odelos-de-series-de-tiempo-8-novv3

November 23, 2023

[ ]:
```
# Importar libreria requerida
import pandas as pd
import numpy as np
import os
```

[ ]:
```
# Métrica de Evaluación
from sklearn.metrics import mean_squared_error
from statsmodels.tools.eval_measures import rmse
from sklearn import metrics
```

[ ]:
```
# No presentar advertencias
import warnings
warnings.filterwarnings("ignore")
```

[ ]:
```
# Visualización de datos
import plotly.express as px
import matplotlib.pyplot as plt
%matplotlib inline
plt.style.use('ggplot')
```

[ ]:
```
#!pip install adfuller
!pip install pmdarima
```

```
Collecting pmdarima
  Downloading pmdarima-2.0.4-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86
_64.manylinux_2_28_x86_64.whl (2.1 MB)
                           2.1/2.1 MB
20.8 MB/s eta 0:00:00
Requirement already satisfied: joblib>=0.11 in
/usr/local/lib/python3.10/dist-packages (from pmdarima) (1.3.2)
Requirement already satisfied: Cython!=0.29.18,!=0.29.31,>=0.29 in
/usr/local/lib/python3.10/dist-packages (from pmdarima) (3.0.5)
Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-
packages (from pmdarima) (1.23.5)
Requirement already satisfied: pandas>=0.19 in /usr/local/lib/python3.10/dist-
packages (from pmdarima) (1.5.3)
Requirement already satisfied: scikit-learn>=0.22 in
/usr/local/lib/python3.10/dist-packages (from pmdarima) (1.2.2)
```

```
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-
packages (from pmdarima) (1.11.3)
Requirement already satisfied: statsmodels>=0.13.2 in
/usr/local/lib/python3.10/dist-packages (from pmdarima) (0.14.0)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-
packages (from pmdarima) (2.0.7)
Requirement already satisfied: setuptools!=50.0.0,>=38.6.0 in
/usr/local/lib/python3.10/dist-packages (from pmdarima) (67.7.2)
Requirement already satisfied: packaging>=17.1 in
/usr/local/lib/python3.10/dist-packages (from pmdarima) (23.2)
Requirement already satisfied: python-dateutil>=2.8.1 in
/usr/local/lib/python3.10/dist-packages (from pandas>=0.19->pmdarima) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-
packages (from pandas>=0.19->pmdarima) (2023.3.post1)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/usr/local/lib/python3.10/dist-packages (from scikit-learn>=0.22->pmdarima)
(3.2.0)
Requirement already satisfied: patsy>=0.5.2 in /usr/local/lib/python3.10/dist-
packages (from statsmodels>=0.13.2->pmdarima) (0.5.3)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages
(from patsy>=0.5.2->statsmodels>=0.13.2->pmdarima) (1.16.0)
Installing collected packages: pmdarima
Successfully installed pmdarima-2.0.4
```

[ ]:
```
# ruta de archivos
files = os.listdir("c:\\archivos\proyecto")
os.chdir(r'C:\archivos\proyecto')

csv_path = 'ind_urgencias_final_2023_filtrado.txt'

# Read data from CSV file
df = pd.read_csv(csv_path,sep=";",header= None)
```

[ ]:
```
# ruta de archivos con colab google

#csv_path = 'ind_urgencias_final_2023_filtrado.txt'
csv_path = 'indicadores de urgencias.txt'

# Read data from CSV file
df = pd.read_csv(csv_path,sep=";",header= None)
```

[ ]:
```
df
```

[ ]:
```
                            0                         1   \
0       TIEMPO_LLEGADA_A_TRIAGE  TIEMPO_TRIAGE_A_INGRESO
1                       0:00:00                   0:16:13
2                       0:00:00                   0:08:06
```

```
3                       0:00:00                  0:33:41
4                       0:00:00                  0:17:52
…                         …                      …
121256                  0:00:00                  0:41:05
121257                  0:00:00                  0:31:57
121258                  0:00:00                  0:10:19
121259                  0:00:00                  0:26:17
121260                  0:00:00                  0:06:08

                            2            3                4   \
0       TIEMPO_INGRESO_A_FOLIO  TIEMPO_TOTAL     FECHA_LLEGADA
1                       0:08:47       0:25:00    2/08/2016 7:19
2                       0:01:27       0:09:33    2/08/2016 7:58
3                       0:04:12       0:37:53    3/08/2016 9:10
4                       0:02:22       0:20:14   3/08/2016 13:05
…                         …           …              …
121256                  0:18:40       0:59:45  19/05/2017 18:05
121257                  0:11:33       0:43:30  18/05/2017 13:18
121258                  0:06:26       0:16:45  20/05/2017 11:31
121259                  0:05:49       0:32:06  25/05/2017 14:20
121260                  0:06:01       0:12:09  25/05/2017 17:39

                     5                6                7   \
0           FECHA_TRIAGE     FECHA_INGRESO    FECHA_CONSULTA
1         2/08/2016 7:19    2/08/2016 7:36    2/08/2016 7:45
2         2/08/2016 7:58    2/08/2016 8:07    2/08/2016 8:09
3         3/08/2016 9:10    3/08/2016 9:44    3/08/2016 9:48
4        3/08/2016 13:05   3/08/2016 13:23   3/08/2016 13:26
…                  …              …              …
121256  19/05/2017 18:05  19/05/2017 18:47  19/05/2017 19:05
121257  18/05/2017 13:18  18/05/2017 13:50  18/05/2017 14:02
121258  20/05/2017 11:31  20/05/2017 11:42  20/05/2017 11:48
121259  25/05/2017 14:20  25/05/2017 14:47  25/05/2017 14:52
121260  25/05/2017 17:39  25/05/2017 17:46  25/05/2017 17:52

                                                    8   \
0                                        CENTRO_ATENCION
1       VA - CENTRO DE SALUD CANDELARIA  I C. BOLÍVAR
2       VA - CENTRO DE SALUD CANDELARIA  I C. BOLÍVAR
3       VA - CENTRO DE SALUD CANDELARIA  I C. BOLÍVAR
4                       VC - CENTRO DE SALUD JERUSALÉN
…                                                  …
121256                     VB - HOSPITAL VISTA HERMOSA
121257                           ME - HOSPITAL MEISSEN
121258                  JC - CENTRO DE SALUD EL CARMEN
121259                  JC - CENTRO DE SALUD EL CARMEN
121260                      VJ - CENTRO DE SALUD MANUE
```

```
                                                  9                    10  \
0                                CLASIFICACION_TRIAGE  PACIENTE_#_DOCUMENTO
1       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS               4108268
2       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS            1026581403
3       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS              19334228
4       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS              52238647
…                                                  …                    …
121256  3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS            1031160974
121257  3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS               5966047
121258  3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS            1018458868
121259      2 - TRIAGE II -  ANTES DE LOS 30 MINUTOS            1033768047
121260                                           NaN                   NaN

                 11               12         13               14  \
0       PACIENTE_EDAD     EDAD_RANGO       SEXO  RÉGIMEN PACIENTE
1           77 AÑO(S)          VEJEZ  MASCULINO        SUBSIDIADO
2           21 AÑO(S)        JUVENTUD   FEMENINO        SUBSIDIADO
3           65 AÑO(S)          VEJEZ  MASCULINO        SUBSIDIADO
4           40 AÑO(S)         ADULTEZ   FEMENINO         VINCULADO
…                 …                …         …                …
121256       3 AÑO(S)  PRIMERA INFANCIA   FEMENINO      CONTRIBUTIVO
121257      70 AÑO(S)          VEJEZ  MASCULINO        SUBSIDIADO
121258      24 AÑO(S)        JUVENTUD   FEMENINO        SUBSIDIADO
121259       4 AÑO(S)  PRIMERA INFANCIA   FEMENINO        SUBSIDIADO
121260            NaN               NaN        NaN               NaN

                                15                              16  \
0                  NOMBRE_ENTIDAD                NOM_TIPO_HISTORIA
1       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS
2       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS
3       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS
4       CAPITAL SALUD EPS-S S.A.S       CONSULTA MEDICINA GENERAL
…                             …                               …
121256        SALUD TOTAL SA EPS   CONSULTA  INICIAL DE URGENCIAS
121257  CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS
121258  CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS
121259  CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS
121260                        NaN                             NaN

                17                                                  18
0       DIAGNOSTICO                                        NOMBRE DX
1              H813  OTROS VERTIGOS PERIFERICOS                     …
2              A060  DISENTERIA AMEBIANA AGUDA                      …
3              A09X  DIARREA Y GASTROENTERITIS DE PRESUNTO ORIGEN I…
4              J039  AMIGDALITIS AGUDA, NO ESPECIFICADA             …
…               …                                                  …
```

```
121256         N390  INFECCION DE VIAS URINARIAS, SITIO NO ESPECIFI…
121257         K297  GASTRITIS, NO ESPECIFICADA                    …
121258         Z359  SUPERVISION DE EMBARAZO DE ALTO RIESGO, SIN OT…
121259         S903  CONTUSION DE OTRAS PARTES Y DE LAS NO ESPECIFI…
121260          NaN                                                NaN

[121261 rows x 19 columns]
```

[ ]:
```
headers =␣
 ↪["TIEMPO_LLEGADA_A_TRIAGE","TIEMPO_TRIAGE_A_INGRESO","TIEMPO_INGRESO_A_FOLIO","TIEMPO_TOTAL
 ↪PACIENTE","NOMBRE_ENTIDAD","NOM_TIPO_HISTORIA","DIAGNOSTICO","NOMBRE DX"]
print("headers\n", headers)
df.columns = headers
df = df.drop(0)
```

```
headers
 ['TIEMPO_LLEGADA_A_TRIAGE', 'TIEMPO_TRIAGE_A_INGRESO',
'TIEMPO_INGRESO_A_FOLIO', 'TIEMPO_TOTAL', 'FECHA_LLEGADA', 'FECHA_TRIAGE',
'FECHA_INGRESO', 'FECHA_CONSULTA', 'CENTRO_ATENCION', 'CLASIFICACION_TRIAGE',
'PACIENTE_#_DOCUMENTO', 'PACIENTE_EDAD', 'EDAD_RANGO', 'SEXO', 'RÉGIMEN
PACIENTE', 'NOMBRE_ENTIDAD', 'NOM_TIPO_HISTORIA', 'DIAGNOSTICO', 'NOMBRE DX']
```

[ ]:
```
df = df.drop(0)
```

[ ]:
```
df
```

[ ]:
```
       TIEMPO_LLEGADA_A_TRIAGE TIEMPO_TRIAGE_A_INGRESO TIEMPO_INGRESO_A_FOLIO  \
1                      0:00:00                0:16:13                0:08:47
2                      0:00:00                0:08:06                0:01:27
3                      0:00:00                0:33:41                0:04:12
4                      0:00:00                0:17:52                0:02:22
5                      0:00:00                0:13:57                0:21:41
…                        …                      …                      …
121256                 0:00:00                0:41:05                0:18:40
121257                 0:00:00                0:31:57                0:11:33
121258                 0:00:00                0:10:19                0:06:26
121259                 0:00:00                0:26:17                0:05:49
121260                 0:00:00                0:06:08                0:06:01

       TIEMPO_TOTAL     FECHA_LLEGADA      FECHA_TRIAGE     FECHA_INGRESO  \
1           0:25:00    2/08/2016 7:19    2/08/2016 7:19    2/08/2016 7:36
2           0:09:33    2/08/2016 7:58    2/08/2016 7:58    2/08/2016 8:07
3           0:37:53    3/08/2016 9:10    3/08/2016 9:10    3/08/2016 9:44
4           0:20:14   3/08/2016 13:05   3/08/2016 13:05   3/08/2016 13:23
5           0:35:38    1/08/2016 8:35    1/08/2016 8:35    1/08/2016 8:49
…             …              …                 …                 …
121256      0:59:45  19/05/2017 18:05  19/05/2017 18:05  19/05/2017 18:47
```

```
121257      0:43:30  18/05/2017 13:18  18/05/2017 13:18  18/05/2017 13:50
121258      0:16:45  20/05/2017 11:31  20/05/2017 11:31  20/05/2017 11:42
121259      0:32:06  25/05/2017 14:20  25/05/2017 14:20  25/05/2017 14:47
121260      0:12:09  25/05/2017 17:39  25/05/2017 17:39  25/05/2017 17:46

          FECHA_CONSULTA                                CENTRO_ATENCION  \
1         2/08/2016 7:45  VA - CENTRO DE SALUD CANDELARIA  I C. BOLÍVAR
2         2/08/2016 8:09  VA - CENTRO DE SALUD CANDELARIA  I C. BOLÍVAR
3         3/08/2016 9:48  VA - CENTRO DE SALUD CANDELARIA  I C. BOLÍVAR
4        3/08/2016 13:26                VC - CENTRO DE SALUD JERUSALÉN
5         1/08/2016 9:11                         ME - HOSPITAL MEISSEN
…                    …                                            …
121256  19/05/2017 19:05                   VB - HOSPITAL VISTA HERMOSA
121257  18/05/2017 14:02                         ME - HOSPITAL MEISSEN
121258  20/05/2017 11:48                JC - CENTRO DE SALUD EL CARMEN
121259  25/05/2017 14:52                JC - CENTRO DE SALUD EL CARMEN
121260  25/05/2017 17:52                    VJ - CENTRO DE SALUD MANUE

                                CLASIFICACION_TRIAGE PACIENTE_#_DOCUMENTO  \
1       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS              4108268
2       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS           1026581403
3       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS             19334228
4       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS             52238647
5       3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS           1033743521
…                                                 …                   …
121256  3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS           1031160974
121257  3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS              5966047
121258  3 - TRIAGE III - NO DEBE SUPERAR LAS 3 HORAS           1018458868
121259      2 - TRIAGE II -  ANTES DE LOS 30 MINUTOS           1033768047
121260                                           NaN                  NaN

       PACIENTE_EDAD        EDAD_RANGO       SEXO RÉGIMEN PACIENTE  \
1          77 AÑO(S)             VEJEZ  MASCULINO       SUBSIDIADO
2          21 AÑO(S)           JUVENTUD   FEMENINO       SUBSIDIADO
3          65 AÑO(S)             VEJEZ  MASCULINO       SUBSIDIADO
4          40 AÑO(S)            ADULTEZ   FEMENINO        VINCULADO
5           6 AÑO(S)           INFANCIA  MASCULINO       SUBSIDIADO
…                 …                  …         …                …
121256      3 AÑO(S)  PRIMERA INFANCIA   FEMENINO     CONTRIBUTIVO
121257     70 AÑO(S)             VEJEZ  MASCULINO       SUBSIDIADO
121258     24 AÑO(S)           JUVENTUD   FEMENINO       SUBSIDIADO
121259      4 AÑO(S)  PRIMERA INFANCIA   FEMENINO       SUBSIDIADO
121260           NaN                NaN        NaN              NaN

                  NOMBRE_ENTIDAD              NOM_TIPO_HISTORIA DIAGNOSTICO  \
1       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        H813
2       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        A060
```

```
3       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        A09X
4       CAPITAL SALUD EPS-S S.A.S       CONSULTA MEDICINA GENERAL        J039
5       CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        M798
…                             …                                 …         …
121256        SALUD TOTAL SA EPS   CONSULTA  INICIAL DE URGENCIAS        N390
121257  CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        K297
121258  CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        Z359
121259  CAPITAL SALUD EPS-S S.A.S  CONSULTA  INICIAL DE URGENCIAS        S903
121260                       NaN                              NaN         NaN

                                                 NOMBRE DX
1       OTROS VERTIGOS PERIFERICOS                       …
2       DISENTERIA AMEBIANA AGUDA                        …
3       DIARREA Y GASTROENTERITIS DE PRESUNTO ORIGEN I…
4       AMIGDALITIS AGUDA, NO ESPECIFICADA               …
5       OTROS TRASTORNOS ESPECIFICADOS DE LOS TEJIDOS …
…                                                        …
121256  INFECCION DE VIAS URINARIAS, SITIO NO ESPECIFI…
121257  GASTRITIS, NO ESPECIFICADA                       …
121258  SUPERVISION DE EMBARAZO DE ALTO RIESGO, SIN OT…
121259  CONTUSION DE OTRAS PARTES Y DE LAS NO ESPECIFI…
121260                                                 NaN

[121260 rows x 19 columns]
```

[ ]:
```
# crear la lista headers
headers =␣
  ↪["FECHA_LLEGADA","FECHA_TRIAGE","FECHA_INGRESO","FECHA_ATENCION","TIEMPO_DGTURNO_A_TRIAGE",
          ␣
  ↪"CENTRO_ATENCION","CLASIFICACION_TRIAGE","PACIENTE_#_DOCUMENTO","EDAD","EDAD_RANGO","SEXO",
  ↪PACIENTE","NOMBRE_ENTIDAD","MEDICO","AÑO","MES","DIA_SEMANA","HOUR","Turnos","TIME","DIA"]
print("headers\n", headers)
df.columns = headers
df = df.drop(0)
```

```
headers
 ['FECHA_LLEGADA', 'FECHA_TRIAGE', 'FECHA_INGRESO', 'FECHA_ATENCION',
'TIEMPO_DGTURNO_A_TRIAGE', 'TIEMPO_TRIAGE_A_INGRESO',
'TIEMPO_INGRESO_A_CONSULTA', 'TIEMPO_TOTAL', 'Tiempo_Minutos_Total',
'CENTRO_ATENCION', 'CLASIFICACION_TRIAGE', 'PACIENTE_#_DOCUMENTO', 'EDAD',
'EDAD_RANGO', 'SEXO', 'RÉGIMEN PACIENTE', 'NOMBRE_ENTIDAD', 'MEDICO', 'AÑO',
'MES', 'DIA_SEMANA', 'HOUR', 'Turnos', 'TIME', 'DIA']
```

[ ]:
```
df.dtypes
```

[ ]:
```
TIEMPO_LLEGADA_A_TRIAGE    object
TIEMPO_TRIAGE_A_INGRESO    object
```

```
TIEMPO_INGRESO_A_FOLIO     object
TIEMPO_TOTAL               object
FECHA_LLEGADA              object
FECHA_TRIAGE               object
FECHA_INGRESO              object
FECHA_CONSULTA             object
CENTRO_ATENCION            object
CLASIFICACION_TRIAGE       object
PACIENTE_#_DOCUMENTO       object
PACIENTE_EDAD              object
EDAD_RANGO                 object
SEXO                       object
RÉGIMEN PACIENTE           object
NOMBRE_ENTIDAD             object
NOM_TIPO_HISTORIA          object
DIAGNOSTICO                object
NOMBRE DX                  object
dtype: object
```

[ ]:
```python
# Arreglar Datos

df['Turnos'] = df['Turnos'].astype('category')
df['DIA_SEMANA'] = df['DIA_SEMANA'].astype('category')
df['CENTRO_ATENCION'] = df['CENTRO_ATENCION'].astype('category')

# convertir datos
df['Tiempo_Total'] = df['Tiempo_Minutos_Total'].str.replace(',', '.',␣
 ↪regex=True)
df['Tiempo_Minutos_Total'] = df['Tiempo_Minutos_Total'].str.replace(',', '.',␣
 ↪regex=True)
df['Tiempo_Minutos_Total'] = pd.to_numeric(df['Tiempo_Minutos_Total'],␣
 ↪errors='coerce')
df['Tiempo_Total'] = pd.to_numeric(df['Tiempo_Total'], errors='coerce')

df['FECHA_LLEGADA'] = pd.to_datetime(df['FECHA_LLEGADA'])

# Luego, usa la función strftime para obtener la fecha en el formato deseado
df['Month'] = df['FECHA_LLEGADA'].dt.strftime('%Y-%m-01')
df['Month'] = pd.to_datetime(df['Month'])

df['MES2'] = df['FECHA_LLEGADA'].dt.strftime('%Y-%m')
df['MES2'] = pd.to_datetime(df['MES2'])

# Cadena Más Común (Moda)  -  para reemplazar los datos vacios con el valor más␣
 ↪frecuente o la moda
promedio = df['Tiempo_Minutos_Total'].median()
df.loc[df['Tiempo_Minutos_Total'] > 420, 'Tiempo_Minutos_Total'] = promedio
```

```
df.loc[df['Tiempo_Minutos_Total'] < 0, 'Tiempo_Minutos_Total'] = promedio
```

[ ]:
```
# cargar una copia
dataset = df
```

[ ]:
```
dataset
```

[ ]:
```
                FECHA_LLEGADA             FECHA_TRIAGE  \
1     2023-01-01 01:20:23.853  2023-01-01 01:28:01.847
2     2023-01-01 01:29:46.050  2023-01-01 01:48:03.070
3     2023-01-01 03:15:35.623  2023-01-01 03:23:01.990
4     2023-01-01 05:54:53.563  2023-01-01 06:00:07.943
5     2023-01-01 06:37:27.237  2023-01-01 07:52:31.687
…                         …                         …
82412 2023-09-18 04:44:41.970  2023-09-18 04:53:22.553
82413 2023-09-18 06:17:00.573  2023-09-18 06:28:43.040
82414 2023-09-18 06:21:37.273  2023-09-18 07:00:57.420
82415 2023-09-18 06:25:33.483  2023-09-18 06:42:02.883
82416 2023-09-18 07:14:58.180  2023-09-18 07:30:50.643

                 FECHA_INGRESO           FECHA_ATENCION  \
1      2023-01-01 01:29:41.210  2023-01-01 02:00:07.590
2      2023-01-01 01:49:40.973  2023-01-01 02:02:53.663
3      2023-01-01 03:23:39.793  2023-01-01 03:30:21.233
4      2023-01-01 06:02:07.320  2023-01-01 06:26:17.050
5      2023-01-01 07:52:37.717  2023-01-01 09:31:15.597
…                          …                         …
82412  2023-09-18 05:05:51.423  2023-09-18 06:09:35.867
82413  2023-09-18 06:35:38.213  2023-09-18 07:40:45.957
82414  2023-09-18 07:16:45.907  2023-09-18 08:27:27.337
82415  2023-09-18 06:51:35.970  2023-09-18 07:28:28.290
82416  2023-09-18 07:34:08.370  2023-09-18 07:49:18.440

      TIEMPO_DGTURNO_A_TRIAGE TIEMPO_TRIAGE_A_INGRESO  \
1                     0:07:38                0:01:40
2                     0:18:17                0:01:37
3                     0:07:26                0:00:38
4                     0:05:14                0:02:00
5                     1:15:04                0:00:06
…                       …                         …
82412                 0:08:41                0:12:29
82413                 0:11:43                0:06:55
82414                 0:39:20                0:15:48
82415                 0:16:29                0:09:33
82416                 0:15:52                0:03:18

      TIEMPO_INGRESO_A_CONSULTA TIEMPO_TOTAL  Tiempo_Minutos_Total  \
```

```
1                      0:30:26      0:39:44                39.73
2                      0:13:13      0:33:07                33.12
3                      0:06:42      0:14:46                14.77
4                      0:24:10      0:31:24                31.40
5                      1:38:38      2:53:48               173.80
…                        …          …                   …
82412                  1:03:44      1:24:54                84.90
82413                  1:05:07      1:23:45                83.75
82414                  1:10:42      2:05:50               125.83
82415                  0:36:53      1:02:55                62.92
82416                  0:15:10      0:34:20                34.33

      CENTRO_ATENCION  …   AÑO MES DIA_SEMANA HOUR  Turnos  \
1                  TN   …  2023   1    DOMINGO    1   NOCHE
2                  ME   …  2023   1    DOMINGO    1   NOCHE
3                  UC   …  2023   1    DOMINGO    3   NOCHE
4                  UC   …  2023   1    DOMINGO    5   NOCHE
5                  TN   …  2023   1    DOMINGO    6   NOCHE
…                 …     …   …    ..        …  …     …
82412              ME   …  2023   9      LUNES    4   NOCHE
82413              ME   …  2023   9      LUNES    6   NOCHE
82414              ME   …  2023   9      LUNES    6   NOCHE
82415              UB   …  2023   9      LUNES    6   NOCHE
82416              TN   …  2023   9      LUNES    7  MAÑANA

                          TIME DIA Tiempo_Total      Month       MES2
1      2023-01-01 01:20:23.853   1        39.73 2023-01-01 2023-01-01
2      2023-01-01 01:29:46.050   1        33.12 2023-01-01 2023-01-01
3      2023-01-01 03:15:35.623   1        14.77 2023-01-01 2023-01-01
4      2023-01-01 05:54:53.563   1        31.40 2023-01-01 2023-01-01
5      2023-01-01 06:37:27.237   1       173.80 2023-01-01 2023-01-01
…                         …  ..          …         …          …
82412  2023-09-18 04:44:41.970  18        84.90 2023-09-01 2023-09-01
82413  2023-09-18 06:17:00.573  18        83.75 2023-09-01 2023-09-01
82414  2023-09-18 06:21:37.273  18       125.83 2023-09-01 2023-09-01
82415  2023-09-18 06:25:33.483  18        62.92 2023-09-01 2023-09-01
82416  2023-09-18 07:14:58.180  18        34.33 2023-09-01 2023-09-01

[82416 rows x 28 columns]
```

[ ]:
```
print(df.isnull().sum())
```

[ ]:
```
# La prueba de Dickey-Fuller aumentada
def Augmented_Dickey_Fuller_Test_func(series , column_name):
    print (f'Resultados de la prueba de Dickey-Fuller para columna:␣
 ↪{column_name}')
    dftest = adfuller(series, autolag='AIC')
```

```
    dfoutput = pd.Series(dftest[0:4], index=['Test Statistic','p-value','No␣
↪Lags Used','Número de observaciones utilizadas'])
    for key,value in dftest[4].items():
       dfoutput['Critical Value (%s)'%key] = value
    print (dfoutput)
    if dftest[1] <= 0.05:
        print("Conclusion:====>")
        print("Rechazar la hipótesis nula")
        print("Los datos son estacionarios")
    else:
        print("Conclusion:====>")
        print("No se puede rechazar la hipótesis nula")
        print("Los datos no son estacionarios")
```

[ ]:
```
# ejecutar la prueba
Augmented_Dickey_Fuller_Test_func(df["Tiempo_Minutos_Total"],"Tiempo_Minutos_Total")
```

[ ]:
```
plt.rcParams["figure.figsize"] = (12, 8)
a = seasonal_decompose(df["Tiempo_Minutos_Total"], model = "add")
a.plot();
```

[ ]:
```
# División de para entrenamiento y prueba
train_data = df[:len(df)-12]
test_data = df[len(df)-12:]
test=test_data.copy()
```

[ ]:
```
def evaluacion_metrica(y_true, y_pred):

    def mean_absolute_percentage_error(y_true, y_pred):
        y_true, y_pred = np.array(y_true), np.array(y_pred)
        return np.mean(np.abs((y_true - y_pred) / y_true)) * 100
    print('Evaluation metric results:-')
    print(f'MSE is : {metrics.mean_squared_error(y_true, y_pred)}')
    print(f'MAE is : {metrics.mean_absolute_error(y_true, y_pred)}')
    print(f'RMSE is : {np.sqrt(metrics.mean_squared_error(y_true, y_pred))}')
    print(f'MAPE is : {mean_absolute_percentage_error(y_true, y_pred)}')
    print(f'R2 is : {metrics.r2_score(y_true, y_pred)}',end='\n\n')
```

[ ]:
```
df = dataset
```

[ ]:
```
df = df.set_index("Month")
#df.index.freq = 'MS'
```

[ ]:
```
df
```

[ ]:
```
df.index.freq = 'MS'
```

```
---------------------------------------------------------------------------
OutOfBoundsDatetime                       Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/arrays/datetimelike.py in␣
 ↪_validate_frequency(cls, index, freq, **kwargs)
   1003         try:
-> 1004             on_freq = cls._generate_range(
   1005                 start=index[0], end=None, periods=len(index), freq=freq␣
 ↪**kwargs

/usr/local/lib/python3.10/dist-packages/pandas/core/arrays/datetimes.py in␣
 ↪_generate_range(cls, start, end, periods, freq, tz, normalize, ambiguous,␣
 ↪nonexistent, inclusive)
    396                 xdr = generate_range(start=start, end=end,␣
 ↪periods=periods, offset=freq)
--> 397                 i8values = np.array([x.value for x in xdr], dtype=np.
 ↪int64)
    398

/usr/local/lib/python3.10/dist-packages/pandas/core/arrays/datetimes.py in␣
 ↪<listcomp>(.0)
    396                 xdr = generate_range(start=start, end=end,␣
 ↪periods=periods, offset=freq)
--> 397                 i8values = np.array([x.value for x in xdr], dtype=np.
 ↪int64)
    398

/usr/local/lib/python3.10/dist-packages/pandas/core/arrays/datetimes.py in␣
 ↪generate_range(start, end, periods, offset)
   2552     if end is None:
-> 2553         end = start + (periods - 1) * offset
   2554

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/offsets.pyx in␣
 ↪pandas._libs.tslibs.offsets.BaseOffset.__add__()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/offsets.pyx in␣
 ↪pandas._libs.tslibs.offsets.BaseOffset.__add__()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/offsets.pyx in␣
 ↪pandas._libs.tslibs.offsets.apply_wraps.wrapper()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/offsets.pyx in␣
 ↪pandas._libs.tslibs.offsets.MonthOffset._apply()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/offsets.pyx in␣
 ↪pandas._libs.tslibs.offsets.shift_month()
```

```
/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/timestamps.pyx in␣
 ↪pandas._libs.tslibs.timestamps.Timestamp.replace()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/conversion.pyx in␣
 ↪pandas._libs.tslibs.conversion.convert_datetime_to_tsobject()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/tslibs/np_datetime.pyx in␣
 ↪pandas._libs.tslibs.np_datetime.check_dts_bounds()

OutOfBoundsDatetime: Out of bounds nanosecond timestamp: 8890-12-01 00:00:00

The above exception was the direct cause of the following exception:

ValueError                                Traceback (most recent call last)
<ipython-input-38-0dc1e7b74d6b> in <cell line: 1>()
----> 1 df.index.freq = 'MS'

/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/extension.py in␣
 ↪fset(self, value)
     79
     80             def fset(self, value):
---> 81                 setattr(self._data, name, value)
     82
     83             fget.__name__ = name

/usr/local/lib/python3.10/dist-packages/pandas/core/arrays/datetimelike.py in␣
 ↪freq(self, value)
    935         if value is not None:
    936             value = to_offset(value)
--> 937             self._validate_frequency(self, value)
    938
    939             if self.ndim > 1:

/usr/local/lib/python3.10/dist-packages/pandas/core/arrays/datetimelike.py in␣
 ↪_validate_frequency(cls, index, freq, **kwargs)
   1017             #  raise a ValueError, which we re-raise with a more target↪d
   1018             #  message.
-> 1019             raise ValueError(
   1020                 f"Inferred frequency {inferred} from passed values "
   1021                 f"does not conform to passed frequency {freq.freqstr}"

ValueError: Inferred frequency None from passed values does not conform to␣
 ↪passed frequency MS
```

[ ]:
```
# agrupar x mes
```

```
DfSalidas = train_data_pr.set_index("MES")
DfSalidas['Original'] = DfSalidas.groupby('MES')['y'].mean()
DfSalida = train_data_pr.groupby('MES')['y'].mean()
DfSalida
```

[ ]:
```
# Modelo 1. Prophet

from prophet import Prophet

df1 = df.copy()
df1=df1.reset_index()

# Asegúrate de que la columna 'ds' sea de tipo datetime

df_fb=df1.rename(columns={"Month":"ds", "Tiempo_Minutos_Total":"y"} )

train_data_pr = df_fb.iloc[:len(df1)-12]
test_data_pr = df_fb.iloc[len(df1)-12:]

m = Prophet()
#m.fit(train_data_pr[mask])
m.fit(train_data_pr)

future = m.make_future_dataframe(periods=12,freq='MS')
#future = m.make_future_dataframe(periods=12)

forecast = m.predict(future)
forecast.tail()
```

```
INFO:prophet:Disabling yearly seasonality. Run prophet with
yearly_seasonality=True to override this.
INFO:prophet:Disabling weekly seasonality. Run prophet with
weekly_seasonality=True to override this.
INFO:prophet:Disabling daily seasonality. Run prophet with
daily_seasonality=True to override this.
DEBUG:cmdstanpy:input tempfile: /tmp/tmplapidlw2/golukt5_.json
DEBUG:cmdstanpy:input tempfile: /tmp/tmplapidlw2/qv29t5sp.json
DEBUG:cmdstanpy:idx 0
DEBUG:cmdstanpy:running CmdStan, num_threads: None
DEBUG:cmdstanpy:CmdStan args: ['/usr/local/lib/python3.10/dist-
packages/prophet/stan_model/prophet_model.bin', 'random', 'seed=72001', 'data',
'file=/tmp/tmplapidlw2/golukt5_.json', 'init=/tmp/tmplapidlw2/qv29t5sp.json',
'output',
'file=/tmp/tmplapidlw2/prophet_model5hto0ztf/prophet_model-20231108134739.csv',
'method=optimize', 'algorithm=lbfgs', 'iter=10000']
13:47:39 - cmdstanpy - INFO - Chain [1] start processing
INFO:cmdstanpy:Chain [1] start processing
```

```
13:47:43 - cmdstanpy - INFO - Chain [1] done processing
INFO:cmdstanpy:Chain [1] done processing
```

[ ]:
```
           ds       trend  yhat_lower  yhat_upper  trend_lower  trend_upper  \
16 2024-05-01  100.188032   12.523192  185.699177    44.276265   151.734825
17 2024-06-01  101.359661   17.585352  190.565635    34.391777   164.849146
18 2024-07-01  102.493496    7.623568  191.643113    25.680326   177.399690
19 2024-08-01  103.665125   -4.099542  204.909838    14.731213   189.954833
20 2024-09-01  104.836754  -11.027283  222.708577     3.026620   204.322978

    additive_terms  additive_terms_lower  additive_terms_upper  \
16             0.0                   0.0                   0.0
17             0.0                   0.0                   0.0
18             0.0                   0.0                   0.0
19             0.0                   0.0                   0.0
20             0.0                   0.0                   0.0

    multiplicative_terms  multiplicative_terms_lower  \
16                   0.0                         0.0
17                   0.0                         0.0
18                   0.0                         0.0
19                   0.0                         0.0
20                   0.0                         0.0

    multiplicative_terms_upper        yhat
16                         0.0  100.188032
17                         0.0  101.359661
18                         0.0  102.493496
19                         0.0  103.665125
20                         0.0  104.836754
```

[ ]:
```
# asignar para grafica
prophet_pred = pd.DataFrame({"Date" : forecast[-12:]['ds'], "Pred" :␣
 ↪forecast[-12:]["yhat"]})
prophet_pred = prophet_pred.set_index("Date")
prophet_pred.index.freq = "MS"
prophet_pred
```

[ ]:
```
                Pred
Date
2023-10-01   92.137806
2023-11-01   93.309436
2023-12-01   94.443270
2024-01-01   95.614899
2024-02-01   96.786528
2024-03-01   97.882568
2024-04-01   99.054197
```

```
2024-05-01  100.188032
2024-06-01  101.359661
2024-07-01  102.493496
2024-08-01  103.665125
2024-09-01  104.836754
```

[ ]:
```
train_data_pr
```

[ ]:
```
       index           FECHA_LLEGADA             FECHA_TRIAGE  \
0          1 2023-01-01 01:20:23.853  2023-01-01 01:28:01.847
1          2 2023-01-01 01:29:46.050  2023-01-01 01:48:03.070
2          3 2023-01-01 03:15:35.623  2023-01-01 03:23:01.990
3          4 2023-01-01 05:54:53.563  2023-01-01 06:00:07.943
4          5 2023-01-01 06:37:27.237  2023-01-01 07:52:31.687
…        …                       …                         …
82399  82400 2023-09-17 21:12:50.687  2023-09-17 21:19:39.883
82400  82401 2023-09-17 22:39:05.587  2023-09-17 22:57:11.653
82401  82402 2023-09-17 22:59:10.483  2023-09-17 23:16:29.810
82402  82403 2023-09-17 23:31:10.827  2023-09-17 23:47:05.270
82403  82404 2023-09-17 23:56:53.490  2023-09-18 00:05:14.693

                  FECHA_INGRESO           FECHA_ATENCION  \
0      2023-01-01 01:29:41.210  2023-01-01 02:00:07.590
1      2023-01-01 01:49:40.973  2023-01-01 02:02:53.663
2      2023-01-01 03:23:39.793  2023-01-01 03:30:21.233
3      2023-01-01 06:02:07.320  2023-01-01 06:26:17.050
4      2023-01-01 07:52:37.717  2023-01-01 09:31:15.597
…                          …                       …
82399  2023-09-17 21:39:45.623  2023-09-17 22:32:02.003
82400  2023-09-17 22:59:29.137  2023-09-17 23:22:06.090
82401  2023-09-17 23:21:23.987  2023-09-18 00:35:01.290
82402  2023-09-17 23:48:34.393  2023-09-18 00:07:43.070
82403  2023-09-18 00:06:16.227  2023-09-18 01:59:02.380

      TIEMPO_DGTURNO_A_TRIAGE TIEMPO_TRIAGE_A_INGRESO  \
0                     0:07:38                 0:01:40
1                     0:18:17                 0:01:37
2                     0:07:26                 0:00:38
3                     0:05:14                 0:02:00
4                     1:15:04                 0:00:06
…                       …                       …
82399                 0:06:49                 0:20:06
82400                 0:18:06                 0:02:18
82401                 0:17:19                 0:04:54
82402                 0:15:55                 0:01:29
82403                 0:08:21                 0:01:02
```

```
      TIEMPO_INGRESO_A_CONSULTA TIEMPO_TOTAL       y  … MEDICO   AÑO MES  \
0                       0:30:26      0:39:44   39.73  …  11065  2023   1
1                       0:13:13      0:33:07   33.12  …   8861  2023   1
2                       0:06:42      0:14:46   14.77  …   5855  2023   1
3                       0:24:10      0:31:24   31.40  …  11072  2023   1
4                       1:38:38      2:53:48  173.80  …   1239  2023   1
…                         …          …     …  …    …   …  ..
82399                   0:52:17      1:19:12   79.20  …   7805  2023   9
82400                   0:22:37      0:43:01   43.02  …  11006  2023   9
82401                   1:13:38      1:35:51   95.85  …    962  2023   9
82402                   0:19:09      0:36:33   36.55  …   8491  2023   9
82403                   1:52:46      2:02:09  122.15  …   3540  2023   9

      DIA_SEMANA HOUR Turnos                      TIME DIA Tiempo_Total  \
0        DOMINGO    1  NOCHE  2023-01-01 01:20:23.853   1        39.73
1        DOMINGO    1  NOCHE  2023-01-01 01:29:46.050   1        33.12
2        DOMINGO    3  NOCHE  2023-01-01 03:15:35.623   1        14.77
3        DOMINGO    5  NOCHE  2023-01-01 05:54:53.563   1        31.40
4        DOMINGO    6  NOCHE  2023-01-01 06:37:27.237   1       173.80
…          …  …    …                          …  ..          …
82399    DOMINGO   21  NOCHE  2023-09-17 21:12:50.687  17        79.20
82400    DOMINGO   22  NOCHE  2023-09-17 22:39:05.587  17        43.02
82401    DOMINGO   22  NOCHE  2023-09-17 22:59:10.483  17        95.85
82402    DOMINGO   23  NOCHE  2023-09-17 23:31:10.827  17        36.55
82403    DOMINGO   23  NOCHE  2023-09-17 23:56:53.490  17       122.15

              ds
0     2023-01-01
1     2023-01-01
2     2023-01-01
3     2023-01-01
4     2023-01-01
…          …
82399 2023-09-01
82400 2023-09-01
82401 2023-09-01
82402 2023-09-01
82403 2023-09-01

[82404 rows x 28 columns]
```

[ ]:
```python
# crear un datagrame
DfSalidas = train_data_pr.set_index("MES")
DfSalidas['Original'] = DfSalidas.groupby('MES')['y'].mean()
DfSalida = train_data_pr.groupby('MES')['y'].mean()
DfSalida
```

[ ]:
```
MES
3    107.974032
4     95.203582
5    104.839185
6     97.895240
7     88.040411
8     90.971641
9     90.144204
1     84.455127
2     92.712531
3    101.072168
4     94.493696
5    105.348111
6     96.142285
7     74.907123
Name: y, dtype: float64
```

[ ]:
```
DfSalidas
```

[ ]:
```
      index           FECHA_LLEGADA             FECHA_TRIAGE  \
MES
1         1 2023-01-01 01:20:23.853  2023-01-01 01:28:01.847
1         2 2023-01-01 01:29:46.050  2023-01-01 01:48:03.070
1         3 2023-01-01 03:15:35.623  2023-01-01 03:23:01.990
1         4 2023-01-01 05:54:53.563  2023-01-01 06:00:07.943
1         5 2023-01-01 06:37:27.237  2023-01-01 07:52:31.687
..      ...                     ...                      ...
9     82400 2023-09-17 21:12:50.687  2023-09-17 21:19:39.883
9     82401 2023-09-17 22:39:05.587  2023-09-17 22:57:11.653
9     82402 2023-09-17 22:59:10.483  2023-09-17 23:16:29.810
9     82403 2023-09-17 23:31:10.827  2023-09-17 23:47:05.270
9     82404 2023-09-17 23:56:53.490  2023-09-18 00:05:14.693

                FECHA_INGRESO           FECHA_ATENCION TIEMPO_DGTURNO_A_TRIAGE  \
MES
1     2023-01-01 01:29:41.210  2023-01-01 02:00:07.590                0:07:38
1     2023-01-01 01:49:40.973  2023-01-01 02:02:53.663                0:18:17
1     2023-01-01 03:23:39.793  2023-01-01 03:30:21.233                0:07:26
1     2023-01-01 06:02:07.320  2023-01-01 06:26:17.050                0:05:14
1     2023-01-01 07:52:37.717  2023-01-01 09:31:15.597                1:15:04
..                        ...                      ...                    ...
9     2023-09-17 21:39:45.623  2023-09-17 22:32:02.003                0:06:49
9     2023-09-17 22:59:29.137  2023-09-17 23:22:06.090                0:18:06
9     2023-09-17 23:21:23.987  2023-09-18 00:35:01.290                0:17:19
9     2023-09-17 23:48:34.393  2023-09-18 00:07:43.070                0:15:55
9     2023-09-18 00:06:16.227  2023-09-18 01:59:02.380                0:08:21
```

```
    TIEMPO_TRIAGE_A_INGRESO TIEMPO_INGRESO_A_CONSULTA TIEMPO_TOTAL       y  \
MES
1                  0:01:40                   0:30:26      0:39:44   39.73
1                  0:01:37                   0:13:13      0:33:07   33.12
1                  0:00:38                   0:06:42      0:14:46   14.77
1                  0:02:00                   0:24:10      0:31:24   31.40
1                  0:00:06                   1:38:38      2:53:48  173.80
..                     …                         …          …     …
9                  0:20:06                   0:52:17      1:19:12   79.20
9                  0:02:18                   0:22:37      0:43:01   43.02
9                  0:04:54                   1:13:38      1:35:51   95.85
9                  0:01:29                   0:19:09      0:36:33   36.55
9                  0:01:02                   1:52:46      2:02:09  122.15

     … MEDICO   AÑO DIA_SEMANA HOUR Turnos                     TIME DIA  \
MES  …
1    …  11065  2023    DOMINGO    1  NOCHE  2023-01-01 01:20:23.853   1
1    …   8861  2023    DOMINGO    1  NOCHE  2023-01-01 01:29:46.050   1
1    …   5855  2023    DOMINGO    3  NOCHE  2023-01-01 03:15:35.623   1
1    …  11072  2023    DOMINGO    5  NOCHE  2023-01-01 05:54:53.563   1
1    …   1239  2023    DOMINGO    6  NOCHE  2023-01-01 06:37:27.237   1
..   …    …   …         …  …    …                       …  ..
9    …   7805  2023    DOMINGO   21  NOCHE  2023-09-17 21:12:50.687  17
9    …  11006  2023    DOMINGO   22  NOCHE  2023-09-17 22:39:05.587  17
9    …    962  2023    DOMINGO   22  NOCHE  2023-09-17 22:59:10.483  17
9    …   8491  2023    DOMINGO   23  NOCHE  2023-09-17 23:31:10.827  17
9    …   3540  2023    DOMINGO   23  NOCHE  2023-09-17 23:56:53.490  17

    Tiempo_Total         ds   Original
MES
1          39.73 2023-01-01  84.455127
1          33.12 2023-01-01  84.455127
1          14.77 2023-01-01  84.455127
1          31.40 2023-01-01  84.455127
1         173.80 2023-01-01  84.455127
..           …        …        …
9          79.20 2023-09-01  90.144204
9          43.02 2023-09-01  90.144204
9          95.85 2023-09-01  90.144204
9          36.55 2023-09-01  90.144204
9         122.15 2023-09-01  90.144204

[82404 rows x 28 columns]
```

[ ]:
```
DfSalida
```

[ ]:
```
MES
3    107.974032
4     95.203582
5    104.839185
6     97.895240
7     88.040411
8     90.971641
9     90.144204
1     84.455127
2     92.712531
3    101.072168
4     94.493696
5    105.348111
6     96.142285
7     74.907123
Name: y, dtype: float64
```

[ ]:
```
# crear la lista headers
headers = ["MES","T_PROM_ORI"]
print("headers\n", headers)
DfSalida.columns = headers
#df = df.drop(0)
```

```
headers
 ['MES', 'T_PROM_ORI']
```

[ ]:
```
#DfSalida
DfSalida.dtypes
```

[ ]:
```
dtype('float64')
```

[ ]:
```
# Modelo 1. Prophet

from prophet import Prophet
mask_Prediccion = 90

df1=df.reset_index()
df1['Fecha'] = df1['FECHA_LLEGADA'].dt.date
dfp = df1[['Fecha', 'Tiempo_Minutos_Total']].copy()
dfp.rename(columns={'Fecha': 'ds', 'Tiempo_Minutos_Total': 'y'}, inplace=True)
# dfp["y"] = pd.to_numeric(dfp["y"],errors='coerce')

train_data_pr = dfp.iloc[:len(dfp)-12]
test_data_pr = dfp.iloc[len(dfp)-12:]
m = Prophet()
#m.fit(dfp[mask])
m.fit(train_data_pr)
```

```
future = m.make_future_dataframe(periods=12,freq='MS')
forecast = m.predict(future)

# forecast.tail()
```

[ ]:
```
dfp
```

[ ]:
```
                ds       y
0       2023-01-01   39.73
1       2023-01-01   33.12
2       2023-01-01   14.77
3       2023-01-01   31.40
4       2023-01-01  173.80
…              …      …
82411   2023-09-18   84.90
82412   2023-09-18   83.75
82413   2023-09-18  125.83
82414   2023-09-18   62.92
82415   2023-09-18   34.33

[82416 rows x 2 columns]
```

[ ]:
```
dfp
dfp['MesO'] = dfp['ds'].dt.month
```

[ ]:
```
dfp
dfp['MesO'] = dfp['ds'].dt.month
dfp2 = dfp.groupby('MesO')['y'].mean()
dfp2
```

[ ]:
```
forecast['MesP'] = forecast['ds'].dt.month
prophet_pred = forecast.groupby('MesP')['yhat'].mean()
prophet_pred
```

[ ]:
```
MesP
1       84.842009
2       90.059295
3       99.192942
4       94.603973
5      103.509761
6       94.966810
7       86.573396
8       90.462421
9       87.756800
10      79.649965
11      88.539396
12      85.312914
```

```
Name: yhat, dtype: float64
```

[ ]:
```
dfp2["Prophet_Predictions"] = prophet_pred['Pred'].values
```

[ ]:
```
dfp2
```

[ ]:
```
ds
1                                                    84.455127
2                                                    92.712531
3                                                   101.368506
4                                                    94.984109
5                                                   104.962839
6                                                    97.645105
7                                                    87.853414
8                                                    90.971641
9                                                     90.11574
Prophet_Predictions    [84.49256491, 92.79432996437498, 101.096437922…
Name: y, dtype: object
```

[ ]:
```
forecast
```

[ ]:
```
                           ds         trend    yhat_lower    yhat_upper  \
0  1970-01-01 00:00:00.000000001  8.449256e+01  2.270472e+01  1.512173e+02
1  1970-01-01 00:00:00.000000002  9.279433e+01  2.718982e+01  1.548589e+02
2  1970-01-01 00:00:00.000000003  1.010964e+02  3.479014e+01  1.647193e+02
3  1970-01-01 00:00:00.000000004  9.536102e+01  3.106702e+01  1.532594e+02
4  1970-01-01 00:00:00.000000005  1.047706e+02  4.215136e+01  1.663403e+02
..                           …           …           …           …
94 1970-03-28 00:00:00.000000009  8.743220e+15 -1.671278e+17  1.934413e+17
95 1970-03-29 00:00:00.000000009  8.844885e+15 -1.696684e+17  1.969466e+17
96 1970-03-30 00:00:00.000000009  8.946550e+15 -1.734813e+17  2.011411e+17
97 1970-03-31 00:00:00.000000009  9.048216e+15 -1.766101e+17  2.043906e+17
98 1970-04-01 00:00:00.000000009  9.149881e+15 -1.794139e+17  2.077006e+17

     trend_lower   trend_upper  additive_terms  additive_terms_lower  \
0   8.449256e+01  8.449256e+01             0.0                   0.0
1   9.279433e+01  9.279433e+01             0.0                   0.0
2   1.010964e+02  1.010964e+02             0.0                   0.0
3   9.536102e+01  9.536102e+01             0.0                   0.0
4   1.047706e+02  1.047706e+02             0.0                   0.0
..           …             …               …                     …
94 -1.671278e+17  1.934413e+17             0.0                   0.0
95 -1.696684e+17  1.969466e+17             0.0                   0.0
96 -1.734813e+17  2.011411e+17             0.0                   0.0
97 -1.766101e+17  2.043906e+17             0.0                   0.0
98 -1.794139e+17  2.077006e+17             0.0                   0.0
```

```
    additive_terms_upper  multiplicative_terms  multiplicative_terms_lower  \
0                    0.0                   0.0                         0.0
1                    0.0                   0.0                         0.0
2                    0.0                   0.0                         0.0
3                    0.0                   0.0                         0.0
4                    0.0                   0.0                         0.0
..                   …                     …                           …
94                   0.0                   0.0                         0.0
95                   0.0                   0.0                         0.0
96                   0.0                   0.0                         0.0
97                   0.0                   0.0                         0.0
98                   0.0                   0.0                         0.0

    multiplicative_terms_upper          yhat
0                          0.0  8.449256e+01
1                          0.0  9.279433e+01
2                          0.0  1.010964e+02
3                          0.0  9.536102e+01
4                          0.0  1.047706e+02
..                         …             …
94                         0.0  8.743220e+15
95                         0.0  8.844885e+15
96                         0.0  8.946550e+15
97                         0.0  9.048216e+15
98                         0.0  9.149881e+15

[99 rows x 13 columns]
```

[ ]:
```
prophet_pred
```

[ ]:
```
                 Pred
Date
2023-10-01   92.137806
2023-11-01   93.309436
2023-12-01   94.443270
2024-01-01   95.614899
2024-02-01   96.786528
2024-03-01   97.882568
2024-04-01   99.054197
2024-05-01  100.188032
2024-06-01  101.359661
2024-07-01  102.493496
2024-08-01  103.665125
2024-09-01  104.836754
```

[ ]:
```
prophet_pred = pd.DataFrame({"Date" : forecast['ds'], "Pred" :␣
↪forecast["yhat"]})
```

[ ]:
```
prophet_pred = pd.DataFrame({"Date" : forecast['ds'], "Pred" : forecast["y"]})
#prophet_pred = prophet_pred.set_index("Date")
#prophet_pred.index.freq = "MS"
```

[ ]:
```
test_data["Prophet_Predictions"] = prophet_pred['Pred'].values
```

[ ]:
```
prophet_pred
```

[ ]:
```
                 Pred
Date
2023-10-01   92.137806
2023-11-01   93.309436
2023-12-01   94.443270
2024-01-01   95.614899
2024-02-01   96.786528
2024-03-01   97.882568
2024-04-01   99.054197
2024-05-01  100.188032
2024-06-01  101.359661
2024-07-01  102.493496
2024-08-01  103.665125
2024-09-01  104.836754
```

[ ]:
```
test_data["Prophet_Predictions"] = prophet_pred['Pred'].values
```

[ ]:
```
test_data
```

[ ]:
```
                FECHA_LLEGADA             FECHA_TRIAGE  \
82405 2023-09-18 07:00:26.697  2023-09-18 07:08:30.043
82406 2023-09-17 17:28:11.360  2023-09-17 17:33:14.930
82407 2023-09-17 18:12:40.660  2023-09-17 18:43:16.430
82408 2023-09-17 18:52:28.640  2023-09-17 19:48:17.070
82409 2023-09-17 19:57:56.033  2023-09-17 20:15:56.793
82410 2023-09-17 20:22:04.970  2023-09-17 20:36:16.703
82411 2023-09-17 21:22:59.137  2023-09-17 21:42:20.273
82412 2023-09-18 04:44:41.970  2023-09-18 04:53:22.553
82413 2023-09-18 06:17:00.573  2023-09-18 06:28:43.040
82414 2023-09-18 06:21:37.273  2023-09-18 07:00:57.420
82415 2023-09-18 06:25:33.483  2023-09-18 06:42:02.883
82416 2023-09-18 07:14:58.180  2023-09-18 07:30:50.643

                FECHA_INGRESO           FECHA_ATENCION  \
82405  2023-09-18 07:14:16.823  2023-09-18 07:32:53.187
82406  2023-09-17 17:34:42.173  2023-09-17 18:36:55.167
82407  2023-09-17 18:48:36.403  2023-09-17 19:40:11.800
82408  2023-09-17 19:49:47.657  2023-09-17 20:32:54.070
82409  2023-09-17 20:28:57.590  2023-09-17 20:46:29.250
```

```
82410  2023-09-17 20:41:12.783  2023-09-17 22:00:50.287
82411  2023-09-17 21:51:04.433  2023-09-17 22:43:13.710
82412  2023-09-18 05:05:51.423  2023-09-18 06:09:35.867
82413  2023-09-18 06:35:38.213  2023-09-18 07:40:45.957
82414  2023-09-18 07:16:45.907  2023-09-18 08:27:27.337
82415  2023-09-18 06:51:35.970  2023-09-18 07:28:28.290
82416  2023-09-18 07:34:08.370  2023-09-18 07:49:18.440

      TIEMPO_DGTURNO_A_TRIAGE TIEMPO_TRIAGE_A_INGRESO  \
82405                 0:08:04                 0:05:46
82406                 0:05:03                 0:01:28
82407                 0:30:36                 0:05:20
82408                 0:55:49                 0:01:30
82409                 0:18:00                 0:13:01
82410                 0:14:12                 0:04:56
82411                 0:19:21                 0:08:44
82412                 0:08:41                 0:12:29
82413                 0:11:43                 0:06:55
82414                 0:39:20                 0:15:48
82415                 0:16:29                 0:09:33
82416                 0:15:52                 0:03:18

      TIEMPO_INGRESO_A_CONSULTA TIEMPO_TOTAL  Tiempo_Minutos_Total  \
82405                   0:18:37      0:32:27                 32.45
82406                   1:02:13      1:08:44                 68.73
82407                   0:51:35      1:27:31                 87.52
82408                   0:43:07      1:40:26                100.43
82409                   0:17:32      0:48:33                 48.55
82410                   1:19:38      1:38:46                 98.77
82411                   0:52:09      1:20:14                 80.23
82412                   1:03:44      1:24:54                 84.90
82413                   1:05:07      1:23:45                 83.75
82414                   1:10:42      2:05:50                125.83
82415                   0:36:53      1:02:55                 62.92
82416                   0:15:10      0:34:20                 34.33

      CENTRO_ATENCION  …   AÑO MES DIA_SEMANA HOUR  Turnos  \
82405              ME  …  2023   9      LUNES    7  MAÑANA
82406              ME  …  2023   9    DOMINGO   17   TARDE
82407              ME  …  2023   9    DOMINGO   18   TARDE
82408              ME  …  2023   9    DOMINGO   18   TARDE
82409              UC  …  2023   9    DOMINGO   19   TARDE
82410              ME  …  2023   9    DOMINGO   20   NOCHE
82411              ME  …  2023   9    DOMINGO   21   NOCHE
82412              ME  …  2023   9      LUNES    4   NOCHE
82413              ME  …  2023   9      LUNES    6   NOCHE
82414              ME  …  2023   9      LUNES    6   NOCHE
```

```
82415              UB  …  2023   9      LUNES    6   NOCHE
82416              TN  …  2023   9      LUNES    7  MAÑANA

                         TIME DIA Tiempo_Total      Month Prophet_Predictions
82405  2023-09-18 07:00:26.697  18        32.45 2023-09-01           92.137806
82406  2023-09-17 17:28:11.360  17        68.73 2023-09-01           93.309436
82407  2023-09-17 18:12:40.660  17        87.52 2023-09-01           94.443270
82408  2023-09-17 18:52:28.640  17       100.43 2023-09-01           95.614899
82409  2023-09-17 19:57:56.033  17        48.55 2023-09-01           96.786528
82410  2023-09-17 20:22:04.970  17        98.77 2023-09-01           97.882568
82411  2023-09-17 21:22:59.137  17        80.23 2023-09-01           99.054197
82412  2023-09-18 04:44:41.970  18        84.90 2023-09-01          100.188032
82413  2023-09-18 06:17:00.573  18        83.75 2023-09-01          101.359661
82414  2023-09-18 06:21:37.273  18       125.83 2023-09-01          102.493496
82415  2023-09-18 06:25:33.483  18        62.92 2023-09-01          103.665125
82416  2023-09-18 07:14:58.180  18        34.33 2023-09-01          104.836754

[12 rows x 28 columns]
```

[ ]:
```
test_data
```

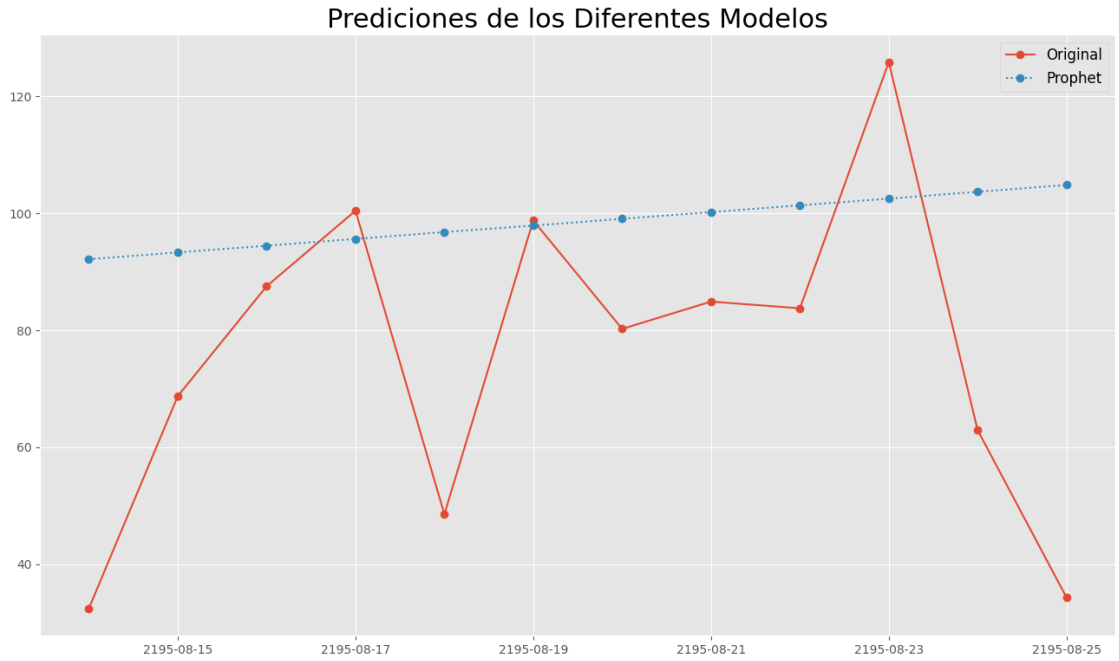
[ ]:
```
a=test_data[["Tiempo_Total","Prophet_Predictions"]]
fig = px.line(a, x=test_data.index, y=a.columns,template = "plotly_dark",
              title="Predicción con Modelo Prophet")
fig.show()
```

[ ]:
```
evaluacion_metrica(test_data["Tiempo_Total"],test_data["Prophet_Predictions"])
```

```
Evaluation metric results:-
MSE is : 1219.9653629266488
MAE is : 27.619987145454747
RMSE is : 34.92800256136398
MAPE is : 56.98639526952371
R2 is : -0.7227982433450808
```

[ ]:
```
# Grafica
plt.figure(figsize=(16,9))
plt.plot_date(test_data.index, test_data["Tiempo_Total"],label="Original",␣
 ↪linestyle="-")
#plt.plot_date(test_data.index, test_data["ARIMA_Predictions"],␣
 ↪label="Arima",linestyle="-.")
#plt.plot_date(test_data.index, test_data["LSTM_Predictions"],label="LSTM",␣
 ↪linestyle="--")
plt.plot_date(test_data.index, test_data["Prophet_Predictions"],␣
 ↪label="Prophet",linestyle=":")
plt.legend(fontsize=12)
```

```
plt.title("Prediciones de los Diferentes Modelos", fontsize=22)
plt.show();
```



[ ]:
```
#!pip install --tarjet=$nb_path skforecast
!pip install skforecast
```

```
Collecting skforecast
  Downloading skforecast-0.10.1-py3-none-any.whl (397 kB)
                             397.3/397.3
kB 6.1 MB/s eta 0:00:00
Requirement already satisfied: numpy<1.26,>=1.20 in
/usr/local/lib/python3.10/dist-packages (from skforecast) (1.23.5)
Requirement already satisfied: pandas<2.1,>=1.2 in
/usr/local/lib/python3.10/dist-packages (from skforecast) (1.5.3)
Collecting tqdm<4.66,>=4.57.0 (from skforecast)
  Downloading tqdm-4.65.2-py3-none-any.whl (77 kB)
                             77.1/77.1 kB
11.9 MB/s eta 0:00:00
Requirement already satisfied: scikit-learn<1.4,>=1.0 in
/usr/local/lib/python3.10/dist-packages (from skforecast) (1.2.2)
Collecting optuna<3.3,>=2.10.0 (from skforecast)
  Downloading optuna-3.2.0-py3-none-any.whl (390 kB)
                             390.6/390.6
kB 36.2 MB/s eta 0:00:00
Requirement already satisfied: joblib<1.4,>=1.1.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from skforecast) (1.3.2)
Collecting alembic>=1.5.0 (from optuna<3.3,>=2.10.0->skforecast)
  Downloading alembic-1.12.1-py3-none-any.whl (226 kB)
                             226.8/226.8
kB 30.4 MB/s eta 0:00:00
Collecting cmaes>=0.9.1 (from optuna<3.3,>=2.10.0->skforecast)
  Downloading cmaes-0.10.0-py3-none-any.whl (29 kB)
Collecting colorlog (from optuna<3.3,>=2.10.0->skforecast)
  Downloading colorlog-6.7.0-py2.py3-none-any.whl (11 kB)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.10/dist-packages (from optuna<3.3,>=2.10.0->skforecast)
(23.2)
Requirement already satisfied: sqlalchemy>=1.3.0 in
/usr/local/lib/python3.10/dist-packages (from optuna<3.3,>=2.10.0->skforecast)
(2.0.23)
Requirement already satisfied: PyYAML in /usr/local/lib/python3.10/dist-packages
(from optuna<3.3,>=2.10.0->skforecast) (6.0.1)
Requirement already satisfied: python-dateutil>=2.8.1 in
/usr/local/lib/python3.10/dist-packages (from pandas<2.1,>=1.2->skforecast)
(2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-
packages (from pandas<2.1,>=1.2->skforecast) (2023.3.post1)
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-
packages (from scikit-learn<1.4,>=1.0->skforecast) (1.11.3)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/usr/local/lib/python3.10/dist-packages (from scikit-
learn<1.4,>=1.0->skforecast) (3.2.0)
Collecting Mako (from alembic>=1.5.0->optuna<3.3,>=2.10.0->skforecast)
  Downloading Mako-1.2.4-py3-none-any.whl (78 kB)
                             78.7/78.7 kB
12.1 MB/s eta 0:00:00
Requirement already satisfied: typing-extensions>=4 in
/usr/local/lib/python3.10/dist-packages (from
alembic>=1.5.0->optuna<3.3,>=2.10.0->skforecast) (4.5.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-
packages (from python-dateutil>=2.8.1->pandas<2.1,>=1.2->skforecast) (1.16.0)
Requirement already satisfied: greenlet!=0.4.17 in
/usr/local/lib/python3.10/dist-packages (from
sqlalchemy>=1.3.0->optuna<3.3,>=2.10.0->skforecast) (3.0.1)
Requirement already satisfied: MarkupSafe>=0.9.2 in
/usr/local/lib/python3.10/dist-packages (from
Mako->alembic>=1.5.0->optuna<3.3,>=2.10.0->skforecast) (2.1.3)
Installing collected packages: tqdm, Mako, colorlog, cmaes, alembic, optuna,
skforecast
  Attempting uninstall: tqdm
    Found existing installation: tqdm 4.66.1
    Uninstalling tqdm-4.66.1:
```

```
      Successfully uninstalled tqdm-4.66.1
Successfully installed Mako-1.2.4 alembic-1.12.1 cmaes-0.10.0 colorlog-6.7.0
optuna-3.2.0 skforecast-0.10.1 tqdm-4.65.2
```

[ ]:
```python
# Modelo 2

import numpy as np
import pandas as pd

# Gráficos
# ==============================================================================
import matplotlib.pyplot as plt
plt.style.use('fivethirtyeight')
plt.rcParams['lines.linewidth'] = 1.5
plt.rcParams['font.size'] = 10

# Modelado y Forecasting
# ==============================================================================
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Lasso
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
from sklearn.preprocessing import StandardScaler

from skforecast.ForecasterAutoreg import ForecasterAutoreg
from skforecast.ForecasterAutoregCustom import ForecasterAutoregCustom
from skforecast.ForecasterAutoregDirect import ForecasterAutoregDirect
from skforecast.model_selection import grid_search_forecaster
from skforecast.model_selection import backtesting_forecaster
from skforecast.utils import save_forecaster
from skforecast.utils import load_forecaster

# Configuración warnings
# ==============================================================================
import warnings
# warnings.filterwarnings('ignore')
```

[ ]:
```python
datos = df
```

[ ]:
```python
url = 'https://raw.githubusercontent.com/JoaquinAmatRodrigo/skforecast/master/
 ↪data/h2o_exog.csv'
datos1 = pd.read_csv(url, sep=',')
```

[ ]:
```python
datos
```

[ ]:

	FECHA_LLEGADA	FECHA_TRIAGE	\
1	2023-01-01 01:20:23.853	2023-01-01 01:28:01.847	
2	2023-01-01 01:29:46.050	2023-01-01 01:48:03.070	
3	2023-01-01 03:15:35.623	2023-01-01 03:23:01.990	
4	2023-01-01 05:54:53.563	2023-01-01 06:00:07.943	
5	2023-01-01 06:37:27.237	2023-01-01 07:52:31.687	
…	…	…	
82412	2023-09-18 04:44:41.970	2023-09-18 04:53:22.553	
82413	2023-09-18 06:17:00.573	2023-09-18 06:28:43.040	
82414	2023-09-18 06:21:37.273	2023-09-18 07:00:57.420	
82415	2023-09-18 06:25:33.483	2023-09-18 06:42:02.883	
82416	2023-09-18 07:14:58.180	2023-09-18 07:30:50.643	

	FECHA_INGRESO	FECHA_ATENCION	\
1	2023-01-01 01:29:41.210	2023-01-01 02:00:07.590	
2	2023-01-01 01:49:40.973	2023-01-01 02:02:53.663	
3	2023-01-01 03:23:39.793	2023-01-01 03:30:21.233	
4	2023-01-01 06:02:07.320	2023-01-01 06:26:17.050	
5	2023-01-01 07:52:37.717	2023-01-01 09:31:15.597	
…	…	…	
82412	2023-09-18 05:05:51.423	2023-09-18 06:09:35.867	
82413	2023-09-18 06:35:38.213	2023-09-18 07:40:45.957	
82414	2023-09-18 07:16:45.907	2023-09-18 08:27:27.337	
82415	2023-09-18 06:51:35.970	2023-09-18 07:28:28.290	
82416	2023-09-18 07:34:08.370	2023-09-18 07:49:18.440	

	TIEMPO_DGTURNO_A_TRIAGE	TIEMPO_TRIAGE_A_INGRESO	\
1	0:07:38	0:01:40	
2	0:18:17	0:01:37	
3	0:07:26	0:00:38	
4	0:05:14	0:02:00	
5	1:15:04	0:00:06	
…	…	…	
82412	0:08:41	0:12:29	
82413	0:11:43	0:06:55	
82414	0:39:20	0:15:48	
82415	0:16:29	0:09:33	
82416	0:15:52	0:03:18	

	TIEMPO_INGRESO_A_CONSULTA	TIEMPO_TOTAL	Tiempo_Minutos_Total	\
1	0:30:26	0:39:44	39.73	
2	0:13:13	0:33:07	33.12	
3	0:06:42	0:14:46	14.77	
4	0:24:10	0:31:24	31.40	
5	1:38:38	2:53:48	173.80	
…	…	…	…	
82412	1:03:44	1:24:54	84.90	

```
82413                  1:05:07      1:23:45                83.75
82414                  1:10:42      2:05:50               125.83
82415                  0:36:53      1:02:55                62.92
82416                  0:15:10      0:34:20                34.33

      CENTRO_ATENCION  …   AÑO MES DIA_SEMANA HOUR  Turnos  \
1                  TN  …  2023   1    DOMINGO    1   NOCHE
2                  ME  …  2023   1    DOMINGO    1   NOCHE
3                  UC  …  2023   1    DOMINGO    3   NOCHE
4                  UC  …  2023   1    DOMINGO    5   NOCHE
5                  TN  …  2023   1    DOMINGO    6   NOCHE
…                 …  …   …   …  ..        …  …     …
82412              ME  …  2023   9      LUNES    4   NOCHE
82413              ME  …  2023   9      LUNES    6   NOCHE
82414              ME  …  2023   9      LUNES    6   NOCHE
82415              UB  …  2023   9      LUNES    6   NOCHE
82416              TN  …  2023   9      LUNES    7  MAÑANA

                          TIME DIA Tiempo_Total      Month       fecha
1      2023-01-01 01:20:23.853   1        39.73 2023-01-01  2023-01-01
2      2023-01-01 01:29:46.050   1        33.12 2023-01-01  2023-01-01
3      2023-01-01 03:15:35.623   1        14.77 2023-01-01  2023-01-01
4      2023-01-01 05:54:53.563   1        31.40 2023-01-01  2023-01-01
5      2023-01-01 06:37:27.237   1       173.80 2023-01-01  2023-01-01
…                         …  ..          …         …          …
82412  2023-09-18 04:44:41.970  18        84.90 2023-09-01  2023-09-01
82413  2023-09-18 06:17:00.573  18        83.75 2023-09-01  2023-09-01
82414  2023-09-18 06:21:37.273  18       125.83 2023-09-01  2023-09-01
82415  2023-09-18 06:25:33.483  18        62.92 2023-09-01  2023-09-01
82416  2023-09-18 07:14:58.180  18        34.33 2023-09-01  2023-09-01

[82416 rows x 28 columns]
```

[ ]:
```
datos1
```

[ ]:
```
# agrupar datos
datos2 = datos.groupby('Month')['Tiempo_Total'].mean()
datos2
```

[ ]:
```
Month
2023-01-01    107.490400
2023-02-01    104.363828
2023-03-01    112.497437
2023-04-01    107.439636
2023-05-01    116.109004
2023-06-01    108.183079
2023-07-01    100.240377
```

```
2023-08-01    106.878000
2023-09-01    111.367566
Name: Tiempo_Total, dtype: float64
```

[ ]:
```
# Preparación del dato
# ==============================================================================
datos['fecha'] = df['Month'].dt.strftime('%Y-%m-01')
datos = datos.set_index('fecha')
datos = datos.rename(columns={'x': 'Tiempo_Total'})
datos = datos.asfreq('MS')
datos = datos.sort_index()
datos.head()
```

[ ]:
```
# Preparación del dato
# ==============================================================================
datos1['fecha'] = pd.to_datetime(datos1['fecha'], format='%Y-%m-%d')
datos1 = datos1.set_index('fecha')
datos1 = datos1.rename(columns={'x': 'y'})
datos1 = datos1.asfreq('MS')
datos1 = datos1.sort_index()
datos1.head()
```

[ ]:
```
datos2
```

[ ]:
```
Month
2023-01-01    107.490400
2023-02-01    104.363828
2023-03-01    112.497437
2023-04-01    107.439636
2023-05-01    116.109004
2023-06-01    108.183079
2023-07-01    100.240377
2023-08-01    106.878000
2023-09-01    111.367566
Name: Tiempo_Total, dtype: float64
```

[ ]:
```
print(f'Número de filas con missing values: {datos.isnull().any(axis=1).
  ↪mean()}')
```

```
Número de filas con missing values: 0.0
```

[ ]:
```
# Verificar que un índice temporal está completo
# ==============================================================================
(datos.index == pd.date_range(
                    start = datos.index.min(),
                    end   = datos.index.max(),
                    freq  = datos.index.freq)
```

```
).all()
```

[ ]:
```
datos_train
```

[ ]:
```
datos_test
```

[ ]:
```
steps = 3
datos_train = datos[:-steps]
datos_test  = datos[-steps:]

print(f"Fechas train : {datos_train.index.min()} --- {datos_train.index.max()} ␣
 ↪(n={len(datos_train)})")
print(f"Fechas test  : {datos_test.index.min()} --- {datos_test.index.max()} ␣
 ↪(n={len(datos_test)})")

fig, ax = plt.subplots(figsize=(6, 2.5))
datos_train['y'].plot(ax=ax, label='train')
datos_test['y'].plot(ax=ax, label='test')
ax.legend();
```

```
Fechas train : 2023-01-01 00:00:00 --- 2023-09-01 00:00:00  (n=82413)
Fechas test  : 2023-09-01 00:00:00 --- 2023-09-01 00:00:00  (n=3)
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in␣
 ↪get_loc(self, key, method, tolerance)
   3801             try:
-> 3802                 return self._engine.get_loc(casted_key)
   3803             except KeyError as err:

/usr/local/lib/python3.10/dist-packages/pandas/_libs/index.pyx in pandas._libs.
 ↪index.IndexEngine.get_loc()

/usr/local/lib/python3.10/dist-packages/pandas/_libs/index.pyx in pandas._libs.
 ↪index.IndexEngine.get_loc()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.
 ↪PyObjectHashTable.get_item()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.
 ↪PyObjectHashTable.get_item()

KeyError: 'y'

The above exception was the direct cause of the following exception:
```

```
KeyError                                  Traceback (most recent call last)
<ipython-input-78-6fe142492622> in <cell line: 9>()
      7
      8 fig, ax = plt.subplots(figsize=(6, 2.5))
----> 9 datos_train['y'].plot(ax=ax, label='train')
     10 datos_test['y'].plot(ax=ax, label='test')
     11 ax.legend();

/usr/local/lib/python3.10/dist-packages/pandas/core/frame.py in␣
 ↪__getitem__(self, key)
   3805             if self.columns.nlevels > 1:
   3806                 return self._getitem_multilevel(key)
-> 3807             indexer = self.columns.get_loc(key)
   3808             if is_integer(indexer):
   3809                 indexer = [indexer]

/usr/local/lib/python3.10/dist-packages/pandas/core/indexes/base.py in␣
 ↪get_loc(self, key, method, tolerance)
   3802                 return self._engine.get_loc(casted_key)
   3803             except KeyError as err:
-> 3804                 raise KeyError(key) from err
   3805             except TypeError:
   3806                 # If we have a listlike key, _check_indexing_error will␣
 ↪raise

KeyError: 'y'
```