

# merged\_DFW\_notebooks

March 5, 2024

## 1 INTRODUCTION

This notebook combines and explores daily flight data from Dallas Fort Worth (DFW) airport and daily weather data for DFW from Jan 1 2018 to Nov 17, 2023. The purpose is to produce models that can predict daily flight traffic, such as the number of total, ontime, cancelled, and delayed flights at Dallas Fort Worth Airport (DFW) from historical flight and weather data. This analysis is exploratory, but could be valuable to DFW airport management.

The daily weather data were obtained from a friend, Monte Lunacek, at the National Renewable Energy Laboratory (NREL) who obtained the data from the National Oceanic and Atmospheric Administration (NOAA), High-Resolution Rapid Refresh (HRRR) Data Archive: AWS OPeN Data Program. The weather flight data was scraped from the Bureau of Transportation Statistics using Selenium..

In addition to merging the daily flight and weather data, this notebook engineers many features potentially relevant to flight traffic, such as time, date, and holiday features, and lag columns for total flights and cancelled flights. Column lists are created for convenient handling of features and targets. The final dataset is saved as “datav3/daily/daily\_flights\_and\_weather\_merged.parquet” for use in machine learning performed in other notebooks.

### 1.1 Libraries

```
[1]: import os
import json
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.dates as mdates
import holidays
import datetime as dt

import seaborn as sns
import sklearn
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression as LR
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.preprocessing import PolynomialFeatures
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
```

```

from sklearn.svm import SVR
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import GridSearchCV
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder, LabelEncoder, FunctionTransformer
from sklearn.decomposition import PCA

DAILY_DATA_PATH = "data.v3/daily"

pd.set_option("display.width", 600)

```

## 2 DAILY FLIGHT DATA

```
[2]: flights_d = pd.read_parquet(os.path.join(DAILY_DATA_PATH, "daily_flights.parquet"))
print(f"Daily flights columns: {flights_d.columns.tolist()}")
print('Daily flights import shape:', flights_d.shape)
```

```
Daily flights columns: ['flights_cancel', 'flights_delay', 'flights_ontime',
'flights_arr', 'flights_dep', 'flights_arr_A', 'flights_arr_B', 'flights_arr_C',
'flights_arr_D', 'flights_arr_E', 'flights_dep_A', 'flights_dep_B',
'flights_dep_C', 'flights_dep_D', 'flights_dep_E', 'flights_arr_cancel',
'flights_arr_delay', 'flights_arr_ontime', 'flights_dep_cancel',
'flights_dep_delay', 'flights_dep_ontime']
Daily flights import shape: (2147, 21)
```

### 2.1 Explore daily flights data

```
[3]: flights_d.describe().round().T
```

	count	mean	std	min	25%	50%	75%	max
flights_cancel	2147.0	40.0	108.0	0.0	4.0	10.0	26.0	1330.0
flights_delay	2147.0	315.0	191.0	0.0	184.0	272.0	404.0	1270.0
flights_ontime	2147.0	1326.0	276.0	33.0	1228.0	1392.0	1508.0	1848.0
flights_arr	2147.0	840.0	138.0	17.0	795.0	867.0	932.0	1106.0
flights_dep	2147.0	841.0	138.0	16.0	792.0	869.0	934.0	1080.0
flights_arr_A	2147.0	154.0	27.0	0.0	143.0	159.0	173.0	227.0
flights_arr_B	2147.0	225.0	38.0	0.0	203.0	228.0	255.0	311.0
flights_arr_C	2147.0	172.0	40.0	0.0	149.0	182.0	202.0	244.0
flights_arr_D	2147.0	108.0	24.0	16.0	93.0	106.0	127.0	169.0
flights_arr_E	2147.0	181.0	48.0	1.0	142.0	185.0	221.0	280.0
flights_dep_A	2147.0	155.0	27.0	0.0	145.0	160.0	174.0	211.0
flights_dep_B	2147.0	224.0	38.0	0.0	203.0	227.0	255.0	319.0
flights_dep_C	2147.0	172.0	39.0	0.0	150.0	182.0	202.0	241.0
flights_dep_D	2147.0	105.0	24.0	16.0	89.0	102.0	124.0	166.0
flights_dep_E	2147.0	184.0	47.0	0.0	146.0	190.0	224.0	271.0

```

flights_arr_cancel 2147.0    21.0    54.0    0.0     2.0    6.0    14.0   643.0
flights_arr_delay  2147.0   148.0    96.0    0.0    84.0   125.0   186.0   651.0
flights_arr_ontime 2147.0   672.0   145.0   17.0   611.0   706.0   771.0   943.0
flights_dep_cancel 2147.0   19.0    55.0    0.0     1.0    4.0    12.0   687.0
flights_dep_delay  2147.0   167.0   99.0    0.0    99.0   148.0   217.0   649.0
flights_dep_ontime 2147.0   655.0   134.0   16.0   612.0   685.0   741.0   905.0

```

[4]: flights\_d.info()

```

<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 2147 entries, 2018-01-01 to 2023-11-17
Data columns (total 21 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   flights_cancel   2147 non-null   float64
 1   flights_delay    2147 non-null   float64
 2   flights_ontime   2147 non-null   float64
 3   flights_arr      2147 non-null   float64
 4   flights_dep      2147 non-null   float64
 5   flights_arr_A    2147 non-null   float64
 6   flights_arr_B    2147 non-null   float64
 7   flights_arr_C    2147 non-null   float64
 8   flights_arr_D    2147 non-null   float64
 9   flights_arr_E    2147 non-null   float64
 10  flights_dep_A    2147 non-null   float64
 11  flights_dep_B    2147 non-null   float64
 12  flights_dep_C    2147 non-null   float64
 13  flights_dep_D    2147 non-null   float64
 14  flights_dep_E    2147 non-null   float64
 15  flights_arr_cancel 2147 non-null   float64
 16  flights_arr_delay 2147 non-null   float64
 17  flights_arr_ontime 2147 non-null   float64
 18  flights_dep_cancel 2147 non-null   float64
 19  flights_dep_delay 2147 non-null   float64
 20  flights_dep_ontime 2147 non-null   float64
dtypes: float64(21)
memory usage: 369.0 KB

```

[5]: flights\_d.head().T

	2018-01-01	2018-01-02	2018-01-03	2018-01-04	2018-01-05
timestamp	2018-01-01	2018-01-02	2018-01-03	2018-01-04	2018-01-05
flights_cancel	115.0	76.0	38.0	82.0	44.0
flights_delay	602.0	649.0	338.0	215.0	231.0
flights_ontime	985.0	1076.0	1349.0	1409.0	1439.0
flights_arr	870.0	884.0	863.0	851.0	857.0
flights_dep	832.0	917.0	862.0	855.0	857.0
flights_arr_A	177.0	178.0	177.0	165.0	172.0
flights_arr_B	298.0	279.0	276.0	282.0	283.0

flights_arr_C	187.0	190.0	193.0	192.0	192.0
flights_arr_D	100.0	110.0	94.0	91.0	93.0
flights_arr_E	108.0	127.0	123.0	121.0	117.0
flights_dep_A	168.0	185.0	175.0	173.0	174.0
flights_dep_B	275.0	301.0	282.0	283.0	282.0
flights_dep_C	180.0	201.0	192.0	183.0	193.0
flights_dep_D	99.0	102.0	91.0	94.0	92.0
flights_dep_E	110.0	128.0	122.0	122.0	116.0
flights_arr_cancel	70.0	36.0	18.0	39.0	23.0
flights_arr_delay	264.0	276.0	142.0	104.0	94.0
flights_arr_ontime	536.0	572.0	703.0	708.0	740.0
flights_dep_cancel	45.0	40.0	20.0	43.0	21.0
flights_dep_delay	338.0	373.0	196.0	111.0	137.0
flights_dep_ontime	449.0	504.0	646.0	701.0	699.0

[6]: flights\_d.tail().T

	2023-11-13	2023-11-14	2023-11-15	2023-11-16	2023-11-17
timestamp	2023-11-13	2023-11-14	2023-11-15	2023-11-16	2023-11-17
flights_cancel	6.0	1.0	6.0	0.0	0.0
flights_delay	214.0	53.0	0.0	0.0	0.0
flights_ontime	1672.0	1767.0	1623.0	65.0	33.0
flights_arr	945.0	910.0	810.0	41.0	17.0
flights_dep	947.0	911.0	819.0	24.0	16.0
flights_arr_A	161.0	161.0	161.0	7.0	0.0
flights_arr_B	249.0	237.0	225.0	0.0	0.0
flights_arr_C	210.0	210.0	191.0	2.0	0.0
flights_arr_D	134.0	125.0	141.0	25.0	16.0
flights_arr_E	191.0	177.0	92.0	7.0	1.0
flights_dep_A	166.0	161.0	162.0	0.0	0.0
flights_dep_B	246.0	236.0	225.0	0.0	0.0
flights_dep_C	213.0	209.0	193.0	0.0	0.0
flights_dep_D	132.0	130.0	136.0	17.0	16.0
flights_dep_E	190.0	175.0	103.0	7.0	0.0
flights_arr_cancel	3.0	0.0	2.0	0.0	0.0
flights_arr_delay	93.0	25.0	0.0	0.0	0.0
flights_arr_ontime	849.0	885.0	808.0	41.0	17.0
flights_dep_cancel	3.0	1.0	4.0	0.0	0.0
flights_dep_delay	121.0	28.0	0.0	0.0	0.0
flights_dep_ontime	823.0	882.0	815.0	24.0	16.0

### 2.1.1 Missing values in daily flight data

```
[7]: flights_d['date'] = flights_d.index
flights_d['year'] = flights_d['date'].dt.year
missing = flights_d.groupby('year').apply(lambda x: x.isnull().sum())
print("Missing values per year:", missing)
```

Missing values per year: flights\_cancel flights\_delay flights\_ontime

```

flights_arr  flights_dep  flights_arr_A  flights_arr_B  flights_arr_C
flights_arr_D  flights_arr_E  ...  flights_dep_D  flights_dep_E
flights_arr_cancel  flights_arr_delay  flights_arr_ontime  flights_dep_cancel
flights_dep_delay  flights_dep_ontime  date  year
year
...
2018          0          0          0          0          0          0          0          0
0          0          0          0          0          0          0          ...
0          0          0          0          0          0          0          0
2019          0          0          0          0          0          0          0          0
0          0          0          0          0          0          0          ...
0          0          0          0          0          0          0          0
2020          0          0          0          0          0          0          0          0
0          0          0          0          0          0          0          ...
0          0          0          0          0          0          0          0
2021          0          0          0          0          0          0          0          0
0          0          0          0          0          0          0          ...
0          0          0          0          0          0          0          0
2022          0          0          0          0          0          0          0          0
0          0          0          0          0          0          0          ...
0          0          0          0          0          0          0          0
2023          0          0          0          0          0          0          0          0
0          0          0          0          0          0          0          ...
0          0          0          0          0          0          0          0

```

[6 rows x 23 columns]

```

/var/folders/l7/c4mdhp113ds3zk1sw7x0mjtccxhkjp/T/ipykernel_67674/938010236.py:3:
DeprecationWarning: DataFrameGroupBy.apply operated on the grouping columns.
This behavior is deprecated, and in a future version of pandas the grouping
columns will be excluded from the operation. Either pass `include_groups=False`
to exclude the groupings or explicitly select the grouping columns after groupby
to silence this warning.
    missing = flights_d.groupby('year').apply(lambda x: x.isnull().sum())

```

### 3 DAILY WEATHER

Source: NOAA Global Systems Laboratory, High-Resolution Rapid Refresh (HRRR) Data Archive:  
AWS OPen Data Program  
Data dictionary: [HRRR Zarr Variable List](#)

```
[8]: weather_d = pd.read_parquet(os.path.join(DAILY_DATA_PATH, "daily_weather.parquet"))
print(f"Weather columns: {weather_d.columns.tolist()}")
print("Daily weather import shape:", weather_d.shape)

Weather columns: ['wx_temperature_max', 'wx_temperature_min', 'wx_apcp',
'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref', 'wx_cape',
'wx_lftx', 'wx_wind_speed', 'wx_wind_direction']
Daily weather import shape: (4809, 13)
```

### 3.1 Explore daily weather

```
[9]: weather_d.describe().round().T
```

	count	mean	std	min	25%	50%	75%	max
wx_temperature_max	1692.0	86.0	21.0	21.0	70.0	86.0	103.0	129.0
wx_temperature_min	1692.0	57.0	17.0	-6.0	43.0	58.0	73.0	86.0
wx_apcp	1692.0	0.0	1.0	0.0	0.0	0.0	0.0	6.0
wx_prate	1692.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
wx_asnow	1692.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
wx_frozr	1692.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
wx_vis	1692.0	10.0	6.0	0.0	8.0	9.0	13.0	41.0
wx_gust	1692.0	26.0	9.0	7.0	19.0	25.0	31.0	61.0
wx_maxref	1692.0	10.0	17.0	0.0	0.0	0.0	20.0	60.0
wx_cape	1692.0	961.0	1157.0	0.0	0.0	310.0	1830.0	5580.0
wx_lftx	1692.0	1.0	9.0	-14.0	-6.0	-2.0	8.0	35.0
wx_wind_speed	1692.0	8.0	3.0	3.0	6.0	8.0	10.0	22.0
wx_wind_direction	1692.0	174.0	62.0	9.0	141.0	177.0	203.0	344.0

```
[10]: weather_d.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 4809 entries, 2010-01-01 to NaT
Data columns (total 13 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   wx_temperature_max 1692 non-null   float64
 1   wx_temperature_min 1692 non-null   float64
 2   wx_apcp            1692 non-null   float64
 3   wx_prate            1692 non-null   float64
 4   wx_asnow            1692 non-null   float64
 5   wx_frozr            1692 non-null   float64
 6   wx_vis              1692 non-null   float64
 7   wx_gust              1692 non-null   float64
 8   wx_maxref            1692 non-null   float32
 9   wx_cape              1692 non-null   float32
 10  wx_lftx              1692 non-null   float32
 11  wx_wind_speed        1692 non-null   float64
```

```
12  wx_wind_direction  1692 non-null    float32
dtypes: float32(4), float64(9)
memory usage: 450.8 KB
```

```
[11]: weather_d.head().T
```

```
[11]:          2010-01-01  2010-01-02  2010-01-03  2010-01-04  2010-01-05
wx_temperature_max      NaN        NaN        NaN        NaN        NaN
wx_temperature_min      NaN        NaN        NaN        NaN        NaN
wx_apcp                 NaN        NaN        NaN        NaN        NaN
wx_prate                 NaN        NaN        NaN        NaN        NaN
wx_asnow                 NaN        NaN        NaN        NaN        NaN
wx_frozr                 NaN        NaN        NaN        NaN        NaN
wx_vis                   NaN        NaN        NaN        NaN        NaN
wx_gust                   NaN        NaN        NaN        NaN        NaN
wx_maxref                 NaN        NaN        NaN        NaN        NaN
wx_cape                   NaN        NaN        NaN        NaN        NaN
wx_lftx                   NaN        NaN        NaN        NaN        NaN
wx_wind_speed              NaN        NaN        NaN        NaN        NaN
wx_wind_direction           NaN        NaN        NaN        NaN        NaN
```

```
[12]: weather_d.tail().T
```

```
[12]:          2023-02-26  2023-02-27  2023-02-28  2023-03-01  NaT
wx_temperature_max    70.112177  80.246021  91.236523  86.436652  NaN
wx_temperature_min   44.515405  43.433032  44.967657  56.921002  NaN
wx_apcp                0.058400  0.193600  0.030600  0.638400  NaN
wx_prate                0.000000  0.014173  0.000000  0.113386  NaN
wx_asnow                0.000000  0.000000  0.000000  0.000000  NaN
wx_frozr                0.000000  0.000000  0.000000  0.000000  NaN
wx_vis                  7.580729  8.699197  19.635330  2.609759  NaN
wx_gust                  46.485129  44.398234  24.038371  21.738880  NaN
wx_maxref                26.437500  44.937500  0.000000  51.562500  NaN
wx_cape                  770.000000 120.000000  0.000000  2110.000000  NaN
wx_lftx                  -3.400000  1.700000  10.500000  -7.000000  NaN
wx_wind_speed             9.476811  9.624294  6.849457  6.756946  NaN
wx_wind_direction         173.093796 239.058182  209.854950  187.290634  NaN
```

### 3.2 Missing values in daily weather

```
[13]: # count the missing values in each column aggregated by year
weather_d['date'] = weather_d.index
weather_d['year'] = weather_d['date'].dt.year
missing = weather_d.groupby('year').apply(lambda x: x.isnull().sum())
print("Missing values by year and variable\n", missing.T)

# Show rows where the year is 2022 and there are missing values in the weather
# data
```

```

print("\nAnomalous missing values on October 1st, 2022\n")
print(weather_d[(weather_d['year'] == 2022) & (weather_d.isnull().any(axis=1))])

```

Missing values by year and variable

	2010.0	2011.0	2012.0	2013.0	2014.0	2015.0	2016.0
year	2017.0	2018.0	2019.0	2020.0	2021.0	2022.0	2023.0
wx_temperature_max	365	365	366	365	365	365	366
365	193	0	0	0	1	0	
wx_temperature_min	365	365	366	365	365	365	366
365	193	0	0	0	1	0	
wx_apcp		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_prate		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_asnow		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_frozr		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_vis		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_gust		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_maxref		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_cape		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_lftx		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_wind_speed		365	365	366	365	365	366
365	193	0	0	0	1	0	
wx_wind_direction		365	365	366	365	365	366
365	193	0	0	0	1	0	
date		0	0	0	0	0	0
0	0	0	0	0	0	0	0
year		0	0	0	0	0	0
0	0	0	0	0	0	0	0

Anomalous missing values on October 1st, 2022

	wx_temperature_max	wx_temperature_min	wx_apcp	wx_prate	wx_asnow	
wx_frozr	wx_vis	wx_gust	wx_maxref	wx_cape	wx_lftx	wx_wind_speed
wx_wind_direction	date	year				
2022-10-01						
NaN	NaN	NaN	NaN	NaN	NaN	NaN
NaN	2022-10-01	2022.0				

```

/var/folders/l7/c4mdhp113ds3zk1sw7x0mjtcxxhkjp/T/ipykernel_67674/1147223249.py:4
: DeprecationWarning: DataFrameGroupBy.apply operated on the grouping columns.

```

This behavior is deprecated, and in a future version of pandas the grouping columns will be excluded from the operation. Either pass `include\_groups=False` to exclude the groupings or explicitly select the grouping columns after groupby to silence this warning.

```
missing = weather_d.groupby('year').apply(lambda x: x.isnull().sum())
```

### 3.3 Drop years and rows with no weather data

```
[14]: weather_d_incomplete = weather_d[weather_d.isnull().any(axis=1)]
weather_d_complete = weather_d[~(weather_d.isnull().any(axis=1))]

print("Number of weather rows with missing values:", weather_d_incomplete.
      ↪shape[0])
print("\nDaily weather final shape:", weather_d_complete.shape)
```

Number of weather rows with missing values: 3117

Daily weather final shape: (1692, 15)

```
[15]: weather_d_complete.head().T
```

```
[15]:
```

	2018-07-13	2018-07-14
2018-07-15	2018-07-16	2018-07-17
wx_temperature_max	114.65921	116.12171
119.0466	119.834155	123.884155
wx_temperature_min	86.081519	75.439008
80.635596	81.717804	82.303101
wx_apcp	0.0104	0.3344
0.0004	0.006	0.006
wx_prate	0.0	0.113386
0.0	0.0	0.0
wx_asnow	0.0	0.0
0.0	0.0	0.0
wx_frozr	0.0	0.0
0.0	0.0	0.0
wx_vis	19.883879	4.846695
13.110933	15.037183	19.262508
wx_gust	23.09549	22.704622
23.629119	23.478253	24.599262
wx_maxref	0.0	30.3125
0.0	0.0	0.0
wx_cape	2110.0	1920.0
1940.0	1810.0	830.0
wx_lftx	-5.1	-4.8
-5.6	-5.7	-3.4
wx_wind_speed	9.254536	7.2707
8.194324	7.721187	7.713826
wx_wind_direction	164.564392	174.650345

198.971619	198.751419	225.905609	
date	2018-07-13 00:00:00	2018-07-14 00:00:00	2018-07-15
00:00:00	2018-07-16 00:00:00	2018-07-17 00:00:00	
year		2018.0	2018.0
2018.0	2018.0	2018.0	

[16]: weather\_d\_complete.tail().T

	2023-02-25	2023-02-26
2023-02-27	2023-02-28	2023-03-01
wx_temperature_max	48.024988	70.112177
80.246021	91.236523	86.436652
wx_temperature_min	39.254712	44.515405
43.433032	44.967657	56.921002
wx_apcp	0.184	0.0584
0.1936	0.0306	0.6384
wx_prate	0.056693	0.0
0.014173	0.0	0.113386
wx_asnow	0.0	0.0
0.0	0.0	0.0
wx_frozr	0.0	0.0
0.0	0.0	0.0
wx_vis	3.728227	7.580729
8.699197	19.63533	2.609759
wx_gust	14.698074	46.485129
44.398234	24.038371	21.73888
wx_maxref	31.75	26.4375
44.9375	0.0	51.5625
wx_cape	0.0	770.0
120.0	0.0	2110.0
wx_lftx	19.4	-3.4
1.7	10.5	-7.0
wx_wind_speed	4.978028	9.476811
9.624294	6.849457	6.756946
wx_wind_direction	161.247086	173.093796
239.058182	209.85495	187.290634
date	2023-02-25 00:00:00	2023-02-26 00:00:00
00:00:00	2023-02-28 00:00:00	2023-03-01 00:00:00
year		2023.0
2023.0	2023.0	2023.0

## 4 MERGE FLIGHT AND WEATHER DATA

Note: The weather data covers a shorter time period than the flights data. Can we get more weather data?

```
[17]: # Merge flights and weather data
df = pd.merge(flights_d.drop(['year', 'date'], axis=1),
              weather_d_complete.drop(['year', 'date'], axis=1),
              left_index=True, right_index=True, how='inner')

print("flights_d shape:", flights_d.shape)
print("weather_d_complete shape:", weather_d_complete.shape)
print("merged shape:", df.shape)
print('\nHEAD\n', df.head(2).T)
print('\nTAIL\n', df.tail(2).T)
```

flights\_d shape: (2147, 23)  
 weather\_d\_complete shape: (1692, 15)  
 merged shape: (1692, 34)

HEAD

	2018-07-13	2018-07-14
flights_cancel	48.000000	12.000000
flights_delay	481.000000	320.000000
flights_ontime	1382.000000	1431.000000
flights_arr	949.000000	881.000000
flights_dep	962.000000	882.000000
flights_arr_A	194.000000	181.000000
flights_arr_B	262.000000	254.000000
flights_arr_C	221.000000	210.000000
flights_arr_D	111.000000	107.000000
flights_arr_E	161.000000	129.000000
flights_dep_A	205.000000	187.000000
flights_dep_B	265.000000	255.000000
flights_dep_C	222.000000	207.000000
flights_dep_D	104.000000	98.000000
flights_dep_E	166.000000	135.000000
flights_arr_cancel	38.000000	9.000000
flights_arr_delay	202.000000	135.000000
flights_arr_ontime	709.000000	737.000000
flights_dep_cancel	10.000000	3.000000
flights_dep_delay	279.000000	185.000000
flights_dep_ontime	673.000000	694.000000
wx_temperature_max	114.659210	116.121710
wx_temperature_min	86.081519	75.439008
wx_apcp	0.010400	0.334400
wx_prate	0.000000	0.113386
wx_asnow	0.000000	0.000000
wx_frozr	0.000000	0.000000
wx_vis	19.883879	4.846695
wx_gust	23.095490	22.704622
wx_maxref	0.000000	30.312500
wx_cape	2110.000000	1920.000000

wx_lftx	-5.100000	-4.800000
wx_wind_speed	9.254536	7.270700
wx_wind_direction	164.564392	174.650345
TAIL		
	2023-02-28	2023-03-01
flights_cancel	6.000000	7.000000
flights_delay	260.000000	601.000000
flights_ontime	1470.000000	1024.000000
flights_arr	866.000000	821.000000
flights_dep	870.000000	811.000000
flights_arr_A	163.000000	144.000000
flights_arr_B	204.000000	200.000000
flights_arr_C	195.000000	191.000000
flights_arr_D	133.000000	129.000000
flights_arr_E	171.000000	157.000000
flights_dep_A	171.000000	145.000000
flights_dep_B	202.000000	205.000000
flights_dep_C	195.000000	179.000000
flights_dep_D	126.000000	125.000000
flights_dep_E	176.000000	157.000000
flights_arr_cancel	4.000000	2.000000
flights_arr_delay	113.000000	338.000000
flights_arr_ontime	749.000000	481.000000
flights_dep_cancel	2.000000	5.000000
flights_dep_delay	147.000000	263.000000
flights_dep_ontime	721.000000	543.000000
wx_temperature_max	91.236523	86.436652
wx_temperature_min	44.967657	56.921002
wx_apcp	0.030600	0.638400
wx_prate	0.000000	0.113386
wx_asnow	0.000000	0.000000
wx_frozr	0.000000	0.000000
wx_vis	19.635330	2.609759
wx_gust	24.038371	21.738880
wx_maxref	0.000000	51.562500
wx_cape	0.000000	2110.000000
wx_lftx	10.500000	-7.000000
wx_wind_speed	6.849457	6.756946
wx_wind_direction	209.854950	187.290634

## 5 FEATURE ENGINEERING

### 5.1 Add time, date, and holiday features

```
[18]: import datetime as dt
from dateutil.easter import easter

# create a date column from index
df['date'] = df.index
df['year'] = df['date'].dt.year
# df['year_c'] = df['date'].dt.year.astype('category')
df['month'] = df['date'].dt.strftime('%B')
df['day_of_week'] = df['date'].dt.strftime('%A')
df['day_of_month'] = df['date'].dt.day

# Create an ordinal date column (days since 1/1/1)
df['ordinal_date'] = df['date'].map(dt.datetime.toordinal)

# add season column
def get_season(date):
    if date.month in [12, 1, 2]:
        return 'winter'
    elif date.month in [3, 4, 5]:
        return 'spring'
    elif date.month in [6, 7, 8]:
        return 'summer'
    else:
        return 'fall'

df['season'] = df['date'].apply(get_season)

# Holidays
years = range(df['year'].min(), df['year'].max()+1)
us_holidays = holidays.US(years = years)

# Reverse dictionaries of US Holidays spanning the years in the dataset
# for year in years:
#     globals()[f"holidays_{year}"] = {v: k for k, v in holidays.US(years=year).items()}

# add holiday column
def check_holiday(date):
    # us_holidays = holidays.US(years = date.year)
    return us_holidays.get(date, "Not a Holiday")
df['holiday'] = df['date'].apply(check_holiday)

# add "halloween" column
```

```

def halloween(date):
    if date.month == 10 and date.day == 31:
        return 'yes'
    else:
        return 'no'
df['halloween'] = df['date'].apply(halloween)

# add "jan_2" column
def jan_2(date):
    if date.month == 1 and date.day == 2:
        return 'yes'
    else:
        return 'no'
df['jan_2'] = df['date'].apply(jan_2)

# add "jan_3" column
def jan_3(date):
    if date.month == 1 and date.day == 3:
        return 'yes'
    else:
        return 'no'
df['jan_3'] = df['date'].apply(jan_3)

# add column for the day before easter
def day_before_easter(date):
    normalized_input_date = date.date()
    day_before_easter_date = easter(date.year) - dt.timedelta(days=1)
    if normalized_input_date == day_before_easter_date:
        return 'yes'
    else:
        return 'no'
df['day_before_easter'] = df['date'].apply(day_before_easter)

# add column for the Xmas Eve
def xmas_eve(date):
    if date.month == 12 and date.day == 24:
        return 'yes'
    else:
        return 'no'
df['xmas_eve'] = df['date'].apply(xmas_eve)

# add column for New Year's eve
def new_years_eve(date):
    if date.month == 12 and date.day == 31:
        return 'yes'
    else:

```

```

        return 'no'
df['new_years_eve'] = df['date'].apply(new_years_eve)

# add "days_until_Xmas" column
def days_until_xmas(date):
    xmas = pd.to_datetime(f"{date.year}-12-25")
    if date > xmas:
        xmas = pd.to_datetime(f"{date.year+1}-12-25")
    return (xmas - date).days
df['days_until_xmas'] = df['date'].apply(days_until_xmas)

# add "days_until_thanksgiving" column
def days_until_thanksgiving(date):
    # Thanksgiving is the 4th Thursday of November
    # https://www.timeanddate.com/holidays/us/thanksgiving-day
    thanksgiving = pd.to_datetime(f"{date.year}-11-01")
    while thanksgiving.weekday() != 3:
        thanksgiving += pd.Timedelta(days=1)
    thanksgiving += pd.Timedelta(days=21)
    return (thanksgiving - date).days
df['days_until_thanksgiving'] = df['date'].apply(days_until_thanksgiving)

# add "days_until_July_4th" column
def days_until_july_4th(date):
    july_4th = pd.to_datetime(f"{date.year}-07-04")
    if date > july_4th:
        july_4th = pd.to_datetime(f"{date.year+1}-07-04")
    return (july_4th - date).days
df['days_until_july_4th'] = df['date'].apply(days_until_july_4th)

# add "days_until_labor_day" column
def days_until_labor_day(date):
    # Labor Day is the first Monday of September
    labor_day = pd.to_datetime(f"{date.year}-09-01")
    while labor_day.weekday() != 0:
        labor_day += pd.Timedelta(days=1)
    return (labor_day - date).days
df['days_until_labor_day'] = df['date'].apply(days_until_labor_day)

# add "days_until_memorial_day" column
def days_until_memorial_day(date):
    # Memorial Day is the last Monday of May
    memorial_day = pd.to_datetime(f"{date.year}-05-01")
    if date > memorial_day:
        memorial_day = pd.to_datetime(f"{date.year+1}-05-01")
    return (memorial_day - date).days

```

```

df['days_until_memorial_day'] = df['date'].apply(days_until_memorial_day)

# add covid column. The WHO declared COVID-19 a pandemic on March 11, 2020. ↳
↳ Record-breaking Thanksgiving travel in 2023 suggests a full recovery by 11/
↳ 23/23.

mask = (df['date'] >= '2020-03-11') & (df['date'] <= '2023-11-23')
df['covid'] = np.where(mask, 'yes', 'no')

```

[19]:

```

# reset index
# df.reset_index(drop=True, inplace=True)
print(df.columns.tolist())
print("Day before easter dates:", df[df['day_before_easter'] == 'yes']['date'].
      tolist())
df.head().T

```

```

['flights_cancel', 'flights_delay', 'flights_ontime', 'flights_arr',
'flights_dep', 'flights_arr_A', 'flights_arr_B', 'flights_arr_C',
'flights_arr_D', 'flights_arr_E', 'flights_dep_A', 'flights_dep_B',
'flights_dep_C', 'flights_dep_D', 'flights_dep_E', 'flights_arr_cancel',
'flights_arr_delay', 'flights_arr_ontime', 'flights_dep_cancel',
'flights_dep_delay', 'flights_dep_ontime', 'wx_temperature_max',
'wx_temperature_min', 'wx_apcp', 'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis',
'wx_gust', 'wx_maxref', 'wx_cape', 'wx_lftx', 'wx_wind_speed',
'wx_wind_direction', 'date', 'year', 'month', 'day_of_week', 'day_of_month',
'ordinal_date', 'season', 'holiday', 'halloween', 'jan_2', 'jan_3',
'day_before_easter', 'xmas_eve', 'new_years_eve', 'days_until_xmas',
'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day',
'days_until_memorial_day', 'covid']

Day before easter dates: [Timestamp('2019-04-20 00:00:00'),
Timestamp('2020-04-11 00:00:00'), Timestamp('2021-04-03 00:00:00'),
Timestamp('2022-04-16 00:00:00')]

```

[19]:

	2018-07-13	2018-07-14
2018-07-15	2018-07-16	2018-07-17
flights_cancel		48.0
14.0	16.0	24.0
flights_delay		481.0
381.0	401.0	378.0
flights_ontime		1382.0
1466.0	1456.0	1475.0
flights_arr		949.0
930.0	934.0	941.0
flights_dep		962.0
931.0	939.0	936.0
flights_arr_A		194.0
193.0	185.0	195.0
flights_arr_B		262.0

267.0	270.0	266.0	
flights_arr_C		221.0	210.0
220.0	231.0	218.0	
flights_arr_D		111.0	107.0
98.0	91.0	102.0	
flights_arr_E		161.0	129.0
152.0	157.0	160.0	
flights_dep_A		205.0	187.0
194.0	188.0	196.0	
flights_dep_B		265.0	255.0
268.0	270.0	263.0	
flights_dep_C		222.0	207.0
226.0	232.0	217.0	
flights_dep_D		104.0	98.0
90.0	87.0	98.0	
flights_dep_E		166.0	135.0
153.0	162.0	162.0	
flights_arr_cancel		38.0	9.0
10.0	9.0	13.0	
flights_arr_delay		202.0	135.0
157.0	170.0	167.0	
flights_arr_ontime		709.0	737.0
763.0	755.0	761.0	
flights_dep_cancel		10.0	3.0
4.0	7.0	11.0	
flights_dep_delay		279.0	185.0
224.0	231.0	211.0	
flights_dep_ontime		673.0	694.0
703.0	701.0	714.0	
wx_temperature_max		114.65921	116.12171
119.0466	119.834155	123.884155	
wx_temperature_min		86.081519	75.439008
80.635596	81.717804	82.303101	
wx_apcp		0.0104	0.3344
0.0004	0.006	0.006	
wx_prate		0.0	0.113386
0.0	0.0	0.0	
wx_asnow		0.0	0.0
0.0	0.0	0.0	
wx_frozr		0.0	0.0
0.0	0.0	0.0	
wx_vis		19.883879	4.846695
13.110933	15.037183	19.262508	
wx_gust		23.09549	22.704622
23.629119	23.478253	24.599262	
wx_maxref		0.0	30.3125
0.0	0.0	0.0	

wx_cape		2110.0	1920.0
1940.0	1810.0	830.0	
wx_lftx		-5.1	-4.8
-5.6	-5.7	-3.4	
wx_wind_speed		9.254536	7.2707
8.194324	7.721187	7.713826	
wx_wind_direction		164.564392	174.650345
198.971619	198.751419	225.905609	
date	2018-07-13 00:00:00	2018-07-14 00:00:00	2018-07-15
00:00:00	2018-07-16 00:00:00	2018-07-17 00:00:00	
year		2018	2018
2018	2018	2018	
month		July	July
July	July	July	
day_of_week		Friday	Saturday
Sunday	Monday	Tuesday	
day_of_month		13	14
15	16	17	
ordinal_date		736888	736889
736890	736891	736892	
season		summer	summer
summer	summer	summer	
holiday		Not a Holiday	Not a Holiday
Holiday	Not a Holiday	Not a Holiday	
halloween		no	no
no	no	no	
jan_2		no	no
no	no	no	
jan_3		no	no
no	no	no	
day_before_easter		no	no
no	no	no	
xmas_eve		no	no
no	no	no	
new_years_eve		no	no
no	no	no	
days_until_xmas		165	164
163	162	161	
days_until_thanksgiving		132	131
130	129	128	
days_until_july_4th		356	355
354	353	352	
days_until_labor_day		52	51
50	49	48	
days_until_memorial_day		292	291
290	289	288	
covid		no	no

```
no          no          no
```

```
[20]: # Move date, holiday, COVID to front of dataframe
cols = df.columns.tolist()
date_cols= ['date', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month', ↴
    ↴'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve', ↴
    ↴'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas', ↴
    ↴'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day', ↴
    ↴'days_until_memorial_day']
col_order = date_cols + [col for col in cols if col not in date_cols]
df = df[col_order]

print(df.head(2).T)
```

	2018-07-13	2018-07-14
date	2018-07-13 00:00:00	2018-07-14 00:00:00
covid	no	no
ordinal_date	736888	736889
year	2018	2018
month	July	July
day_of_month	13	14
day_of_week	Friday	Saturday
season	summer	summer
holiday	Not a Holiday	Not a Holiday
halloween	no	no
xmas_eve	no	no
new_years_eve	no	no
jan_2	no	no
jan_3	no	no
day_before_easter	no	no
days_until_xmas	165	164
days_until_thanksgiving	132	131
days_until_july_4th	356	355
days_until_labor_day	52	51
days_until_memorial_day	292	291
flights_cancel	48.0	12.0
flights_delay	481.0	320.0
flights_ontime	1382.0	1431.0
flights_arr	949.0	881.0
flights_dep	962.0	882.0
flights_arr_A	194.0	181.0
flights_arr_B	262.0	254.0
flights_arr_C	221.0	210.0
flights_arr_D	111.0	107.0
flights_arr_E	161.0	129.0
flights_dep_A	205.0	187.0
flights_dep_B	265.0	255.0
flights_dep_C	222.0	207.0

flights_dep_D	104.0	98.0
flights_dep_E	166.0	135.0
flights_arr_cancel	38.0	9.0
flights_arr_delay	202.0	135.0
flights_arr_ontime	709.0	737.0
flights_dep_cancel	10.0	3.0
flights_dep_delay	279.0	185.0
flights_dep_ontime	673.0	694.0
wx_temperature_max	114.65921	116.12171
wx_temperature_min	86.081519	75.439008
wx_apcp	0.0104	0.3344
wx_prate	0.0	0.113386
wx_asnow	0.0	0.0
wx_frozr	0.0	0.0
wx_vis	19.883879	4.846695
wx_gust	23.09549	22.704622
wx_maxref	0.0	30.3125
wx_cape	2110.0	1920.0
wx_lftx	-5.1	-4.8
wx_wind_speed	9.254536	7.2707
wx_wind_direction	164.564392	174.650345

## 5.2 Add flights total and percent delayed, ontime, cancelled columns

```
[21]: # Calculate percentages for total flights
df['flights_total'] = df['flights_cancel'] + df['flights_delay'] + df['flights_ontime']

df['flights_cancel_pct'] = 100*df['flights_cancel'] / df['flights_total']
df['flights_delay_pct'] = 100*df['flights_delay'] / df['flights_total']
df['flights_ontime_pct'] = 100*df['flights_ontime'] / df['flights_total']

# Calculate percentages for arrivals
df['flights_arr_delay_pct'] = 100*df['flights_arr_delay'] / df['flights_arr']
df['flights_arr_ontime_pct'] = 100*df['flights_arr_ontime'] / df['flights_arr']
df['flights_arr_cancel_pct'] = 100*df['flights_arr_cancel'] / df['flights_arr']

# Calculate percentages for departures
df['flights_dep_delay_pct'] = 100*df['flights_dep_delay'] / df['flights_dep']
df['flights_dep_ontime_pct'] = 100*df['flights_dep_ontime'] / df['flights_dep']
df['flights_dep_cancel_pct'] = 100*df['flights_dep_cancel'] / df['flights_dep']

print(df.head().T)

print('shape:', df.shape)
```

	2018-07-13	2018-07-14
2018-07-15	2018-07-16	2018-07-17
date	2018-07-13 00:00:00	2018-07-14 00:00:00
	2018-07-15	2018-07-15

```

00:00:00 2018-07-16 00:00:00 2018-07-17 00:00:00
covid no no no
no no no
ordinal_date 736888 736889
736890 736891 736892
year 2018 2018
2018 2018 2018
month July July July
July July July
...
...
flights_arr_ontime_pct 74.710221 83.654938
82.043011 80.835118 80.871413
flights_arr_cancel_pct 4.004215 1.021566
1.075269 0.963597 1.381509
flights_dep_delay_pct 29.002079 20.975057
24.06015 24.600639 22.542735
flights_dep_ontime_pct 69.95842 78.684807
75.510204 74.653887 76.282051
flights_dep_cancel_pct 1.039501 0.340136
0.429646 0.745474 1.175214

[64 rows x 5 columns]
shape: (1692, 64)

```

### 5.3 Add 7 lag features each for cancelled, delayed, and ontime flights using 1 day steps

```
[22]: df_lag = df.copy()

lag_cols = []

cols_to_lag = ['flights_cancel', 'flights_delay', 'flights_ontime']
for col in cols_to_lag:
    for lag in [1, 2, 3, 4, 5, 6, 7]:
        df_lag[f"{col}_lag_{lag}"] = df[col].shift(lag)
        lag_cols.append(f"{col}_lag_{lag}")

df_lag.dropna(inplace=True)

print(df_lag.shape)
print(f" Lag cols: {lag_cols}")
# print("\n", df_lag[['flights_total', 'flights_total_lag_1', 'flights_total_lag_2', 'flights_total_lag_3']].head().T)
print("\n", df_lag[['flights_cancel', 'flights_cancel_lag_1', 'flights_cancel_lag_2', 'flights_cancel_lag_3']].head().T)
```

```

print("\n", df_lag[['flights_delay', 'flights_delay_lag_1', 'flights_delay_lag_2', 'flights_delay_lag_3']].head().T)
print("\n", df_lag[['flights_ontime', 'flights_ontime_lag_1', 'flights_ontime_lag_2', 'flights_ontime_lag_3']].head().T)

(1685, 85)
Lag cols: ['flights_cancel_lag_1', 'flights_cancel_lag_2', 'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5', 'flights_cancel_lag_6', 'flights_cancel_lag_7', 'flights_delay_lag_1', 'flights_delay_lag_2', 'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5', 'flights_delay_lag_6', 'flights_delay_lag_7', 'flights_ontime_lag_1', 'flights_ontime_lag_2', 'flights_ontime_lag_3', 'flights_ontime_lag_4', 'flights_ontime_lag_5', 'flights_ontime_lag_6', 'flights_ontime_lag_7']

2018-07-20 2018-07-21 2018-07-22 2018-07-23
2018-07-24
flights_cancel 24.0 30.0 18.0 48.0 14.0
flights_cancel_lag_1 25.0 24.0 30.0 18.0 48.0
flights_cancel_lag_2 16.0 25.0 24.0 30.0 18.0
flights_cancel_lag_3 24.0 16.0 25.0 24.0 30.0

2018-07-20 2018-07-21 2018-07-22 2018-07-23 2018-07-24
flights_delay 430.0 364.0 362.0 430.0 416.0
flights_delay_lag_1 398.0 430.0 364.0 362.0 430.0
flights_delay_lag_2 365.0 398.0 430.0 364.0 362.0
flights_delay_lag_3 378.0 365.0 398.0 430.0 364.0

2018-07-20 2018-07-21 2018-07-22 2018-07-23
2018-07-24
flights_ontime 1444.0 1390.0 1470.0 1415.0 1428.0
flights_ontime_lag_1 1463.0 1444.0 1390.0 1470.0 1415.0
flights_ontime_lag_2 1487.0 1463.0 1444.0 1390.0 1470.0
flights_ontime_lag_3 1475.0 1487.0 1463.0 1444.0 1390.0

```

## 5.4 Add a random feature to test RFE

```
[23]: # Add a random variable to df_lag with repeatable results
np.random.seed(42)
df_lag['random'] = np.random.randint(0, 100, df_lag.shape[0])
```

## 5.5 Column Groups (flights, weather, date)

```
[24]: # Flights column groups
flights_terminal_cols = ['flights_arr_A', 'flights_arr_B', 'flights_arr_C', 'flights_arr_D', 'flights_arr_E',
```

```

        'flights_dep_A', 'flights_dep_B', 'flights_dep_C', □
↳ 'flights_dep_D', 'flights_dep_E']

flights_non_terminal_cols = ['flights_total', 'flights_cancel', □
↳ 'flights_delay', 'flights_ontime',
                                'flights_arr_ontime', 'flights_arr_delay', □
↳ 'flights_arr_cancel',
                                'flights_dep_ontime', 'flights_dep_delay', □
↳ 'flights_dep_cancel']

flights_percentage_cols = ['flights_cancel_pct', 'flights_delay_pct', □
↳ 'flights_ontime_pct',
                                'flights_arr_delay_pct', 'flights_arr_ontime_pct', □
↳ 'flights_arr_cancel_pct',
                                'flights_dep_delay_pct', 'flights_dep_ontime_pct', □
↳ 'flights_dep_cancel_pct']

# Date column groups
date_cols = ['date', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month', □
↳ 'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve', □
↳ 'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas', □
↳ 'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day', □
↳ 'days_until_memorial_day']

# Weather column groups
weather_cols = ['wx_temperature_max', 'wx_temperature_min', 'wx_apcp', □
↳ 'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref', □
↳ 'wx_cape', 'wx_lftx', 'wx_wind_speed', 'wx_wind_direction']

# Lag column groups
lag_cols = ['flights_cancel_lag_1', 'flights_cancel_lag_2', □
↳ 'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5', □
↳ 'flights_cancel_lag_6', 'flights_cancel_lag_7',
                                'flights_delay_lag_1', 'flights_delay_lag_2', □
↳ 'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5', □
↳ 'flights_delay_lag_6', 'flights_delay_lag_7',
                                'flights_ontime_lag_1', 'flights_ontime_lag_2', □
↳ 'flights_ontime_lag_3', 'flights_ontime_lag_4', 'flights_ontime_lag_5', □
↳ 'flights_ontime_lag_6', 'flights_ontime_lag_7']

```

## 5.6 Export data to parquet

```
[25]: # Export the final dataframe
df_lag.to_parquet(os.path.join(DAILY_DATA_PATH, □
↳ "daily_flights_and_weather_merged.parquet"))
```

## 6 INTRODUCTION

This notebook imports the merged and preprocessed data for daily flights and weather produced by “1. daily\_import\_merge\_engineer.ipynb”. Exploratory data analysis is performed in this notebook.

### 6.1 Libraries

```
[1]: import os
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

### 6.2 Import data & column groups

```
[2]: DAILY_DATA_PATH = "data.v3/daily"

df = pd.read_parquet(os.path.join(DAILY_DATA_PATH, "daily_flights_and_weather_merged.parquet"))

# Flights column groups
flights_terminal_cols = ['flights_arr_A', 'flights_arr_B', 'flights_arr_C',
                         'flights_arr_D', 'flights_arr_E',
                         'flights_dep_A', 'flights_dep_B', 'flights_dep_C',
                         'flights_dep_D', 'flights_dep_E']

flights_non_terminal_cols = ['flights_total', 'flights_cancel',
                             'flights_delay', 'flights_ontime',
                             'flights_arr_ontime', 'flights_arr_delay',
                             'flights_arr_cancel',
                             'flights_dep_ontime', 'flights_dep_delay',
                             'flights_dep_cancel']

flights_percentage_cols = ['flights_cancel_pct', 'flights_delay_pct',
                           'flights_ontime_pct',
                           'flights_arr_delay_pct', 'flights_arr_ontime_pct',
                           'flights_arr_cancel_pct',
                           'flights_dep_delay_pct', 'flights_dep_ontime_pct',
                           'flights_dep_cancel_pct']

# Date column groups
date_cols = ['date', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month',
             'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve',
             'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas',
             'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day',
             'days_until_memorial_day']
```

```

# Weather column groups
weather_cols = ['wx_temperature_max', 'wx_temperature_min', 'wx_apcp', □
    ↵'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref', □
    ↵'wx_cape', 'wx_lftx', 'wx_wind_speed', 'wx_wind_direction']

# Lag column groups
lag_cols = ['flights_cancel_lag_1', 'flights_cancel_lag_2', □
    ↵'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5', □
    ↵'flights_cancel_lag_6', 'flights_cancel_lag_7',
        'flights_delay_lag_1', 'flights_delay_lag_2', □
    ↵'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5', □
    ↵'flights_delay_lag_6', 'flights_delay_lag_7',
        'flights_ontime_lag_1', 'flights_ontime_lag_2', □
    ↵'flights_ontime_lag_3', 'flights_ontime_lag_4', 'flights_ontime_lag_5', □
    ↵'flights_ontime_lag_6', 'flights_ontime_lag_7',]

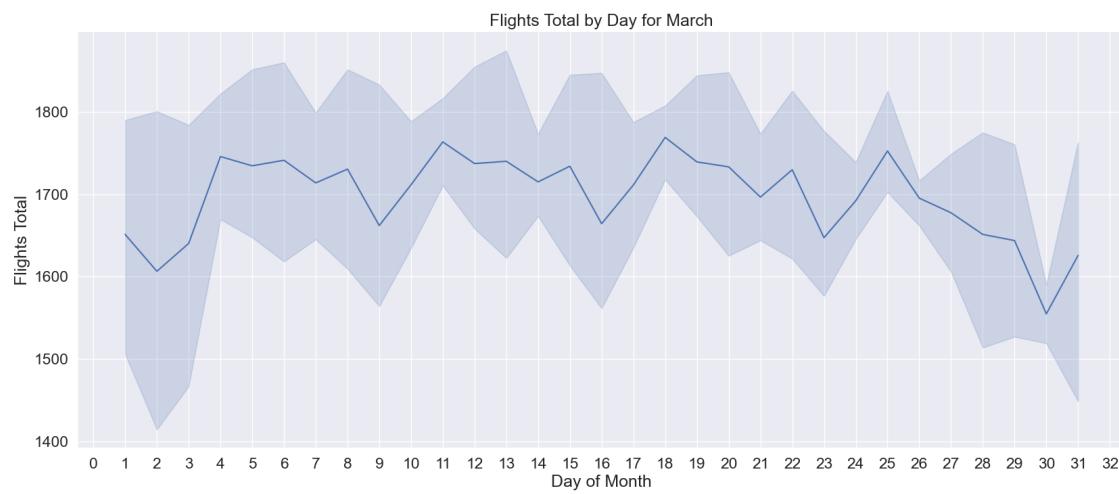
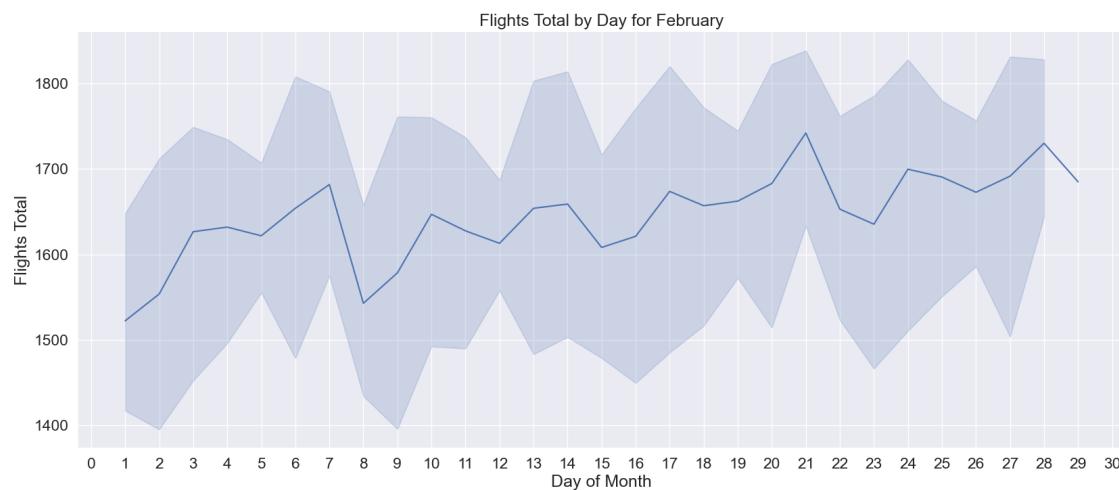
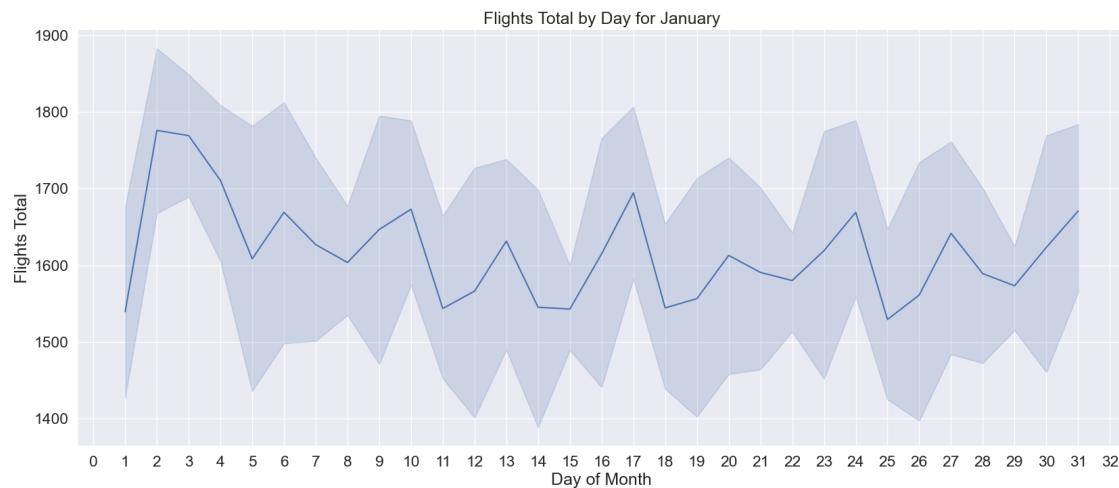
```

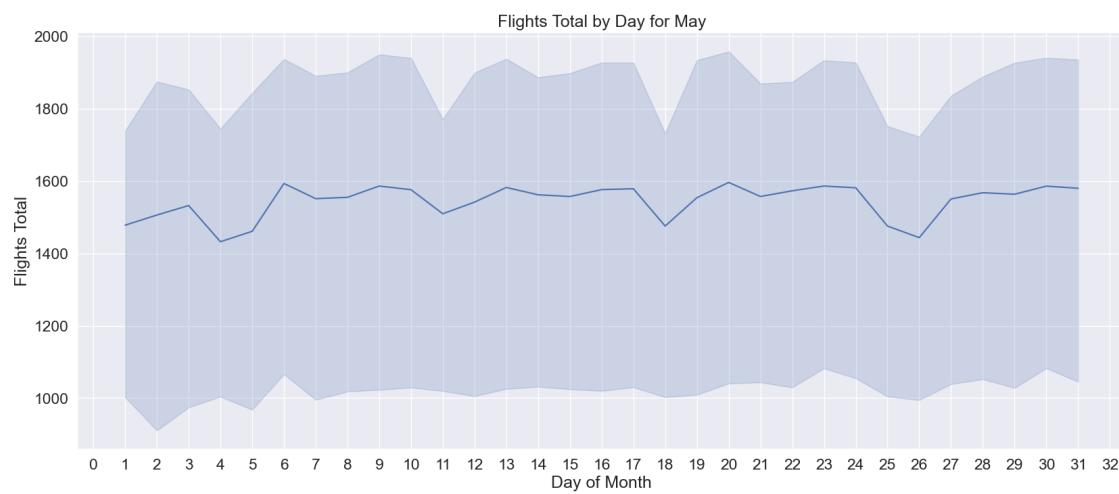
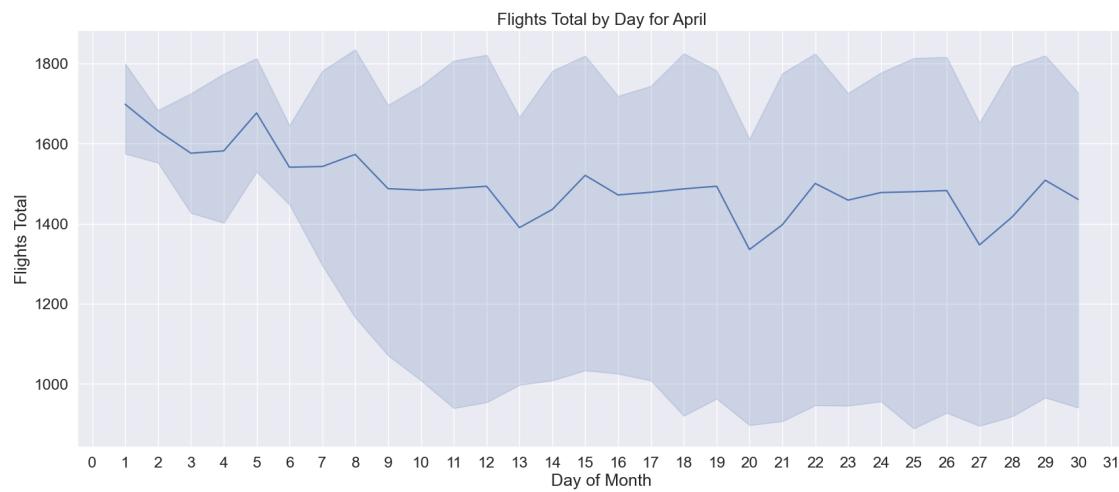
## 7 EXPLORATORY DATA ANALYSIS

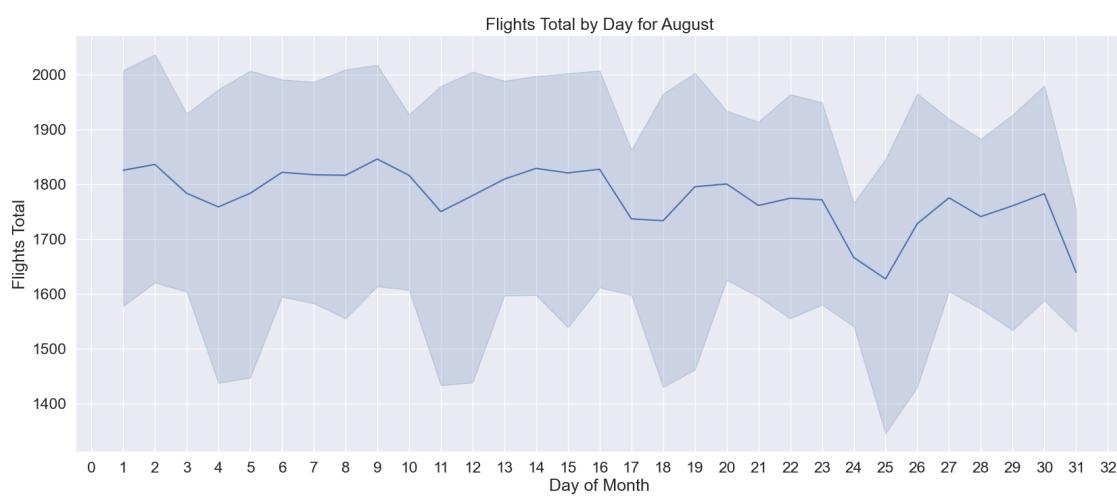
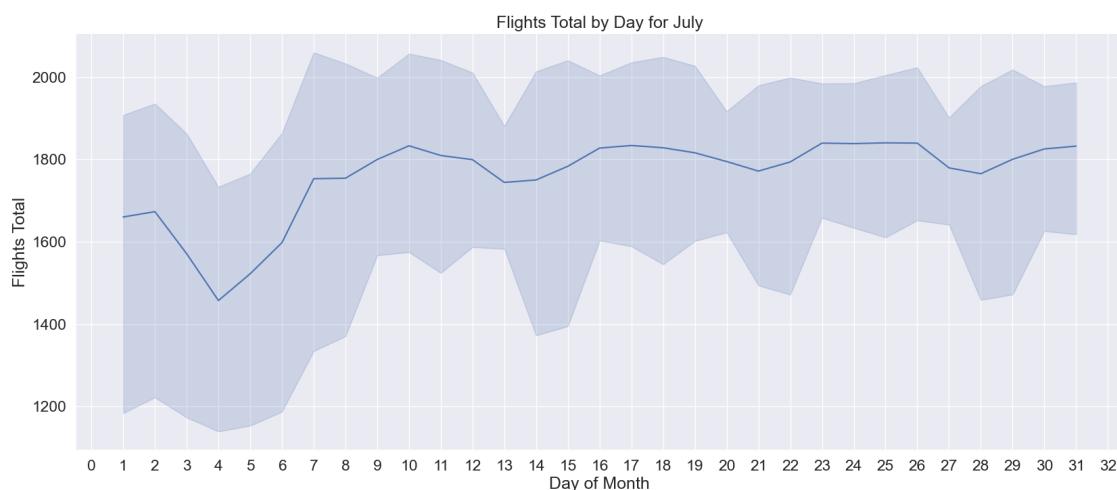
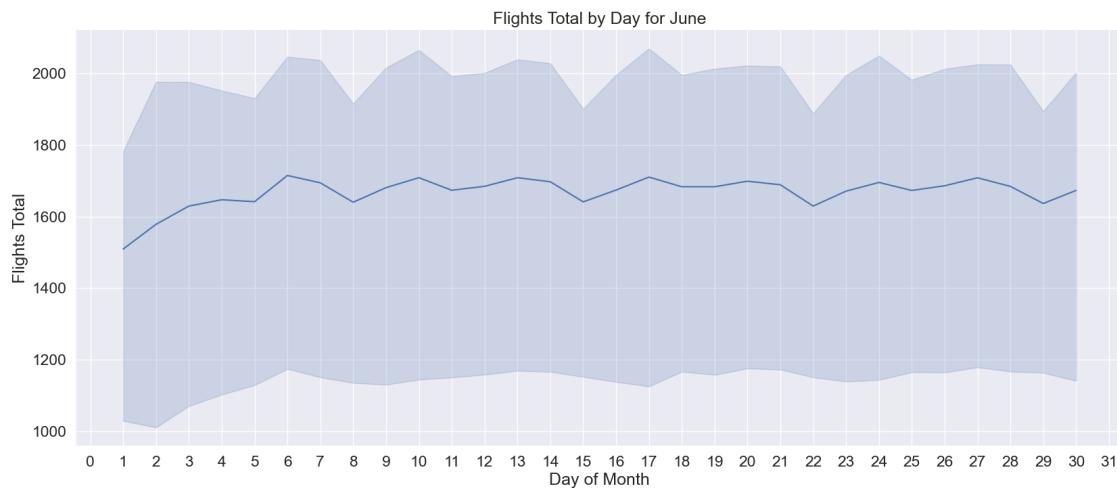
### 7.1 Total flights by day for each month

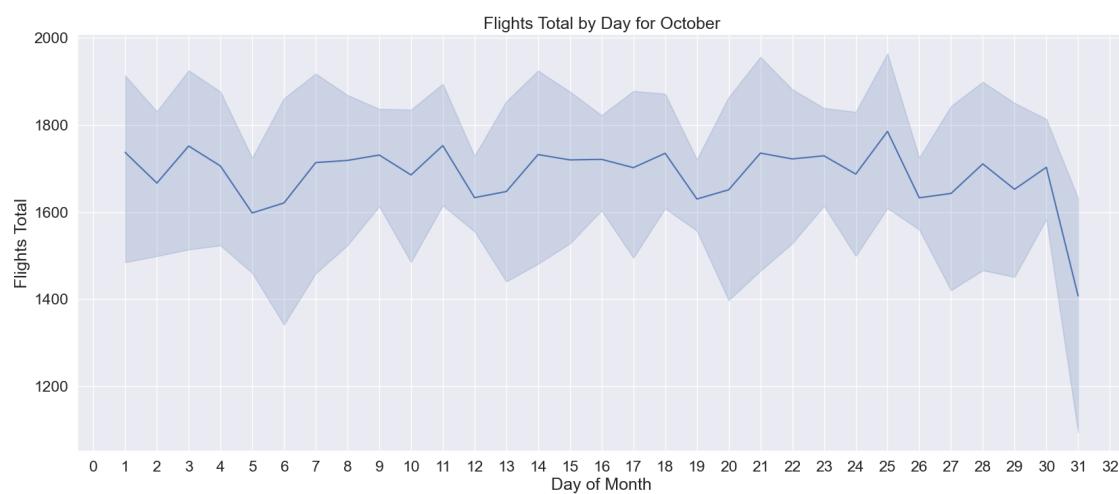
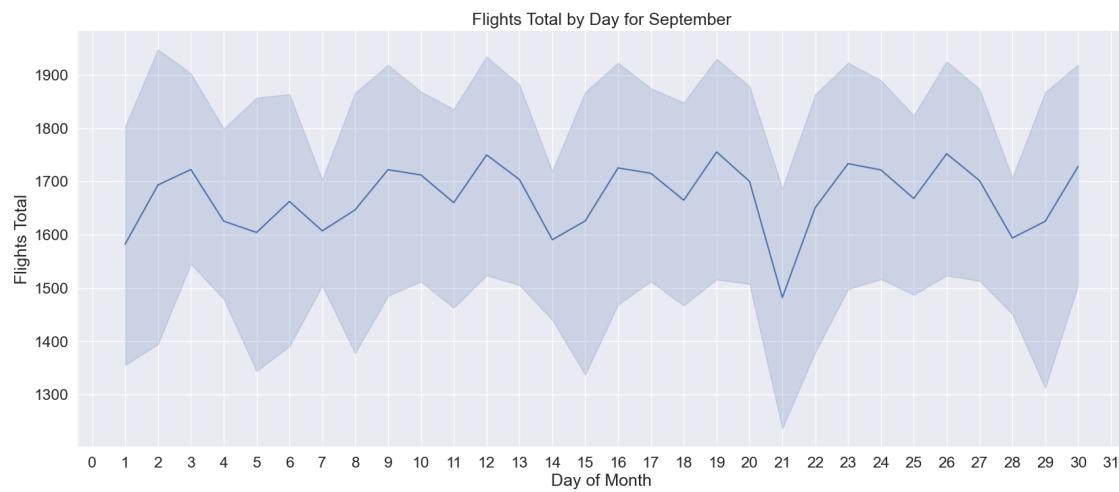
```
[3]: # Pointrange plot of the mean and standard deviation of flights_total by day
    ↵for December
import matplotlib.ticker as ticker

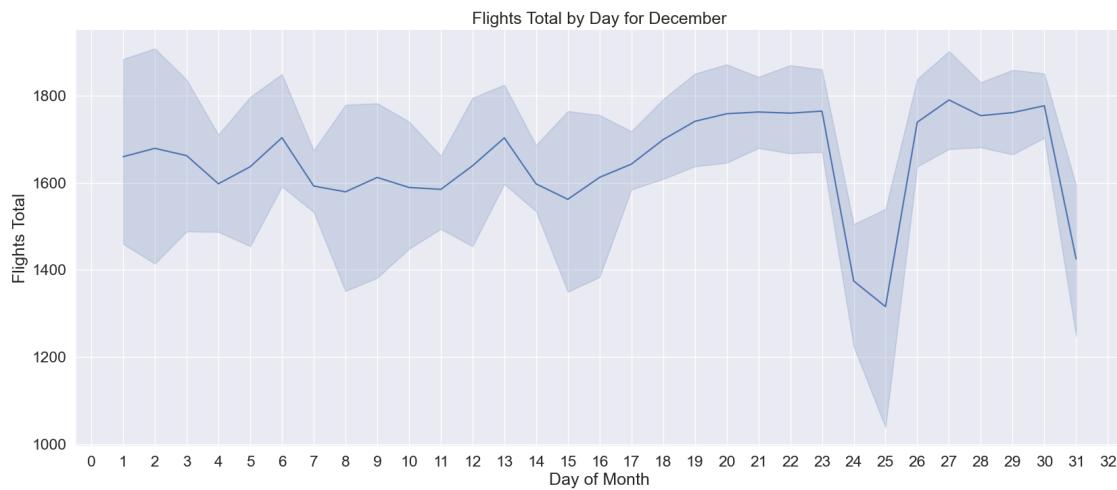
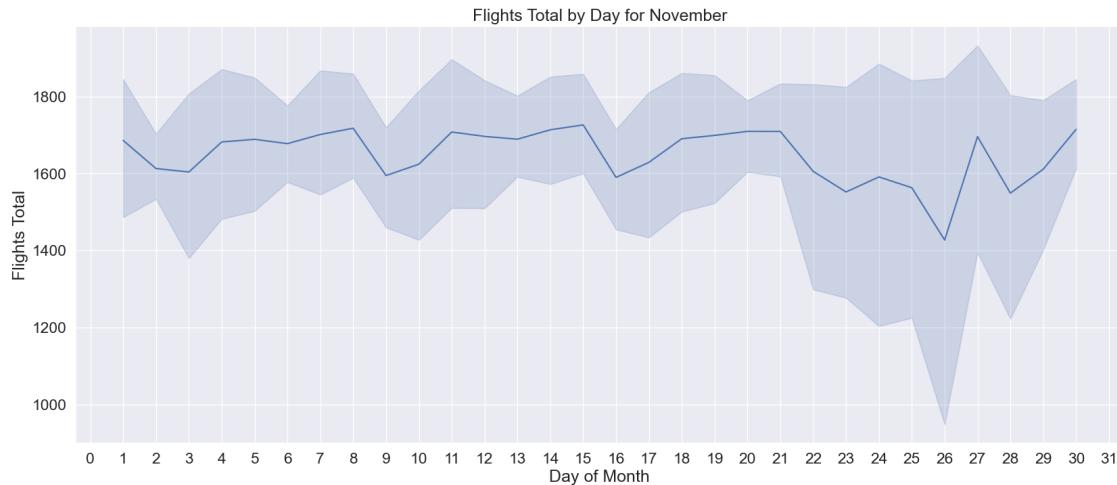
for month in ['January', 'February', 'March', 'April', 'May', 'June', 'July', □
    ↵'August', 'September', 'October', 'November', 'December']:
    sns.set_theme(rc={'figure.figsize':(20,8)})
    sns.set_theme(font_scale=1.5)
    sns.lineplot(data=df[(df['month'] == month)], x="day_of_month", □
    ↵y="flights_total")
    plt.title(f'Flights Total by Day for {month}')
    plt.xlabel('Day of Month')
    plt.ylabel('Flights Total')
    # Setting x-axis major ticks to each day
    plt.gca().xaxis.set_major_locator(ticker.MultipleLocator(1))
    plt.show()
```











## 7.2 Flights and weather correlations

```
[4]: # Get lists of weather features sorted by Pearson correlation coefficient for
    # correlation with flights_total, flights_cancel, flights_delay, and
    # flights_ontime
weather_cols_total_corr = df[['flights_total']] + weather_cols].corr(method =
    #'spearman')[['flights_total']].sort_values(ascending=False)
weather_cols_cancel_corr = df[['flights_cancel']] + weather_cols].corr(method =
    #'spearman')[['flights_cancel']].sort_values(ascending=False)
weather_cols_delay_corr = df[['flights_delay']] + weather_cols].corr(method =
    #'spearman')[['flights_delay']].sort_values(ascending=False)
weather_cols_ontime_corr = df[['flights_ontime']] + weather_cols].corr(method =
    #'spearman')[['flights_ontime']].sort_values(ascending=False)
```

```

# Combine the three lists of correlations into a dataframe
weather_cols_corr = pd.concat([weather_cols_total_corr.drop(['flights_total']), 
    ↪axis=0),
                                weather_cols_cancel_corr.
    ↪drop(['flights_cancel']), axis=0),
                                weather_cols_delay_corr.drop(['flights_delay']), 
    ↪axis=0),
                                weather_cols_ontime_corr.
    ↪drop(['flights_ontime']), axis=0)], axis=1)

print(weather_cols_corr)

# Get the average absolute value of the correlation coefficients for each column

print("\nAverage absolute value correlation with weather features:\n",
    ↪weather_cols_corr.abs().mean(axis=0))

```

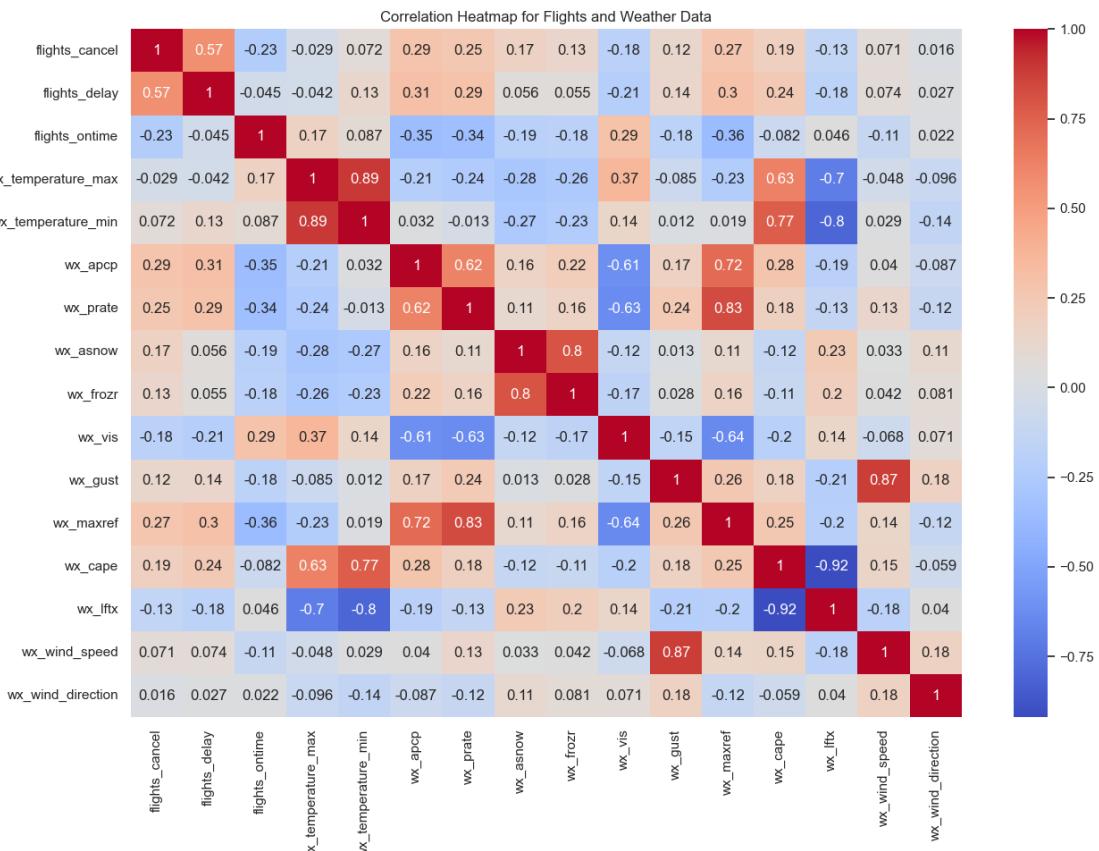
	flights_total	flights_cancel	flights_delay
wx_temperature_min	0.262753	0.072188	0.126683
wx_temperature_max	0.218874	-0.029377	-0.042117
wx_cape	0.213871	0.191506	0.244203
wx_vis	0.063524	-0.177864	-0.209756
wx_apcp	0.009994	0.285349	0.309797
wx_wind_direction	0.002613	0.015853	0.026593
wx_prate	-0.019207	0.252918	0.289769
wx_maxref	-0.021786	0.269684	0.297660
wx_gust	-0.037115	0.124035	0.137291
wx_wind_speed	-0.050225	0.071265	0.073756
wx_asnow	-0.085609	0.170197	0.056183
wx_frozr	-0.093290	0.131685	0.055155
wx_lftx	-0.189835	-0.133529	-0.177331
	flights_ontime		
wx_temperature_min	0.086555		
wx_temperature_max	0.173462		
wx_cape	-0.081715		
wx_vis	0.288370		
wx_apcp	-0.350307		
wx_wind_direction	0.021892		
wx_prate	-0.342281		
wx_maxref	-0.361259		
wx_gust	-0.175685		
wx_wind_speed	-0.113706		
wx_asnow	-0.193250		
wx_frozr	-0.181137		
wx_lftx	0.045875		

Average absolute value correlation with weather features:

```
flights_total      0.097592
flights_cancel    0.148112
flights_delay     0.157407
flights_ontime    0.185807
dtype: float64
```

### 7.3 Heatmap of correlations for weather data

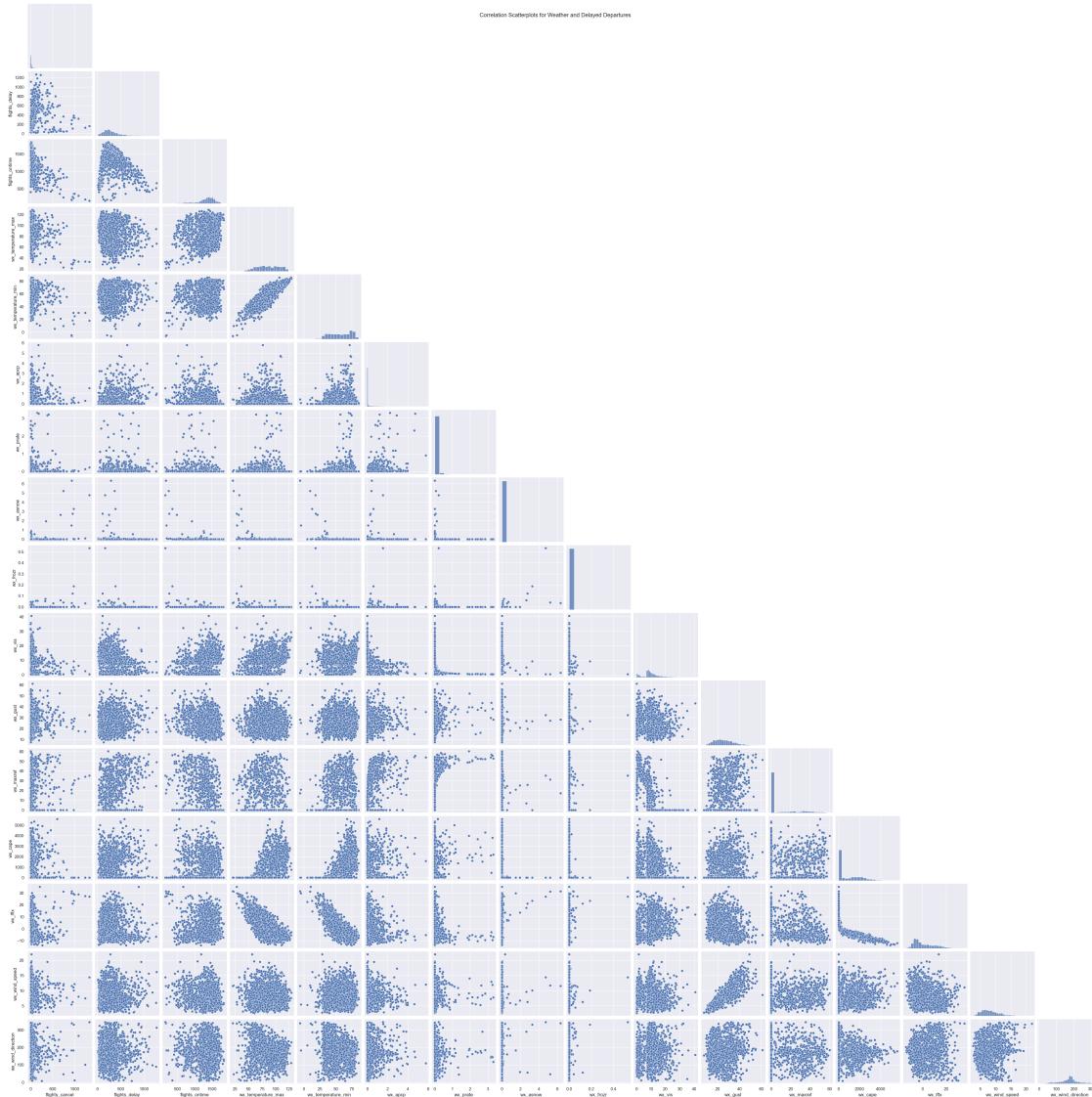
```
[5]: plt.figure(figsize=(15, 10))
sns.set_theme(font_scale=1.0)
sns.heatmap(df[['flights_cancel', 'flights_delay', 'flights_ontime']] +_
            ~weather_cols].corr(method='spearman'), annot=True, cmap='coolwarm')
plt.title('Correlation Heatmap for Flights and Weather Data')
plt.show()
```



## 7.4 Correlation pairplot for weather and delayed departures

```
[6]: plt.figure(figsize=(10, 10))
sns.pairplot(df[['flights_cancel', 'flights_delay', 'flights_ontime'] + 
    ↪weather_cols], corner=True)
plt.suptitle('Correlation Scatterplots for Weather and Delayed Departures')
plt.show()
```

<Figure size 1000x1000 with 0 Axes>



## 8 INTRODUCTION

This notebook performs linear regression on the pre-processed data from “1. daily\_import\_merge\_engineer.ipynb”.

### 8.1 Libraries

```
[4]: import os
import pandas as pd
import numpy as np
import joblib

from sklearn.model_selection import train_test_split
from sklearn.linear_model import Lasso, Ridge, ElasticNet
from sklearn.metrics import r2_score, mean_squared_error, mean_absolute_error, mean_absolute_percentage_error
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import GridSearchCV
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder

DAILY_DATA_PATH = "data.v3/daily"
```

### 8.2 Import data & column groups

```
[5]: df = pd.read_parquet(os.path.join(DAILY_DATA_PATH,
                                       "daily_flights_and_weather_merged.parquet"))

# Flights column groups
flights_terminal_cols = ['flights_arr_A', 'flights_arr_B', 'flights_arr_C',
                         'flights_arr_D', 'flights_arr_E',
                         'flights_dep_A', 'flights_dep_B', 'flights_dep_C',
                         'flights_dep_D', 'flights_dep_E']

flights_non_terminal_cols = ['flights_total', 'flights_cancel',
                             'flights_delay', 'flights_ontime',
                             'flights_arr_ontime', 'flights_arr_delay',
                             'flights_arr_cancel',
                             'flights_dep_ontime', 'flights_dep_delay',
                             'flights_dep_cancel']

flights_percentage_cols = ['flights_cancel_pct', 'flights_delay_pct',
                           'flights_ontime_pct',
                           'flights_arr_delay_pct', 'flights_arr_ontime_pct',
                           'flights_arr_cancel_pct',
```

```

        'flights_dep_delay_pct', 'flights_dep_ontime_pct', □
↳'flights_dep_cancel_pct']

# Date column groups
date_cols = ['date', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month', □
↳'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve', □
↳'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas', □
↳'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day', □
↳'days_until_memorial_day']

# Weather column groups
weather_cols = ['wx_temperature_max', 'wx_temperature_min', 'wx_apcp', □
↳'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref', □
↳'wx_cape', 'wx_lftx', 'wx_wind_speed', 'wx_wind_direction']

# Lag column groups
lag_cols = ['flights_cancel_lag_1', 'flights_cancel_lag_2', □
↳'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5', □
↳'flights_cancel_lag_6', 'flights_cancel_lag_7',
          'flights_delay_lag_1', 'flights_delay_lag_2', □
↳'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5', □
↳'flights_delay_lag_6', 'flights_delay_lag_7',
          'flights_ontime_lag_1', 'flights_ontime_lag_2', □
↳'flights_ontime_lag_3', 'flights_ontime_lag_4', 'flights_ontime_lag_5', □
↳'flights_ontime_lag_6', 'flights_ontime_lag_7',]

```

## 9 DATA PREPROCESSING

### 9.1 Train Test Split

The shuffle=True/False argument drastically changes the linear model fit. If shuffle=False, the data are split sequentially into train, validate, and test sets (80:10:10). The entire data set covers a little over 5 years, shuffle=False means the last year is not used in training the data. Omitting the last year of data from the training dataset crushes the validation model accuracy (r-squared, mean squared error) and is not surprising given the dramatic disruption of air traffic caused by the COVID-19 pandemic and the relatively recent recovery.

Using shuffle=True leads to robust r-squared and MSE metrics that will likely be mostly retained in the test set. However, the accuracy of the model on future data will likely be lower as air-traffic is likely to continue changing for unpredictable reasons. Any forecasting model will likely require frequent training updates with current data to stay relevant.

“shuffle=False” is used for this analysis. This will have implications for prediction algorithms and reduce the effectiveness of algorithms like recurrent neural networks that are designed to digest sequences of data, “windows”, such as 7 days of sequential data.

```
[26]: # Select training features
train_features = ['random'] + date_cols + weather_cols + lag_cols
```

```

# Create X and y
X = df[train_features].drop('date', axis=1)
y = df[flights_non_terminal_cols + flights_percentage_cols]

print(X.columns.tolist())
print("\nTarget columns\n", y.head())

# Split data into train and test sets
X_train_full, X_test, y_train_full, y_test = train_test_split(X, y, test_size=0.
    ↪1, random_state=42)

# Split data into train and validation sets
X_train, X_val, y_train, y_val = train_test_split(X_train_full, y_train_full, ↪
    ↪test_size=0.1, random_state=42)

# Print shapes
print("X_train_full shape:", X_train_full.shape)
print("y_train_full shape:", y_train_full.shape)
print("X_train shape:", X_train.shape)
print("y_train shape:", y_train.shape)
print("X_Test shape:", X_test.shape)

```

```

['random', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month',
'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve', 'new_years_eve',
'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas',
'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day',
'days_until_memorial_day', 'wx_temperature_max', 'wx_temperature_min',
'wx_apcp', 'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref',
'wx_cape', 'wx_lftx', 'wx_wind_speed', 'wx_wind_direction',
'flights_cancel_lag_1', 'flights_cancel_lag_2', 'flights_cancel_lag_3',
'flights_cancel_lag_4', 'flights_cancel_lag_5', 'flights_cancel_lag_6',
'flights_cancel_lag_7', 'flights_delay_lag_1', 'flights_delay_lag_2',
'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5',
'flights_delay_lag_6', 'flights_delay_lag_7', 'flights_ontime_lag_1',
'flights_ontime_lag_2', 'flights_ontime_lag_3', 'flights_ontime_lag_4',
'flights_ontime_lag_5', 'flights_ontime_lag_6', 'flights_ontime_lag_7']

```

Target columns

	flights_total	flights_cancel	flights_delay	flights_ontime	\
2018-07-20	1898.0	24.0	430.0	1444.0	
2018-07-21	1784.0	30.0	364.0	1390.0	
2018-07-22	1850.0	18.0	362.0	1470.0	
2018-07-23	1893.0	48.0	430.0	1415.0	
2018-07-24	1858.0	14.0	416.0	1428.0	
					flights_arr_ontime
					flights_arr_delay
					flights_arr_cancel
					\

2018-07-20	754.0	177.0	11.0	
2018-07-21	735.0	140.0	15.0	
2018-07-22	755.0	150.0	11.0	
2018-07-23	727.0	196.0	24.0	
2018-07-24	738.0	180.0	7.0	
	flights_dep_ontime	flights_dep_delay	flights_dep_cancel	\
2018-07-20	690.0	253.0	13.0	
2018-07-21	655.0	224.0	15.0	
2018-07-22	715.0	212.0	7.0	
2018-07-23	688.0	234.0	24.0	
2018-07-24	690.0	236.0	7.0	
	flights_cancel_pct	flights_delay_pct	flights_ontime_pct	\
2018-07-20	1.264489	22.655427	76.080084	
2018-07-21	1.681614	20.403587	77.914798	
2018-07-22	0.972973	19.567568	79.459459	
2018-07-23	2.535658	22.715267	74.749076	
2018-07-24	0.753498	22.389666	76.856835	
	flights_arr_delay_pct	flights_arr_ontime_pct	\	
2018-07-20	18.789809	80.042463		
2018-07-21	15.730337	82.584270		
2018-07-22	16.375546	82.423581		
2018-07-23	20.696938	76.768743		
2018-07-24	19.459459	79.783784		
	flights_arr_cancel_pct	flights_dep_delay_pct	\	
2018-07-20	1.167728	26.464435		
2018-07-21	1.685393	25.055928		
2018-07-22	1.200873	22.698073		
2018-07-23	2.534319	24.735729		
2018-07-24	0.756757	25.294748		
	flights_dep_ontime_pct	flights_dep_cancel_pct		
2018-07-20	72.175732	1.359833		
2018-07-21	73.266219	1.677852		
2018-07-22	76.552463	0.749465		
2018-07-23	72.727273	2.536998		
2018-07-24	73.954984	0.750268		

X\_train\_full shape: (1516, 54)  
y\_train\_full shape: (1516, 19)  
X\_train shape: (1364, 54)  
y\_train shape: (1364, 19)  
X\_Test shape: (169, 54)

## 9.2 Column transformers

```
[27]: categorical_transformer = make_pipeline(OneHotEncoder(handle_unknown='ignore'))  
    ↪# Some observed holidays may not be in the training data  
numeric_transformer = make_pipeline(StandardScaler())  
  
# print value counts of unique data types in X  
print(X.dtypes.value_counts())  
  
# Identify categorical and numeric columns in X_train_full  
categorical_cols = X.select_dtypes(include=['object', 'category']).columns.  
    tolist()  
numeric_cols = X.select_dtypes(include = ['float64', 'float32', 'int32',  
    ↪'int64']).columns.tolist()  
  
# Check that all columns are accounted for  
print(f"categorical columns: {categorical_cols}")  
print(f"numeric columns: {numeric_cols}")  
print(len(categorical_cols) + len(numeric_cols) == X_train_full.shape[1])  
  
# Linear regression transformer  
LR__transformer = ColumnTransformer(  
    transformers=[  
        ('cat', categorical_transformer, categorical_cols),  
        ('num', numeric_transformer, numeric_cols)  
    ])
```

```
float64      30  
object       11  
int64        7  
float32      4  
int32        2  
Name: count, dtype: int64  
categorical columns: ['covid', 'month', 'day_of_week', 'season', 'holiday',  
'halloween', 'xmas_eve', 'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter']  
numeric columns: ['random', 'ordinal_date', 'year', 'day_of_month',  
'days_until_xmas', 'days_until_thanksgiving', 'days_until_july_4th',  
'days_until_labor_day', 'days_until_memorial_day', 'wx_temperature_max',  
'wx_temperature_min', 'wx_apcp', 'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis',  
'wx_gust', 'wx_maxref', 'wx_cape', 'wx_lftx', 'wx_wind_speed',  
'wx_wind_direction', 'flights_cancel_lag_1', 'flights_cancel_lag_2',  
'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5',  
'flights_cancel_lag_6', 'flights_cancel_lag_7', 'flights_delay_lag_1',  
'flights_delay_lag_2', 'flights_delay_lag_3', 'flights_delay_lag_4',  
'flights_delay_lag_5', 'flights_delay_lag_6', 'flights_delay_lag_7',  
'flights_ontime_lag_1', 'flights_ontime_lag_2', 'flights_ontime_lag_3',  
'flights_ontime_lag_4', 'flights_ontime_lag_5', 'flights_ontime_lag_6',  
'flights_ontime_lag_7']
```

True

### 9.3 Lasso regression

Lasso regression on all targets using gridsearchCV to tune alpha

```
[28]: from sklearn.exceptions import ConvergenceWarning
import warnings

param_grid = {'lasso_alpha': [.01, .1, 1, 10, 20]}

lasso_pipeline = make_pipeline(
    LR_transformer,
    Lasso(max_iter=10000)
)

grid_search = GridSearchCV(
    lasso_pipeline,
    param_grid,
    cv=5,
    scoring='neg_mean_squared_error',
    n_jobs=-1, # n_jobs=-1 means use all available CPU cores
    verbose=0
)

lasso_models = {}
convergence_issues = {}

# Fit lasso models for all targets
for target in y.columns.tolist():
    grid_search.fit(X_train, y_train[target])

    # Save best model parameters, best alpha, and best model
    best_model = grid_search.best_estimator_
    best_alpha = best_model.named_steps['lasso'].get_params()['alpha']
    lasso_models[f"lasso_{target}"] = best_alpha

    # Identify convergence issues for the best alpha values
    with warnings.catch_warnings(record=True) as w:
        warnings.simplefilter("always", ConvergenceWarning)
        best_model.fit(X_train, y_train[target])
        if any(issubclass(warn.category, ConvergenceWarning) for warn in w):
            convergence_issues[target] = best_alpha

# Print convergence issues
if convergence_issues:
    print("Convergence issues:")
    for target, alpha in convergence_issues.items():
```

```

        print(f"[target] did not converge with alpha = {alpha}")
else:
    print("No convergence issues for the best alpha values of any target")

/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.042e+04, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.984e+04, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.243e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.539e+03, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.703e+05, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.104e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-

```

```

packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.108e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.618e+06, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.263e+06, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.885e+05, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.601e+06, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.173e+06, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.370e+04, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.604e+05, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.027e+05, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.309e+04, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.192e+05, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.853e+04, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.688e+04, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.915e+04, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
```

```

/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.375e+04, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.645e+04, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.103e+03, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.700e+04, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.832e+04, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.252e+03, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.052e+03, tolerance: 3.161e+02

```

```

model = cd_fast.enet_coordinate_descent(
No convergence issues for the best alpha values of any target
Best lasso alpha, r-squared, and mean absolute error on validation set for each target

```

```
[29]: lasso_results = pd.DataFrame(columns=['TARGET', 'ALPHA', 'R2', 'MAE'])

# Print best alpha and R2 for all lasso models
for target in y.columns.tolist():
    model = lasso_models[f"lasso_{target}"]
    alpha = model.named_steps['lasso'].get_params()['alpha']
    r2 = r2_score(y_val[target], model.predict(X_val)).round(3)
    mae = mean_absolute_error(y_val[target], model.predict(X_val)).round(3)
    temp = pd.DataFrame({'TARGET': target, 'ALPHA': alpha, 'R2': r2, 'MAE': mae}, index=[0])

    with warnings.catch_warnings():
        warnings.simplefilter(action="ignore", category=FutureWarning)
        lasso_results = pd.concat([lasso_results, temp], ignore_index=True)

print("Validation Metrics for Lasso Regression:")
print(lasso_results)
```

Validation Metrics for Lasso Regression:

	TARGET	ALPHA	R2	MAE
0	flights_total	0.10	0.916	59.421
1	flights_cancel	1.00	0.811	32.279
2	flights_delay	1.00	0.350	92.219
3	flights_ontime	0.10	0.671	121.566
4	flights_arr_ontime	0.10	0.684	59.914
5	flights_arr_delay	1.00	0.300	47.343
6	flights_arr_cancel	1.00	0.822	14.694
7	flights_dep_ontime	0.10	0.656	63.003
8	flights_dep_delay	0.10	0.408	47.548
9	flights_dep_cancel	1.00	0.791	16.593
10	flights_cancel_pct	0.10	0.792	2.062
11	flights_delay_pct	0.10	0.263	5.122
12	flights_ontime_pct	0.10	0.586	5.911
13	flights_arr_delay_pct	0.10	0.235	5.308
14	flights_arr_ontime_pct	0.10	0.552	6.126
15	flights_arr_cancel_pct	0.10	0.794	1.952
16	flights_dep_delay_pct	0.01	0.305	5.335
17	flights_dep_ontime_pct	0.10	0.606	6.113
18	flights_dep_cancel_pct	0.10	0.777	2.196

## 9.4 Ridge regression

Here I use ridge regression on a single target, flights\_ontime, and rank the coefficients from most important to least important. Because the continuous features were standardized, coefficient magnitudes generally correspond to importance. A preview of the first 5 features yields no surprises, as Thanksgiving, Saturdays, Christmas eve, and yesterday's ontime flights are expected to be strong predictors of ontime\_flights.

```
[30]: # Ridge pipeline for flights_ontime
ridge_pipeline = make_pipeline(
    LR_transformer,
    Ridge(alpha=10)
)

# Ridge fit
ridge_pipeline.fit(X_train, y_train['flights_ontime'])

# Ridge predictions
y_pred_ontime = ridge_pipeline.predict(X_val)
print("R2 score:", r2_score(y_val['flights_ontime'], y_pred_ontime))

# Features and coefficients with non-zero coefficients
ridge_ontime_features = ridge_pipeline.named_steps['columntransformer'].
    get_feature_names_out()
ridge_ontime_coef = ridge_pipeline.named_steps['ridge'].coef_

# Create a dataframe of features and coefficients
ridge_ontime_df = pd.DataFrame({'features': ridge_ontime_features, ▾
    'coefficients': ridge_ontime_coef})

# Sort the dataframe by coefficient absolute value, largest to smallest
ridge_ontime_df['coefficients_abs'] = ridge_ontime_df['coefficients'].abs()
ridge_ontime_df.sort_values(by='coefficients_abs', inplace=True, ▾
    ascending=False)

# Filter the dataframe for coefficients_abs > .1
ridge_ontime_df = ridge_ontime_df[ridge_ontime_df['coefficients_abs'] > .1]

print("Ridge coefficients:\n", ridge_ontime_df)
```

R2 score: 0.6686829700384376

Ridge coefficients:

	features	coefficients	coefficients_abs
38	cat__holiday_Thanksgiving	-181.891491	181.891491
70	num__wx_maxref	-86.768167	86.768167
89	num__flights_ontime_lag_1	69.218829	69.218829
16	cat__day_of_week_Saturday	-64.810300	64.810300
44	cat__xmas_eve_yes	-60.865488	60.865488

```

...
52  cat__day_before_easter_yes    ...      ...
51  cat__day_before_easter_no     ...      ...
64          num__wx_apcp        -0.941440   0.941440
45          cat__new_years_eve_no  0.240445   0.240445
46          cat__new_years_eve_yes -0.240445   0.240445

```

[96 rows x 3 columns]

## 9.5 Ridge regression on all targets using grid search CV to tune alpha

```

[31]: param_grid = {'ridge__alpha': [.01, .1, 1, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100]}

ridge_pipeline = make_pipeline(
    LR__transformer,
    Ridge(max_iter=10000)
)

grid_search = GridSearchCV(
    ridge_pipeline,
    param_grid,
    cv=5,
    scoring='neg_mean_squared_error',
    n_jobs=-1, # n_jobs=-1 means use all available CPU cores
    verbose=0
)

ridge_models = {}
convergence_issues = {}

# Fit lasso models for all targets
for target in y.columns.tolist():
    grid_search.fit(X_train, y_train[target])

    # Save best model parameters, best alpha, and best model
    best_model = grid_search.best_estimator_
    best_alpha = best_model.named_steps['ridge'].get_params()['alpha']
    ridge_models[f"ridge_{target}"] = grid_search.best_estimator_

    # Identify convergence issues for the best alpha values
    with warnings.catch_warnings(record=True) as w:
        warnings.simplefilter("always", ConvergenceWarning)
        best_model.fit(X_train, y_train[target])
        if any(issubclass(warn.category, ConvergenceWarning) for warn in w):
            convergence_issues[target] = best_alpha

```

```

# Print convergence issues
if convergence_issues:
    print("Convergence issues:")
    for target, alpha in convergence_issues.items():
        print(f"{target} did not converge with alpha = {alpha}")
else:
    print("No convergence issues for the best alpha values of any target")

```

No convergence issues for the best alpha values of any target

Get alpha, r-squared, and MAE for best ridge fit for each target

```

[32]: ridge_results = pd.DataFrame(columns=['TARGET', 'ALPHA', 'R2', 'MAE'])

# Print best alpha and R2 for all ridge models
for target in y.columns.tolist():
    model = ridge_models[f"ridge_{target}"]
    alpha = model.named_steps['ridge'].get_params()['alpha']
    r2 = r2_score(y_val[target], model.predict(X_val)).round(3)
    mae = mean_absolute_error(y_val[target], model.predict(X_val)).round(3)
    temp = pd.DataFrame({'TARGET': target, 'ALPHA': alpha, 'R2': r2, 'MAE': mae}, index=[0])

    with warnings.catch_warnings():
        warnings.simplefilter(action="ignore", category=FutureWarning)
    ridge_results = pd.concat([ridge_results, temp], ignore_index=True)

print(ridge_results)

```

	TARGET	ALPHA	R2	MAE
0	flights_total	0.1	0.916	60.873
1	flights_cancel	100.0	0.814	32.343
2	flights_delay	30.0	0.370	91.431
3	flights_ontime	1.0	0.672	121.471
4	flights_arr_ontime	1.0	0.678	60.743
5	flights_arr_delay	30.0	0.324	46.997
6	flights_arr_cancel	100.0	0.828	15.355
7	flights_dep_ontime	1.0	0.655	62.930
8	flights_dep_delay	30.0	0.414	47.084
9	flights_dep_cancel	100.0	0.788	17.482
10	flights_cancel_pct	100.0	0.800	2.112
11	flights_delay_pct	60.0	0.278	5.081
12	flights_ontime_pct	50.0	0.590	5.929
13	flights_arr_delay_pct	80.0	0.249	5.246
14	flights_arr_ontime_pct	60.0	0.561	6.058
15	flights_arr_cancel_pct	100.0	0.808	2.007
16	flights_dep_delay_pct	60.0	0.310	5.279
17	flights_dep_ontime_pct	60.0	0.610	6.102
18	flights_dep_cancel_pct	100.0	0.781	2.250

```
[33]: elastic_net_pipeline = make_pipeline(
    LR_transformer,
    ElasticNet(alpha=10,
               l1_ratio=0.5,
               max_iter=10000))

# get a list of 200 values from .0001 to .4
alpha_values = [round(x, 4) for x in np.linspace(.0001, .4, 200)]
l1_ratio_values = [round(x, 2) for x in np.linspace(.1, .9, 9)]

param_grid = {'elasticnet__alpha': alpha_values,
              'elasticnet__l1_ratio': l1_ratio_values}

grid_search = GridSearchCV(
    elastic_net_pipeline,
    param_grid,
    cv=5,
    scoring='neg_mean_squared_error',
    n_jobs=-1, # n_jobs=-1 means use all available CPU cores
    verbose=0
)

elastic_net_models = []
convergence_issues = []
models_dir = "models/elastic_net"
os.makedirs(models_dir, exist_ok=True)

for target in y.columns.tolist():
    grid_search.fit(X_train, y_train[target])

    # Save best model parameters, best alpha, and best model
    best_model = grid_search.best_estimator_
    best_alpha = best_model.named_steps['elasticnet'].get_params()['alpha']
    best_l1_ratio = best_model.named_steps['elasticnet'].
        get_params()['l1_ratio']
    elastic_net_models[f"elastic_net_{target}"] = grid_search.best_estimator_

    # Identify convergence issues for the best alpha values and l1_ratio
    with warnings.catch_warnings(record=True) as w:
        warnings.simplefilter("always", ConvergenceWarning)
        best_model.fit(X_train, y_train[target])
        if any(issubclass(warn.category, ConvergenceWarning) for warn in w):
            convergence_issues[target] = (best_alpha, best_l1_ratio)

# Print convergence issues
if convergence_issues:
    print("Convergence issues:")

```

```

    for target, alpha_l1_ratio in convergence_issues.items():
        print(f"{target} did not converge with alpha = {alpha_l1_ratio[0]} and l1_ratio = {alpha_l1_ratio[1]}")
    else:
        print("No convergence issues for the best alpha and l1_ratio values of any target")

    # print(f"Best parameters for elastic_net_{target}:\\n{grid_search.best_params_}")

# Save best elastic net models
for target, model in elastic_net_models.items():
    model_path = os.path.join(models_dir, f"{target}.joblib")
    joblib.dump(model, model_path)
    print(f"Saved {target} model to {model_path}")

```

```

/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.638e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.134e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.442e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.736e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

```

```
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.198e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.376e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.625e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.264e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.581e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.367e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.436e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

```

packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.101e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.193e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.318e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.288e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.552e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.087e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.162e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.287e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.540e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.154e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.135e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.267e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.084e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.534e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.923e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.126e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.036e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.085e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.252e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.522e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.112e+06, tolerance: 9.067e+03
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.081e+06, tolerance: 9.212e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.595e+06, tolerance: 9.587e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.118e+06, tolerance: 9.143e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.231e+06, tolerance: 9.123e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.199e+06, tolerance: 9.067e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.222e+06, tolerance: 9.123e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

```

```

gap: 3.130e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.317e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.676e+06, tolerance: 9.587e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.173e+06, tolerance: 9.212e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.294e+06, tolerance: 9.067e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.326e+06, tolerance: 9.123e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.446e+06, tolerance: 9.143e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

```

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check the scale of the features or consider increasing regularisation. Duality
gap: 2.963e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.626e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.046e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.113e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.574e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.172e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.083e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

```

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.227e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.338e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.146e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.972e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.705e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.327e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.136e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.007e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.925e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.842e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.915e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.137e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.414e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.089e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.032e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.918e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.523e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.613e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.183e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.927e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.141e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.141e+06, tolerance: 1.564e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.279e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.266e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.404e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.930e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.409e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.992e+06, tolerance: 1.541e+03
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.662e+06, tolerance: 1.197e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.323e+06, tolerance: 1.271e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.676e+06, tolerance: 1.197e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.166e+06, tolerance: 1.564e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.509e+06, tolerance: 1.271e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.228e+06, tolerance: 1.564e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 2.638e+06, tolerance: 1.391e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.078e+06, tolerance: 1.541e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.692e+06, tolerance: 1.271e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.766e+06, tolerance: 1.197e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.031e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.086e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.850e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 7.860e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.900e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.996e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.819e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.115e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.975e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.019e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.079e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.838e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.800e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.042e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.057e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.963e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.011e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.825e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.782e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.958e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.046e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.828e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.041e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.788e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.010e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.777e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.011e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.953e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.037e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.946e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.823e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.819e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.768e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.031e+06, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.964e+06, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.008e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.786e+06, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.843e+06, tolerance: 4.024e+03
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.047e+06, tolerance: 3.843e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.045e+06, tolerance: 4.024e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.990e+06, tolerance: 4.132e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.808e+06, tolerance: 4.129e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.077e+06, tolerance: 3.843e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.073e+06, tolerance: 4.024e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 7.869e+06, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.866e+04, tolerance: 4.132e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.187e+03, tolerance: 4.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.871e+04, tolerance: 4.129e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.722e+03, tolerance: 3.843e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.317e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.406e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 1.421e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.325e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.323e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.299e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.329e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.415e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.399e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.291e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.287e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.411e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.409e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.395e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.313e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.319e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.317e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.312e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.393e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.408e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.286e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.312e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.286e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.316e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.408e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.393e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.312e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.407e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.393e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.287e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.314e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.312e+07, tolerance: 8.782e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.313e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.392e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.286e+07, tolerance: 8.537e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.409e+07, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.317e+07, tolerance: 8.782e+03
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.292e+07, tolerance: 8.537e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.316e+07, tolerance: 9.064e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.397e+07, tolerance: 8.610e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.414e+07, tolerance: 9.401e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.323e+07, tolerance: 8.782e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.299e+07, tolerance: 8.537e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 1.401e+07, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.321e+07, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.850e+04, tolerance: 9.401e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.046e+05, tolerance: 9.064e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.880e+03, tolerance: 8.610e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.376e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.419e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.678e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.649e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.428e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.660e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.381e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.458e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.338e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.634e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.627e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.411e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.365e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.611e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.627e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.321e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.362e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.402e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.624e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.605e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.318e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.365e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.321e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.398e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.624e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.605e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.327e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.370e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.396e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.607e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.621e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.372e+06, tolerance: 2.449e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.606e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.391e+06, tolerance: 2.512e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.328e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.637e+06, tolerance: 2.595e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.413e+06, tolerance: 2.512e+03
```

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model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.354e+06, tolerance: 2.377e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.401e+06, tolerance: 2.449e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.633e+06, tolerance: 2.404e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.663e+06, tolerance: 2.595e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.429e+06, tolerance: 2.449e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.441e+06, tolerance: 2.512e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 3.387e+06, tolerance: 2.377e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.656e+06, tolerance: 2.404e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.250e+06, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.161e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.008e+06, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.174e+06, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.202e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 2.182e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.184e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.157e+06, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.226e+06, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.174e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.151e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.147e+06, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.989e+06, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.216e+06, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.169e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.979e+06, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.148e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.142e+06, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.168e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.975e+06, tolerance: 9.824e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.148e+06, tolerance: 1.031e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.213e+06, tolerance: 1.024e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.140e+06, tolerance: 1.049e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.974e+06, tolerance: 9.824e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.215e+06, tolerance: 1.024e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.167e+06, tolerance: 1.043e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.149e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.139e+06, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.974e+06, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.217e+06, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.165e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.149e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.136e+06, tolerance: 1.049e+03
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.972e+06, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.218e+06, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.177e+06, tolerance: 1.043e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.164e+06, tolerance: 1.031e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.983e+06, tolerance: 9.824e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.239e+06, tolerance: 1.024e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.149e+06, tolerance: 1.049e+03
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.179e+06, tolerance: 1.031e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.193e+06, tolerance: 1.043e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.164e+06, tolerance: 1.049e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.000e+06, tolerance: 9.824e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.256e+06, tolerance: 1.024e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.975e+05, tolerance: 2.890e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 6.911e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.802e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.159e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.460e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.754e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.187e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.678e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.250e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.589e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.788e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.477e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.740e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.297e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.385e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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```

Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.185e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.736e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.465e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.767e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.370e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.709e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.240e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.240e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.365e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.749e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.434e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.259e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.013e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.745e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.527e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.913e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.017e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.802e+05, tolerance: 3.845e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.266e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.578e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.224e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.118e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.263e+05, tolerance: 2.890e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.738e+05, tolerance: 3.153e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.429e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.156e+05, tolerance: 3.386e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.845e+05, tolerance: 3.808e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.849e+05, tolerance: 2.890e+02
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.126e+05, tolerance: 3.845e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.534e+05, tolerance: 3.153e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.413e+06, tolerance: 2.110e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.302e+06, tolerance: 1.983e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.361e+06, tolerance: 2.038e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.386e+06, tolerance: 2.110e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 3.628e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.600e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.657e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.403e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.368e+06, tolerance: 2.110e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.610e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.563e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.256e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.543e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.340e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.234e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.600e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.331e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.357e+06, tolerance: 2.110e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.534e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.226e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.596e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.331e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.350e+06, tolerance: 2.110e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.227e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.333e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

```
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.532e+06, tolerance: 2.000e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.532e+06, tolerance: 2.000e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.344e+06, tolerance: 2.110e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.231e+06, tolerance: 1.983e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.587e+06, tolerance: 2.202e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.593e+06, tolerance: 2.202e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
  Objective did not converge. You might want to increase the number of iterations,  
  check the scale of the features or consider increasing regularisation. Duality  
  gap: 3.333e+06, tolerance: 2.038e+03  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.232e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.602e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.529e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.336e+06, tolerance: 2.110e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.360e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.265e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.352e+06, tolerance: 2.110e+03
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.561e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.632e+06, tolerance: 2.202e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.381e+06, tolerance: 2.110e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.399e+06, tolerance: 2.038e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.592e+06, tolerance: 2.000e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.308e+06, tolerance: 1.983e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.343e+03, tolerance: 2.202e+03
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.611e+03, tolerance: 2.110e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.769e+06, tolerance: 1.030e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.954e+06, tolerance: 1.103e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.013e+06, tolerance: 1.087e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.976e+06, tolerance: 1.073e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.017e+06, tolerance: 1.116e+03
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

```

```
gap: 1.956e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.968e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.034e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.751e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.006e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.991e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.945e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
```

```

check the scale of the features or consider increasing regularisation. Duality
gap: 1.979e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.945e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.000e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.740e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.939e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.734e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.939e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

```

```
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.974e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.937e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.997e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.936e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.731e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.973e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.995e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

```

packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.936e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.934e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.730e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.991e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.974e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.934e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.726e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.930e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.972e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.001e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.945e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.939e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.735e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.992e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.019e+06, tolerance: 1.116e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.965e+06, tolerance: 1.073e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.954e+06, tolerance: 1.103e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.011e+06, tolerance: 1.087e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.755e+06, tolerance: 1.030e+03
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.491e+05, tolerance: 4.059e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.897e+05, tolerance: 3.980e+02
```

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model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.722e+05, tolerance: 3.161e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.438e+05, tolerance: 3.980e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.554e+05, tolerance: 3.277e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.808e+05, tolerance: 3.634e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.774e+05, tolerance: 4.059e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.297e+05, tolerance: 3.634e+02
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 5.276e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.308e+05, tolerance: 4.059e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.360e+05, tolerance: 3.277e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.244e+05, tolerance: 3.980e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.214e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.898e+05, tolerance: 3.277e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.353e+05, tolerance: 4.059e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.123e+05, tolerance: 3.634e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.215e+05, tolerance: 3.634e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.194e+05, tolerance: 3.980e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.311e+05, tolerance: 4.059e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.621e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.142e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.224e+05, tolerance: 3.980e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.771e+05, tolerance: 3.277e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.132e+05, tolerance: 3.634e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.331e+05, tolerance: 4.059e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.896e+05, tolerance: 3.634e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.369e+05, tolerance: 3.277e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.272e+05, tolerance: 3.980e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.567e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.246e+05, tolerance: 3.277e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 8.335e+05, tolerance: 4.059e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 5.311e+05, tolerance: 3.634e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 6.846e+05, tolerance: 3.161e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 7.286e+05, tolerance: 3.980e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 8.421e+05, tolerance: 4.059e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.877e+05, tolerance: 3.277e+02  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.962e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.063e+05, tolerance: 3.634e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.541e+05, tolerance: 3.980e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.239e+05, tolerance: 3.277e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.772e+05, tolerance: 4.059e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.522e+05, tolerance: 3.634e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.086e+05, tolerance: 3.980e+02
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.330e+05, tolerance: 3.161e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.357e+05, tolerance: 3.277e+02
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.893e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.551e+02, tolerance: 4.754e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.459e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.334e+03, tolerance: 6.081e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.525e+03, tolerance: 6.081e+00
```

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model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.946e+02, tolerance: 5.531e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.273e+02, tolerance: 5.020e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.880e+03, tolerance: 6.224e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.734e+02, tolerance: 4.754e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.377e+02, tolerance: 4.754e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.250e+03, tolerance: 6.081e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 1.485e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.819e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.157e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.298e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.569e+03, tolerance: 6.081e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.617e+02, tolerance: 4.754e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.047e+03, tolerance: 6.081e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.686e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.394e+02, tolerance: 4.754e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.267e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.345e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.276e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.760e+02, tolerance: 6.081e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.460e+02, tolerance: 4.754e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.767e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.501e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.605e+02, tolerance: 6.081e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.114e+03, tolerance: 4.754e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.957e+03, tolerance: 6.224e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.809e+02, tolerance: 5.531e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.941e+02, tolerance: 6.081e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-

```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.439e+03, tolerance: 4.754e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.454e+03, tolerance: 6.224e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.445e+02, tolerance: 5.531e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.793e+03, tolerance: 4.754e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 5.294e+02, tolerance: 6.081e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.258e+04, tolerance: 1.130e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.259e+04, tolerance: 1.111e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.110e+04, tolerance: 1.130e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.310e+04, tolerance: 1.151e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.230e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.061e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.190e+04, tolerance: 1.151e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.367e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.100e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.924e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.148e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.026e+04, tolerance: 1.130e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.011e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.842e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.098e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.114e+04, tolerance: 1.151e+01
```

```
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.982e+04, tolerance: 1.130e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.068e+04, tolerance: 1.151e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.074e+04, tolerance: 1.167e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.796e+04, tolerance: 1.074e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.961e+04, tolerance: 1.130e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.039e+04, tolerance: 1.151e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
```

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gap: 1.771e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.970e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.956e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.056e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.950e+04, tolerance: 1.130e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.952e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.755e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 2.016e+04, tolerance: 1.151e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.027e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.933e+04, tolerance: 1.130e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.983e+04, tolerance: 1.151e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.016e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.727e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.986e+04, tolerance: 1.151e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.938e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.072e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.669e+04, tolerance: 1.074e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.939e+04, tolerance: 1.130e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.233e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.159e+04, tolerance: 1.130e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.216e+04, tolerance: 1.111e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.927e+04, tolerance: 1.074e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.179e+04, tolerance: 1.151e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.921e+04, tolerance: 2.019e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.466e+04, tolerance: 1.759e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.705e+04, tolerance: 1.851e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.382e+04, tolerance: 1.893e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.622e+04, tolerance: 1.893e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.733e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.545e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.718e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.450e+04, tolerance: 1.851e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.621e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.314e+04, tolerance: 1.851e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.437e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.103e+04, tolerance: 1.759e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.251e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.558e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.234e+04, tolerance: 1.759e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.526e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.185e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.251e+04, tolerance: 1.851e+01
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.372e+04, tolerance: 1.971e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.014e+04, tolerance: 1.759e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.040e+04, tolerance: 1.759e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.159e+04, tolerance: 1.893e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.334e+04, tolerance: 1.971e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.230e+04, tolerance: 1.851e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 3.506e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.150e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.306e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.472e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.003e+04, tolerance: 1.759e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.226e+04, tolerance: 1.851e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.125e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.212e+04, tolerance: 1.851e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.973e+04, tolerance: 1.759e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.476e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.143e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.264e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.415e+04, tolerance: 1.851e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.985e+04, tolerance: 1.759e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.293e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.760e+04, tolerance: 2.019e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.501e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.554e+04, tolerance: 1.971e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.643e+04, tolerance: 1.851e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.319e+04, tolerance: 1.759e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.654e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.548e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.516e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.490e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.401e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.339e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.592e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.443e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.237e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.249e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.397e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.258e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.146e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.354e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.352e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.351e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.212e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.102e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.223e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.277e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.330e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.205e+04, tolerance: 1.218e+01
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.303e+04, tolerance: 1.224e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.084e+04, tolerance: 1.167e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.220e+04, tolerance: 1.195e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.259e+04, tolerance: 1.224e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.319e+04, tolerance: 1.246e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.208e+04, tolerance: 1.218e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 2.232e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.076e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.298e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.205e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.231e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.231e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.308e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 2.339e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.261e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.079e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.422e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.056e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.554e+04, tolerance: 1.246e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.504e+04, tolerance: 1.218e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.482e+04, tolerance: 1.224e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.302e+04, tolerance: 1.167e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.606e+04, tolerance: 1.195e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.784e+04, tolerance: 1.990e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.912e+04, tolerance: 1.940e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.887e+04, tolerance: 2.097e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.700e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-

```

```
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.898e+04, tolerance: 2.055e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 4.097e+04, tolerance: 2.097e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.693e+04, tolerance: 1.854e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.519e+04, tolerance: 1.990e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.389e+04, tolerance: 1.990e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.629e+04, tolerance: 1.940e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.434e+04, tolerance: 1.854e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.769e+04, tolerance: 2.097e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.487e+04, tolerance: 1.940e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.304e+04, tolerance: 1.854e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.582e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.708e+04, tolerance: 2.097e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.337e+04, tolerance: 1.990e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.517e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.248e+04, tolerance: 1.854e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.329e+04, tolerance: 1.990e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.681e+04, tolerance: 2.097e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.438e+04, tolerance: 1.940e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.235e+04, tolerance: 1.854e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.484e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.434e+04, tolerance: 1.940e+01
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.452e+04, tolerance: 1.940e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.644e+04, tolerance: 2.097e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.671e+04, tolerance: 2.097e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.341e+04, tolerance: 1.990e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.463e+04, tolerance: 2.055e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.238e+04, tolerance: 1.854e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 3.335e+04, tolerance: 1.990e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.224e+04, tolerance: 1.854e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.430e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.449e+04, tolerance: 1.940e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.488e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.542e+04, tolerance: 1.990e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.670e+04, tolerance: 2.097e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
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```

check the scale of the features or consider increasing regularisation. Duality
gap: 3.369e+04, tolerance: 1.854e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.720e+04, tolerance: 1.940e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.975e+04, tolerance: 2.097e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.796e+04, tolerance: 1.990e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.768e+04, tolerance: 2.055e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.646e+04, tolerance: 1.854e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.991e+04, tolerance: 1.940e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.853e+02, tolerance: 4.564e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.193e+03, tolerance: 6.087e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.141e+03, tolerance: 4.964e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.052e+03, tolerance: 6.087e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.302e+03, tolerance: 5.994e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.253e+03, tolerance: 5.994e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.465e+02, tolerance: 5.383e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

```
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.058e+02, tolerance: 5.383e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 6.634e+02, tolerance: 4.564e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 4.167e+02, tolerance: 4.564e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 9.491e+01, tolerance: 4.964e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.218e+03, tolerance: 5.994e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 9.238e+01, tolerance: 5.383e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 3.521e+03, tolerance: 6.087e+00  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.170e+03, tolerance: 6.087e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.313e+02, tolerance: 4.564e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.552e+03, tolerance: 5.994e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.362e+01, tolerance: 5.383e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.212e+02, tolerance: 4.564e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.029e+03, tolerance: 5.994e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.396e+01, tolerance: 5.383e+00
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.042e+03, tolerance: 6.087e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.604e+03, tolerance: 6.087e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.578e+02, tolerance: 5.994e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.142e+03, tolerance: 4.564e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.918e+01, tolerance: 5.383e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.792e+01, tolerance: 5.383e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.090e+03, tolerance: 6.087e+00
```

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model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.249e+03, tolerance: 4.564e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.313e+02, tolerance: 5.994e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.320e+03, tolerance: 6.087e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.458e+01, tolerance: 5.383e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.220e+02, tolerance: 5.994e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.396e+03, tolerance: 4.564e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 5.982e+00, tolerance: 4.964e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.392e+03, tolerance: 6.087e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.308e+01, tolerance: 5.383e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.570e+02, tolerance: 5.994e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.587e+03, tolerance: 4.564e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.268e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.330e+04, tolerance: 1.197e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 2.029e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.397e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.297e+04, tolerance: 1.170e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.219e+04, tolerance: 1.197e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.276e+04, tolerance: 1.160e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.154e+04, tolerance: 1.170e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.186e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.900e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.146e+04, tolerance: 1.197e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.036e+04, tolerance: 1.160e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.066e+04, tolerance: 1.170e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.125e+04, tolerance: 1.160e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.818e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.135e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.014e+04, tolerance: 1.170e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.066e+04, tolerance: 1.197e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.987e+04, tolerance: 1.160e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.102e+04, tolerance: 1.216e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 2.098e+04, tolerance: 1.197e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.983e+04, tolerance: 1.170e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-  
wZNm__h8/lib/python3.11/site-  
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:  
Objective did not converge. You might want to increase the number of iterations,  
check the scale of the features or consider increasing regularisation. Duality  
gap: 1.765e+04, tolerance: 1.105e+01  
    model = cd_fast.enet_coordinate_descent(  
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.732e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.962e+04, tolerance: 1.160e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.075e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.961e+04, tolerance: 1.170e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.945e+04, tolerance: 1.160e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.038e+04, tolerance: 1.197e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.705e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.036e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.930e+04, tolerance: 1.170e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.999e+04, tolerance: 1.197e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.667e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.000e+04, tolerance: 1.216e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.960e+04, tolerance: 1.197e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.586e+04, tolerance: 1.105e+01
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.919e+04, tolerance: 1.160e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.888e+04, tolerance: 1.170e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.941e+04, tolerance: 1.160e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.221e+04, tolerance: 1.216e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.130e+04, tolerance: 1.170e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.166e+04, tolerance: 1.197e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 1.844e+04, tolerance: 1.105e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.170e+04, tolerance: 1.160e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.081e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.899e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.546e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.524e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.822e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

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check the scale of the features or consider increasing regularisation. Duality
gap: 3.860e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.694e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.762e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.785e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.314e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.573e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.587e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

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Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.176e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.382e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.429e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.717e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.302e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.518e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.676e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

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packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.351e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.097e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.474e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.258e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.058e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.312e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
  Objective did not converge. You might want to increase the number of iterations,
  check the scale of the features or consider increasing regularisation. Duality
  gap: 3.646e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

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wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.233e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.437e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.035e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.289e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.601e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.194e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.387e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
```

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/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.992e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.585e+04, tolerance: 2.067e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.256e+04, tolerance: 1.893e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.379e+04, tolerance: 2.007e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.152e+04, tolerance: 1.923e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.904e+04, tolerance: 1.785e+01
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.295e+04, tolerance: 1.893e+01
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.874e+04, tolerance: 2.067e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.544e+04, tolerance: 1.923e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.331e+04, tolerance: 1.785e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.652e+04, tolerance: 2.007e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.674e+04, tolerance: 1.893e+01
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.274e+02, tolerance: 5.776e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality

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gap: 6.811e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 8.976e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.755e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.023e+03, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.374e+02, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.706e+03, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.254e+02, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,

```

```

check the scale of the features or consider increasing regularisation. Duality
gap: 3.445e+02, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.060e+02, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.769e+02, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.573e+03, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.395e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.260e+02, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.586e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:

```

```
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.955e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.168e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.653e+02, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.485e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.858e+03, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.541e+02, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.280e+03, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
```

```

packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.892e+01, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.270e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 9.489e+01, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.097e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.109e+03, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.766e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.606e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-

```

```
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.186e+02, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 7.439e+02, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.987e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.530e+03, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.754e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 2.235e+02, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm_h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 6.413e+02, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
```

```
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.250e+02, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.887e+03, tolerance: 5.036e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 4.407e+01, tolerance: 6.275e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.164e+02, tolerance: 5.185e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 3.014e+03, tolerance: 6.474e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.077e+03, tolerance: 5.776e+00
    model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 5.532e+02, tolerance: 6.275e+00
```

```

model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.942e+03, tolerance: 5.036e+00
model = cd_fast.enet_coordinate_descent(
/Users/shobbs/.local/share/virtualenvs/predicting_flight_traffic-
wZNm__h8/lib/python3.11/site-
packages/sklearn/linear_model/_coordinate_descent.py:678: ConvergenceWarning:
Objective did not converge. You might want to increase the number of iterations,
check the scale of the features or consider increasing regularisation. Duality
gap: 1.110e+02, tolerance: 5.185e+00
model = cd_fast.enet_coordinate_descent()

No convergence issues for the best alpha and l1_ratio values of any target
Saved elastic_net_flights_total model to
models/elastic_net/elastic_net_flights_total.joblib
Saved elastic_net_flights_cancel model to
models/elastic_net/elastic_net_flights_cancel.joblib
Saved elastic_net_flights_delay model to
models/elastic_net/elastic_net_flights_delay.joblib
Saved elastic_net_flights_ontime model to
models/elastic_net/elastic_net_flights_ontime.joblib
Saved elastic_net_flights_arr_ontime model to
models/elastic_net/elastic_net_flights_arr_ontime.joblib
Saved elastic_net_flights_arr_delay model to
models/elastic_net/elastic_net_flights_arr_delay.joblib
Saved elastic_net_flights_arr_cancel model to
models/elastic_net/elastic_net_flights_arr_cancel.joblib
Saved elastic_net_flights_dep_ontime model to
models/elastic_net/elastic_net_flights_dep_ontime.joblib
Saved elastic_net_flights_dep_delay model to
models/elastic_net/elastic_net_flights_dep_delay.joblib
Saved elastic_net_flights_dep_cancel model to
models/elastic_net/elastic_net_flights_dep_cancel.joblib
Saved elastic_net_flights_cancel_pct model to
models/elastic_net/elastic_net_flights_cancel_pct.joblib
Saved elastic_net_flights_delay_pct model to
models/elastic_net/elastic_net_flights_delay_pct.joblib
Saved elastic_net_flights_ontime_pct model to
models/elastic_net/elastic_net_flights_ontime_pct.joblib
Saved elastic_net_flights_arr_delay_pct model to
models/elastic_net/elastic_net_flights_arr_delay_pct.joblib
Saved elastic_net_flights_arr_ontime_pct model to
models/elastic_net/elastic_net_flights_arr_ontime_pct.joblib
Saved elastic_net_flights_arr_cancel_pct model to

```

```

models/elastic_net/elastic_net_flights_arr_cancel_pct.joblib
Saved elastic_net_flights_dep_delay_pct model to
models/elastic_net/elastic_net_flights_dep_delay_pct.joblib
Saved elastic_net_flights_dep_ontime_pct model to
models/elastic_net/elastic_net_flights_dep_ontime_pct.joblib
Saved elastic_net_flights_dep_cancel_pct model to
models/elastic_net/elastic_net_flights_dep_cancel_pct.joblib

[34]: elastic_net_results = pd.DataFrame(columns=['TARGET', 'ALPHA', 'L1 RATIO', ↴
    'R2', 'MAE', 'MSE'])

for target in y.columns.tolist():
    model = elastic_net_models[f"elastic_net_{target}"]
    alpha = model.named_steps['elasticnet'].get_params()['alpha']
    l1_ratio = model.named_steps['elasticnet'].get_params()['l1_ratio']
    r2 = r2_score(y_val[target], model.predict(X_val)).round(3)
    mae = mean_absolute_error(y_val[target], model.predict(X_val)).round(3)
    mse = mean_squared_error(y_val[target], model.predict(X_val)).round(1)
    temp = pd.DataFrame({'TARGET': target, 'ALPHA': alpha, 'L1 RATIO': ↴
        l1_ratio, 'R2': r2, 'MAE': mae, 'MSE': mse}, index=[0])

    with warnings.catch_warnings():
        warnings.simplefilter(action="ignore", category=FutureWarning)
        elastic_net_results = pd.concat([elastic_net_results, temp], ↴
            ignore_index=True)

# Create "model_output" directory
os.makedirs("model_output", exist_ok=True)

# Save results to a csv file
elastic_net_results.to_csv("model_output/elastic_net_results.csv", index=False)

print(elastic_net_results)

```

	TARGET	ALPHA	L1 RATIO	R2	MAE	MSE
0	flights_total	0.0021		0.9	0.917	60.230
1	flights_cancel	0.2352		0.6	0.816	31.606
2	flights_delay	0.0282		0.1	0.371	91.290
3	flights_ontime	0.0122		0.9	0.673	121.274
4	flights_arr_ontime	0.0122		0.9	0.680	60.480
5	flights_arr_delay	0.0343		0.1	0.325	46.894
6	flights_arr_cancel	0.4000		0.8	0.831	14.607
7	flights_dep_ontime	0.0142		0.9	0.655	63.192
8	flights_dep_delay	0.0302		0.1	0.413	47.030
9	flights_dep_cancel	0.1247		0.1	0.786	17.073
10	flights_cancel_pct	0.1287		0.4	0.806	2.001
11	flights_delay_pct	0.0503		0.3	0.278	5.077
12	flights_ontime_pct	0.0523		0.1	0.592	5.897

13	flights_arr_delay_pct	0.1187	0.9	0.235	5.301	83.9
14	flights_arr_ontime_pct	0.0604	0.3	0.563	6.050	102.5
15	flights_arr_cancel_pct	0.1247	0.5	0.811	1.905	17.8
16	flights_dep_delay_pct	0.0523	0.1	0.310	5.269	78.1
17	flights_dep_ontime_pct	0.0523	0.1	0.610	6.094	97.9
18	flights_dep_cancel_pct	0.1388	0.4	0.787	2.129	21.2

## 10 INTRODUCTION

### 10.1 Libraries

```
[20]: import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import datetime
import random

from sklearn.model_selection import train_test_split
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler, OneHotEncoder, MinMaxScaler
from sklearn.metrics import mean_absolute_error, mean_squared_error, □
    ↪mean_absolute_percentage_error, r2_score
from sklearn.compose import ColumnTransformer

import tensorflow as tf
from tensorflow.data import Dataset, AUTOTUNE

from keras import layers, models, Sequential, regularizers
from keras.layers import SimpleRNN, Dense, Dropout, Embedding, LSTM, GRU
from keras.optimizers.legacy import Adam, RMSprop, SGD
from keras.callbacks import EarlyStopping, ModelCheckpoint, TensorBoard
from keras.utils import timeseries_dataset_from_array
from keras.utils import plot_model
from keras.regularizers import L1, L2, L1L2

import keras_tuner as kt

%load_ext tensorboard
```

The tensorboard extension is already loaded. To reload it, use:

```
%reload_ext tensorboard
```

## 10.2 Import data & column groups

```
[21]: DAILY_DATA_PATH = "data.v3/daily"

df = pd.read_parquet(os.path.join(DAILY_DATA_PATH, "daily_flights_and_weather_merged.parquet"))

# Flights column groups
flights_terminal_cols = ['flights_arr_A', 'flights_arr_B', 'flights_arr_C', 'flights_arr_D', 'flights_arr_E',
                           'flights_dep_A', 'flights_dep_B', 'flights_dep_C', 'flights_dep_D', 'flights_dep_E']

flights_non_terminal_cols = ['flights_total', 'flights_cancel', 'flights_delay', 'flights_ontime',
                             'flights_arr_ontime', 'flights_arr_delay', 'flights_arr_cancel',
                             'flights_dep_ontime', 'flights_dep_delay', 'flights_dep_cancel']

flights_percentage_cols = ['flights_cancel_pct', 'flights_delay_pct', 'flights_ontime_pct',
                           'flights_arr_delay_pct', 'flights_arr_ontime_pct', 'flights_arr_cancel_pct',
                           'flights_dep_delay_pct', 'flights_dep_ontime_pct', 'flights_dep_cancel_pct']

# Date column groups
date_cols = ['date', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month', 'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve', 'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas', 'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day', 'days_until_memorial_day']

# Weather column groups
weather_cols = ['wx_temperature_max', 'wx_temperature_min', 'wx_apcp', 'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref', 'wx_cape', 'wx_lftx', 'wx_wind_speed', 'wx_wind_direction']

# Lag column groups
lag_cols = ['flights_cancel_lag_1', 'flights_cancel_lag_2', 'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5', 'flights_cancel_lag_6', 'flights_cancel_lag_7',
            'flights_delay_lag_1', 'flights_delay_lag_2', 'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5', 'flights_delay_lag_6', 'flights_delay_lag_7',
```

```

'flights_ontime_lag_1', 'flights_ontime_lag_2',  

↳ 'flights_ontime_lag_3', 'flights_ontime_lag_4', 'flights_ontime_lag_5',  

↳ 'flights_ontime_lag_6', 'flights_ontime_lag_7',]

```

### 10.3 Train Test Split - “flights\_ontime”

```
[22]: # Select features and targets
train_features = ['random'] + date_cols + weather_cols + lag_cols
targets = flights_non_terminal_cols + flights_percentage_cols

# Create X and y
X = df[train_features].drop('date', axis=1)
y = df[targets]

# Split data into train and test sets
X_train_full, X_test, y_train_full, y_test = train_test_split(X,  

    ↳ y['flights_ontime'], test_size=0.1, random_state=42)

# Split data into X_train_rull and y_train_full into train and validation sets
X_train, X_val, y_train, y_val = train_test_split(X_train_full, y_train_full,  

    ↳ test_size=0.1, random_state=42)

# Print shapes
print("X_train_full shape:", X_train_full.shape)
print("y_train_full shape:", y_train_full.shape)

print("X_train shape:", X_train.shape)
print("y_train shape:", y_train.shape)

print("X_Test shape:", X_test.shape)
print("y_Test shape:", y_test.shape)

X_train_full shape: (1516, 54)
y_train_full shape: (1516,)
X_train shape: (1364, 54)
y_train shape: (1364,)
X_Test shape: (169, 54)
y_Test shape: (169,)
```

## 11 PREPROCESS FOR DENSE NETWORK

```
[23]: print(f"Feature names: {X.columns.tolist()}")
print(f"Target columns: {y.columns.tolist()}", end="\n\n")
print("Unique data types in X", X.dtypes.value_counts(), sep = '\n')

# Identify categorical and numeric columns in X
```

```

categorical_cols = X.select_dtypes(include=['object', 'category']).columns.
    ↪tolist()
numeric_cols = X.select_dtypes(include = ['float64', 'float32', 'int32', ↪
    'int64']).columns.tolist()

print(f"\nCategorical columns to one-hot-encode: {categorical_cols}")

# Fit transformers to the training data
f_scaler = StandardScaler()
f_scaler.fit(X_train[numeric_cols])

ohe = OneHotEncoder(sparse_output=False, handle_unknown='ignore') # Some
↪observed holidays may not be in the training data
ohe.fit(X_train[categorical_cols])

t_scaler = StandardScaler()
t_scaler.fit(y_train.values.reshape(-1, 1)) # reshape y_train to be 2D

# Define preprocessor
def preprocess(features, target, set_global_scaler = False):
    global global_targer_scaler

    scaled_features = f_scaler.transform(features[numeric_cols])
    encoded_features = ohe.transform(features[categorical_cols])
    scaled_target = t_scaler.transform(target.values.reshape(-1, 1))
    processed_features = np.concatenate([scaled_features, encoded_features], ↪
    ↪axis=1)

    if set_global_scaler:
        global_targer_scaler = t_scaler

    return processed_features, scaled_target

# Preprocess the data
X_train_d, y_train_d = preprocess(X_train, y_train, set_global_scaler=True)
X_val_d, y_val_d = preprocess(X_val, y_val)

```

Feature names: ['random', 'covid', 'ordinal\_date', 'year', 'month',  
'day\_of\_month', 'day\_of\_week', 'season', 'holiday', 'halloween', 'xmas\_eve',  
'new\_years\_eve', 'jan\_2', 'jan\_3', 'day\_before\_easter', 'days\_until\_xmas',  
'days\_until\_thanksgiving', 'days\_until\_july\_4th', 'days\_until\_labor\_day',  
'days\_until\_memorial\_day', 'wx\_temperature\_max', 'wx\_temperature\_min',  
'wx\_apcp', 'wx\_prate', 'wx\_asnow', 'wx\_frozr', 'wx\_vis', 'wx\_gust', 'wx\_maxref',  
'wx\_cape', 'wx\_lftx', 'wx\_wind\_speed', 'wx\_wind\_direction',  
'flights\_cancel\_lag\_1', 'flights\_cancel\_lag\_2', 'flights\_cancel\_lag\_3',  
'flights\_cancel\_lag\_4', 'flights\_cancel\_lag\_5', 'flights\_cancel\_lag\_6',  
'flights\_cancel\_lag\_7', 'flights\_delay\_lag\_1', 'flights\_delay\_lag\_2',

```

'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5',
'flights_delay_lag_6', 'flights_delay_lag_7', 'flights_ontime_lag_1',
'flights_ontime_lag_2', 'flights_ontime_lag_3', 'flights_ontime_lag_4',
'flights_ontime_lag_5', 'flights_ontime_lag_6', 'flights_ontime_lag_7']
Target columns: ['flights_total', 'flights_cancel', 'flights_delay',
'flights_ontime', 'flights_arr_ontime', 'flights_arr_delay',
'flights_arr_cancel', 'flights_dep_ontime', 'flights_dep_delay',
'flights_dep_cancel', 'flights_cancel_pct', 'flights_delay_pct',
'flights_ontime_pct', 'flights_arr_delay_pct', 'flights_arr_ontime_pct',
'flights_arr_cancel_pct', 'flights_dep_delay_pct', 'flights_dep_ontime_pct',
'flights_dep_cancel_pct']

```

Unique data types in X

float64	30
object	11
int64	7
float32	4
int32	2
Name: count, dtype: int64	

Categorical columns to one-hot-encode: ['covid', 'month', 'day\_of\_week',  
'season', 'holiday', 'halloween', 'xmas\_eve', 'new\_years\_eve', 'jan\_2', 'jan\_3',  
'day\_before\_easter']

## 12 ONE-NEURON “LINEAR MODEL”

The goal of this section is to simulate linear regression using a neural network with one neuron and no activation function. I'll use L1 and L2 regularization to simulate elastic net regression and compare results to those found in 3.daily\_linear\_regression.ipynb.

### 12.1 Create TensorFlow datasets

```
[24]: # TensorFlow datasets
train_ds_flights_ontime_d = Dataset.from_tensor_slices((X_train_d, y_train_d)).
    shuffle(len(X_train_d))
val_ds_flights_ontime_d = Dataset.from_tensor_slices((X_val_d, y_val_d)).
    shuffle(len(X_val_d))

# Batch and prefetch
batch_size = 32
train_ds_flights_ontime_d = train_ds_flights_ontime_d.batch(batch_size).
    prefetch(AUTOTUNE)
val_ds_flights_ontime_d = val_ds_flights_ontime_d.batch(batch_size).
    prefetch(AUTOTUNE)
```

## 12.2 Create R-squared metric

```
[25]: from keras import backend as K

def r_squared(y_true, y_pred):
    y_true_inv = tf.numpy_function(global_targer_scaler.inverse_transform, [
        [y_true], tf.float32)
    y_pred_inv = tf.numpy_function(global_targer_scaler.inverse_transform, [
        [y_pred], tf.float32)
    SS_res = K.sum(K.square(y_true_inv - y_pred_inv))
    SS_tot = K.sum(K.square(y_true_inv - K.mean(y_true_inv)))
    return (1 - SS_res/(SS_tot + K.epsilon()))
```

## 12.3 Build one-neuron hypermodel

```
[26]: def model_builder(hp):
    learning_rate = hp.Float('learning_rate', min_value=1e-4, max_value=1e-2,
    sampling='LOG', default=1e-3)
    l1_regularization = hp.Float('l1_regularization', min_value=1e-5, max_value=1e-1,
    sampling='LOG', default=1e-2)
    l2_regularization = hp.Float('l2_regularization', min_value=1e-5, max_value=1e-1,
    sampling='LOG', default=1e-2)

    model = Sequential([
        Dense(units = 1,
              input_dim=X_train_d.shape[1],
              kernel_regularizer=L1L2(l1_regularization, l2_regularization))
    ])

    model.compile(optimizer=Adam(learning_rate=learning_rate),
                  loss='mean_squared_error',
                  metrics=['mean_absolute_error', r_squared])

    return model
```

## 12.4 Get one-neuron hyperparameters using Keras random search tuner

```
[ ]: # Callbacks & Tensorboard Setup
early_stopping_1n_RS = EarlyStopping(monitor='val_loss', patience=10,
    restore_best_weights=True)

# Create a Keras Tuner
OneNeuron_tuner_RS = kt.RandomSearch(
    hypermodel = model_builder,
    objective='val_loss',
    max_trials=100,
    executions_per_trial=2,
```

```
        directory='logs/flights_ontime/dense_lr/',
        project_name='tuner',
        overwrite = True
    )
```

```
[29]: # Search for best hyperparameters
OneNeuron_tuner_RS.search(train_ds_flights_ontime_d,
                           validation_data=val_ds_flights_ontime_d,
                           epochs=500,
                           callbacks=[early_stopping_1n_RS])
```

```
Trial 100 Complete [00h 00m 06s]
val_loss: 0.41847823560237885
```

```
Best val_loss So Far: 0.4020496606826782
Total elapsed time: 00h 16m 12s
```

## 12.5 Best 3 one-model fits: hyperparameters and validation score

```
[30]: OneNeuron_tuner_RS.results_summary(num_trials=3)
```

```
Results summary
Results in logs/flights_ontime/dense_lr/tuner
Showing 3 best trials
Objective(name="val_loss", direction="min")
```

```
Trial 019 summary
Hyperparameters:
learning_rate: 0.009929423316917789
l1_regularization: 1.3613167506559008e-05
l2_regularization: 0.00012991522868696756
Score: 0.4020496606826782
```

```
Trial 059 summary
Hyperparameters:
learning_rate: 0.004606695421104385
l1_regularization: 0.00029860952692165044
l2_regularization: 5.808762353159573e-05
Score: 0.4038938581943512
```

```
Trial 054 summary
Hyperparameters:
learning_rate: 0.0006717233174087713
l1_regularization: 9.528015594093438e-05
l2_regularization: 0.00024633112762105513
Score: 0.4060898572206497
```

## 12.6 Get model weights and save best one-neuron model

```
[31]: # Get best hyperparameters
best_hps = OneNeuron_tuner_RS.get_best_hyperparameters(num_trials = 1)[0]

# Tensorboard setup
!rm -rf ./logs/flights_ontime/OneNeuron/tensorboard/
log_dir = "logs/flights_ontime/OneNeuron/tensorboard/" + datetime.datetime.now().strftime("%Y%m%d-%H%M%S")
tensorboard_callback = TensorBoard(log_dir=log_dir, histogram_freq=1)

early_stopping_best = EarlyStopping(monitor='val_loss', patience=50,
                                     restore_best_weights=True)

best_hps = OneNeuron_tuner_RS.get_best_hyperparameters(num_trials = 1)[0]
OneNeuron_LR_model = OneNeuron_tuner_RS.hypermodel.build(best_hps)
history = OneNeuron_LR_model.fit(train_ds_flights_ontime_d,
                                   validation_data=val_ds_flights_ontime_d,
                                   epochs=500,
                                   callbacks=[early_stopping_best, tensorboard_callback],
                                   verbose=0)

# Save the trained model
OneNeuron_LR_model.save('models/flights_ontime/OneNeuron_LR_model')
```

```
INFO:tensorflow:Assets written to:
models/flights_ontime/OneNeuron_LR_model/assets

INFO:tensorflow:Assets written to:
models/flights_ontime/OneNeuron_LR_model/assets
```

## 12.7 TensorBoard for best 1-neuron model

The TensorBoard dashboard shows plots generated from training logs that provide insight into the training of a model.

The time series tab shows several plots within expandable windows for our one-neuronal model, “dense\_#” and for the loss and training metrics by epoch. Under dense\_#, TesnorBoard shows histograms of the bias values “bias\_0” and weight values, “kernel\_0” by epoch. The epoch number is on the y-axis with the first epochs at the top and the most recent epoch at the bottom. These plots show how the bias and weight distributions change with training. For the one-neuron model, the weights appear to stabilize well before the training ended, at around 50 to 60 epochs, while the bias terms continued to drift downwards with training.

The other plots under Time Series show how the loss and metrics change with training epoch or iteration (batch number). Based on these plots, the one-neuron model appears to have high bias and high variance. High bias is indicated by the large difference in loss and performance metrics between the train and validation datasets. High variance is indicated by the large variation in the validation loss, mae, and r-squared metrics that persists through training, even after these metrics

stabilize on the training set at around epoch 40. Taken together, the one-neuron model appears to lack flexibility and would also benefit from having more data to train the weights.

```
[32]: %tensorboard --logdir logs/flights_ontime/OneNeuron/tensorboard
```

```
Reusing TensorBoard on port 6008 (pid 3470), started 23:22:38 ago. (Use '!kill 3470' to kill it.)  
<IPython.core.display.HTML object>
```

## 12.8 Load and evaluate the best 1-neuron model

```
[33]: # Load the trained model  
OneNeuron_LR_model = models.load_model('models/flights_ontime/  
    ↪OneNeuron_LR_model', custom_objects={'r_squared': r_squared})  
  
# Inverse transform the predicted values and get validation MAE, MSE, and R^2  
y_pred = OneNeuron_LR_model.predict(X_val_d)  
y_pred_inv = global_targer_scaler.inverse_transform(y_pred)  
y_val_inv = global_targer_scaler.inverse_transform(y_val_d)  
  
OneNeuron_val_mae = mean_absolute_error(y_val_inv, y_pred_inv)  
OneNeuron_val_mse = mean_squared_error(y_val_inv, y_pred_inv)  
OneNeuron_val_r2 = r2_score(y_val_inv, y_pred_inv)  
  
print(f"""Validation Metrics:  
- Validation MAE: {OneNeuron_val_mae:.2f}  
- Validation MSE: {OneNeuron_val_mse:.2f}  
- Validation R^2: {OneNeuron_val_r2:.3f}  
""")
```

```
5/5 [=====] - 0s 584us/step  
Validation Metrics:  
- Validation MAE: 117.60  
- Validation MSE: 31933.98  
- Validation R^2: 0.688
```

# 13 SHALLOW DENSE NEURAL NETWORK (SDNN)

## 13.1 Build SDNN Hypermodel

```
[34]: def build_model(hp):  
    n_input_neurons = hp.Int('n_input_neurons', min_value=4, max_value=16,  
    ↪default=8)  
    n_hidden_neurons = hp.Int('n_hidden_neurons', min_value=4, max_value=16,  
    ↪default=8)
```

```

learning_rate = hp.Float('learning_rate', min_value=1e-4, max_value=1e-2,
    sampling='LOG', default=1e-3)
dropout_rate = hp.Float('dropout_rate', min_value=0.02, max_value=0.03,
    sampling='LOG', default=0.0)
l2_regularization = hp.Float('l2_regularization', min_value=1e-5,
    max_value=1e-1, sampling='LOG', default=1e-2)

model = Sequential()

# Input layer
model.add(Dense(units=n_input_neurons,
                 activation='relu',
                 kernel_regularizer=L2(l2_regularization)))
model.add(Dropout(dropout_rate))

# Hidden layer
model.add(Dense(units=n_hidden_neurons,
                 activation='relu',
                 kernel_regularizer=L2(l2_regularization)))
model.add(Dropout(dropout_rate))

# Output layer
model.add(Dense(1))

model.compile(optimizer=Adam(learning_rate=learning_rate),
              loss='mean_squared_error',
              metrics=['mean_absolute_error'])

return model

```

### 13.2 Get hyperparameters for SDNN using Bayesian optimization

```
[35]: early_stopping_B0 = EarlyStopping(monitor='val_loss', patience=10,
    restore_best_weights=True)

SDNN_tuner_B0 = kt.BayesianOptimization(
    hypermodel = build_model,
    objective='val_loss',
    max_trials=100,
    executions_per_trial=2,
    num_initial_points=2,
    directory = "logs/flights_ontime/SDNN",
    project_name = "bayesian_optimization_tuner",
    overwrite=True
)

SDNN_tuner_B0.search(train_ds_flights_ontime_d,
```

```

    epochs=500,
    validation_data=val_ds_flights_ontime_d,
    callbacks=[early_stopping_BO])

```

Trial 100 Complete [00h 00m 05s]

val\_loss: 0.4497844725847244

Best val\_loss So Far: 0.38925886154174805

Total elapsed time: 00h 11m 41s

### 13.3 Get hyperparameters for SDNN using random search

In the interest of time, I didn't use the random search tuner on the last training run. This approach consistently underperformed compared to Bayesian optimization and hyperband.

```
[ ]: # early_stopping_RS = EarlyStopping(monitor='val_loss', patience=10, restore_best_weights=True)

# SDNN_tuner_RS = kt.RandomSearch(
#     hypermodel = build_model,
#     objective='val_loss',
#     max_trials=100,
#     executions_per_trial=2,
#     directory = "logs/flights_ontime/SDNN",
#     project_name = "random_search_tuner",
#     overwrite=True
# )

# SDNN_tuner_RS.search(train_ds_flights_ontime_d,
#     epochs=500,
#     validation_data=val_ds_flights_ontime_d,
#     callbacks=[early_stopping_RS])
```

### 13.4 Get hyperparameters for best SDNN model using hyperband

```
[36]: early_stopping_HB = EarlyStopping(monitor='val_loss', patience=10, restore_best_weights=True)

SDNN_tuner_HB = kt.Hyperband(
    hypermodel = build_model,
    objective='val_loss',
    max_epochs=600,
    factor=3,
    directory = "logs/flights_ontime/SDNN",
    project_name = "hyperband_tuner",
    overwrite=True
)
```

```
SDNN_tuner_HB.search(train_ds_flights_ontime_d,
                      epochs=600,
                      validation_data=val_ds_flights_ontime_d,
                      callbacks=[early_stopping_HB])
```

Trial 725 Complete [00h 00m 02s]

val\_loss: 0.44303569197654724

Best val\_loss So Far: 0.3603585958480835

Total elapsed time: 00h 21m 51s

### 13.5 Get weights and save best SDNN model (from hyperband search)

```
[37]: # Get best hyperparameters from Hyperband tuner
best_hps = SDNN_tuner_HB.get_best_hyperparameters(num_trials = 1)[0]

# Initialize Early Stopping
early_stopping_SDNN_best = EarlyStopping(monitor='val_loss', patience=50, ▾
                                         restore_best_weights=True)

# Setup TensorBoard
!rm -rf ./logs/flights_ontime/SDNN_HB/tensorboard/
log_dir = "logs/flights_ontime/SDNN_HB/tensorboard/" + datetime.datetime.now().strftime("%Y%m%d-%H%M%S")
tensorboard_callback = TensorBoard(log_dir=log_dir, histogram_freq=1)

# Train the model with the best hyperparameters
SDNN_model = SDNN_tuner_HB.hypermodel.build(best_hps)
history = SDNN_model.fit(train_ds_flights_ontime_d,
                          validation_data=val_ds_flights_ontime_d,
                          epochs=500,
                          callbacks=[early_stopping_SDNN_best, tensorboard_callback],
                          verbose=0)

# Save the trained model
SDNN_model.save('models/flights_ontime/SDNN_model')
```

INFO:tensorflow:Assets written to: models/flights\_ontime/SDNN\_model/assets

INFO:tensorflow:Assets written to: models/flights\_ontime/SDNN\_model/assets

### 13.6 TensorBoard

```
[38]: # TensorBoard
%tensorboard --logdir logs/flights_ontime/SDNN_HB/tensorboard
```

Reusing TensorBoard on port 6009 (pid 27548), started 23:29:38 ago. (Use '!kill ▾ 27548' to kill it.)

```
<IPython.core.display.HTML object>
```

### 13.7 Best SDNN model summary

```
[154]: # Load the trained model
SDNN_model = models.load_model('models/flights_ontime/SDNN_model')

# Print the best hyperparameters
print(f"""Best Hyperparameters:
- Number of Hidden Layers: {best_hps.get('n_hidden')}
- Number of Neurons: {best_hps.get('n_neurons')}
- Learning Rate: {best_hps.get('learning_rate')}
- Dropout Rate: {best_hps.get('dropout_rate')}
- L2 Regularization: {best_hps.get('l2_regularization')}
""")
```

```
Best Hyperparameters:
- Number of Hidden Layers: 1
- Number of Neurons: 8
- Learning Rate: 0.006415517608465564
- Dropout Rate: 0.024849650762982137
- L2 Regularization: 0.0007243411260176605
```

### 13.8 Model architecture

```
[39]: SDNN_model.summary()
```

```
Model: "sequential_1"
```

Layer (type)	Output Shape	Param #
dense_3 (Dense)	(None, 13)	1261
dropout_2 (Dropout)	(None, 13)	0
dense_4 (Dense)	(None, 8)	112
dropout_3 (Dropout)	(None, 8)	0
dense_5 (Dense)	(None, 1)	9

```
Total params: 1382 (5.40 KB)
Trainable params: 1382 (5.40 KB)
Non-trainable params: 0 (0.00 Byte)
```

### 13.9 Best SDNN model evaluation

```
[40]: # Inverse transform the predicted values and get validation MAE, MSE
y_pred = SDNN_model.predict(X_val_d)
y_pred_inv = global_targer_scaler.inverse_transform(y_pred)
y_val_inv = global_targer_scaler.inverse_transform(y_val_d)

SDNN_val_mae = mean_absolute_error(y_val_inv, y_pred_inv)
SDNN_val_mse = mean_squared_error(y_val_inv, y_pred_inv)

print(f"""Validation Metrics:
- Validation MAE: {SDNN_val_mae:.2f}
- Validation MSE: {SDNN_val_mse:.2f}
""")
```

```
5/5 [=====] - 0s 1ms/step
```

```
Validation Metrics:
```

```
- Validation MAE: 117.43
- Validation MSE: 33070.08
```

## 14 RECURRENT NEURAL NETWORK (RNN)

### 14.1 Remove lag variables from X train, val, and test sets

The lag variables are redundant with the recurrent loops of an RNN that feed historical information into each neuron. I dropped the lag variables to reduce the redundancy and dimensionality in the RNN datasets. However, the lag variables may have value in an RNN despite introducing redundancy and multicollinearity. Time permitting, I'll retain the lag variables and train the RNN's a second time.

```
[41]: rnn_X_train_full = X_train_full.drop(lag_cols, axis=1)
rnn_X_train = X_train.drop(lag_cols, axis=1)
rnn_X_val = X_val.drop(lag_cols, axis=1)
rnn_X_test = X_test.drop(lag_cols, axis=1)
```

### 14.2 RNN column transformers

```
[42]: rnn_numeric_cols = [col for col in numeric_cols if col not in lag_cols]

# Fit transformers to the training data
rnn_f_scaler = StandardScaler()
rnn_f_scaler.fit(rnn_X_train[rnn_numeric_cols])

# Create a function to preprocess TensorFlow datasets
def rnn_preprocess(features, target):
    scaled_features = rnn_f_scaler.transform(features[rnn_numeric_cols])
    encoded_features = ohe.transform(features[categorical_cols])
```

```

    scaled_target = t_scaler.transform(target.values.reshape(-1, 1)) # Scaling the target can speed up training, improve convergence, and reduce the impact of outliers for RNNs
    ↵
    processed_features = np.concatenate([scaled_features, encoded_features], axis=1)
    ↵
    return processed_features, scaled_target

# Transform the data
X_train_rnn, y_train_rnn = rnn_preprocess(X_train, y_train)
X_val_rnn, y_val_rnn = rnn_preprocess(X_val, y_val)
X_test_rnn, y_test_rnn = rnn_preprocess(X_test, y_test)

```

### 14.3 Create timeseries datasets

The timeseries datasets below use a sequence length of 7 and a time step of 1. Each recurrent neuron will process the sequences in 7 recurrent steps, updating its hidden state based on the current input and the previous hidden state.

```
[43]: seed_value = 42
np.random.seed(seed_value)
tf.random.set_seed(seed_value)

seq_length = 7
batch_size = 32

train_rnn = timeseries_dataset_from_array(
    data = X_train_rnn,
    targets = y_train_rnn,
    sequence_length = seq_length,
    sequence_stride = 1,
    shuffle = True,
    batch_size = batch_size
)

val_rnn = timeseries_dataset_from_array(
    data = X_val_rnn,
    targets = y_val_rnn[seq_length-1:],
    sequence_length = seq_length,
    sequence_stride = 1,
    shuffle = True,
    batch_size = batch_size
)

test_rnn = timeseries_dataset_from_array(
    data = X_test_rnn,
    targets = y_test_rnn[seq_length-1:],
    sequence_length = seq_length,
```

```

        sequence_stride = 1,
        shuffle = True,
        batch_size = batch_size
)

```

## 15 ONE RECURRENT NEURON

### 15.1 Build one-neuron RNN hypermodel

```
[44]: # Build one-neuron RNN hypermodel
def OneRNN_model_builder(hp):
    learning_rate = hp.Float('learning_rate', min_value=1e-4, max_value=1e-2, ↴
    sampling='LOG', default=1e-3)
    kernel_reg = hp.Float('kernel_reg', min_value=1e-5, max_value=1e-1, ↴
    sampling='LOG', default=1e-2)
    recur_rreg = hp.Float('recurr_reg', min_value=1e-5, max_value=1e-1, ↴
    sampling='LOG', default=1e-2)
    model = Sequential([
        SimpleRNN(units = 1,
                   input_shape = (None, X_train_rnn.shape[1]),
                   kernel_regularizer=L2(kernel_reg),
                   recurrent_regularizer=L2(recurr_reg),
                   )
    ])
    model.compile(optimizer=Adam(learning_rate=learning_rate),
                  loss='mean_squared_error',
                  metrics=['mean_absolute_error', r_squared])
    return model
```

```
[45]: # Create a Keras Hyperband tuner
OneRNN_tuner_HB = kt.Hyperband(
    hypermodel = OneRNN_model_builder,
    objective='val_loss',
    max_epochs=50,
    factor=3,
    directory='logs/flights_ontime/OneRNN',
    project_name='hyperband_tuner',
    overwrite = True
)

early_stopping = EarlyStopping(monitor='val_loss', patience=10, ↴
    restore_best_weights=True)

# Search for best hyperparameters
```

```
OneRNN_tuner_HB.search(train_rnn,
                       validation_data=val_rnn,
                       epochs=50,
                       callbacks=[early_stopping])
```

```
Trial 90 Complete [00h 00m 05s]
val_loss: 1.3041276931762695

Best val_loss So Far: 1.1027542352676392
Total elapsed time: 00h 05m 33s
```

## 15.2 Get weights and save best one-neuron RNN model

```
[46]: best_hps = OneRNN_tuner_HB.get_best_hyperparameters(num_trials = 1)[0]
OneRNN_model = OneRNN_tuner_HB.hypermodel.build(best_hps)

# Setup TensorBoard
!rm -rf ./logs/flights_ontime/OneRNN/tensorboard/
log_dir = "logs/flights_ontime/OneRNN/tensorboard/" + datetime.datetime.now() .
    .strftime("%Y%m%d-%H%M%S")
tensorboard_callback = TensorBoard(log_dir=log_dir, histogram_freq=1)

early_stopping = EarlyStopping(monitor='val_loss', patience=50, □
    .restore_best_weights=True)

# Train the model with the best hyperparameters
history = OneRNN_model.fit(train_rnn,
                            validation_data=val_rnn,
                            epochs=500,
                            callbacks=[early_stopping, tensorboard_callback],
                            verbose=0)

# Save the trained model
OneRNN_model.save('models/flights_ontime/OneRNN_model')
```

```
INFO:tensorflow:Assets written to: models/flights_ontime/OneRNN_model/assets
INFO:tensorflow:Assets written to: models/flights_ontime/OneRNN_model/assets
```

```
[76]: %tensorboard --logdir logs/flights_ontime/OneRNN/tensorboard
```

```
Reusing TensorBoard on port 6012 (pid 41285), started 0:00:05 ago. (Use '!kill □
    41285' to kill it.)
```

<IPython.core.display.HTML object>

### 15.3 Load and evaluate the best one-neuron RNN model

```
[47]: OneRNN_model = models.load_model('models/flights_ontime/OneRNN_model',  
    ↪custom_objects={'r_squared': r_squared})  
  
# Inverse transform the predicted values and get validation MAE, MSE, and R^2  
y_pred = OneRNN_model.predict(val_rnn)  
y_pred_inv = global_targer_scaler.inverse_transform(y_pred)  
y_val_inv = global_targer_scaler.inverse_transform(y_val_rnn[seq_length-1:])  
  
OneRNN_val_mae = mean_absolute_error(y_val_inv, y_pred_inv)  
OneRNN_val_mse = mean_squared_error(y_val_inv, y_pred_inv)  
  
print(f"""Validation Metrics:  
- Validation MAE: {OneRNN_val_mae:.2f}  
- Validation MSE: {OneRNN_val_mse:.2f}  
""")  
  
5/5 [=====] - 0s 1ms/step  
Validation Metrics:  
- Validation MAE: 248.49  
- Validation MSE: 109553.02
```

## 16 SHALLOW RNN

### 16.1 Build shallow RNN Hypermodel

```
[48]: def build_model(hp):  
    n_neurons = hp.Int('n_neurons', min_value=1, max_value=32, default=16)  
    learning_rate = hp.Float('learning_rate', min_value=1e-4, max_value=1e-2,  
    ↪sampling='LOG', default=1e-3)  
    dropout_rate = hp.Float('dropout_rate', min_value=0.0, max_value=0.5,  
    ↪default=0.0)  
    recurrent_dropout_rate = hp.Float('recurrent_dropout_rate', min_value=0.0,  
    ↪max_value=0.5, default=0.0)  
    kernel_reg = hp.Float('kernel_reg', min_value=1e-4, max_value=1e-1,  
    ↪sampling='LOG', default=1e-2)  
    recurr_reg = hp.Float('recurr_reg', min_value=1e-4, max_value=1e-1,  
    ↪sampling='LOG', default=1e-2)  
  
    model = Sequential()  
  
    # Input Layer  
    model.add(SimpleRNN(units=n_neurons,  
                        activation='tanh',  
                        return_sequences=False,
```

```

        kernel_regularizer=L2(kernel_reg),
        recurrent_regularizer=L2(recurr_reg),
        dropout = dropout_rate,
        recurrent_dropout = recurrent_dropout_rate))

# Output layer
model.add(Dense(1))

# Compile the model
model.compile(optimizer=Adam(learning_rate=learning_rate),
              loss='mean_squared_error',
              metrics=['mean_absolute_error'])

return model

```

## 16.2 Get hyperparameters for shallow RNN using a random search

```
[ ]: # RNN_shallow_tuner_RS = kt.RandomSearch(
#       build_model,
#       objective='val_loss',
#       max_trials=100,
#       overwrite=True
# )

# early_stopping = EarlyStopping(monitor='val_loss', patience=10, □
#                                restore_best_weights=True)

# RNN_shallow_tuner_RS.search(train_rnn, epochs=500, validation_data=val_rnn, □
#                             callbacks=[early_stopping])
```

## 16.3 Get hyperparameters for shallow RNN using Bayesian optimization

```
[49]: RNN_shallow_tuner_BO = kt.BayesianOptimization(
    build_model,
    objective='val_loss',
    max_trials=100,
    num_initial_points=2,
    overwrite=True
)
early_stopping = EarlyStopping(monitor='val_loss', patience=10, □
                               restore_best_weights=True)

RNN_shallow_tuner_BO.search(train_rnn, epochs=50, validation_data=val_rnn, □
                            callbacks=[early_stopping])
```

Trial 100 Complete [00h 00m 07s]

```
val_loss: 1.3063130378723145  
  
Best val_loss So Far: 1.1599246263504028  
Total elapsed time: 00h 13m 04s
```

## 16.4 Get hyperparameters for shallow RNN using Hyperband tuner

```
[50]: RNN_shallow_tuner_HB = kt.Hyperband(  
        build_model,  
        objective='val_loss',  
        max_epochs=200,  
        factor=2,  
        overwrite=True  
)  
  
early_stopping = EarlyStopping(monitor='val_loss', patience=10, □  
    ↪restore_best_weights=True)  
  
RNN_shallow_tuner_HB.search(train_rnn,  
                           epochs=200,  
                           validation_data=val_rnn,  
                           callbacks=[early_stopping])
```

```
Trial 689 Complete [00h 00m 10s]  
val_loss: 1.3770010471343994
```

```
Best val_loss So Far: 1.124523639678955  
Total elapsed time: 01h 09m 43s
```

## 16.5 Get model weights and save the best shallow RNN model

The Hyperband tuner produced the best model based on validation loss.

```
[51]: # Get best hyperparameters  
best_hps = RNN_shallow_tuner_HB.get_best_hyperparameters(num_trials=1)[0]  
RNN_shallow_model = RNN_shallow_tuner_HB.hypermodel.build(best_hps)  
  
# TensorBoard setup  
!rm -rf ./logs/flights_ontime/RNN_shallow/tensorboard/  
log_dir = "logs/flights_ontime/RNN_shallow/tensorboard/" + datetime.datetime.  
    ↪now().strftime("%Y%m%d-%H%M%S")  
tensorboard_callback = TensorBoard(log_dir=log_dir, histogram_freq=1)  
  
early_stopping = EarlyStopping(monitor='val_loss', patience=50, □  
    ↪restore_best_weights=True)  
  
# Train the model  
history = RNN_shallow_model.fit(train_rnn,
```

```

        validation_data=val_rnn,
        epochs=500,
        callbacks=[early_stopping, tensorboard_callback])

# Save the best trained model
RNN_shallow_model.save('models/flights_ontime/RNN_shallow_model')

Epoch 1/500
43/43 [=====] - 1s 5ms/step - loss: 1.2611 -
mean_absolute_error: 0.8335 - val_loss: 1.5629 - val_mean_absolute_error: 0.8765
Epoch 2/500
43/43 [=====] - 0s 3ms/step - loss: 1.1531 -
mean_absolute_error: 0.8097 - val_loss: 1.4719 - val_mean_absolute_error: 0.8568
Epoch 3/500
43/43 [=====] - 0s 2ms/step - loss: 1.1014 -
mean_absolute_error: 0.7794 - val_loss: 1.4003 - val_mean_absolute_error: 0.8181
Epoch 4/500
43/43 [=====] - 0s 2ms/step - loss: 1.0665 -
mean_absolute_error: 0.7649 - val_loss: 1.3524 - val_mean_absolute_error: 0.8220
Epoch 5/500
43/43 [=====] - 0s 2ms/step - loss: 1.0247 -
mean_absolute_error: 0.7550 - val_loss: 1.3243 - val_mean_absolute_error: 0.8314
Epoch 6/500
43/43 [=====] - 0s 2ms/step - loss: 1.0218 -
mean_absolute_error: 0.7637 - val_loss: 1.3088 - val_mean_absolute_error: 0.8355
Epoch 7/500
43/43 [=====] - 0s 2ms/step - loss: 1.0215 -
mean_absolute_error: 0.7605 - val_loss: 1.2987 - val_mean_absolute_error: 0.8373
Epoch 8/500
43/43 [=====] - 0s 2ms/step - loss: 1.0127 -
mean_absolute_error: 0.7630 - val_loss: 1.2929 - val_mean_absolute_error: 0.8397
Epoch 9/500
43/43 [=====] - 0s 2ms/step - loss: 0.9994 -
mean_absolute_error: 0.7565 - val_loss: 1.2896 - val_mean_absolute_error: 0.8415
Epoch 10/500
43/43 [=====] - 0s 2ms/step - loss: 1.0058 -
mean_absolute_error: 0.7612 - val_loss: 1.2875 - val_mean_absolute_error: 0.8426
Epoch 11/500
43/43 [=====] - 0s 2ms/step - loss: 1.0096 -
mean_absolute_error: 0.7643 - val_loss: 1.2851 - val_mean_absolute_error: 0.8439
Epoch 12/500
43/43 [=====] - 0s 2ms/step - loss: 0.9996 -
mean_absolute_error: 0.7605 - val_loss: 1.2851 - val_mean_absolute_error: 0.8448
Epoch 13/500
43/43 [=====] - 0s 2ms/step - loss: 1.0036 -
mean_absolute_error: 0.7623 - val_loss: 1.2835 - val_mean_absolute_error: 0.8458
Epoch 14/500
43/43 [=====] - 0s 2ms/step - loss: 0.9992 -

```

```
mean_absolute_error: 0.7610 - val_loss: 1.2832 - val_mean_absolute_error: 0.8448
Epoch 15/500
43/43 [=====] - 0s 2ms/step - loss: 0.9987 -
mean_absolute_error: 0.7568 - val_loss: 1.2834 - val_mean_absolute_error: 0.8448
Epoch 16/500
43/43 [=====] - 0s 2ms/step - loss: 1.0008 -
mean_absolute_error: 0.7582 - val_loss: 1.2818 - val_mean_absolute_error: 0.8469
Epoch 17/500
43/43 [=====] - 0s 2ms/step - loss: 0.9992 -
mean_absolute_error: 0.7602 - val_loss: 1.2823 - val_mean_absolute_error: 0.8453
Epoch 18/500
43/43 [=====] - 0s 2ms/step - loss: 0.9966 -
mean_absolute_error: 0.7559 - val_loss: 1.2831 - val_mean_absolute_error: 0.8440
Epoch 19/500
43/43 [=====] - 0s 2ms/step - loss: 0.9918 -
mean_absolute_error: 0.7562 - val_loss: 1.2818 - val_mean_absolute_error: 0.8455
Epoch 20/500
43/43 [=====] - 0s 2ms/step - loss: 1.0054 -
mean_absolute_error: 0.7609 - val_loss: 1.2826 - val_mean_absolute_error: 0.8441
Epoch 21/500
43/43 [=====] - 0s 2ms/step - loss: 0.9993 -
mean_absolute_error: 0.7600 - val_loss: 1.2807 - val_mean_absolute_error: 0.8465
Epoch 22/500
43/43 [=====] - 0s 3ms/step - loss: 0.9993 -
mean_absolute_error: 0.7570 - val_loss: 1.2812 - val_mean_absolute_error: 0.8455
Epoch 23/500
43/43 [=====] - 0s 2ms/step - loss: 0.9953 -
mean_absolute_error: 0.7563 - val_loss: 1.2815 - val_mean_absolute_error: 0.8437
Epoch 24/500
43/43 [=====] - 0s 2ms/step - loss: 0.9967 -
mean_absolute_error: 0.7550 - val_loss: 1.2804 - val_mean_absolute_error: 0.8448
Epoch 25/500
43/43 [=====] - 0s 2ms/step - loss: 0.9978 -
mean_absolute_error: 0.7573 - val_loss: 1.2789 - val_mean_absolute_error: 0.8463
Epoch 26/500
43/43 [=====] - 0s 2ms/step - loss: 1.0014 -
mean_absolute_error: 0.7584 - val_loss: 1.2788 - val_mean_absolute_error: 0.8465
Epoch 27/500
43/43 [=====] - 0s 2ms/step - loss: 0.9985 -
mean_absolute_error: 0.7609 - val_loss: 1.2784 - val_mean_absolute_error: 0.8472
Epoch 28/500
43/43 [=====] - 0s 2ms/step - loss: 0.9907 -
mean_absolute_error: 0.7559 - val_loss: 1.2802 - val_mean_absolute_error: 0.8446
Epoch 29/500
43/43 [=====] - 0s 2ms/step - loss: 0.9992 -
mean_absolute_error: 0.7592 - val_loss: 1.2796 - val_mean_absolute_error: 0.8453
Epoch 30/500
43/43 [=====] - 0s 2ms/step - loss: 0.9928 -
```

```
mean_absolute_error: 0.7558 - val_loss: 1.2798 - val_mean_absolute_error: 0.8446
Epoch 31/500
43/43 [=====] - 0s 2ms/step - loss: 0.9895 -
mean_absolute_error: 0.7546 - val_loss: 1.2796 - val_mean_absolute_error: 0.8463
Epoch 32/500
43/43 [=====] - 0s 2ms/step - loss: 0.9998 -
mean_absolute_error: 0.7634 - val_loss: 1.2798 - val_mean_absolute_error: 0.8459
Epoch 33/500
43/43 [=====] - 0s 2ms/step - loss: 1.0002 -
mean_absolute_error: 0.7612 - val_loss: 1.2801 - val_mean_absolute_error: 0.8448
Epoch 34/500
43/43 [=====] - 0s 2ms/step - loss: 0.9915 -
mean_absolute_error: 0.7573 - val_loss: 1.2795 - val_mean_absolute_error: 0.8443
Epoch 35/500
43/43 [=====] - 0s 2ms/step - loss: 0.9972 -
mean_absolute_error: 0.7575 - val_loss: 1.2786 - val_mean_absolute_error: 0.8441
Epoch 36/500
43/43 [=====] - 0s 2ms/step - loss: 0.9884 -
mean_absolute_error: 0.7530 - val_loss: 1.2775 - val_mean_absolute_error: 0.8439
Epoch 37/500
43/43 [=====] - 0s 2ms/step - loss: 0.9989 -
mean_absolute_error: 0.7583 - val_loss: 1.2763 - val_mean_absolute_error: 0.8446
Epoch 38/500
43/43 [=====] - 0s 2ms/step - loss: 0.9915 -
mean_absolute_error: 0.7585 - val_loss: 1.2745 - val_mean_absolute_error: 0.8465
Epoch 39/500
43/43 [=====] - 0s 2ms/step - loss: 0.9945 -
mean_absolute_error: 0.7577 - val_loss: 1.2761 - val_mean_absolute_error: 0.8425
Epoch 40/500
43/43 [=====] - 0s 2ms/step - loss: 0.9843 -
mean_absolute_error: 0.7523 - val_loss: 1.2757 - val_mean_absolute_error: 0.8438
Epoch 41/500
43/43 [=====] - 0s 2ms/step - loss: 0.9965 -
mean_absolute_error: 0.7557 - val_loss: 1.2744 - val_mean_absolute_error: 0.8436
Epoch 42/500
43/43 [=====] - 0s 2ms/step - loss: 0.9917 -
mean_absolute_error: 0.7588 - val_loss: 1.2736 - val_mean_absolute_error: 0.8424
Epoch 43/500
43/43 [=====] - 0s 2ms/step - loss: 0.9893 -
mean_absolute_error: 0.7552 - val_loss: 1.2735 - val_mean_absolute_error: 0.8426
Epoch 44/500
43/43 [=====] - 0s 2ms/step - loss: 0.9875 -
mean_absolute_error: 0.7549 - val_loss: 1.2738 - val_mean_absolute_error: 0.8429
Epoch 45/500
43/43 [=====] - 0s 2ms/step - loss: 0.9901 -
mean_absolute_error: 0.7561 - val_loss: 1.2744 - val_mean_absolute_error: 0.8443
Epoch 46/500
43/43 [=====] - 0s 2ms/step - loss: 0.9911 -
```

```
mean_absolute_error: 0.7573 - val_loss: 1.2757 - val_mean_absolute_error: 0.8462
Epoch 47/500
43/43 [=====] - 0s 2ms/step - loss: 0.9986 -
mean_absolute_error: 0.7607 - val_loss: 1.2756 - val_mean_absolute_error: 0.8458
Epoch 48/500
43/43 [=====] - 0s 2ms/step - loss: 0.9916 -
mean_absolute_error: 0.7573 - val_loss: 1.2757 - val_mean_absolute_error: 0.8461
Epoch 49/500
43/43 [=====] - 0s 2ms/step - loss: 0.9855 -
mean_absolute_error: 0.7557 - val_loss: 1.2748 - val_mean_absolute_error: 0.8439
Epoch 50/500
43/43 [=====] - 0s 2ms/step - loss: 0.9904 -
mean_absolute_error: 0.7562 - val_loss: 1.2751 - val_mean_absolute_error: 0.8450
Epoch 51/500
43/43 [=====] - 0s 2ms/step - loss: 0.9851 -
mean_absolute_error: 0.7530 - val_loss: 1.2765 - val_mean_absolute_error: 0.8440
Epoch 52/500
43/43 [=====] - 0s 4ms/step - loss: 0.9880 -
mean_absolute_error: 0.7552 - val_loss: 1.2774 - val_mean_absolute_error: 0.8443
Epoch 53/500
43/43 [=====] - 0s 5ms/step - loss: 0.9902 -
mean_absolute_error: 0.7554 - val_loss: 1.2766 - val_mean_absolute_error: 0.8430
Epoch 54/500
43/43 [=====] - 0s 5ms/step - loss: 0.9889 -
mean_absolute_error: 0.7584 - val_loss: 1.2767 - val_mean_absolute_error: 0.8453
Epoch 55/500
43/43 [=====] - 0s 2ms/step - loss: 0.9889 -
mean_absolute_error: 0.7533 - val_loss: 1.2780 - val_mean_absolute_error: 0.8449
Epoch 56/500
43/43 [=====] - 0s 2ms/step - loss: 0.9956 -
mean_absolute_error: 0.7572 - val_loss: 1.2762 - val_mean_absolute_error: 0.8398
Epoch 57/500
43/43 [=====] - 0s 2ms/step - loss: 0.9867 -
mean_absolute_error: 0.7553 - val_loss: 1.2745 - val_mean_absolute_error: 0.8442
Epoch 58/500
43/43 [=====] - 0s 2ms/step - loss: 0.9889 -
mean_absolute_error: 0.7560 - val_loss: 1.2741 - val_mean_absolute_error: 0.8423
Epoch 59/500
43/43 [=====] - 0s 2ms/step - loss: 0.9876 -
mean_absolute_error: 0.7537 - val_loss: 1.2726 - val_mean_absolute_error: 0.8407
Epoch 60/500
43/43 [=====] - 0s 2ms/step - loss: 0.9852 -
mean_absolute_error: 0.7560 - val_loss: 1.2728 - val_mean_absolute_error: 0.8439
Epoch 61/500
43/43 [=====] - 0s 2ms/step - loss: 0.9898 -
mean_absolute_error: 0.7573 - val_loss: 1.2727 - val_mean_absolute_error: 0.8440
Epoch 62/500
43/43 [=====] - 0s 2ms/step - loss: 0.9872 -
```

```
mean_absolute_error: 0.7579 - val_loss: 1.2743 - val_mean_absolute_error: 0.8432
Epoch 63/500
43/43 [=====] - 0s 2ms/step - loss: 0.9900 -
mean_absolute_error: 0.7579 - val_loss: 1.2731 - val_mean_absolute_error: 0.8425
Epoch 64/500
43/43 [=====] - 0s 2ms/step - loss: 0.9869 -
mean_absolute_error: 0.7555 - val_loss: 1.2729 - val_mean_absolute_error: 0.8432
Epoch 65/500
43/43 [=====] - 0s 2ms/step - loss: 0.9804 -
mean_absolute_error: 0.7548 - val_loss: 1.2738 - val_mean_absolute_error: 0.8427
Epoch 66/500
43/43 [=====] - 0s 2ms/step - loss: 0.9851 -
mean_absolute_error: 0.7525 - val_loss: 1.2745 - val_mean_absolute_error: 0.8430
Epoch 67/500
43/43 [=====] - 0s 2ms/step - loss: 0.9865 -
mean_absolute_error: 0.7557 - val_loss: 1.2733 - val_mean_absolute_error: 0.8422
Epoch 68/500
43/43 [=====] - 0s 2ms/step - loss: 0.9863 -
mean_absolute_error: 0.7544 - val_loss: 1.2746 - val_mean_absolute_error: 0.8434
Epoch 69/500
43/43 [=====] - 0s 2ms/step - loss: 0.9880 -
mean_absolute_error: 0.7588 - val_loss: 1.2753 - val_mean_absolute_error: 0.8441
Epoch 70/500
43/43 [=====] - 0s 2ms/step - loss: 0.9864 -
mean_absolute_error: 0.7572 - val_loss: 1.2748 - val_mean_absolute_error: 0.8430
Epoch 71/500
43/43 [=====] - 0s 2ms/step - loss: 0.9844 -
mean_absolute_error: 0.7561 - val_loss: 1.2738 - val_mean_absolute_error: 0.8409
Epoch 72/500
43/43 [=====] - 0s 2ms/step - loss: 0.9751 -
mean_absolute_error: 0.7480 - val_loss: 1.2742 - val_mean_absolute_error: 0.8421
Epoch 73/500
43/43 [=====] - 0s 2ms/step - loss: 0.9823 -
mean_absolute_error: 0.7544 - val_loss: 1.2760 - val_mean_absolute_error: 0.8427
Epoch 74/500
43/43 [=====] - 0s 2ms/step - loss: 0.9819 -
mean_absolute_error: 0.7548 - val_loss: 1.2779 - val_mean_absolute_error: 0.8401
Epoch 75/500
43/43 [=====] - 0s 2ms/step - loss: 0.9907 -
mean_absolute_error: 0.7567 - val_loss: 1.2756 - val_mean_absolute_error: 0.8434
Epoch 76/500
43/43 [=====] - 0s 2ms/step - loss: 0.9775 -
mean_absolute_error: 0.7508 - val_loss: 1.2750 - val_mean_absolute_error: 0.8396
Epoch 77/500
43/43 [=====] - 0s 2ms/step - loss: 0.9852 -
mean_absolute_error: 0.7538 - val_loss: 1.2704 - val_mean_absolute_error: 0.8417
Epoch 78/500
43/43 [=====] - 0s 2ms/step - loss: 0.9876 -
```

```
mean_absolute_error: 0.7560 - val_loss: 1.2702 - val_mean_absolute_error: 0.8384
Epoch 79/500
43/43 [=====] - 0s 2ms/step - loss: 0.9846 -
mean_absolute_error: 0.7531 - val_loss: 1.2704 - val_mean_absolute_error: 0.8363
Epoch 80/500
43/43 [=====] - 0s 2ms/step - loss: 0.9854 -
mean_absolute_error: 0.7532 - val_loss: 1.2706 - val_mean_absolute_error: 0.8401
Epoch 81/500
43/43 [=====] - 0s 2ms/step - loss: 0.9889 -
mean_absolute_error: 0.7601 - val_loss: 1.2689 - val_mean_absolute_error: 0.8416
Epoch 82/500
43/43 [=====] - 0s 2ms/step - loss: 0.9888 -
mean_absolute_error: 0.7578 - val_loss: 1.2694 - val_mean_absolute_error: 0.8406
Epoch 83/500
43/43 [=====] - 0s 2ms/step - loss: 0.9750 -
mean_absolute_error: 0.7519 - val_loss: 1.2689 - val_mean_absolute_error: 0.8409
Epoch 84/500
43/43 [=====] - 0s 2ms/step - loss: 0.9898 -
mean_absolute_error: 0.7550 - val_loss: 1.2691 - val_mean_absolute_error: 0.8396
Epoch 85/500
43/43 [=====] - 0s 2ms/step - loss: 0.9863 -
mean_absolute_error: 0.7570 - val_loss: 1.2689 - val_mean_absolute_error: 0.8417
Epoch 86/500
43/43 [=====] - 0s 2ms/step - loss: 0.9835 -
mean_absolute_error: 0.7533 - val_loss: 1.2691 - val_mean_absolute_error: 0.8382
Epoch 87/500
43/43 [=====] - 0s 2ms/step - loss: 0.9853 -
mean_absolute_error: 0.7535 - val_loss: 1.2673 - val_mean_absolute_error: 0.8410
Epoch 88/500
43/43 [=====] - 0s 2ms/step - loss: 0.9812 -
mean_absolute_error: 0.7541 - val_loss: 1.2684 - val_mean_absolute_error: 0.8405
Epoch 89/500
43/43 [=====] - 0s 2ms/step - loss: 0.9836 -
mean_absolute_error: 0.7526 - val_loss: 1.2695 - val_mean_absolute_error: 0.8398
Epoch 90/500
43/43 [=====] - 0s 2ms/step - loss: 0.9832 -
mean_absolute_error: 0.7542 - val_loss: 1.2706 - val_mean_absolute_error: 0.8392
Epoch 91/500
43/43 [=====] - 0s 2ms/step - loss: 0.9753 -
mean_absolute_error: 0.7511 - val_loss: 1.2712 - val_mean_absolute_error: 0.8404
Epoch 92/500
43/43 [=====] - 0s 2ms/step - loss: 0.9810 -
mean_absolute_error: 0.7515 - val_loss: 1.2703 - val_mean_absolute_error: 0.8358
Epoch 93/500
43/43 [=====] - 0s 2ms/step - loss: 0.9788 -
mean_absolute_error: 0.7552 - val_loss: 1.2685 - val_mean_absolute_error: 0.8386
Epoch 94/500
43/43 [=====] - 0s 2ms/step - loss: 0.9816 -
```

```
mean_absolute_error: 0.7524 - val_loss: 1.2690 - val_mean_absolute_error: 0.8377
Epoch 95/500
43/43 [=====] - 0s 2ms/step - loss: 0.9809 -
mean_absolute_error: 0.7561 - val_loss: 1.2687 - val_mean_absolute_error: 0.8389
Epoch 96/500
43/43 [=====] - 0s 2ms/step - loss: 0.9787 -
mean_absolute_error: 0.7542 - val_loss: 1.2696 - val_mean_absolute_error: 0.8364
Epoch 97/500
43/43 [=====] - 0s 2ms/step - loss: 0.9708 -
mean_absolute_error: 0.7473 - val_loss: 1.2704 - val_mean_absolute_error: 0.8344
Epoch 98/500
43/43 [=====] - 0s 2ms/step - loss: 0.9808 -
mean_absolute_error: 0.7509 - val_loss: 1.2669 - val_mean_absolute_error: 0.8349
Epoch 99/500
43/43 [=====] - 0s 2ms/step - loss: 0.9874 -
mean_absolute_error: 0.7557 - val_loss: 1.2671 - val_mean_absolute_error: 0.8368
Epoch 100/500
43/43 [=====] - 0s 2ms/step - loss: 0.9809 -
mean_absolute_error: 0.7546 - val_loss: 1.2656 - val_mean_absolute_error: 0.8372
Epoch 101/500
43/43 [=====] - 0s 2ms/step - loss: 0.9815 -
mean_absolute_error: 0.7523 - val_loss: 1.2668 - val_mean_absolute_error: 0.8368
Epoch 102/500
43/43 [=====] - 0s 2ms/step - loss: 0.9914 -
mean_absolute_error: 0.7590 - val_loss: 1.2675 - val_mean_absolute_error: 0.8369
Epoch 103/500
43/43 [=====] - 0s 2ms/step - loss: 0.9810 -
mean_absolute_error: 0.7503 - val_loss: 1.2655 - val_mean_absolute_error: 0.8379
Epoch 104/500
43/43 [=====] - 0s 2ms/step - loss: 0.9752 -
mean_absolute_error: 0.7516 - val_loss: 1.2650 - val_mean_absolute_error: 0.8379
Epoch 105/500
43/43 [=====] - 0s 2ms/step - loss: 0.9770 -
mean_absolute_error: 0.7497 - val_loss: 1.2674 - val_mean_absolute_error: 0.8397
Epoch 106/500
43/43 [=====] - 0s 2ms/step - loss: 0.9868 -
mean_absolute_error: 0.7538 - val_loss: 1.2678 - val_mean_absolute_error: 0.8346
Epoch 107/500
43/43 [=====] - 0s 2ms/step - loss: 0.9736 -
mean_absolute_error: 0.7497 - val_loss: 1.2691 - val_mean_absolute_error: 0.8388
Epoch 108/500
43/43 [=====] - 0s 2ms/step - loss: 0.9801 -
mean_absolute_error: 0.7523 - val_loss: 1.2684 - val_mean_absolute_error: 0.8379
Epoch 109/500
43/43 [=====] - 0s 2ms/step - loss: 0.9814 -
mean_absolute_error: 0.7506 - val_loss: 1.2686 - val_mean_absolute_error: 0.8347
Epoch 110/500
43/43 [=====] - 0s 2ms/step - loss: 0.9732 -
```

```
mean_absolute_error: 0.7490 - val_loss: 1.2647 - val_mean_absolute_error: 0.8355
Epoch 111/500
43/43 [=====] - 0s 2ms/step - loss: 0.9789 -
mean_absolute_error: 0.7547 - val_loss: 1.2653 - val_mean_absolute_error: 0.8342
Epoch 112/500
43/43 [=====] - 0s 2ms/step - loss: 0.9765 -
mean_absolute_error: 0.7516 - val_loss: 1.2652 - val_mean_absolute_error: 0.8362
Epoch 113/500
43/43 [=====] - 0s 2ms/step - loss: 0.9801 -
mean_absolute_error: 0.7511 - val_loss: 1.2664 - val_mean_absolute_error: 0.8327
Epoch 114/500
43/43 [=====] - 0s 3ms/step - loss: 0.9875 -
mean_absolute_error: 0.7552 - val_loss: 1.2663 - val_mean_absolute_error: 0.8352
Epoch 115/500
43/43 [=====] - 0s 2ms/step - loss: 0.9788 -
mean_absolute_error: 0.7542 - val_loss: 1.2666 - val_mean_absolute_error: 0.8340
Epoch 116/500
43/43 [=====] - 0s 2ms/step - loss: 0.9829 -
mean_absolute_error: 0.7546 - val_loss: 1.2657 - val_mean_absolute_error: 0.8335
Epoch 117/500
43/43 [=====] - 0s 2ms/step - loss: 0.9846 -
mean_absolute_error: 0.7560 - val_loss: 1.2649 - val_mean_absolute_error: 0.8330
Epoch 118/500
43/43 [=====] - 0s 2ms/step - loss: 0.9804 -
mean_absolute_error: 0.7516 - val_loss: 1.2659 - val_mean_absolute_error: 0.8346
Epoch 119/500
43/43 [=====] - 0s 2ms/step - loss: 0.9744 -
mean_absolute_error: 0.7533 - val_loss: 1.2682 - val_mean_absolute_error: 0.8373
Epoch 120/500
43/43 [=====] - 0s 2ms/step - loss: 0.9815 -
mean_absolute_error: 0.7557 - val_loss: 1.2687 - val_mean_absolute_error: 0.8359
Epoch 121/500
43/43 [=====] - 0s 2ms/step - loss: 0.9821 -
mean_absolute_error: 0.7515 - val_loss: 1.2689 - val_mean_absolute_error: 0.8344
Epoch 122/500
43/43 [=====] - 0s 2ms/step - loss: 0.9781 -
mean_absolute_error: 0.7563 - val_loss: 1.2681 - val_mean_absolute_error: 0.8382
Epoch 123/500
43/43 [=====] - 0s 2ms/step - loss: 0.9852 -
mean_absolute_error: 0.7555 - val_loss: 1.2701 - val_mean_absolute_error: 0.8383
Epoch 124/500
43/43 [=====] - 0s 2ms/step - loss: 0.9709 -
mean_absolute_error: 0.7479 - val_loss: 1.2709 - val_mean_absolute_error: 0.8367
Epoch 125/500
43/43 [=====] - 0s 2ms/step - loss: 0.9892 -
mean_absolute_error: 0.7582 - val_loss: 1.2698 - val_mean_absolute_error: 0.8367
Epoch 126/500
43/43 [=====] - 0s 2ms/step - loss: 0.9788 -
```

```
mean_absolute_error: 0.7536 - val_loss: 1.2654 - val_mean_absolute_error: 0.8351
Epoch 127/500
43/43 [=====] - 0s 2ms/step - loss: 0.9732 -
mean_absolute_error: 0.7505 - val_loss: 1.2650 - val_mean_absolute_error: 0.8364
Epoch 128/500
43/43 [=====] - 0s 2ms/step - loss: 0.9782 -
mean_absolute_error: 0.7503 - val_loss: 1.2681 - val_mean_absolute_error: 0.8351
Epoch 129/500
43/43 [=====] - 0s 2ms/step - loss: 0.9709 -
mean_absolute_error: 0.7515 - val_loss: 1.2674 - val_mean_absolute_error: 0.8333
Epoch 130/500
43/43 [=====] - 0s 2ms/step - loss: 0.9803 -
mean_absolute_error: 0.7530 - val_loss: 1.2652 - val_mean_absolute_error: 0.8328
Epoch 131/500
43/43 [=====] - 0s 2ms/step - loss: 0.9705 -
mean_absolute_error: 0.7521 - val_loss: 1.2636 - val_mean_absolute_error: 0.8370
Epoch 132/500
43/43 [=====] - 0s 2ms/step - loss: 0.9808 -
mean_absolute_error: 0.7558 - val_loss: 1.2654 - val_mean_absolute_error: 0.8330
Epoch 133/500
43/43 [=====] - 0s 2ms/step - loss: 0.9828 -
mean_absolute_error: 0.7517 - val_loss: 1.2681 - val_mean_absolute_error: 0.8364
Epoch 134/500
43/43 [=====] - 0s 2ms/step - loss: 0.9811 -
mean_absolute_error: 0.7548 - val_loss: 1.2694 - val_mean_absolute_error: 0.8355
Epoch 135/500
43/43 [=====] - 0s 2ms/step - loss: 0.9907 -
mean_absolute_error: 0.7565 - val_loss: 1.2667 - val_mean_absolute_error: 0.8357
Epoch 136/500
43/43 [=====] - 0s 2ms/step - loss: 0.9823 -
mean_absolute_error: 0.7528 - val_loss: 1.2669 - val_mean_absolute_error: 0.8374
Epoch 137/500
43/43 [=====] - 0s 2ms/step - loss: 0.9780 -
mean_absolute_error: 0.7513 - val_loss: 1.2673 - val_mean_absolute_error: 0.8341
Epoch 138/500
43/43 [=====] - 0s 2ms/step - loss: 0.9783 -
mean_absolute_error: 0.7525 - val_loss: 1.2676 - val_mean_absolute_error: 0.8350
Epoch 139/500
43/43 [=====] - 0s 2ms/step - loss: 0.9871 -
mean_absolute_error: 0.7519 - val_loss: 1.2666 - val_mean_absolute_error: 0.8367
Epoch 140/500
43/43 [=====] - 0s 2ms/step - loss: 0.9804 -
mean_absolute_error: 0.7550 - val_loss: 1.2666 - val_mean_absolute_error: 0.8361
Epoch 141/500
43/43 [=====] - 0s 2ms/step - loss: 0.9722 -
mean_absolute_error: 0.7523 - val_loss: 1.2663 - val_mean_absolute_error: 0.8338
Epoch 142/500
43/43 [=====] - 0s 2ms/step - loss: 0.9779 -
```

```
mean_absolute_error: 0.7497 - val_loss: 1.2661 - val_mean_absolute_error: 0.8317
Epoch 143/500
43/43 [=====] - 0s 2ms/step - loss: 0.9834 -
mean_absolute_error: 0.7514 - val_loss: 1.2658 - val_mean_absolute_error: 0.8351
Epoch 144/500
43/43 [=====] - 0s 2ms/step - loss: 0.9754 -
mean_absolute_error: 0.7489 - val_loss: 1.2670 - val_mean_absolute_error: 0.8343
Epoch 145/500
43/43 [=====] - 0s 2ms/step - loss: 0.9811 -
mean_absolute_error: 0.7588 - val_loss: 1.2678 - val_mean_absolute_error: 0.8355
Epoch 146/500
43/43 [=====] - 0s 2ms/step - loss: 0.9759 -
mean_absolute_error: 0.7531 - val_loss: 1.2686 - val_mean_absolute_error: 0.8337
Epoch 147/500
43/43 [=====] - 0s 2ms/step - loss: 0.9804 -
mean_absolute_error: 0.7517 - val_loss: 1.2712 - val_mean_absolute_error: 0.8340
Epoch 148/500
43/43 [=====] - 0s 2ms/step - loss: 0.9699 -
mean_absolute_error: 0.7507 - val_loss: 1.2712 - val_mean_absolute_error: 0.8349
Epoch 149/500
43/43 [=====] - 0s 2ms/step - loss: 0.9792 -
mean_absolute_error: 0.7550 - val_loss: 1.2672 - val_mean_absolute_error: 0.8333
Epoch 150/500
43/43 [=====] - 0s 5ms/step - loss: 0.9777 -
mean_absolute_error: 0.7529 - val_loss: 1.2676 - val_mean_absolute_error: 0.8341
Epoch 151/500
43/43 [=====] - 0s 3ms/step - loss: 0.9794 -
mean_absolute_error: 0.7529 - val_loss: 1.2671 - val_mean_absolute_error: 0.8350
Epoch 152/500
43/43 [=====] - 0s 2ms/step - loss: 0.9829 -
mean_absolute_error: 0.7528 - val_loss: 1.2664 - val_mean_absolute_error: 0.8318
Epoch 153/500
43/43 [=====] - 0s 2ms/step - loss: 0.9822 -
mean_absolute_error: 0.7521 - val_loss: 1.2652 - val_mean_absolute_error: 0.8370
Epoch 154/500
43/43 [=====] - 0s 2ms/step - loss: 0.9795 -
mean_absolute_error: 0.7558 - val_loss: 1.2665 - val_mean_absolute_error: 0.8336
Epoch 155/500
43/43 [=====] - 0s 2ms/step - loss: 0.9762 -
mean_absolute_error: 0.7521 - val_loss: 1.2662 - val_mean_absolute_error: 0.8352
Epoch 156/500
43/43 [=====] - 0s 2ms/step - loss: 0.9852 -
mean_absolute_error: 0.7539 - val_loss: 1.2671 - val_mean_absolute_error: 0.8353
Epoch 157/500
43/43 [=====] - 0s 2ms/step - loss: 0.9833 -
mean_absolute_error: 0.7539 - val_loss: 1.2686 - val_mean_absolute_error: 0.8354
Epoch 158/500
43/43 [=====] - 0s 3ms/step - loss: 0.9799 -
```

```
mean_absolute_error: 0.7530 - val_loss: 1.2673 - val_mean_absolute_error: 0.8351
Epoch 159/500
43/43 [=====] - 0s 2ms/step - loss: 0.9794 -
mean_absolute_error: 0.7514 - val_loss: 1.2661 - val_mean_absolute_error: 0.8358
Epoch 160/500
43/43 [=====] - 0s 2ms/step - loss: 0.9757 -
mean_absolute_error: 0.7531 - val_loss: 1.2667 - val_mean_absolute_error: 0.8321
Epoch 161/500
43/43 [=====] - 0s 2ms/step - loss: 0.9809 -
mean_absolute_error: 0.7539 - val_loss: 1.2667 - val_mean_absolute_error: 0.8317
Epoch 162/500
43/43 [=====] - 0s 2ms/step - loss: 0.9784 -
mean_absolute_error: 0.7539 - val_loss: 1.2678 - val_mean_absolute_error: 0.8319
Epoch 163/500
43/43 [=====] - 0s 2ms/step - loss: 0.9775 -
mean_absolute_error: 0.7550 - val_loss: 1.2645 - val_mean_absolute_error: 0.8307
Epoch 164/500
43/43 [=====] - 0s 2ms/step - loss: 0.9833 -
mean_absolute_error: 0.7573 - val_loss: 1.2641 - val_mean_absolute_error: 0.8337
Epoch 165/500
43/43 [=====] - 0s 2ms/step - loss: 0.9793 -
mean_absolute_error: 0.7524 - val_loss: 1.2647 - val_mean_absolute_error: 0.8314
Epoch 166/500
43/43 [=====] - 0s 2ms/step - loss: 0.9729 -
mean_absolute_error: 0.7527 - val_loss: 1.2639 - val_mean_absolute_error: 0.8319
Epoch 167/500
43/43 [=====] - 0s 2ms/step - loss: 0.9835 -
mean_absolute_error: 0.7592 - val_loss: 1.2652 - val_mean_absolute_error: 0.8320
Epoch 168/500
43/43 [=====] - 0s 2ms/step - loss: 0.9802 -
mean_absolute_error: 0.7535 - val_loss: 1.2655 - val_mean_absolute_error: 0.8315
Epoch 169/500
43/43 [=====] - 0s 2ms/step - loss: 0.9791 -
mean_absolute_error: 0.7557 - val_loss: 1.2686 - val_mean_absolute_error: 0.8353
Epoch 170/500
43/43 [=====] - 0s 2ms/step - loss: 0.9840 -
mean_absolute_error: 0.7517 - val_loss: 1.2707 - val_mean_absolute_error: 0.8347
Epoch 171/500
43/43 [=====] - 0s 2ms/step - loss: 0.9803 -
mean_absolute_error: 0.7536 - val_loss: 1.2718 - val_mean_absolute_error: 0.8344
Epoch 172/500
43/43 [=====] - 0s 2ms/step - loss: 0.9738 -
mean_absolute_error: 0.7497 - val_loss: 1.2715 - val_mean_absolute_error: 0.8352
Epoch 173/500
43/43 [=====] - 0s 2ms/step - loss: 0.9851 -
mean_absolute_error: 0.7557 - val_loss: 1.2691 - val_mean_absolute_error: 0.8363
Epoch 174/500
43/43 [=====] - 0s 2ms/step - loss: 0.9745 -
```

```

mean_absolute_error: 0.7497 - val_loss: 1.2704 - val_mean_absolute_error: 0.8335
Epoch 175/500
43/43 [=====] - 0s 2ms/step - loss: 0.9732 -
mean_absolute_error: 0.7490 - val_loss: 1.2700 - val_mean_absolute_error: 0.8340
Epoch 176/500
43/43 [=====] - 0s 2ms/step - loss: 0.9747 -
mean_absolute_error: 0.7502 - val_loss: 1.2690 - val_mean_absolute_error: 0.8352
Epoch 177/500
43/43 [=====] - 0s 2ms/step - loss: 0.9778 -
mean_absolute_error: 0.7510 - val_loss: 1.2670 - val_mean_absolute_error: 0.8345
Epoch 178/500
43/43 [=====] - 0s 2ms/step - loss: 0.9804 -
mean_absolute_error: 0.7546 - val_loss: 1.2684 - val_mean_absolute_error: 0.8334
Epoch 179/500
43/43 [=====] - 0s 2ms/step - loss: 0.9767 -
mean_absolute_error: 0.7550 - val_loss: 1.2696 - val_mean_absolute_error: 0.8350
Epoch 180/500
43/43 [=====] - 0s 2ms/step - loss: 0.9858 -
mean_absolute_error: 0.7556 - val_loss: 1.2694 - val_mean_absolute_error: 0.8349
Epoch 181/500
43/43 [=====] - 0s 2ms/step - loss: 0.9763 -
mean_absolute_error: 0.7513 - val_loss: 1.2689 - val_mean_absolute_error: 0.8335
INFO:tensorflow:Assets written to:
models/flights_ontime/RNN_shallow_model/assets

INFO:tensorflow:Assets written to:
models/flights_ontime/RNN_shallow_model/assets

```

## 16.6 TensorBoard

```
[98]: %tensorboard --logdir logs/flights_ontime/RNN_shallow/tensorboard
```

```
Reusing TensorBoard on port 6013 (pid 49139), started 0:02:24 ago. (Use '!kill -9 49139' to kill it.)
```

```
<IPython.core.display.HTML object>
```

## 16.7 Load the best shallow RNN model (from Hyperband tuner)

```
[52]: # Load the best trained model
RNN_shallow_model = models.load_model('models/flights_ontime/RNN_shallow_model')
```

## 16.8 Best shallow RNN model hyperparameters

```
[54]: # Print the best hyperparameters
print(f"""Best Hyperparameters:
- Number of Neurons: {best_hps.get('n_neurons')}
- Learning Rate: {best_hps.get('learning_rate')}
- Dropout Rate: {best_hps.get('dropout_rate')}""")
```

```
- Recurrent Dropout Rate: {best_hps.get('recurrent_dropout_rate')}
- Kernel Regularization: {best_hps.get('kernel_reg')}
- Recurrent Regularization: {best_hps.get('recurr_reg')}
""")
```

Best Hyperparameters:

- Number of Neurons: 1
- Learning Rate: 0.002332058207624143
- Dropout Rate: 0.2471209924895985
- Recurrent Dropout Rate: 0.4440972042279873
- Kernel Regularization: 0.00014973417105600966
- Recurrent Regularization: 0.0003706212687198221

## 16.9 Summarize the model

```
[55]: RNN_shallow_model.summary()
```

Model: "sequential\_1"

Layer (type)	Output Shape	Param #
simple_rnn_1 (SimpleRNN)	(None, 1)	77
dense_1 (Dense)	(None, 1)	2

Total params: 79 (316.00 Byte)  
Trainable params: 79 (316.00 Byte)  
Non-trainable params: 0 (0.00 Byte)

## 16.10 Evaluate the best shallow RNN model

```
[57]: y_pred = RNN_shallow_model.predict(val_rnn)
y_pred_inv = global_targer_scaler.inverse_transform(y_pred)
y_val_inv = global_targer_scaler.inverse_transform(y_val_rnn[seq_length-1:])

shallow_rnn_val_mae = mean_absolute_error(y_val_inv, y_pred_inv)
shallow_rnn_val_mse = mean_squared_error(y_val_inv, y_pred_inv)

print(f"""Validation Metrics:
- Validation MAE: {shallow_rnn_val_mae:.2f}
- Validation MSE: {shallow_rnn_val_mse:.2f}
""")
```

5/5 [=====] - 0s 2ms/step

Validation Metrics:

- Validation MAE: 241.78

- Validation MSE: 104769.82

## 17 MODEL TYPE COMPARISON

```
[58]: # Get the Elastic Net metrics
EN_data = pd.read_csv("model_output/elastic_net_results.csv")
LR_mae = EN_data.loc[EN_data['TARGET'] == 'flights_ontime', 'MAE'].values[0]
LR_mse = EN_data.loc[EN_data['TARGET'] == 'flights_ontime', 'MSE'].values[0]

models = ['Linear Reg', 'One Neuron', 'Shallow NN', 'One RN', 'Shallow RNN']
mae = [LR_mae, OneNeuron_val_mae, SDNN_val_mae, OneRNN_val_mae, ↵
       shallow_rnn_val_mae]
mse = [LR_mse, OneNeuron_val_mse, SDNN_val_mse, OneRNN_val_mse, ↵
       shallow_rnn_val_mse]

# Sort by MAE
sorted_indices_mae = np.argsort(mae)
sorted_models_mae = [models[i] for i in sorted_indices_mae]
sorted_mae = [mae[i] for i in sorted_indices_mae]

# Sort by MSE
sorted_indices_mse = np.argsort(mse)
sorted_models_mse = [models[i] for i in sorted_indices_mse]
sorted_mse = [mse[i] for i in sorted_indices_mse]

x = np.arange(len(models))
bar_width = 0.35

fix, axes = plt.subplots(nrows=1, ncols=2, figsize=(16, 4))

# MAE
bars_mae = axes[0].bar(x, sorted_mae, bar_width, label='MAE')
axes[0].set_xlabel('Models')
axes[0].set_ylabel('MAE Scores')
axes[0].set_title('MAE Scores by model')
axes[0].set_xticks(x)
axes[0].set_xticklabels(sorted_models_mae)
axes[0].legend()

# Add values above MAE bars
for bar, value in zip(bars_mae, sorted_mae):
    height = bar.get_height()
    axes[0].text(bar.get_x() + bar.get_width() / 2, height + 0.01, f'{value:.2f}', ha='center', va='bottom')

# MSE
```

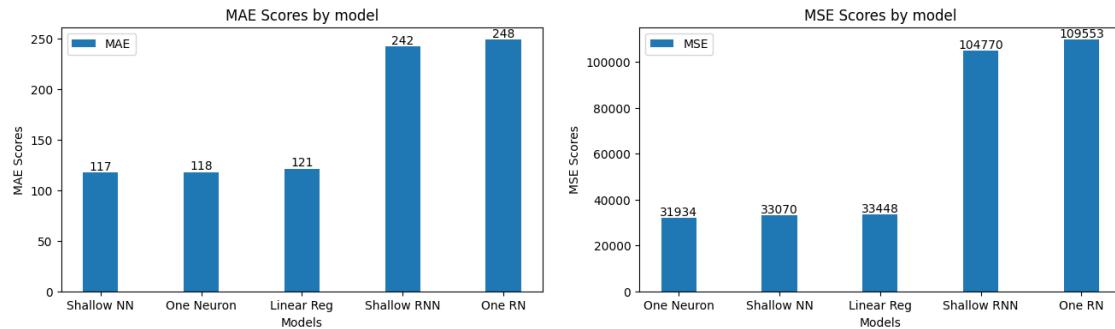
```

bar_mse = axes[1].bar(x, sorted_mse, bar_width, label='MSE')
axes[1].set_xlabel('Models')
axes[1].set_ylabel('MSE Scores')
axes[1].set_title('MSE Scores by model')
axes[1].set_xticks(x)
axes[1].set_xticklabels(sorted_models_mse)
axes[1].legend()

# Add values above MSE bars
for bar, value in zip(bar_mse, sorted_mse):
    height = bar.get_height()
    axes[1].text(bar.get_x() + bar.get_width() / 2, height + 0.01, f'{value:.2f}', ha='center', va='bottom')

plt.tight_layout
plt.show()

```



## 18 SUMMARY & CONCLUSION

Both single neuron and shallow dense neural networks were able to at least match, if not slightly improve upon, the prediction accuracy of mutlilple linear regression applied to ontine flights. Three different keras tuners were used to search hypermodels for optimum hyperparameters, including the number of hidden layers, number of neurons per layer, learning rate, dropout rate, regularization rate, and optimizer algorithm. The Hyperband tuner consistently found the best hyperparameters, but required the longest search time. The most influential hyperparameters proved to be the learning rate, regularization rates, and dropout rates. Eventually, I dropped the number of layers and optimizer type from the hyperparameter search in favor of a single hidden layer and the Adam optimimzer, as they generally showed the best results. One implication is that complex interactions that would be revealed by complex architectures are unlikely to figure prominently in this dataset.

The TensorBoard module proved to be an effective tool for evaluating a model fit, easily displaying loss and metric plots that show if the model is over or under trained and if high bias or high variance exist. Plots for the bias and weights within each layer of a network help reveal the stability of the training process

One major flaw in this analysis is the data splitting used for the RNN models. The data should have been split sequentially with training data coming before validation data coming before test data. Instead the data were shuffled before splitting, meaning that each dataset contains non-sequential data, which is fine for linear regression and the dense neural networks, problematic for the RNN time series analysis. Additionally, I failed to take the additional steps to Window the data and create tensors for the inputs and labels of each window. Having discovered these mistakes near the submission deadline, I decided to write my summary and conclusion before attempting to fix the errors. Now that I've produced a summary of the work to date, I will begin a new notebook, 5.DFW\_daily\_flights\_LSTM that follows methods used in the [TensorFlow timeseries tutorial](#). I won't have time to write a separate summary and conclusion for this additional code, so please consider this to "supplemental" material.

## 19 INTRODUCTION

### 19.1 Libraries

```
[78]: import os
import datetime
import IPython

import pandas as pd
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
import seaborn as sns
import random

from sklearn.model_selection import train_test_split
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler, OneHotEncoder, MinMaxScaler
from sklearn.metrics import mean_absolute_error, mean_squared_error, □
    ↪mean_absolute_percentage_error, r2_score
from sklearn.compose import ColumnTransformer

import tensorflow as tf
from tensorflow.data import Dataset, AUTOTUNE

from keras import layers, models, Sequential, regularizers
from keras.layers import SimpleRNN, Dense, Dropout, Embedding, LSTM, GRU
from keras.optimizers.legacy import Adam, RMSprop, SGD
from keras.callbacks import EarlyStopping, ModelCheckpoint, TensorBoard
from keras.utils import timeseries_dataset_from_array
from keras.utils import plot_model
from keras.regularizers import L1, L2, L1L2

import keras_tuner as kt
```

```
mpl.rcParams['figure.figsize'] = (8, 6)
mpl.rcParams['axes.grid'] = False
```

## 19.2 Import data & column groups

```
[2]: DAILY_DATA_PATH = "data.v3/daily"

df = pd.read_parquet(os.path.join(DAILY_DATA_PATH, "daily_flights_and_weather_merged.parquet"))

# Flights column groups
flights_terminal_cols = ['flights_arr_A', 'flights_arr_B', 'flights_arr_C', 'flights_arr_D', 'flights_arr_E', 'flights_dep_A', 'flights_dep_B', 'flights_dep_C', 'flights_dep_D', 'flights_dep_E']

flights_non_terminal_cols = ['flights_total', 'flights_cancel', 'flights_delay', 'flights_ontime', 'flights_arr_ontime', 'flights_arr_delay', 'flights_arr_cancel', 'flights_dep_ontime', 'flights_dep_delay', 'flights_dep_cancel']

flights_percentage_cols = ['flights_cancel_pct', 'flights_delay_pct', 'flights_ontime_pct', 'flights_arr_delay_pct', 'flights_arr_ontime_pct', 'flights_arr_cancel_pct', 'flights_dep_delay_pct', 'flights_dep_ontime_pct', 'flights_dep_cancel_pct']

# Date column groups
date_cols = ['date', 'covid', 'ordinal_date', 'year', 'month', 'day_of_month', 'day_of_week', 'season', 'holiday', 'halloween', 'xmas_eve', 'new_years_eve', 'jan_2', 'jan_3', 'day_before_easter', 'days_until_xmas', 'days_until_thanksgiving', 'days_until_july_4th', 'days_until_labor_day', 'days_until_memorial_day']

# Weather column groups
weather_cols = ['wx_temperature_max', 'wx_temperature_min', 'wx_apcp', 'wx_prate', 'wx_asnow', 'wx_frozr', 'wx_vis', 'wx_gust', 'wx_maxref', 'wx_cape', 'wx_lftx', 'wx_wind_speed', 'wx_wind_direction']

# Lag column groups
```

```

lag_cols = ['flights_cancel_lag_1', 'flights_cancel_lag_2',  

    ↴'flights_cancel_lag_3', 'flights_cancel_lag_4', 'flights_cancel_lag_5',  

    ↴'flights_cancel_lag_6', 'flights_cancel_lag_7',  

        'flights_delay_lag_1', 'flights_delay_lag_2',  

    ↴'flights_delay_lag_3', 'flights_delay_lag_4', 'flights_delay_lag_5',  

    ↴'flights_delay_lag_6', 'flights_delay_lag_7',  

        'flights_ontime_lag_1', 'flights_ontime_lag_2',  

    ↴'flights_ontime_lag_3', 'flights_ontime_lag_4', 'flights_ontime_lag_5',  

    ↴'flights_ontime_lag_6', 'flights_ontime_lag_7',]

# Drop lag columns and date from data
df = df.drop(columns=lag_cols + ['date'])

print("Unique data types in df", df.dtypes.value_counts(), sep = '\n')

# Identify categorical and numeric columns in df
categorical_cols = df.select_dtypes(include=['object', 'category']).columns.  

    ↴tolist()
numeric_cols = df.select_dtypes(include = ['float64', 'float32', 'int32',  

    ↴'int64']).columns.tolist()
num_features = df.shape[1]

print(f"\nCategorical columns: {categorical_cols}")
print(f"Numeric columns: {numeric_cols}")
print(f"\nAll columns accounted for: {len(categorical_cols) + len(numeric_cols)}  

    ↴== num_features")

```

Unique data types in df

float64	40
object	11
int64	7
float32	4
int32	2
Name: count, dtype: int64	

Categorical columns: ['covid', 'month', 'day\_of\_week', 'season', 'holiday',  
 'halloween', 'xmas\_eve', 'new\_years\_eve', 'jan\_2', 'jan\_3', 'day\_before\_easter']  
 Numeric columns: ['ordinal\_date', 'year', 'day\_of\_month', 'days\_until\_xmas',  
 'days\_until\_thanksgiving', 'days\_until\_july\_4th', 'days\_until\_labor\_day',  
 'days\_until\_memorial\_day', 'flights\_cancel', 'flights\_delay', 'flights\_ontime',  
 'flights\_arr', 'flights\_dep', 'flights\_arr\_A', 'flights\_arr\_B', 'flights\_arr\_C',  
 'flights\_arr\_D', 'flights\_arr\_E', 'flights\_dep\_A', 'flights\_dep\_B',  
 'flights\_dep\_C', 'flights\_dep\_D', 'flights\_dep\_E', 'flights\_arr\_cancel',  
 'flights\_arr\_delay', 'flights\_arr\_ontime', 'flights\_dep\_cancel',  
 'flights\_dep\_delay', 'flights\_dep\_ontime', 'wx\_temperature\_max',  
 'wx\_temperature\_min', 'wx\_apcp', 'wx\_prate', 'wx\_asnow', 'wx\_frozr', 'wx\_vis',  
 'wx\_gust', 'wx\_maxref', 'wx\_cape', 'wx\_lftx', 'wx\_wind\_speed',

```
'wx_wind_direction', 'flights_total', 'flights_cancel_pct', 'flights_delay_pct',
'flights_ontime_pct', 'flights_arr_delay_pct', 'flights_arr_ontime_pct',
'flights_arr_cancel_pct', 'flights_dep_delay_pct', 'flights_dep_ontime_pct',
'flights_dep_cancel_pct', 'random']
```

All columns accounted for: True

### 19.3 Split data sequentially 70/20/10

```
[3]: column_indices = {name: i for i, name in enumerate(df.columns)}

n = len(df)
train_df = df[0:int(n*0.7)]
val_df = df[int(n*0.7):int(n*0.9)]
test_df = df[int(n*0.9):]

# print data shapes
print(f"Train data shape: {train_df.shape}")
print(f"Validation data shape: {val_df.shape}")
print(f"Test data shape: {test_df.shape}")
```

```
Train data shape: (1179, 64)
Validation data shape: (337, 64)
Test data shape: (169, 64)
```

### 19.4 Preprocess data for recurrent neural network (RNN)

```
[4]: # Fit transformers to the training data
scaler = StandardScaler()
scaler.fit(train_df[numerical_cols])

ohe = OneHotEncoder(sparse_output=False, handle_unknown='ignore') # Some
    ↪ observed holidays may not be in the training data
ohe.fit(train_df[categorical_cols])
ohe_column_names = ohe.get_feature_names_out(input_features=categorical_cols)

# Define preprocessor
def preprocess(data):
    scaled_features = scaler.transform(data[numerical_cols])
    encoded_features = ohe.transform(data[categorical_cols])
    processed_data = pd.DataFrame(np.concatenate([scaled_features, ↪
        encoded_features], axis=1),
                                    columns = numerical_cols + ↪
                                    list(ohe_column_names))
    return processed_data

# Preprocess the data
```

```

train_df = preprocess(train_df)
val_df = preprocess(val_df)
test_df = preprocess(test_df)

print(f"\nNumber of columns before preprocessing: {num_features}")
print(f"Number of features after preprocessing: {train_df.shape[1]}")

```

Number of columns before preprocessing: 64  
Number of features after preprocessing: 105

## 19.5 WindowGenerator

The `WindowGenerator` class stores the raw data, that has already been split into train, validate, and test sets, and it handles indexes and offsets for windowing. Several methods are added to this class after it's initial creation. When the `split_window` method is added, the class will split data windows into separate tensors for features and labels. The `plot` method, produces a plot of an example batch showing inputs, labels, and predictions. The `make_dataset` method creates TensorFlow timeseries datasets that are batched, windowed, and ready for use in modeling.

```

[5]: class WindowGenerator():
    def __init__(self, input_width, label_width, shift,
                 train_df=train_df, val_df=val_df, test_df=test_df,
                 label_columns=None):

        # Store the raw data.
        self.train_df = train_df
        self.val_df = val_df
        self.test_df = test_df

        # Work out the label column indices.
        self.label_columns = label_columns
        if label_columns is not None:
            self.label_columns_indices = {name: i for i, name in
                                         enumerate(label_columns)}
        self.column_indices = {name: i for i, name in
                              enumerate(train_df.columns)}

        # Work out the window parameters.
        self.input_width = input_width
        self.label_width = label_width
        self.shift = shift

        self.total_window_size = input_width + shift

        self.input_slice = slice(0, input_width)
        self.input_indices = np.arange(self.total_window_size)[self.input_slice]

```

```

    self.label_start = self.total_window_size - self.label_width
    self.labels_slice = slice(self.label_start, None)
    self.label_indices = np.arange(self.total_window_size)[self.labels_slice]

def __repr__(self):
    return '\n'.join([
        f'Total window size: {self.total_window_size}',
        f'Input indices: {self.input_indices}',
        f'Label indices: {self.label_indices}',
        f'Label column name(s): {self.label_columns}'])

```

## 19.6 Instantiate WindowGenerators

```
[6]: w1 = WindowGenerator(input_width=24, label_width=1, shift=24,
                        label_columns=['flights_ontime'])

w2 = WindowGenerator(input_width=6, label_width=1, shift=1,
                        label_columns=['flights_ontime'])
```

## 19.7 Add split\_window method

```
[7]: def split_window(self, features):
    inputs = features[:, self.input_slice, :]
    labels = features[:, self.labels_slice, :]
    if self.label_columns is not None:
        labels = tf.stack(
            [labels[:, :, self.column_indices[name]] for name in self.
             ↵label_columns],
            axis=-1)

    inputs.set_shape([None, self.input_width, None])
    labels.set_shape([None, self.label_width, None])

    return inputs, labels

# Add the method to the class
WindowGenerator.split_window = split_window
```

Demonstrate split\_window on an example batch of 3 windows

```
[8]: # Stack three slices, the length of the total window. This creates an example
      ↵batch of 3 windows, each of 7-timesteps and 105 features
example_batch = tf.stack([np.array(train_df[:w2.total_window_size]),
                        np.array(train_df[100:100+w2.total_window_size]),
                        np.array(train_df[200:200+w2.total_window_size])])

example_inputs, example_labels = w2.split_window(example_batch)
```

```

print('All shapes are: (batch, time, features)')
print(f'Window shape: {example_batch.shape}')
print(f'Inputs shape: {example_inputs.shape}')
print(f'Labels shape: {example_labels.shape}')

```

All shapes are: (batch, time, features)  
 Window shape: (3, 7, 105)  
 Inputs shape: (3, 6, 105)  
 Labels shape: (3, 1, 1)

Create an “example” attribute for w2 and add the example batch inputs and labels

[9]: w2.example = example\_inputs, example\_labels

## 19.8 Add plot method

```

[45]: def plot(self, model=None, plot_col='flights_ontime', max_subplots=3):
    inputs, labels = self.example
    plt.figure(figsize=(12, 8))
    plot_col_index = self.column_indices[plot_col]
    max_n = min(max_subplots, len(inputs))
    for n in range(max_n):
        plt.subplot(max_n, 1, n+1)
        plt.ylabel(f'{plot_col} [normed]')

        # Plot inputs
        plt.plot(self.input_indices, inputs[n, :, plot_col_index],
                 label='Inputs', marker='.', zorder=-10)

        # Plot labels
        if self.label_columns:
            label_col_index = self.label_columns_indices.get(plot_col, None)
        else:
            label_col_index = plot_col_index

        if label_col_index is None:
            continue

        plt.scatter(self.label_indices, labels[n, :, label_col_index],
                    edgecolors='k', label='Labels', c='#2ca02c', s=64)

        # Plot predictions
        if model is not None:
            predictions = model(inputs)
            plt.scatter(self.label_indices, predictions[n, :, label_col_index],
                        marker='X', edgecolors='k', label='Predictions',
                        c='#ff7f0e', s=64)

```

```

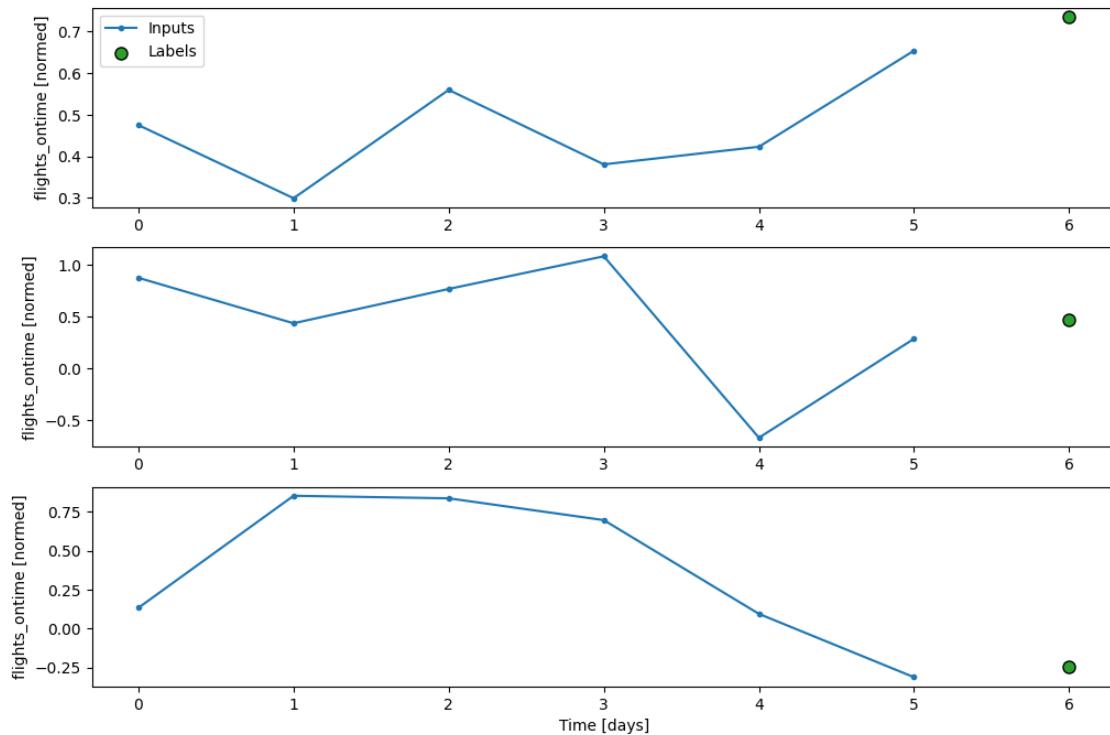
if n == 0:
    plt.legend()

plt.xlabel('Time [days]')

# Add the method to the class
WindowGenerator.plot = plot

```

[46]: w2.plot()



## 19.9 Add make\_dataset

The `make_dataset` method creates TensorFlow timeseries datasets from the data objects held by `WindowGenerator`. The `split_window` function is mapped over the windows of the TensorFlow datasets, creating inputs and labels for each window.

[47]:

```

def make_dataset(self,data):
    data = np.array(data, dtype=np.float32)
    ds = tf.keras.preprocessing.timeseries_dataset_from_array(
        data=data,
        targets=None,
        sequence_length=self.total_window_size,

```

```

        sequence_stride=1,
        shuffle=True,
        batch_size=32,)

ds = ds.map(self.split_window)

return ds

# Add the method to the class
WindowGenerator.make_dataset = make_dataset

```

## 20 Add properties to datasets within WindowGenerator

Add properties for accessing the train, validation, and test datasets as TensorFlow timeseries datasets created by make\_dataset. The `@property` decorator is used to define getter methods for properties of a class, allowing access to the result of a method as an attribute of the class.

```
[48]: @property
def train(self):
    return self.make_dataset(self.train_df)

@property
def val(self):
    return self.make_dataset(self.val_df)

@property
def test(self):
    return self.make_dataset(self.test_df)

@property
def example(self):
    """Get and cache an example batch of `inputs, labels` for plotting."""
    result = getattr(self, '_example', None)
    if result is None:
        # No example batch was found, so get one from the `train` dataset
        result = next(iter(self.train))
        # And cache it for next time
        self._example = result
    return result

# Add the properties to the class (redundant because the train, val, test, and
# example properties are already defined in the class)
WindowGenerator.train = train
WindowGenerator.val = val
WindowGenerator.test = test
WindowGenerator.example = example
```

The `element_spec` attribute

Inspect an element of a `tf.data.Dataset` of `w2` using the `element_spec` attribute

```
[49]: # Each element is an (inputs, label) pair.  
w2.train.element_spec
```

```
[49]: (TensorSpec(shape=(None, 6, 105), dtype=tf.float32, name=None),  
 TensorSpec(shape=(None, 1, 1), dtype=tf.float32, name=None))
```

Iterating over a `tf` timeseries dataset produced and held within a `WindowGenerator` instance, e.g. `w2.train` produces batches of data, where each batch has an input tensor and a labels tensor.

```
[51]: for example_inputs, example_labels in w2.train.take(1):  
    print(f'Inputs shape (batch, time steps, features): {example_inputs.shape}')  
    print(f'Labels shape (batch, time steps, features): {example_labels.shape}')
```

```
Inputs shape (batch, time steps, features): (32, 6, 105)  
Labels shape (batch, time steps, features): (32, 1, 1)
```

## 20.1 single\_step\_window

```
[52]: single_step_window = WindowGenerator(  
        input_width=1, label_width=1, shift=1,  
        label_columns=['flights_ontime'])  
single_step_window
```

```
[52]: Total window size: 2  
Input indices: [0]  
Label indices: [1]  
Label column name(s): ['flights_ontime']
```

Like for `w2.train`, iterating over `single_step_window.train` produces batches of two `Tensors`, inputs and labels. `w2` used 6 steps in the input and `single_step_window` uses 1.

```
[53]: for example_inputs, example_labels in single_step_window.train.take(1):  
    print(f'Inputs shape (batch, time, features): {example_inputs.shape}')  
    print(f'Labels shape (batch, time, features): {example_labels.shape}')
```

```
Inputs shape (batch, time, features): (32, 1, 105)  
Labels shape (batch, time, features): (32, 1, 1)
```

## 20.2 Baseline

The `Baseline` class inherits from `keras.Model` and uses the current value of a label to predict a label one step (one day) into the future, ignoring all other information. We hope to beat this model with a LSTM recurrent network that considers current and recent values of the label and other features.

```
[18]: class Baseline(tf.keras.Model):
    def __init__(self, label_index=None):
        super().__init__()
        self.label_index = label_index

    def call(self, inputs):
        if self.label_index is None:
            return inputs
        result = inputs[:, :, self.label_index]
        return result[:, :, tf.newaxis]
```

The baseline model of using the previous day's ontime flights to predict the next day's ontime flights produced MSE and MAE validation set scores of 2.51 and 1.36 respectively. Again, we'll try to beat this with a LSTM recurrent network.

```
[54]: baseline = Baseline(label_index=column_indices['flights_ontime'])

baseline.compile(loss=tf.keras.losses.MeanSquaredError(),
                  metrics=[tf.keras.metrics.MeanAbsoluteError()])

val_performance = {}
performance = {}
val_performance['Baseline'] = baseline.evaluate(single_step_window.val, verbose=0)
performance['Baseline'] = baseline.evaluate(single_step_window.test, verbose=0)

print("Validation performance: ", val_performance)
print("Test performance: ", performance)
```

Validation performance: {'Baseline': [2.5069453716278076, 1.3683136701583862]}  
Test performance: {'Baseline': [2.7119243144989014, 1.335585117340088]}

Below we create a wider window of 28 days (4 weeks) for visually evaluating the baseline model.

```
[55]: wide_window = WindowGenerator(
    input_width=28, label_width=28, shift=1,
    label_columns=['flights_ontime'])

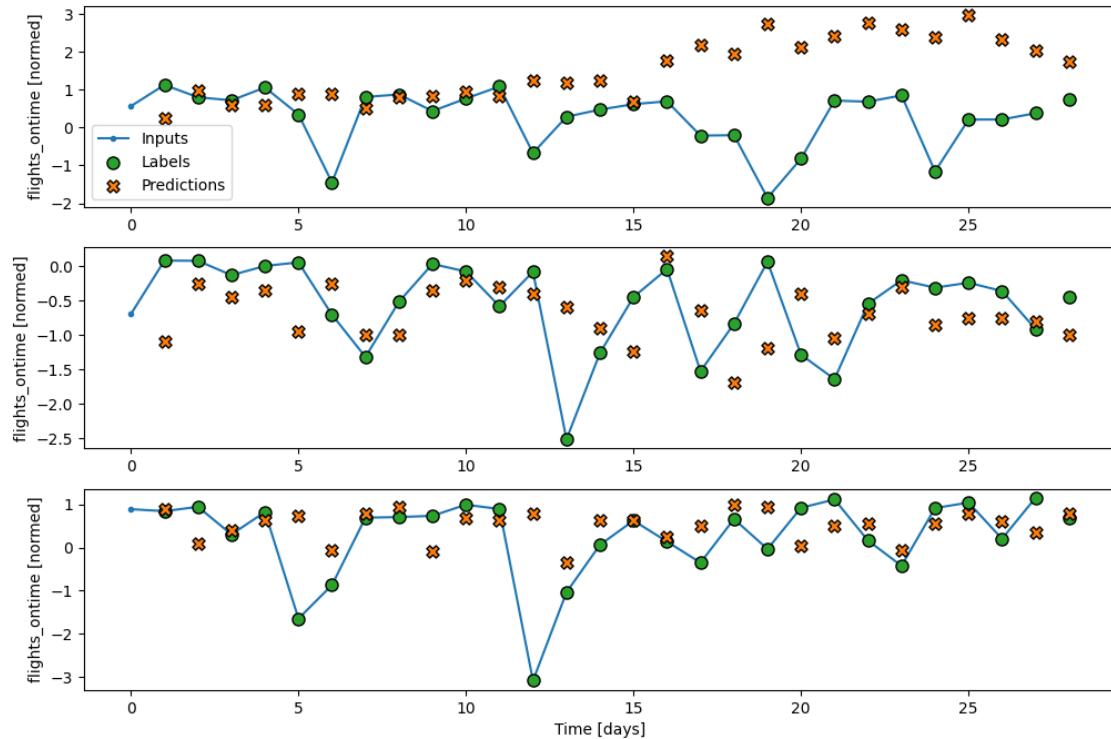
wide_window
```

```
[55]: Total window size: 29
Input indices: [ 0  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]
Label indices: [ 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]
Label column name(s): ['flights_ontime']
```

```
[56]: print('Input shape:', wide_window.example[0].shape)
print('Output shape:', baseline(wide_window.example[0]).shape)
```

Input shape: (32, 28, 105)  
Output shape: (32, 28, 1)

```
[57]: wide_window.plot(baseline)
```



```
[21]: wide_window.example[0]
```

```
[21]: <tf.Tensor: shape=(32, 28, 105), dtype=float32, numpy=
array([[[[-0.99603975, -0.654722, 1.2736163, ..., 0,
          1., 0.],
         [-0.9931016, -0.654722, 1.3867904, ..., 0.,
          1., 0.],
         [-0.9901634, -0.654722, 1.4999645, ..., 0.,
          1., 0.],
         ...,
         [-0.9225855, -0.654722, 0.5945719, ..., 0.,
          1., 0.],
         [-0.91964734, -0.654722, 0.70774597, ..., 0.,
          1., 0.],
         [-0.9167091, -0.654722, 0.82092, ..., 0.,
          1., 0.],
         [-0.9137709, -0.654722, 0.9341588, ..., 0.,
          1., 0.],
         [-0.9108327, -0.654722, 1.0473957, ..., 0.,
          1., 0.],
         [-0.9078945, -0.654722, 1.1606326, ..., 0.,
          1., 0.],
         [-0.9049563, -0.654722, 1.2738695, ..., 0.,
          1., 0.],
         [-0.9020181, -0.654722, 1.3871064, ..., 0.,
          1., 0.],
         [-0.8980799, -0.654722, 1.4999645, ..., 0.,
          1., 0.],
         [-0.8941417, -0.654722, 1.6132014, ..., 0.,
          1., 0.],
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          1., 0.],
         [-0.8862653, -0.654722, 1.8396752, ..., 0.,
          1., 0.],
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          1., 0.],
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          1., 0.],
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          1., 0.],
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          1., 0.],
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          1., 0.],
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          1., 0.],
         [-0.8586979, -0.654722, 2.6323334, ..., 0.,
          1., 0.],
         [-0.8547597, -0.654722, 2.7455703, ..., 0.,
          1., 0.],
         [-0.8508215, -0.654722, 2.8588072, ..., 0.,
          1., 0.],
         [-0.8468833, -0.654722, 2.9720441, ..., 0.,
          1., 0.],
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          1., 0.],
         [-0.8389069, -0.654722, 3.1985179, ..., 0.,
          1., 0.],
         [-0.8349687, -0.654722, 3.3117548, ..., 0.,
          1., 0.],
         [-0.8310305, -0.654722, 3.425], ...])
```

```

1. , 0. ]],

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...,
[ 0.9020183 , 1.3580999 , -1.6689097 , ..., 0. ,
1. , 0. ],
[ 0.90495646, 1.3580999 , -1.5557356 , ..., 0. ,
1. , 0. ],
[ 0.9078947 , 1.3580999 , -1.4425615 , ..., 1. ,
1. , 0. ]],

[[ 1.1811445 , 1.3580999 , -1.1030393 , ..., 0. ,
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1. , 0. ],
...,
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1. , 0. ]],

...,

[[ 1.1693918 , 1.3580999 , -1.5557356 , ..., 0. ,
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0. , 1. ],
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...,
[ 1.242846 , 1.3580999 , 1.2736163 , ..., 0. ,
1. , 0. ],
[ 1.2457843 , 1.3580999 , 1.3867904 , ..., 0. ,
1. , 0. ],
[ 1.2487224 , 1.3580999 , 1.4999645 , ..., 0. ,
1. , 0. ]],

[[-1.1811445 , -0.654722 , 0.82092 , ..., 0. ,

```

```

        1.          ,  0.          ],
[-1.1782063 , -0.654722  ,  0.9340941 , ...,  0.          ,
 1.          ,  0.          ],
[-1.1752682 , -0.654722  ,  1.0472682 , ...,  0.          ,
 1.          ,  0.          ],
...,
[-1.1076902 , -0.654722  ,  0.14187557, ...,  0.          ,
 1.          ,  0.          ],
[-1.1047521 , -0.654722  ,  0.25504965, ...,  0.          ,
 1.          ,  0.          ],
[-1.1018139 , -0.654722  ,  0.36822373, ...,  0.          ,
 1.          ,  0.          ]],

[[ 0.2379918 ,  0.35168898,  0.48139778, ...,  0.          ,
 1.          ,  0.          ],
[ 0.24092998,  0.35168898,  0.5945719 , ...,  0.          ,
 1.          ,  0.          ],
[ 0.24386814,  0.35168898,  0.70774597, ...,  0.          ,
 1.          ,  0.          ],
...,
[ 0.31144607,  0.35168898, -0.19764666, ...,  0.          ,
 1.          ,  0.          ],
[ 0.31438422,  0.35168898, -0.0844726 , ...,  0.          ,
 1.          ,  0.          ],
[ 0.3173224 ,  0.35168898,  0.02870148, ...,  0.          ,
 1.          ,  0.          ]]], dtype=float32)>

```

```
[60]: linear = Sequential([Dense(units=1)])

print('Input shape:', single_step_window.example[0].shape)
print('Output shape:', linear(single_step_window.example[0]).shape)
```

Input shape: (32, 1, 105)  
Output shape: (32, 1, 1)

```
[70]: MAX_EPOCHS = 20

def compile_and_fit(model, window, patience=2):
    early_stopping = tf.keras.callbacks.EarlyStopping(monitor='val_loss',
                                                       patience=patience,
                                                       mode='min')

    model.compile(loss='mean_squared_error',
                  optimizer=Adam(),
                  metrics=['mean_absolute_error'])

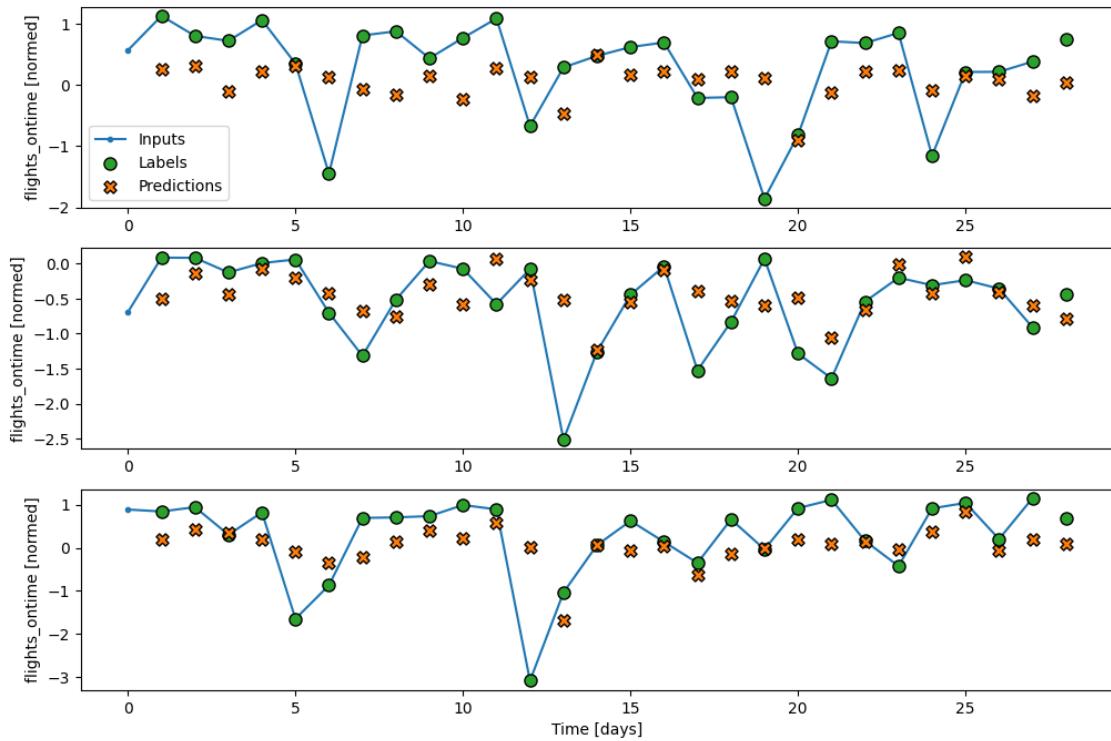
    history = model.fit(window.train, epochs=MAX_EPOCHS,
                        validation_data=window.val,
```

```
        callbacks=[early_stopping])  
    return history
```

```
[71]: history = compile_and_fit(linear, single_step_window)  
  
val_performance['Linear'] = linear.evaluate(single_step_window.val)  
performance['Linear'] = linear.evaluate(single_step_window.test, verbose=0)
```

```
Epoch 1/20  
37/37 [=====] - 0s 3ms/step - loss: 0.4619 -  
mean_absolute_error: 0.4787 - val_loss: 0.3916 - val_mean_absolute_error: 0.4188  
Epoch 2/20  
37/37 [=====] - 0s 2ms/step - loss: 0.4526 -  
mean_absolute_error: 0.4757 - val_loss: 0.3765 - val_mean_absolute_error: 0.4100  
Epoch 3/20  
37/37 [=====] - 0s 2ms/step - loss: 0.4481 -  
mean_absolute_error: 0.4727 - val_loss: 0.3717 - val_mean_absolute_error: 0.4082  
Epoch 4/20  
37/37 [=====] - 0s 2ms/step - loss: 0.4436 -  
mean_absolute_error: 0.4668 - val_loss: 0.3709 - val_mean_absolute_error: 0.4067  
Epoch 5/20  
37/37 [=====] - 0s 2ms/step - loss: 0.4402 -  
mean_absolute_error: 0.4683 - val_loss: 0.3706 - val_mean_absolute_error: 0.4069  
Epoch 6/20  
37/37 [=====] - 0s 1ms/step - loss: 0.4389 -  
mean_absolute_error: 0.4617 - val_loss: 0.3729 - val_mean_absolute_error: 0.4072  
Epoch 7/20  
37/37 [=====] - 0s 1ms/step - loss: 0.4361 -  
mean_absolute_error: 0.4646 - val_loss: 0.3727 - val_mean_absolute_error: 0.4077  
11/11 [=====] - 0s 489us/step - loss: 0.3727 -  
mean_absolute_error: 0.4077
```

```
[72]: wide_window.plot(linear)
```



```
[74]: lstm_model = tf.keras.models.Sequential([
    # Shape [batch, time, features] => [batch, time, lstm_units]
    tf.keras.layers.LSTM(32, return_sequences=True),
    # Shape => [batch, time, features]
    tf.keras.layers.Dense(units=1)
])
```

```
[76]: print('Input shape:', wide_window.example[0].shape)
print('Output shape:', lstm_model(wide_window.example[0]).shape)
```

Input shape: (32, 28, 105)  
 Output shape: (32, 28, 1)

```
[79]: history = compile_and_fit(lstm_model, wide_window)

IPython.display.clear_output()
val_performance['LSTM'] = lstm_model.evaluate(wide_window.val)
performance['LSTM'] = lstm_model.evaluate(wide_window.test, verbose=0)
```

10/10 [=====] - 0s 2ms/step - loss: 0.7129 -  
 mean\_absolute\_error: 0.6277

```
[80]: wide_window.plot(lstm_model)
```

