis	segunda_dosis	index
0	21/01/2021	0	0	0	0
1	22/01/2021	108	108	0	1
2	27/01/2021	2982	2982	0	2
3	04/02/2021	6228	6228	0	3
4	17/02/2021	8190	6228	1962	4

In [111]:

```
filt = df[df['fecha'].isin(["04/05/2021"])]
filt
```

Out[111]:

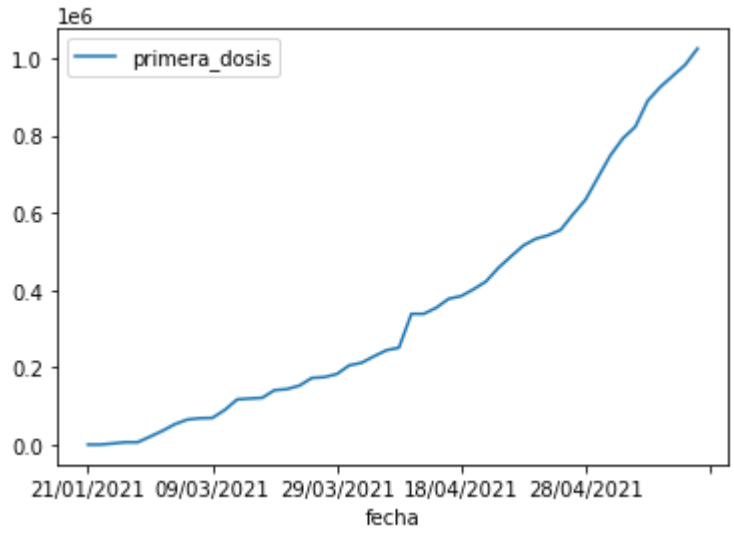
	fecha	dosis_total	primera_dosis	segunda_dosis	index
45	04/05/2021	1141262	889218	252044	45

In [112]:

```
df.plot(x ='fecha', y='primera_dosis')
```

Out[112]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417d1c37f0>
```

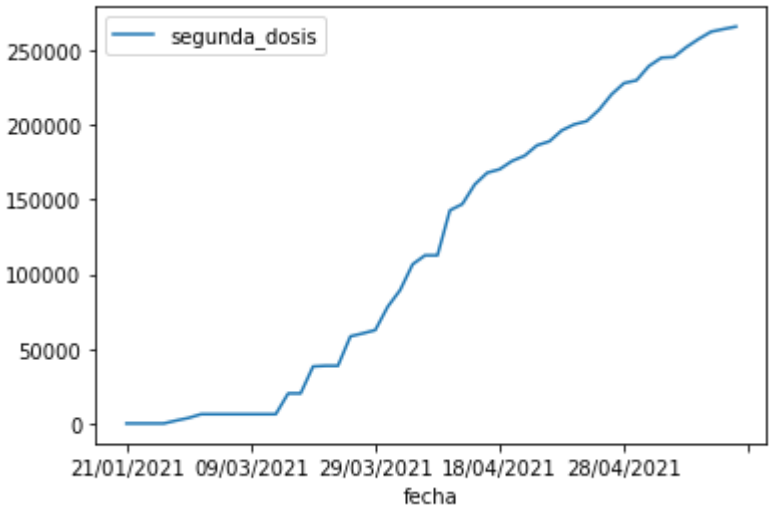


In [113]:

```
df.plot(x ='fecha', y='segunda_dosis')
```

Out[113]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417d41bdf0>
```

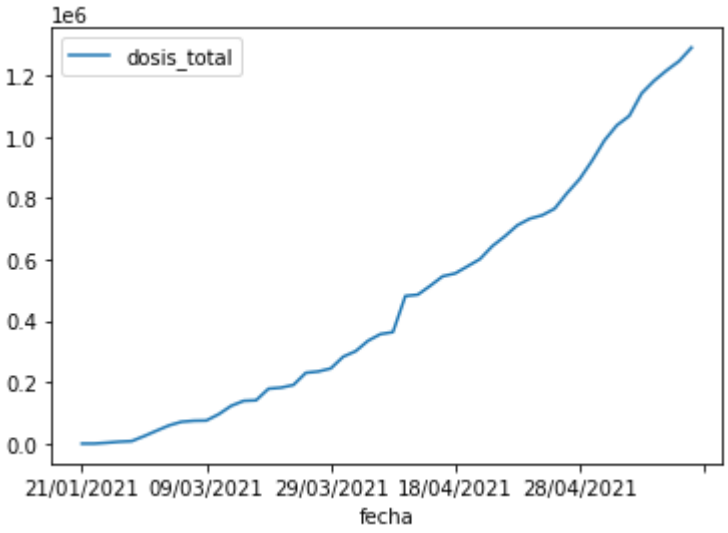


In [114]:

```
df.plot(x ='fecha', y='dosis_total')
```

Out[114]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417d47ff70>
```



Datos por fabricante y fechas.

In [115]:

```
url_fab = 'https://raw.githubusercontent.com/andrab/ecuacovid/master/datos_crudos/vacunas/fabricantes.csv'

df_fab = pd.read_csv(url_fab)
df_fab
```

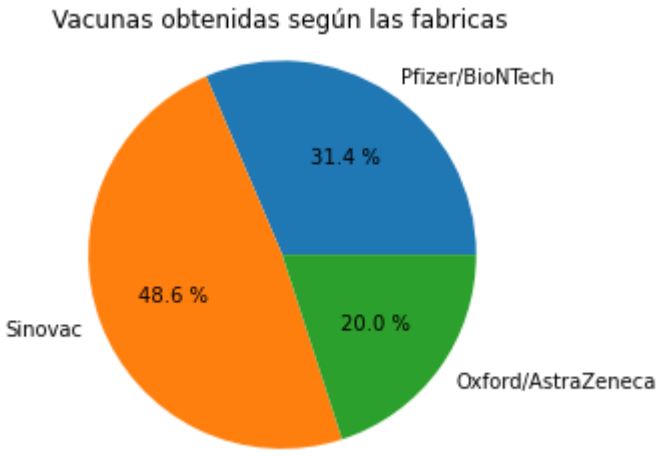
Out[115]:

	vaccine	total	arrived_at
0	Pfizer/BioNTech	8190	20/01/2021
1	Pfizer/BioNTech	16380	17/02/2021
2	Pfizer/BioNTech	17550	24/02/2021
3	Pfizer/BioNTech	31590	03/03/2021
4	Sinovac	20000	06/03/2021
5	Pfizer/BioNTech	73710	10/03/2021
6	Oxford/AstraZeneca	84000	17/03/2021
7	Pfizer/BioNTech	62010	17/03/2021
8	Pfizer/BioNTech	65520	24/03/2021
9	Pfizer/BioNTech	66690	31/03/2021
10	Pfizer/BioNTech	53820	05/04/2021
11	Sinovac	300000	07/04/2021
12	Sinovac	700000	10/04/2021
13	Pfizer/BioNTech	53820	14/04/2021
14	Pfizer/BioNTech	54990	21/04/2021
15	Oxford/AstraZeneca	336000	24/04/2021
16	Pfizer/BioNTech	54990	28/04/2021
17	Pfizer/BioNTech	100620	04/05/2021

Gráfica de pie de vacunas obtenidas en total

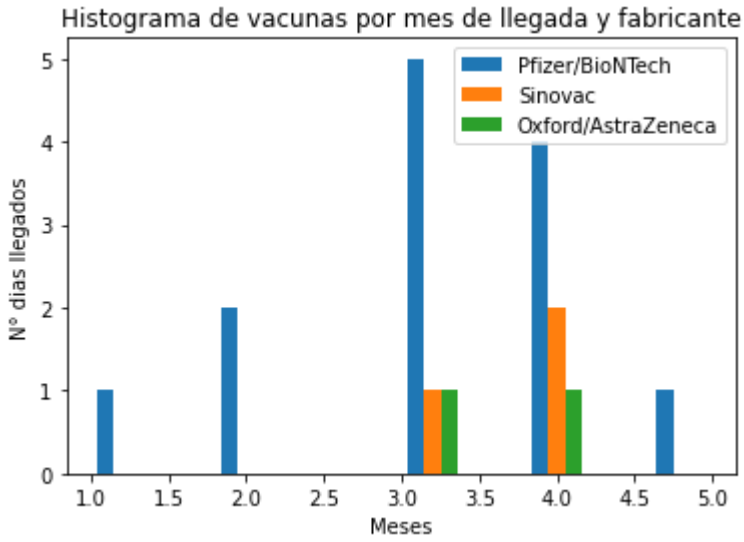
In [116]:

```
pfizer = df_fab[df_fab['vaccine'].isin(['Pfizer/BioNTech'])]
sinovac = df_fab[df_fab['vaccine'].isin(['Sinovac'])]
oxford = df_fab[df_fab["vaccine"].isin(['Oxford/AstraZeneca'])]

#print(pfizer)
#print(sinovac)
#print(oxford)

ptot = pfizer["total"]
pdat = pfizer["arrived_at"]
stot = sinovac["total"]
sdat = sinovac["arrived_at"]
otot = oxford["total"]
odat = oxford["arrived_at"]

psum = ptot.values.sum()
ssum = stot.values.sum()
osum = otot.values.sum()

datos = [psum,ssum, osum]
facts = ['Pfizer/BioNTech','Sinovac','Oxford/AstraZeneca']

'''plt.plot(pfizer["total"],pfizer['arrived_at'],'blue',sinovac["total"], sinovac["arri
ved_at"],\
        oxford["total"], oxford["arrived_at"])
    plt.legend(["Pfizer/BioTech","Sinovac","Oxford/AstraZeneca"])
        '''

#print(datos.values)
plt.pie(datos, labels=facts, autopct="%0.1f %%")

plt.axis("equal")
plt.title("Vacunas obtenidas según las fabricas")
plt.show()
```



In [117]:

```
#df_fab["month"] = df_fab['arrived_at']
month= df_fab['arrived_at']
me = []
for m in month:
    mes = m.split("/")
    me.append(int(mes[1]))
df_fab["month"]=me


pfi = df_fab[df_fab['vaccine'].isin(['Pfizer/BioNTech'])]
pfi = pfi.loc[:,['total','month']]

sin = df_fab[df_fab['vaccine'].isin(['Sinovac'])]
sin = sin.loc[:,['total', 'month']]

oxf = df_fab[df_fab['vaccine'].isin(['Oxford/AstraZeneca'])]
oxf = oxf.loc[:,['total', 'month']]

plt.title("Histograma de vacunas por mes de llegada y fabricante")
plt.xlabel("Meses")
plt.ylabel("N° dias llegados")

plt.hist([pfi["month"], sin["month"],oxf['month']], label=['Pfizer/BioNTech','Sinovac',
'Oxford/AstraZeneca'])
plt.legend(loc="upper right")
plt.show()
sin
```



Out[117]:

	total	month
4	20000	3
11	300000	4
12	700000	4

Falta implementar parametrizar por rango de fechas inicio y fin.

In [118]:

```
df_fab
```

Out[118]:

	vaccine	total	arrived_at	month
0	Pfizer/BioNTech	8190	20/01/2021	1
1	Pfizer/BioNTech	16380	17/02/2021	2
2	Pfizer/BioNTech	17550	24/02/2021	2
3	Pfizer/BioNTech	31590	03/03/2021	3
4	Sinovac	20000	06/03/2021	3
5	Pfizer/BioNTech	73710	10/03/2021	3
6	Oxford/AstraZeneca	84000	17/03/2021	3
7	Pfizer/BioNTech	62010	17/03/2021	3
8	Pfizer/BioNTech	65520	24/03/2021	3
9	Pfizer/BioNTech	66690	31/03/2021	3
10	Pfizer/BioNTech	53820	05/04/2021	4
11	Sinovac	300000	07/04/2021	4
12	Sinovac	700000	10/04/2021	4
13	Pfizer/BioNTech	53820	14/04/2021	4
14	Pfizer/BioNTech	54990	21/04/2021	4
15	Oxford/AstraZeneca	336000	24/04/2021	4
16	Pfizer/BioNTech	54990	28/04/2021	4
17	Pfizer/BioNTech	100620	04/05/2021	5

Modelos de simulación

Regresión lineal

In [119]:

```
df_dos = df

month= df['fecha']
me = []
for m in month:
    mes = m.split("/")
    me.append(int(mes[1]))
df_dos["total"] = df["dosis_total"]
df_dos["mes"] = me
del df_dos["dosis_total"]
df_dos.head()
```

Out[119]:

	fecha	primera_dosis	segunda_dosis	index	total	mes
0	21/01/2021	0	0	0	0	1
1	22/01/2021	108	0	1	108	1
2	27/01/2021	2982	0	2	2982	1
3	04/02/2021	6228	0	3	6228	2
4	17/02/2021	6228	1962	4	8190	2

In [125]:

```
x = list(df.iloc[:,5])#Fecha
y = list(df.iloc[:,4])#Total
regr = linear_model.LinearRegression()
regr.fit(np.array(x).reshape(-1,1),y)

# Veamos los coeficienetes obtenidos, En nuestro caso, serán la Tangente
print('Coefficients: \n', regr.coef_)
# Este es el valor donde corta el eje Y (en X=0)
print('Independent term: \n', regr.intercept_)
# Error Cuadrado Medio
```

```
Coefficients:
 [334108.28718762]
Independent term:
 -711493.2566441887
```

In [137]:

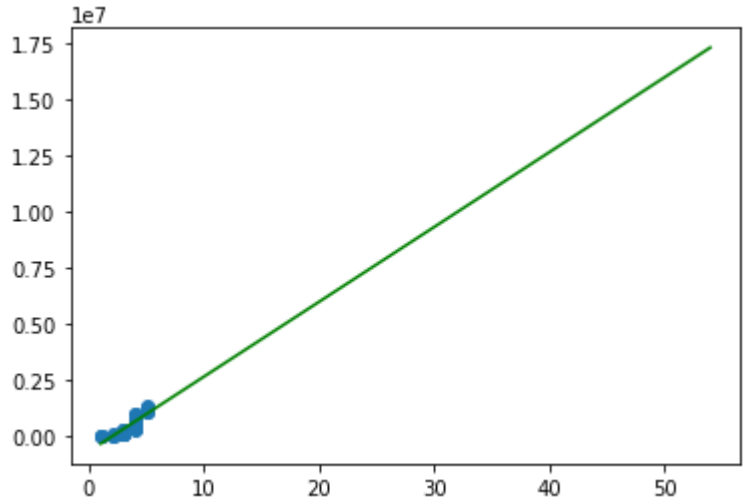
```
#Vamos a comprobar:
# Quiero predecir cuántos "Casos" voy a obtener por en el dia 100,
# según nuestro modelo, hacemos:
n = 55
y_prediccion = regr.predict([[n]])
pred = int(y_prediccion)
if pred >= 17268000:
    print('Problación 17 268 000',' n° vacunar',pred)
    print('Tiempo para vacunación de población completa: ',round(n/12,2)," Años = ",n,'
meses.')
else:
    print('vacunados ',pred)
```

```
Problación 17 268 000  n° vacunar 17664462
Tiempo para vacunación de población completa:  4.58  Años =  55  meses.
```

In [138]:

```
#Grafica
plt.scatter(x, y)
x_real = np.array(range(1, 55))

print(x_real)
plt.plot(x_real, regr.predict(x_real.reshape(-1, 1)), color='green')
plt.show()
```

```
[ 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
 49 50 51 52 53 54]
```



Graficar

plt.scatter(x, y) x_real = np.array(range(1, 6)) print(x_real) plt.plot(x_real, regr.predict(x_real.reshape(-1, 1)), color='green') plt.show()

Modelo exponencial

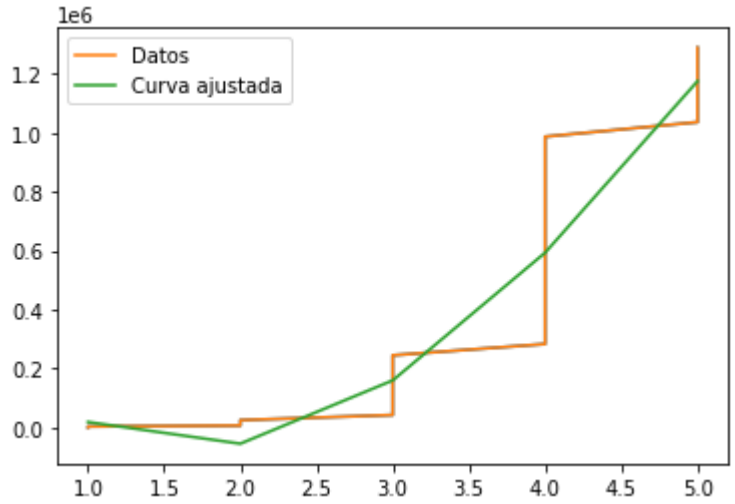
In [139]:

```
from scipy.optimize import curve_fit
x = np.array(df["mes"])
y = np.array(df["total"])
#y[0]=1

def func(x, a, b, c, d):
    return a*x**3 + b*x**2 +c*x + d

res1 , res2 = curve_fit(func,x,y)
print(res1)
print(res2)
```

```
[ -11646.56510892  214175.38317867 -634600.53432616  450209.7682928 ]
[[ 1.97563658e+08 -1.84230568e+09  5.12288633e+09 -3.91790539e+09]
 [-1.84230568e+09  1.74096905e+10 -4.92238360e+10  3.85623690e+10]
 [ 5.12288633e+09 -4.92238360e+10  1.42445201e+11 -1.15938000e+11]
 [-3.91790539e+09  3.85623690e+10 -1.15938000e+11  1.01467466e+11]]
```

In [140]:

```
#Grafica
plt.plot(x,y)
plt.plot(x,y, label="Datos")

plt.plot(x, func(x, *res1), label="Curva ajustada")

plt.legend(loc='upper left')
plt.show()
```



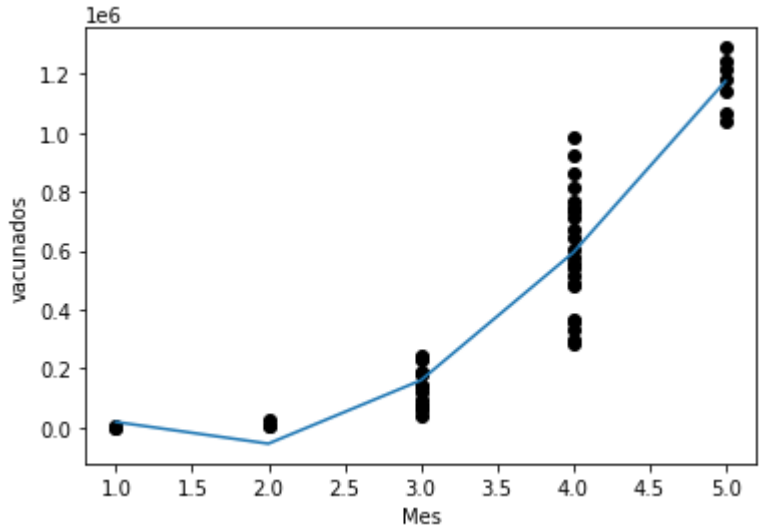
Modelo polinomico

In [141]:

```
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures

x = x.reshape(-1,1)
y = y.reshape(-1,1)

model = LinearRegression()
pre_proces = PolynomialFeatures(degree=3)

x_polin = pre_proces.fit_transform(x)

pr_model = LinearRegression()
pr_model.fit(x_polin,y)
y_pred = pr_model.predict(x_polin)

plt.scatter(x,y,c="black")
plt.xlabel("Mes")
plt.ylabel("vacunados")
plt.plot(x,y_pred)
```

Out[141]:

```
[<matplotlib.lines.Line2D at 0x2417a52b400>]
```



In [142]:

```
y_mes = pr_model.predict(pre_proces.fit_transform([[12]]))
y_mes
```

Out[142]:

```
array([[3550992.17432014]])
```

In [ ]:

Datos de vacunación en España

URL:https://raw.githubusercontent.com/montera34/escovid19data/master/data/original/vacunas/estado_vacuna
(https://raw.githubusercontent.com/montera34/escovid19data/master/data/original/vacunas/estado_vacunacior

In [143]:

```
url_es = 'https://raw.githubusercontent.com/montera34/escovid19data/master/data/origina
l/vacunas/estado_vacunacion_.csv'

df_es = pd.read_csv(url_es)
print('Total=>',df_es["Total pauta completada"].tail(1))
df_es.head()
```

```
Total=> 1834    6327447.0
Name: Total pauta completada, dtype: float64
```

Out[143]:

	date_pub	ccaa	Dosis entregadas Pfizer	Dosis entregadas Moderna	Dosis entregadas AstraZeneca	Dosis entregadas Janssen	Dosis entregadas	admi
0	4/1/21	Andalucía	NaN	NaN	NaN	NaN	140295	
1	4/1/21	Aragón	NaN	NaN	NaN	NaN	23715	
2	4/1/21	Asturias	NaN	NaN	NaN	NaN	23720	
3	4/1/21	Baleares	NaN	NaN	NaN	NaN	8940	
4	4/1/21	Canarias	NaN	NaN	NaN	NaN	20835	

In [144]:

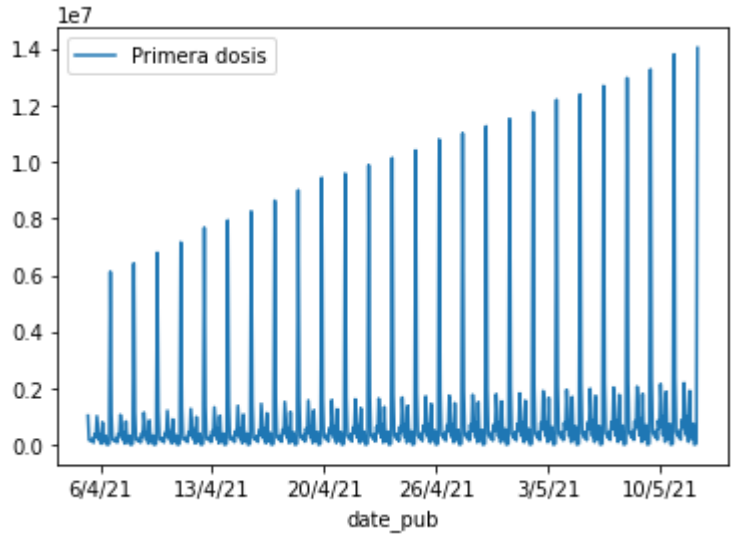
```
month= df_es['date_pub']
me = []
for m in month:
    mes = m.split("/")
    me.append(int(mes[1]))
df_es["mes"]=me
```

In [145]:

```
mes = np.array(df_es["date_pub"])

df_es.plot(x='date_pub', y = "Total 1 vacuna",label="Primera dosis")
```

Out[145]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x241793c08e0>
```

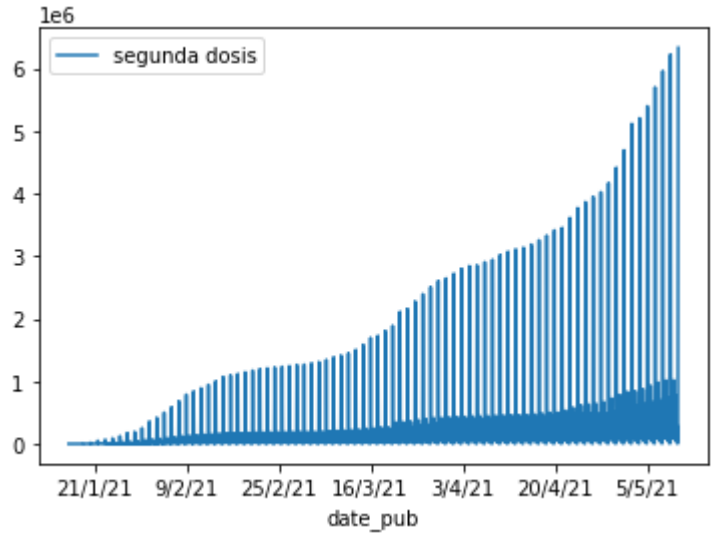


In [146]:

```
df_es.plot(x="date_pub", y = 'Total pauta completada', label='segunda dosis')
```

Out[146]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x241739dfbb0>
```

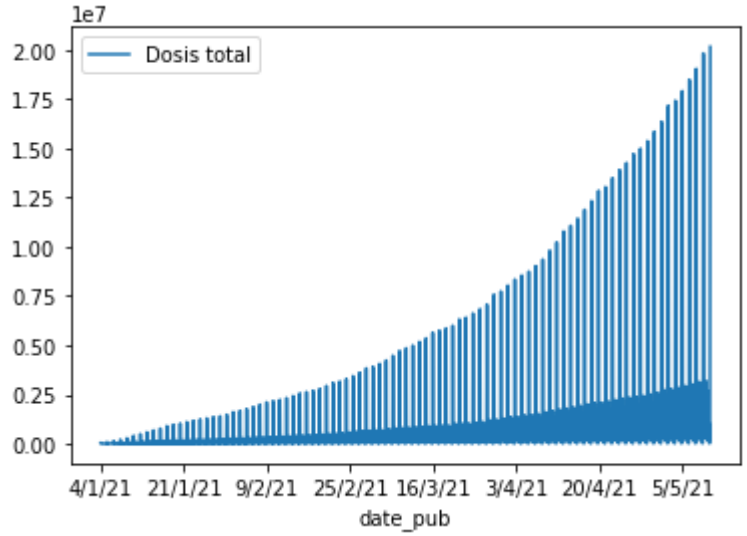


In [147]:

```
df_es.plot(x="date_pub", y = 'Dosis administradas', label ="Dosis total")
```

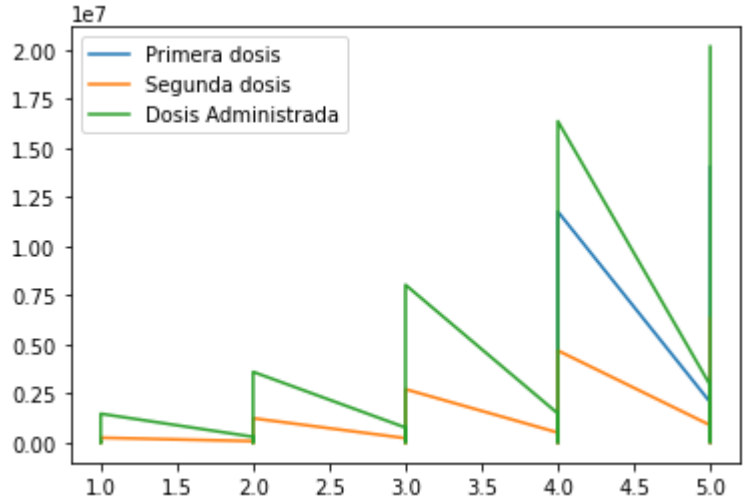
Out[147]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417392b5e0>
```



In [148]:

```
plt.plot(df_es["mes"],df_es["Total 1 vacuna"], label="Primera dosis")
plt.plot(df_es["mes"], df_es["Total pauta completada"], label='Segunda dosis')
plt.plot(df_es["mes"], df_es["Dosis administradas"], label="Dosis Administrada")
plt.legend(loc='upper left')
plt.show()
```



Datos de chile

https://raw.githubusercontent.com/montera34/escovid19data/master/data/original/vacunas/estado_vacunacion_
(https://raw.githubusercontent.com/montera34/escovid19data/master/data/original/vacunas/estado_vacunacior

In [149]:

```
url_ch = "https://raw.githubusercontent.com/montera34/escovid19data/master/data/original/vacunas/estado_vacunacion_.csv"
df_ch = pd.read_csv(url_ch)
df_ch.head()
```

Out[149]:

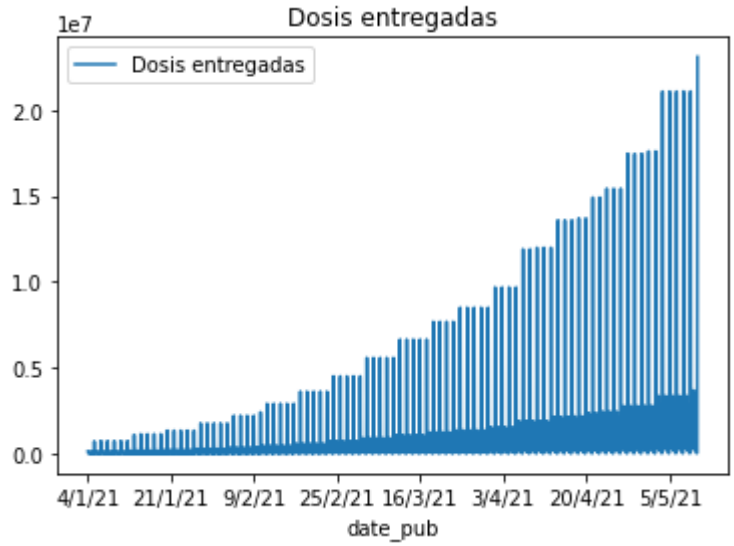
	date_pub	ccaa	Dosis entregadas Pfizer	Dosis entregadas Moderna	Dosis entregadas AstraZeneca	Dosis entregadas Janssen	Dosis entregadas	admi
0	4/1/21	Andalucía	NaN	NaN	NaN	NaN	140295	
1	4/1/21	Aragón	NaN	NaN	NaN	NaN	23715	
2	4/1/21	Asturias	NaN	NaN	NaN	NaN	23720	
3	4/1/21	Baleares	NaN	NaN	NaN	NaN	8940	
4	4/1/21	Canarias	NaN	NaN	NaN	NaN	20835	

In [150]:

```
month= df_ch['date_pub']
me = []
for m in month:
    mes = m.split("/")
    me.append(int(mes[1]))
df_ch["mes"]=me

df_ch.plot(x = "date_pub", y ="Dosis entregadas")
plt.title("Dosis entregadas")
```

Out[150]:

```
Text(0.5, 1.0, 'Dosis entregadas')
```

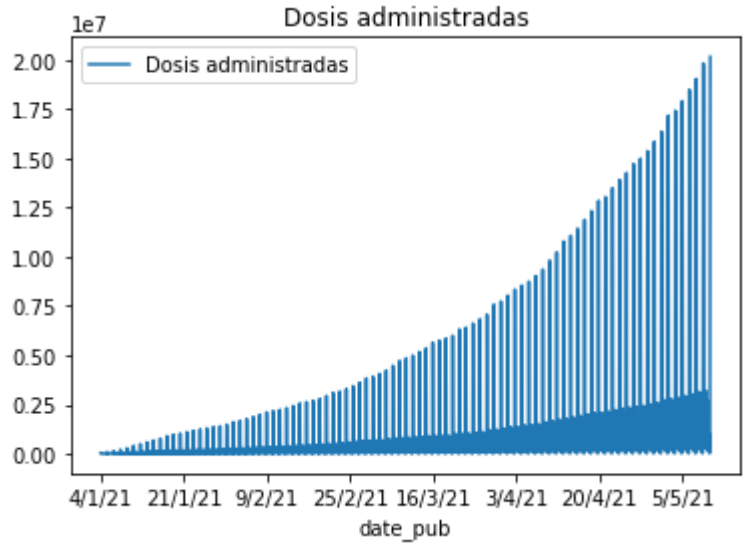


In [151]:

```
df_ch.plot(x = "date_pub", y ="Dosis administradas")
plt.title("Dosis administradas")
```

Out[151]:

```
Text(0.5, 1.0, 'Dosis administradas')
```



Datos de vacunación en Estados Unidos

https://raw.githubusercontent.com/MinCiencia/Datos-COVID19/master/input/Vacunacion/WORK_ARCHIVO_1.csv (https://raw.githubusercontent.com/MinCiencia/Datos-COVID19/master/input/Vacunacion/WORK_ARCHIVO_1.csv)

In [152]:

```
url_eu = 'https://raw.githubusercontent.com/MinCiencia/Datos-COVID19/master/input/Vacunacion/WORK_ARCHIVO_1.csv'
```

In [153]:

```
df_eu = pd.read_csv(url_eu,sep=";",encoding="latin-1")

month= df_eu['FECHA_INMUNIZACION']
me = []
for m in month:
    mes = m.split("/")
    me.append(int(mes[1]))
df_eu["mes"]=me

tot = np.array(df_eu["SUM_of_SUM_of_1aDOSIS"])+np.array(df_eu['SUM_of_SUM_of_2aDOSIS'])
df_eu["total"]=tot
df_eu
```

Out[153]:

	REGION_CORTO	COD_COMUNA_FINAL	FECHA_INMUNIZACION	SUM_of_SUM_of_1aDO
0	Metropolitana Santiago	13101	24/12/2020	2
1	Metropolitana Santiago	13108	24/12/2020	
2	Metropolitana Santiago	13123	24/12/2020	
3	Bíobío	8101	25/12/2020	4
4	Bíobío	8107	25/12/2020	
...	...	...	...	
26666	Ñuble	16301	10/05/2021	2
26667	Ñuble	16302	10/05/2021	1
26668	Ñuble	16303	10/05/2021	
26669	Ñuble	16304	10/05/2021	
26670	Ñuble	16305	10/05/2021	

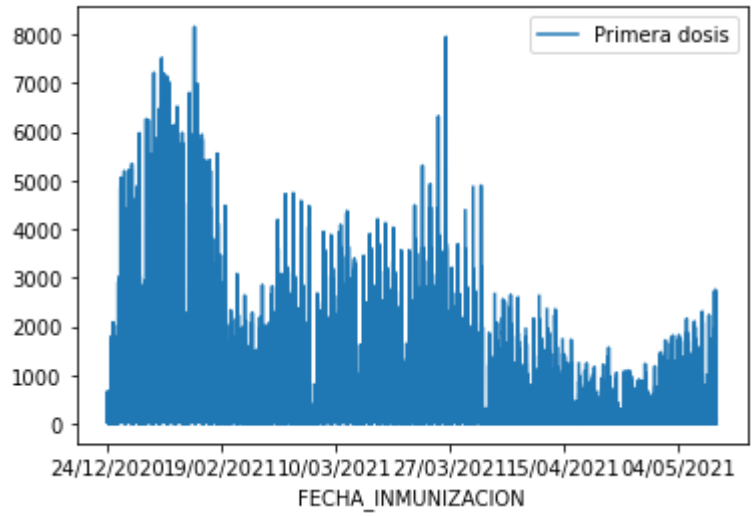
26671 rows × 7 columns

In [154]:

```
df_eu.plot(x="FECHA_INMUNIZACION", y ="SUM_of_SUM_of_1aDOSIS", label="Primera dosis")
```

Out[154]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417b9e9610>
```

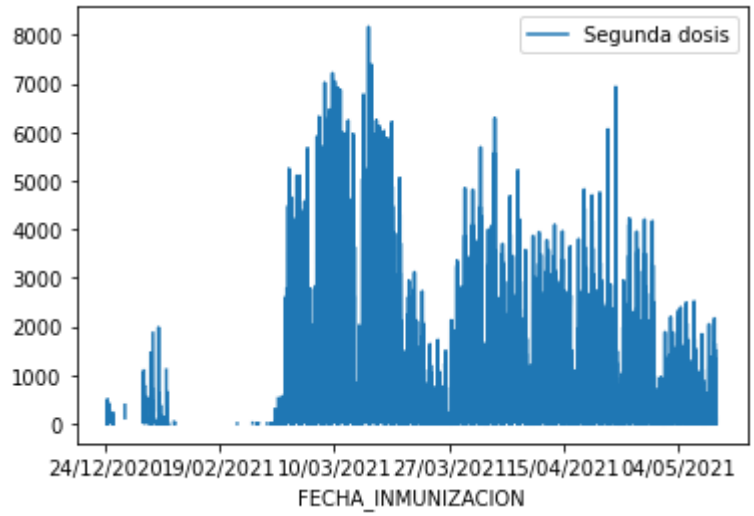


In [155]:

```
df_eu.plot(x='FECHA_INMUNIZACION', y="SUM_of_SUM_of_2aDOSIS", label="Segunda dosis")
```

Out[155]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417ba9e7f0>
```

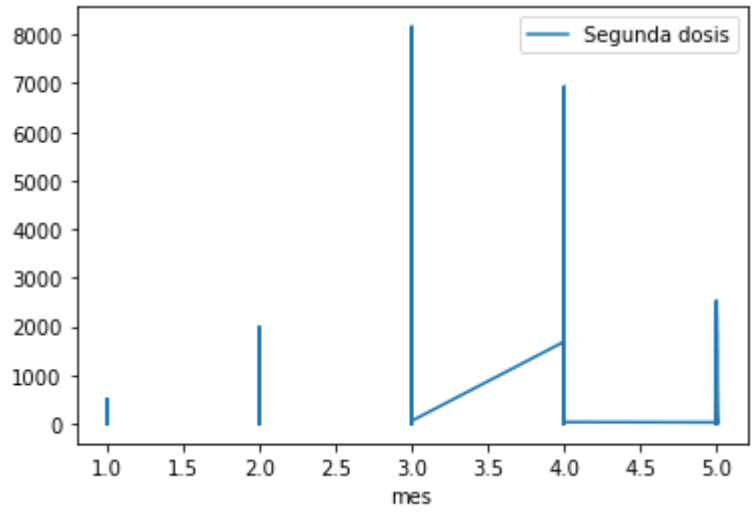


In [156]:

```
df_eu.plot(x='mes', y="SUM_of_SUM_of_2aDOSIS", label="Segunda dosis")
```

Out[156]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417b9cce50>
```

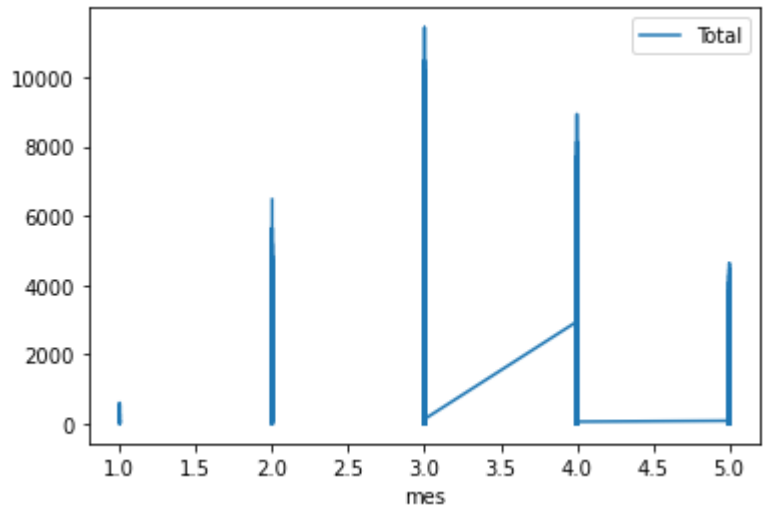


In [157]:

```
df_eu.plot(x="mes", y ="total", label="Total")
```

Out[157]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417a473310>
```



Comparación en paises

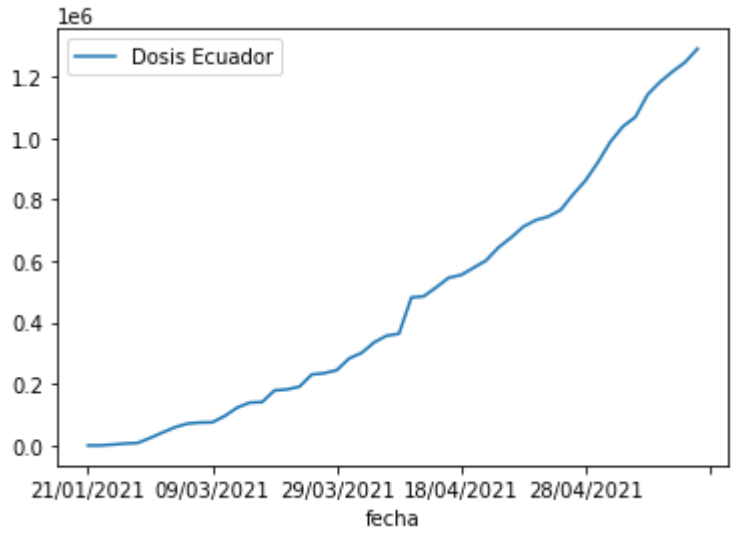
Ecuador.

In [158]:

```
df.plot(x='fecha', y ="total", label="Dosis Ecuador")
```

Out[158]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2417a4c06d0>
```

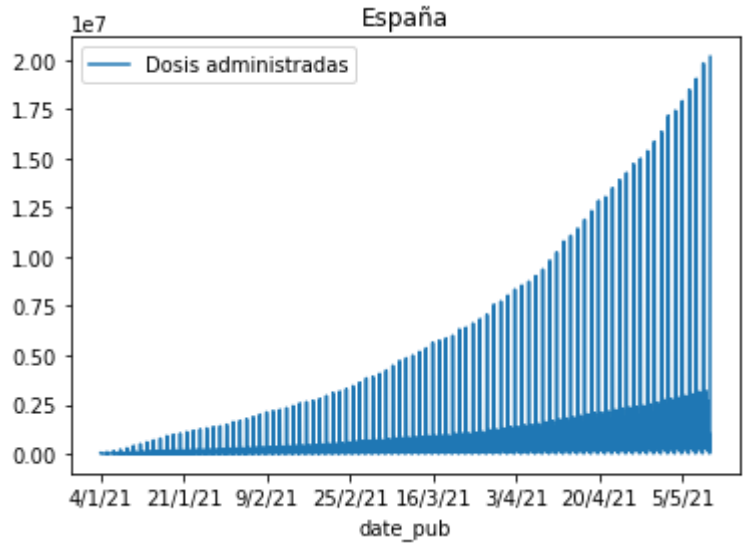


España

In [159]:

```
df_es.plot(x="date_pub",y = "Dosis administradas")
plt.title("España")
print('total',df_es["Dosis administradas"].tail(-1))
```

```
total 1           2004
2            9380
3             153
4            4846
5             304
           ...
1830      1039070
1831        26314
1832        21973
1833        75974
1834     20162661
Name: Dosis administradas, Length: 1834, dtype: int64
```



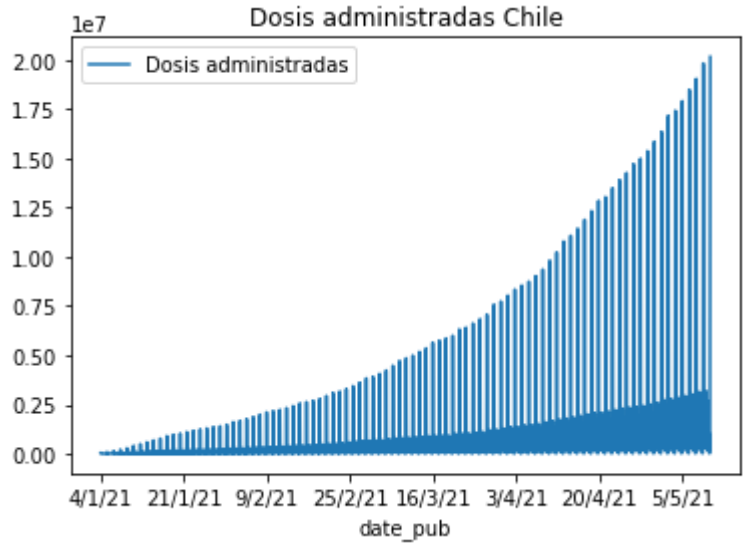
Chile

In [160]:

```
df_ch.plot(x="date_pub", y = "Dosis administradas")
plt.title("Dosis administradas Chile")
```

Out[160]:

```
Text(0.5, 1.0, 'Dosis administradas Chile')
```

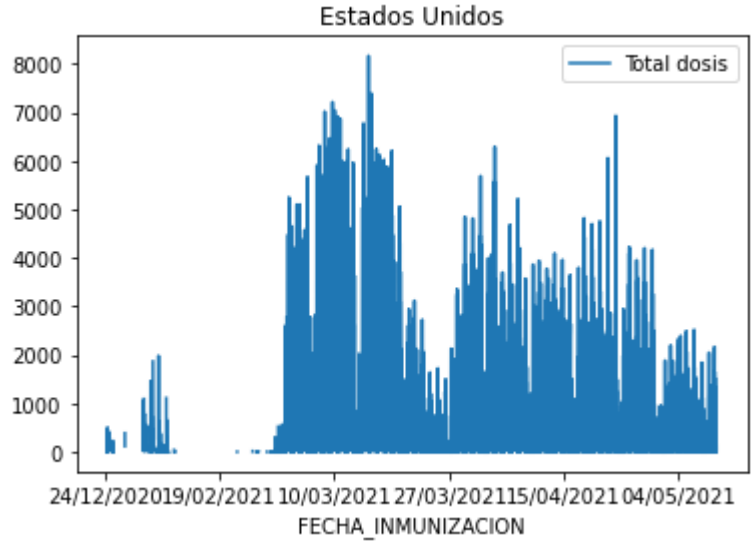


Estados Unidos

In [162]:

```
df_eu.plot(x='FECHA_INMUNIZACION', y="SUM_of_SUM_of_2aDOSIS", label="Total dosis")
plt.title("Estados Unidos")
print(df_eu["total"].tail(1))
```

```
26670    107.0
Name: total, dtype: float64
```



In [ ]:

```
```

Bibliografia.

[link] https://github.com/montera34/escovid19data/blob/master/data/original/vacunas/estado_vacunacion_.csv (https://github.com/montera34/escovid19data/blob/master/data/original/vacunas/estado_vacunacion_.csv)
[link] https://raw.githubusercontent.com/MinCiencia/Datos-COVID19/master/input/Vacunacion/WORK_ARCHIVO_1.csv (https://raw.githubusercontent.com/MinCiencia/Datos-COVID19/master/input/Vacunacion/WORK_ARCHIVO_1.csv)
[link] https://github.com/andrab/ecuacovid/blob/master/datos_crudos/vacunas/vacunas.csv (https://github.com/andrab/ecuacovid/blob/master/datos_crudos/vacunas/vacunas.csv)

![La funcion exponencial y logaritmica] https://www.superprof.es/apuntes/escolar/matematicas/calculo/funciones/funcion-exponencial.html (https://www.superprof.es/apuntes/escolar/matematicas/calculo/funciones/funcion-exponencial.html)