3_inf_1

May 14, 2021

[ ]:
```
import pandas as pd
import numpy as np
import math
from statistics import mean, median
import matplotlib.pyplot as plt
```

[ ]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call
drive.mount("/content/drive", force_remount=True).
```

[ ]:
```
%cd '/content/drive/MyDrive/CSE544_PROJECT'
```

```
/content/drive/.shortcut-targets-by-
id/1YQyVsZWGB7sACOZzGllQA0QwFc_E5Nb1/CSE544_PROJECT
```

[ ]:
```
from datetime import datetime as dt
import datetime

def get_data_fuel(start, end, df_clean):
  date = [(df_clean['Date'][i]) for i in range(0, len(df_clean['Date'])) if dt.
 ↪strptime(df_clean['Date'][i], "%Y-%m-%d")>=start and dt.
 ↪strptime(df_clean['Date'][i], "%Y-%m-%d")<=end]
  price = [(df_clean['Price'][i]) for i in range(0, len(df_clean['Date'])) if␣
 ↪dt.strptime(df_clean['Date'][i], "%Y-%m-%d")>=start and dt.
 ↪strptime(df_clean['Date'][i], "%Y-%m-%d")<=end]
  # MT_daily_death = [int(df_clean['MT daily death'][i]) for i in range(0,␣
 ↪len(df_clean['Date'])) if dt.strptime(df_clean['Date'][i], "%m/%d/
 ↪%Y")>=start and dt.strptime(df_clean['Date'][i], "%m/%d/%Y")<=end]
  # NC_daily_death = [int(df_clean['NC daily death'][i]) for i in range(0,␣
 ↪len(df_clean['Date'])) if dt.strptime(df_clean['Date'][i], "%m/%d/
 ↪%Y")>=start and dt.strptime(df_clean['Date'][i], "%m/%d/%Y")<=end]
  return date, price

def get_data_COVID(start, end, df_clean):
```

```
  cases = [int(df_clean['Cases'][i]) for i in range(0, len(df_clean['Date']))␣
↪if dt.strptime(df_clean['Date'][i], "%Y-%m-%d")>=start and dt.
↪strptime(df_clean['Date'][i], "%Y-%m-%d")<=end]
  death = [int(df_clean['Death'][i]) for i in range(0, len(df_clean['Date']))␣
↪if dt.strptime(df_clean['Date'][i], "%Y-%m-%d")>=start and dt.
↪strptime(df_clean['Date'][i], "%Y-%m-%d")<=end]
  # MT_daily_death = [int(df_clean['MT daily death'][i]) for i in range(0,␣
↪len(df_clean['Date'])) if dt.strptime(df_clean['Date'][i], "%m/%d/
↪%Y")>=start and dt.strptime(df_clean['Date'][i], "%m/%d/%Y")<=end]
  # NC_daily_death = [int(df_clean['NC daily death'][i]) for i in range(0,␣
↪len(df_clean['Date'])) if dt.strptime(df_clean['Date'][i], "%m/%d/
↪%Y")>=start and dt.strptime(df_clean['Date'][i], "%m/%d/%Y")<=end]
  return cases, death
```

[ ]:
```
# Using the pearson test to see if the datasets are linearly corelated

def pearson_coeff(sample_A, sample_B):
  # print(sample_A)
  # print(sample_B)
  sample_A_mean = mean(sample_A)
  sample_B_mean = mean(sample_B)

  diff_squ_A = 0
  for x in sample_A:
    diff_squ_A += (x-sample_A_mean)**2
  diff_squ_B = 0
  for x in sample_B:
    diff_squ_B += (x-sample_B_mean)**2
  numerator = 0
  for i in range(len(sample_A)):
    numerator += (sample_A[i]-sample_A_mean)*(sample_B[i]-sample_B_mean)
  # print(numerator)
  ro = numerator/(((diff_squ_A)*(diff_squ_B))**0.5)
  # print(ro)
  return ro
```

[ ]:
```
# Apply chi test to check for dependence

def chi_squared_test(cases, price, case_count, amount):
  cases_less_than_100000 = 0
  for x in cases:
    if x<case_count:
      cases_less_than_100000 +=1
  # print(cases_less_than_100000)
  cases_more_than_100000 = len(cases) - cases_less_than_100000
  # print(cases_more_than_100000)
```

```
  price_less_than_10985 = 0
  for x in price:
    # print(x)
    if x<amount:
      price_less_than_10985 +=1
  # print(price_less_than_10985)
  price_more_than_10985 = len(cases) - price_less_than_10985
  # print(price_more_than_10985)
  a = 0
  b = 0
  c = 0
  d = 0
  for i in range(len(cases)):
    if price[i]<amount:
      if cases[i]<case_count:
        a += 1
      else:
        b += 1
    else:
      if cases[i]<case_count:
        c += 1
      else:
        d += 1
  # print(a, b, c, d)
  total_observations = len(cases)
  expected_a = cases_less_than_100000 * price_less_than_10985 /␣
↪total_observations
  expected_b = cases_more_than_100000 * price_less_than_10985 /␣
↪total_observations
  expected_c = cases_less_than_100000 * price_more_than_10985 /␣
↪total_observations
  expected_d = cases_more_than_100000 * price_more_than_10985 /␣
↪total_observations
  # print(expected_a, expected_b, expected_c, expected_d)
  Q_obs = (((expected_a - a)**2)/expected_a)+(((expected_b - b)**2)/
↪expected_b)+(((expected_c - c)**2)/expected_c)+(((expected_d - d)**2)/
↪expected_d)
  return Q_obs
```

[ ]:
```
# Applying the Linear Regression to see if the price can be predicted using the␣
↪past 3 days covid data.

def LR1(cases, price, days):
  original = np.array(cases, copy=True)
  price = np.array(price).reshape(len(price),1)
  # print(len(price))
  # print(len(original))
```

```
X = []
Y = []
index = days

for day in original[days-1:7]:
  # Y.append(day)
  Xs = []
  Xs.append(1)
  for i in range(0,days):
    Xs.append(original[index-i])
  X.append(Xs)
  index += 1

for cost in price[days-1:7]:
  Y.append(cost)
X = np.array(X)
Y = np.array(Y).reshape(len(Y),1)
# print(X.shape)
betas = np.matmul(np.matmul(np.linalg.inv(np.matmul(np.transpose(X),X)),np.
↪transpose(X)), Y)
# print(betas)
# print(Y.shape)
# print(len(cases))
Z = np.array(Y, copy=True)
total = 0
for i in range(7,len(cases)):
  total +=1
  pred = betas[0][0]
  count = 0
  # print(betas.shape)
  for x in range(1,days+1):
    # print(i-count)
    # print(betas[x][0]*cases[i-count])
    pred += betas[x][0]*original[i-count]
    count += 1

  Z = np.append(Z, [[pred]], axis = 0)
# print(total)
# print(Z.shape)
# print(price.shape)
price = price[days-1:]
# print(price.shape)
plt.plot(price, label = "true")
plt.plot(Z, label = "predicted")
plt.ylim((0, 2))
plt.xlabel("Day")
plt.ylabel("Fuel Price")
```

```
  plt.legend(loc='center left', bbox_to_anchor=(1, 0.5))
  return price, Z, total
```

[ ]:
```
df_clean1 = pd.read_csv('fuel_clean.csv')
df_clean2 = pd.read_csv('USA_clean.csv')

start = datetime.datetime(2020, 3, 4)
end = datetime.datetime(2020, 3, 18)

# Person coeffecient corelation

date, price = get_data_fuel(start, end, df_clean1)
cases, death = get_data_COVID(start, end, df_clean2)

ro2 = pearson_coeff(cases, price)
print(ro2)

# The value is < -0.5
# This shows that there is a negative linear corelation
```

```
-0.6302524583131404
```

[ ]:
```
Q_obs = chi_squared_test(cases, price, 397, 1)
print(Q_obs)


# P(Chi square < Qobs) = 0 < alpha              (alpha = 0.05)
# Thus we reject the null hypothesis.
# The cases and price are not independent. The are dependent.
```

```
11.428571428571432
```

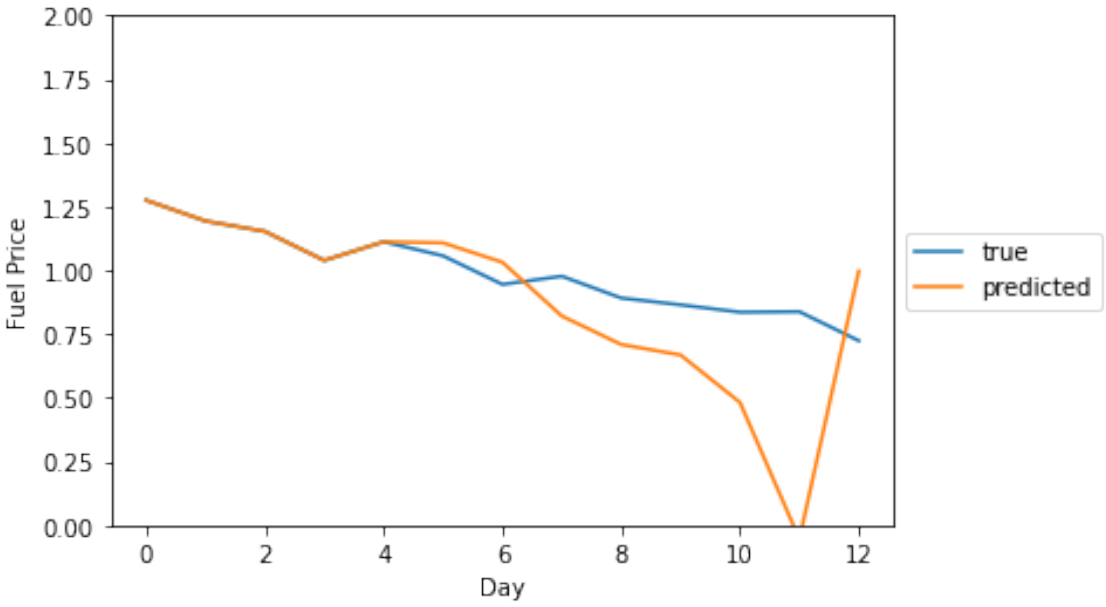
[ ]:
```
date, price = get_data_fuel(start, end, df_clean1)
cases, death = get_data_COVID(start, end, df_clean2)

price, Z, total = LR1(cases, price, 3)

mape = np.sum(abs((price[-total:] - Z[-total:])/price[-total:]))/total * 100
print(mape)

# The MAPE error is on the lower sde considering that only 4 days are available␣
 ↪for training.
```

```
32.443863191954996
```


2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Fuel Price
0
2
4
6
8
10
12
Day
true
predicted

[ ]: