Optimisasi Kebijakan Tenaga Kerja Melalui Prediksi Time Series Tingkat Pengangguran dan Peluang Kerja di Jawa Barat

Business Undesrtanding

Salah satu provonsi di Indonesia yaitu Jawa Barat menghadapi tantangan kompleks dalam mengelola angka pengangguran dan peluang kerja. Pendekatan yang canggih diperlukan untuk memahami dan memprediksi tren di pasar tenaga kerja. Dengan membuat model prediksi time series untuk tingkat pengangguran dan peluang kerja di Jawa Barat mampu memberikan dasar yang kuat untuk perencanaan kebijakan yang efisien dan disesuaikan dengan dinamika pasar tenaga kerja di Jawa Barat.

Goal : Predictive Tingkat Pengangguran untuk Peluang Kerja 1 Tahun Kedepan

Case problem : Time Series

Jenis Machine Learning = Supervised Learning

Algoritma :

- Moving average
- Exponential smoothing
- SARIMAX
- ARIMA
- LSTM

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import plotly.express as px
import seaborn as sns
from sklearn.metrics import mean_absolute_error, mean_squared_error
from google.colab import drive
drive.mount('/content/drive')
```

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

DATA PENGANGGURAN

```
path='/content/drive/MyDrive/DataProject/persentase_tingkat_pengangguran.csv'
load_data=pd.read_csv(path)
load_data.head()
```

1 to 5 of 5 entries Filter

index	id	kode_provinsi	nama_provinsi	kode_kabupaten_kota	nama_kabupaten_kota	persentase_tingkat_pengangguran_terbuka	satuan	tahun
0	1	32	JAWA BARAT	3201	KABUPATEN BOGOR	14.26	PERSEN	2007
1	2	32	JAWA BARAT	3202	KABUPATEN SUKABUMI	10.85	PERSEN	2007
2	3	32	JAWA BARAT	3203	KABUPATEN CIANJUR	13.82	PERSEN	2007
3	4	32	JAWA BARAT	3204	KABUPATEN BANDUNG	17.37	PERSEN	2007
4	5	32	JAWA BARAT	3205	KABUPATEN GARUT	12.18	PERSEN	2007

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df=pd.DataFrame(load_data)
df
```

1 to 25 of 370 entries Filter

index	id	kode_provinsi	nama_provinsi	kode_kabupaten_kota	nama_kabupaten_kota	persentase_tingkat_pengangguran_terbuka	satuan	tahun
0	1	32	JAWA BARAT	3201	KABUPATEN BOGOR	14.26	PERSEN	2007
1	2	32	JAWA BARAT	3202	KABUPATEN SUKABUMI	10.85	PERSEN	2007
2	3	32	JAWA BARAT	3203	KABUPATEN CIANJUR	13.82	PERSEN	2007
3	4	32	JAWA BARAT	3204	KABUPATEN BANDUNG	17.37	PERSEN	2007
4	5	32	JAWA BARAT	3205	KABUPATEN GARUT	12.18	PERSEN	2007
5	6	32	JAWA BARAT	3206	KABUPATEN TASIKMALAYA	8.48	PERSEN	2007
6	7	32	JAWA BARAT	3207	KABUPATEN CIAMIS	4.39	PERSEN	2007
7	8	32	JAWA BARAT	3208	KABUPATEN KUNINGAN	10.56	PERSEN	2007
8	9	32	JAWA BARAT	3209	KABUPATEN CIREBON	13.64	PERSEN	2007
9	10	32	JAWA BARAT	3210	KABUPATEN MAJALENGKA	7.46	PERSEN	2007
10	11	32	JAWA BARAT	3211	KABUPATEN SUMEDANG	7.83	PERSEN	2007
11	12	32	JAWA BARAT	3212	KABUPATEN INDRAMAYU	10.45	PERSEN	2007
12	13	32	JAWA BARAT	3213	KABUPATEN SUBANG	7.51	PERSEN	2007
13	14	32	JAWA BARAT	3214	KABUPATEN PURWAKARTA	12.76	PERSEN	2007
14	15	32	JAWA BARAT	3215	KABUPATEN KARAWANG	17.02	PERSEN	2007
15	16	32	JAWA BARAT	3216	KABUPATEN BEKASI	15.12	PERSEN	2007
16	17	32	JAWA BARAT	3271	KOTA BOGOR	18.89	PERSEN	2007

```
df_filtered = df.loc[(df['tahun'] < 2007) | (df['tahun'] > 2015)]
df_filtered
```

1 to 25 of 162 entries Filter

index	id	kode_provinsi	nama_provinsi	kode_kabupaten_kota	nama_kabupaten_kota	persentase_tingkat_pengangguran_terbuka	satuan	tahun
208	209	32	JAWA BARAT	3201	KABUPATEN BOGOR	9.55	PERSEN	2017
209	210	32	JAWA BARAT	3202	KABUPATEN SUKABUMI	7.66	PERSEN	2017
210	211	32	JAWA BARAT	3203	KABUPATEN CIANJUR	10.1	PERSEN	2017
211	212	32	JAWA BARAT	3204	KABUPATEN BANDUNG	3.92	PERSEN	2017
212	213	32	JAWA BARAT	3205	KABUPATEN GARUT	7.86	PERSEN	2017
213	214	32	JAWA BARAT	3206	KABUPATEN TASIKMALAYA	6.61	PERSEN	2017
214	215	32	JAWA BARAT	3207	KABUPATEN CIAMIS	5.17	PERSEN	2017
215	216	32	JAWA BARAT	3208	KABUPATEN KUNINGAN	7.94	PERSEN	2017
216	217	32	JAWA BARAT	3209	KABUPATEN CIREBON	9.61	PERSEN	2017
217	218	32	JAWA BARAT	3210	KABUPATEN MAJALENGKA	5.02	PERSEN	2017
218	219	32	JAWA BARAT	3211	KABUPATEN SUMEDANG	7.15	PERSEN	2017
219	220	32	JAWA BARAT	3212	KABUPATEN INDRAMAYU	8.64	PERSEN	2017
220	221	32	JAWA BARAT	3213	KABUPATEN SUBANG	8.74	PERSEN	2017
221	222	32	JAWA BARAT	3214	KABUPATEN PURWAKARTA	9.11	PERSEN	2017
222	223	32	JAWA BARAT	3215	KABUPATEN KARAWANG	9.55	PERSEN	2017
223	224	32	JAWA BARAT	3216	KABUPATEN BEKASI	10.97	PERSEN	2017
224	225	32	JAWA BARAT	3217	KABUPATEN BANDUNG BARAT	9.33	PERSEN	2017
225	226	32	JAWA BARAT	3218	KABUPATEN PANGANDARAN	3.34	PERSEN	2017
226	227	32	JAWA BARAT	3271	KOTA BOGOR	9.57	PERSEN	2017
227	228	32	JAWA BARAT	3272	KOTA SUKABUMI	8.0	PERSEN	2017
228	229	32	JAWA BARAT	3273	KOTA BANDUNG	8.44	PERSEN	2017
229	230	32	JAWA BARAT	3274	KOTA CIREBON	9.29	PERSEN	2017
230	231	32	JAWA BARAT	3275	KOTA BEKASI	9.32	PERSEN	2017
231	232	32	JAWA BARAT	3276	KOTA DEPOK	7.0	PERSEN	2017
232	233	32	JAWA BARAT	3277	KOTA CIMAHI	8.43	PERSEN	2017

```
df_mean = df_filtered.groupby('tahun')['persentase_tingkat_pengangguran_terbuka'].mean().reset_index()
df_mean.columns = ['tahun', 'mean_tingkat_pengangguran']
df_mean
```

1 to 6 of 6 entries Filter

index	tahun	mean_tingkat_pengangguran
0	2017	7.895555555555556
1	2018	7.87037037037037
2	2019	7.794074074074074
3	2020	9.979999999999999
4	2021	9.40111111111111
5	2022	7.801111111111111

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

DATA JUMLAH LOWONGAN PEKERJAAN

```
path1='/content/drive/MyDrive/DataProject/jumlah_lowongan_kerja.csv'
load_data1=pd.read_csv(path1)
load_data1.head()
```

1 to 5 of 5 entries Filter

index	id	kode_provinsi	nama_provinsi	kode_kabupaten_kota	nama_kabupaten_kota	jumlah_lowongan_kerja	satuan	tahun
0	1	32	JAWA BARAT	3201	KABUPATEN BOGOR	20	LOWONGAN KERJA	2018
1	2	32	JAWA BARAT	3202	KABUPATEN SUKABUMI	193	LOWONGAN KERJA	2018
2	3	32	JAWA BARAT	3203	KABUPATEN CIANJUR	0	LOWONGAN KERJA	2018
3	4	32	JAWA BARAT	3204	KABUPATEN BANDUNG	0	LOWONGAN KERJA	2018
4	5	32	JAWA BARAT	3205	KABUPATEN GARUT	2	LOWONGAN KERJA	2018

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df1=pd.DataFrame(load_data1)
df1
```

1 to 25 of 135 entries Filter

index	id	kode_provinsi	nama_provinsi	kode_kabupaten_kota	nama_kabupaten_kota	jumlah_lowongan_kerja	satuan	tahun
0	1	32	JAWA BARAT	3201	KABUPATEN BOGOR	20	LOWONGAN KERJA	2018
1	2	32	JAWA BARAT	3202	KABUPATEN SUKABUMI	193	LOWONGAN KERJA	2018
2	3	32	JAWA BARAT	3203	KABUPATEN CIANJUR	0	LOWONGAN KERJA	2018
3	4	32	JAWA BARAT	3204	KABUPATEN BANDUNG	0	LOWONGAN KERJA	2018
4	5	32	JAWA BARAT	3205	KABUPATEN GARUT	2	LOWONGAN KERJA	2018
5	6	32	JAWA BARAT	3206	KABUPATEN TASIKMALAYA	150	LOWONGAN KERJA	2018
6	7	32	JAWA BARAT	3207	KABUPATEN CIAMIS	112	LOWONGAN KERJA	2018
7	8	32	JAWA BARAT	3208	KABUPATEN KUNINGAN	2241	LOWONGAN KERJA	2018
8	9	32	JAWA BARAT	3209	KABUPATEN CIREBON	10	LOWONGAN KERJA	2018
9	10	32	JAWA BARAT	3210	KABUPATEN MAJALENGKA	0	LOWONGAN KERJA	2018
10	11	32	JAWA BARAT	3211	KABUPATEN SUMEDANG	0	LOWONGAN KERJA	2018
11	12	32	JAWA BARAT	3212	KABUPATEN INDRAMAYU	80	LOWONGAN KERJA	2018
12	13	32	JAWA BARAT	3213	KABUPATEN SUBANG	1074	LOWONGAN KERJA	2018
13	14	32	JAWA BARAT	3214	KABUPATEN PURWAKARTA	323	LOWONGAN KERJA	2018
14	15	32	JAWA BARAT	3215	KABUPATEN KARAWANG	0	LOWONGAN KERJA	2018
15	16	32	JAWA BARAT	3216	KABUPATEN BEKASI	0	LOWONGAN KERJA	2018
16	17	32	JAWA BARAT	3217	KABUPATEN BANDUNG BARAT	3	LOWONGAN KERJA	2018
17	18	32	JAWA BARAT	3218	KABUPATEN PANGANDARAN	2	LOWONGAN KERJA	2018
18	19	32	JAWA BARAT	3271	KOTA BOGOR	515	LOWONGAN KERJA	2018
19	20	32	JAWA BARAT	3272	KOTA SUKABUMI	121	LOWONGAN KERJA	2018
20	21	32	JAWA BARAT	3273	KOTA BANDUNG	3001	LOWONGAN KERJA	2018
21	22	32	JAWA BARAT	3274	KOTA CIREBON	0	LOWONGAN KERJA	2018
22	23	32	JAWA BARAT	3275	KOTA BEKASI	0	LOWONGAN KERJA	2018
23	24	32	JAWA BARAT	3276	KOTA DEPOK	1	LOWONGAN KERJA	2018
24	25	32	JAWA BARAT	3277	KOTA CIMAHI	0	LOWONGAN KERJA	2018

Show 25 per page

1 2 3 4 5 6

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df1_lowongan = df1.groupby('tahun')['jumlah_lowongan_kerja'].sum().reset_index()
df1_lowongan.columns = ['tahun', 'total_jumlah_lowongan_kerja']
df1_lowongan
```

1 to 5 of 5 entries Filter

index	tahun	total_jumlah_lowongan_kerja
0	2018	8498
1	2019	10068
2	2020	4509
3	2021	143707
4	2022	169005

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

DATA JUMLAH PENDUDUK BERDASARKAN JENIS KELAMIN

```
path2='/content/drive/MyDrive/DataProject/jumlah_penduduk_yang_bekerja_berdasarkan_jenis_kelamin.csv'
load_data2=pd.read_csv(path2)
load_data2.head()
```

1 to 5 of 5 entries Filter

index	id	kode_provinsi	nama_provinsi	jenis_kelamin	jumlah_penduduk	satuan	tahun
0	1	32	JAWA BARAT	LAKI-LAKI	11739481	ORANG	2011
1	2	32	JAWA BARAT	PEREMPUAN	5715300	ORANG	2011
2	3	32	JAWA BARAT	LAKI-LAKI	12174176	ORANG	2012
3	4	32	JAWA BARAT	PEREMPUAN	6146932	ORANG	2012
4	5	32	JAWA BARAT	LAKI-LAKI	12635203	ORANG	2013

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df2=pd.DataFrame(load_data2)
df2
```

1 to 24 of 24 entries Filter

index	id	kode_provinsi	nama_provinsi	jenis_kelamin	jumlah_penduduk	satuan	tahun
0	1	32	JAWA BARAT	LAKI-LAKI	11739481	ORANG	2011
1	2	32	JAWA BARAT	PEREMPUAN	5715300	ORANG	2011
2	3	32	JAWA BARAT	LAKI-LAKI	12174176	ORANG	2012
3	4	32	JAWA BARAT	PEREMPUAN	6146932	ORANG	2012
4	5	32	JAWA BARAT	LAKI-LAKI	12635203	ORANG	2013
5	6	32	JAWA BARAT	PEREMPUAN	6096740	ORANG	2013
6	7	32	JAWA BARAT	LAKI-LAKI	12871114	ORANG	2014
7	8	32	JAWA BARAT	PEREMPUAN	6359829	ORANG	2014
8	9	32	JAWA BARAT	LAKI-LAKI	12865217	ORANG	2015
9	10	32	JAWA BARAT	PEREMPUAN	5926265	ORANG	2015
10	11	32	JAWA BARAT	LAKI-LAKI	12816484	ORANG	2016
11	12	32	JAWA BARAT	PEREMPUAN	6385554	ORANG	2016
12	13	32	JAWA BARAT	LAKI-LAKI	13531806	ORANG	2017
13	14	32	JAWA BARAT	PEREMPUAN	7019769	ORANG	2017
14	15	32	JAWA BARAT	LAKI-LAKI	13888195	ORANG	2018
15	16	32	JAWA BARAT	PEREMPUAN	6891693	ORANG	2018
16	17	32	JAWA BARAT	LAKI-LAKI	14164530	ORANG	2019
17	18	32	JAWA BARAT	PEREMPUAN	7738428	ORANG	2019
18	19	32	JAWA BARAT	LAKI-LAKI	13829693	ORANG	2020
19	20	32	JAWA BARAT	PEREMPUAN	7845161	ORANG	2020
20	21	32	JAWA BARAT	LAKI-LAKI	14124533	ORANG	2021
21	22	32	JAWA BARAT	PEREMPUAN	8188948	ORANG	2021
22	23	32	JAWA BARAT	LAKI-LAKI	14988897	ORANG	2022
23	24	32	JAWA BARAT	PEREMPUAN	8463671	ORANG	2022

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df2_jml_penduduk = df2.groupby('tahun')['jumlah_penduduk'].sum().reset_index()
df2_jml_penduduk.columns = ['tahun', 'total_jumlah_penduduk']
df2_jml_penduduk
```

1 to 12 of 12 entries Filter

index	tahun	total_jumlah_penduduk
0	2011	17454781
1	2012	18321108
2	2013	18731943
3	2014	19230943
4	2015	18791482
5	2016	19202038
6	2017	20551575
7	2018	20779888
8	2019	21902958
9	2020	21674854
10	2021	22313481
11	2022	23452568

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

DATA GABUNGAN

```
data = df_mean.merge(df1_lowongan, on='tahun').merge(df2_jml_penduduk, on='tahun')
data
```

1 to 5 of 5 entries Filter

index	tahun	mean_tingkat_pengangguran	total_jumlah_lowongan_kerja	total_jumlah_penduduk
0	2018	7.87037037037037	8498	20779888
1	2019	7.794074074074074	10068	21902958
2	2020	9.979999999999999	4509	21674854
3	2021	9.40111111111111	143707	22313481
4	2022	7.801111111111111	169005	23452568

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
# data.to_excel('/content/drive/MyDrive/DataProject/data_before_2018-2022.xlsx', index=False)
```

Data Understanding

```
path3='/content/drive/MyDrive/DataProject/data_before_2018-2022.xlsx'
load_data3=pd.read_excel(path3)
load_data3
```

1 to 5 of 5 entries Filter

index	tahun	mean_tingkat_pengangguran	total_jumlah_lowongan_kerja	total_jumlah_penduduk	tingkat_pengangguran_ma
0	2018	7.87037037037037	8498	20779888	NaN
1	2019	7.794074074074074	10068	21902958	NaN
2	2020	9.979999999999999	4509	21674854	8.548148148148147
3	2021	9.40111111111111	143707	22313481	9.058395061728394
4	2022	7.801111111111111	169005	23452568	9.060740740740739

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df3=pd.DataFrame(load_data3)
df3
```

1 to 3 of 3 entries Filter

index	tahun	mean_tingkat_pengangguran	total_jumlah_lowongan_kerja	total_jumlah_penduduk	tingkat_pengangguran_ma	tingkat_pengangguran_ex
2	2020-01-01 00:00:00	9.979999999999999	4509	21674854	8.548148148148147	10.150406
3	2021-01-01 00:00:00	9.40111111111111	143707	22313481	9.058395061728394	9.060825
4	2022-01-01 00:00:00	7.801111111111111	169005	23452568	9.060740740740739	7.971243

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df3.info()
```

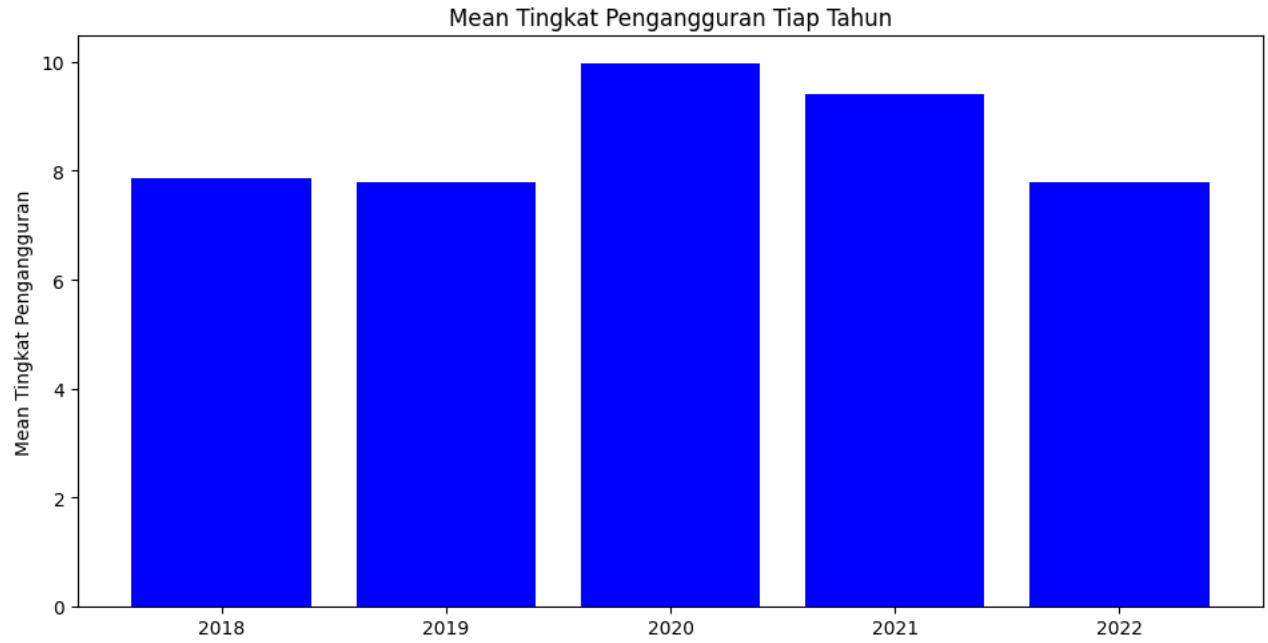
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5 entries, 0 to 4
Data columns (total 4 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tahun                       5 non-null      int64
 1   mean_tingkat_pengangguran   5 non-null      float64
 2   total_jumlah_lowongan_kerja 5 non-null      int64
 3   total_jumlah_penduduk       5 non-null      int64
dtypes: float64(1), int64(3)
memory usage: 288.0 bytes
```

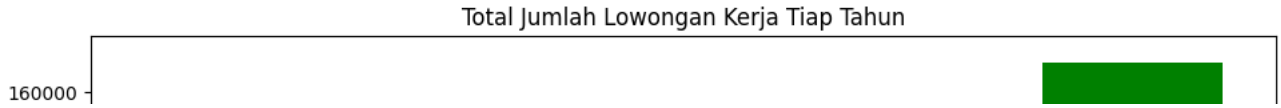
```
df3.isnull().sum()
```

```
tahun                         0
mean_tingkat_pengangguran     0
total_jumlah_lowongan_kerja   0
total_jumlah_penduduk         0
dtype: int64
```

Data Preparation

```
tahun = [2018, 2019, 2020, 2021, 2022]
mean_tingkat_pengangguran = [7.870370, 7.794074, 9.98, 9.401111, 7.801111]
total_jumlah_lowongan_kerja = [8498, 10068, 4509, 143707, 169005]
total_jumlah_penduduk = [20779888, 21902958, 21674854, 22313481, 23452568]

fig, (ax1, ax2, ax3) = plt.subplots(3, 1, figsize=(10, 15))

ax1.bar(tahun, mean_tingkat_pengangguran, color='blue')
ax1.set_title('Mean Tingkat Pengangguran Tiap Tahun')
ax1.set_ylabel('Mean Tingkat Pengangguran')

ax2.bar(tahun, total_jumlah_lowongan_kerja, color='green')
ax2.set_title('Total Jumlah Lowongan Kerja Tiap Tahun')
ax2.set_ylabel('Total Jumlah Lowongan Kerja')

ax3.bar(tahun, total_jumlah_penduduk, color='orange')
ax3.set_title('Total Jumlah Penduduk Tiap Tahun')
ax3.set_ylabel('Total Jumlah Penduduk')

plt.xlabel('Tahun')
plt.tight_layout()
plt.show()
```





Data modelling

MOVING AVERAGE

```
window_size = 3
df3['tingkat_pengangguran_ma'] = df3['mean_tingkat_pengangguran'].rolling(window=window_size).mean()
print(df3[['tahun', 'mean_tingkat_pengangguran', 'tingkat_pengangguran_ma']])
```

```
   tahun  mean_tingkat_pengangguran  tingkat_pengangguran_ma
0   2018                          8                      NaN
1   2019                          8                      NaN
2   2020                         10                        9
3   2021                          9                        9
4   2022                          8                        9
```

Evaluation model

```
df3.dropna(inplace=True)

mae = mean_absolute_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_ma'])
print(f'MAE Moving Average: {mae}')


rmse = np.sqrt(mean_squared_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_ma']))
print(f'RMSE Moving Average: {rmse}')
```

```
MAE Moving Average: 1.0113991769547317
RMSE Moving Average: 1.118677913133318
```

EXPONENTIAL SMOOTHING

```
!pip install statsmodels
```

```
Requirement already satisfied: statsmodels in /usr/local/lib/python3.10/dist-packages (0.14.0)
Requirement already satisfied: numpy>=1.18 in /usr/local/lib/python3.10/dist-packages (from statsmodels) (1.23.5)
Requirement already satisfied: scipy!=1.9.2,>=1.4 in /usr/local/lib/python3.10/dist-packages (from statsmodels) (1.11.4)
Requirement already satisfied: pandas>=1.0 in /usr/local/lib/python3.10/dist-packages (from statsmodels) (1.5.3)
Requirement already satisfied: patsy>=0.5.2 in /usr/local/lib/python3.10/dist-packages (from statsmodels) (0.5.3)
Requirement already satisfied: packaging>=21.3 in /usr/local/lib/python3.10/dist-packages (from statsmodels) (23.2)
Requirement already satisfied: python-dateutil>=2.8.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.0->statsmodels) (2
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.0->statsmodels) (2023.3.post1
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from patsy>=0.5.2->statsmodels) (1.16.0)
```

```
from statsmodels.tsa.holtwinters import ExponentialSmoothing


df3['tahun'] = pd.to_datetime(df3['tahun'], format='%Y')
model = ExponentialSmoothing(df3['mean_tingkat_pengangguran'], trend='add', seasonal=None)
fit_model = model.fit()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning:

An unsupported index was provided and will be ignored when e.g. forecasting.
```

```
# Melakukan prediksi untuk data yang telah ada
df3['tingkat_pengangguran_exp_smooth'] = fit_model.fittedvalues

# Melakukan prediksi untuk 1 tahun ke depan
forecast = fit_model.forecast(steps=12)
df3['tingkat_pengangguran_exp_smooth_forecast'] = forecast
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning:

No supported index is available. Prediction results will be given with an integer index beginning at `start`.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning:

No supported index is available. In the next version, calling this method in a model without a supported index will result in an exc
```

Evaluation model

```
mae_exp_smooth = mean_absolute_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_exp_smooth'])
rmse_exp_smooth = np.sqrt(mean_squared_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_exp_smooth']))

print(f'MAE Exponential Smoothing: {mae_exp_smooth}')
print(f'RMSE Exponential Smoothing: {rmse_exp_smooth}')
```

```
MAE Exponential Smoothing: 0.22694174108274337
RMSE Exponential Smoothing: 0.2406782397314199
```

SARIMAX

```
from statsmodels.tsa.statespace.sarimax import SARIMAX


order = (1, 1, 1)  # Parameter order (p, d, q) yang dapat disesuaikan
seasonal_order = (1, 1, 1, 12)  # Parameter seasonal order (P, D, Q, m) yang dapat disesuaikan
model_sarimax = SARIMAX(df3['mean_tingkat_pengangguran'], order=order, seasonal_order=seasonal_order)
fit_model_sarimax = model_sarimax.fit(disp=False)
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning:

An unsupported index was provided and will be ignored when e.g. forecasting.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning:

An unsupported index was provided and will be ignored when e.g. forecasting.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/statespace/sarimax.py:866: UserWarning:

Too few observations to estimate starting parameters for ARMA and trend. All parameters except for variances will be set to zeros.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/statespace/sarimax.py:866: UserWarning:

Too few observations to estimate starting parameters for seasonal ARMA. All parameters except for variances will be set to zeros.
```

```
# Melakukan prediksi untuk data yang telah ada
df3['tingkat_pengangguran_sarimax'] = fit_model_sarimax.fittedvalues

# Melakukan prediksi untuk 1 tahun ke depan
forecast_sarimax = fit_model_sarimax.get_forecast(steps=12)
df3['tingkat_pengangguran_sarimax_forecast'] = forecast_sarimax.predicted_mean
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning:

No supported index is available. Prediction results will be given with an integer index beginning at `start`.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning:
```

```
No supported index is available. In the next version, calling this method in a model without a supported index will result in an exc
```

Evaluation model

```
mae_sarimax = mean_absolute_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_sarimax'])
rmse_sarimax = np.sqrt(mean_squared_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_sarimax']))

print(f'MAE SARIMAX: {mae_sarimax}')
print(f'RMSE SARIMAX: {rmse_sarimax}')
```

```
MAE SARIMAX: 4.052962962962962
RMSE SARIMAX: 5.845098013027069
```

ARIMA

```
from statsmodels.tsa.arima.model import ARIMA
```

```
order = (1, 1, 1)  # Parameter order (p, d, q) yang dapat disesuaikan
model_arima = ARIMA(df3['mean_tingkat_pengangguran'], order=order)
fit_model_arima = model_arima.fit()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning:

An unsupported index was provided and will be ignored when e.g. forecasting.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning:

An unsupported index was provided and will be ignored when e.g. forecasting.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning:

An unsupported index was provided and will be ignored when e.g. forecasting.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/statespace/sarimax.py:866: UserWarning:

Too few observations to estimate starting parameters for ARMA and trend. All parameters except for variances will be set to zeros.
```

```
# Melakukan prediksi untuk data yang telah ada
df3['tingkat_pengangguran_arima'] = fit_model_arima.fittedvalues

# Melakukan prediksi untuk 1 tahun ke depan
forecast_arima = fit_model_arima.get_forecast(steps=12)
df3['tingkat_pengangguran_arima_forecast'] = forecast_arima.predicted_mean
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning:

No supported index is available. Prediction results will be given with an integer index beginning at `start`.

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning:

No supported index is available. In the next version, calling this method in a model without a supported index will result in an exc
```

Evaluation model

```
mae_arima = mean_absolute_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_arima'])
rmse_arima = np.sqrt(mean_squared_error(df3['mean_tingkat_pengangguran'], df3['tingkat_pengangguran_arima']))

print(f'MAE ARIMA: {mae_arima}')
print(f'RMSE ARIMA: {rmse_arima}')
```

```
MAE ARIMA: 3.9294957106343396
RMSE ARIMA: 5.81513577241923
```

LSTM

```
import tensorflow as tf
```

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense
from sklearn.preprocessing import MinMaxScaler


print(df3.mean_tingkat_pengangguran)
```

```
2   10
3    9
4    8
Name: mean_tingkat_pengangguran, dtype: float64
```

```
from keras.models import Sequential
from keras.layers import LSTM, Dense

df4 = pd.DataFrame({'mean_tingkat_pengangguran': [7.870370, 7.794074, 9.98, 9.401111, 7.801111]})
array_data = df4['mean_tingkat_pengangguran'].values

scaler = MinMaxScaler(feature_range=(0, 1))
scaled_data = scaler.fit_transform(array_data.reshape(-1, 1))

time_steps = 2
def create_dataset(dataset, time_steps, target_column=0):
    x_data, y_data = [], []
    for i in range(len(dataset) - time_steps):
        a = dataset[i:(i + time_steps), :]
        x_data.append(a)
        y_data.append(dataset[i + time_steps, target_column])
    return np.array(x_data), np.array(y_data)

x_data, y_data = create_dataset(scaled_data, time_steps)

x_data = np.reshape(x_data, (x_data.shape[0], x_data.shape[1], 1))

model_lstm = Sequential()
model_lstm.add(LSTM(units=50, return_sequences=True, input_shape=(x_data.shape[1], 1)))
model_lstm.add(LSTM(units=50))
model_lstm.add(Dense(units=1))
model_lstm.compile(optimizer='adam', loss='mean_squared_error')

model_lstm.fit(x_data, y_data, epochs=50, batch_size=1, verbose=2)

predictions = model_lstm.predict(x_data)

predictions_original = scaler.inverse_transform(predictions.reshape(-1, 1))
y_data_original = scaler.inverse_transform(y_data.reshape(-1, 1))
```

```
Epoch 1/50
3/3 - 6s - loss: 0.5088 - 6s/epoch - 2s/step
Epoch 2/50
3/3 - 0s - loss: 0.4894 - 44ms/epoch - 15ms/step
Epoch 3/50
3/3 - 0s - loss: 0.4687 - 66ms/epoch - 22ms/step
Epoch 4/50
3/3 - 0s - loss: 0.4516 - 38ms/epoch - 13ms/step
Epoch 5/50
3/3 - 0s - loss: 0.4333 - 57ms/epoch - 19ms/step
Epoch 6/50
3/3 - 0s - loss: 0.4157 - 27ms/epoch - 9ms/step
Epoch 7/50
3/3 - 0s - loss: 0.4058 - 42ms/epoch - 14ms/step
Epoch 8/50
3/3 - 0s - loss: 0.3818 - 47ms/epoch - 16ms/step
Epoch 9/50
3/3 - 0s - loss: 0.3676 - 25ms/epoch - 8ms/step
Epoch 10/50
3/3 - 0s - loss: 0.3490 - 31ms/epoch - 10ms/step
Epoch 11/50
3/3 - 0s - loss: 0.3252 - 27ms/epoch - 9ms/step
Epoch 12/50
3/3 - 0s - loss: 0.3062 - 24ms/epoch - 8ms/step
Epoch 13/50
3/3 - 0s - loss: 0.3024 - 23ms/epoch - 8ms/step
Epoch 14/50
3/3 - 0s - loss: 0.2832 - 19ms/epoch - 6ms/step
Epoch 15/50
3/3 - 0s - loss: 0.2606 - 22ms/epoch - 7ms/step
Epoch 16/50
3/3 - 0s - loss: 0.2467 - 21ms/epoch - 7ms/step
Epoch 17/50
3/3 - 0s - loss: 0.2310 - 26ms/epoch - 9ms/step
Epoch 18/50
3/3 - 0s - loss: 0.2174 - 21ms/epoch - 7ms/step
Epoch 19/50
3/3 - 0s - loss: 0.2097 - 22ms/epoch - 7ms/step
Epoch 20/50
```

```
3/3 - 0s - loss: 0.1986 - 29ms/epoch - 10ms/step
Epoch 21/50
3/3 - 0s - loss: 0.1803 - 21ms/epoch - 7ms/step
Epoch 22/50
3/3 - 0s - loss: 0.1645 - 21ms/epoch - 7ms/step
Epoch 23/50
3/3 - 0s - loss: 0.1496 - 27ms/epoch - 9ms/step
Epoch 24/50
3/3 - 0s - loss: 0.1412 - 29ms/epoch - 10ms/step
Epoch 25/50
3/3 - 0s - loss: 0.1242 - 42ms/epoch - 14ms/step
Epoch 26/50
3/3 - 0s - loss: 0.1113 - 28ms/epoch - 9ms/step
Epoch 27/50
3/3 - 0s - loss: 0.0968 - 35ms/epoch - 12ms/step
Epoch 28/50
3/3 - 0s - loss: 0.0835 - 31ms/epoch - 10ms/step
Epoch 29/50
3/3 - 0s - loss: 0.0707 - 29ms/epoch - 10ms/step
```

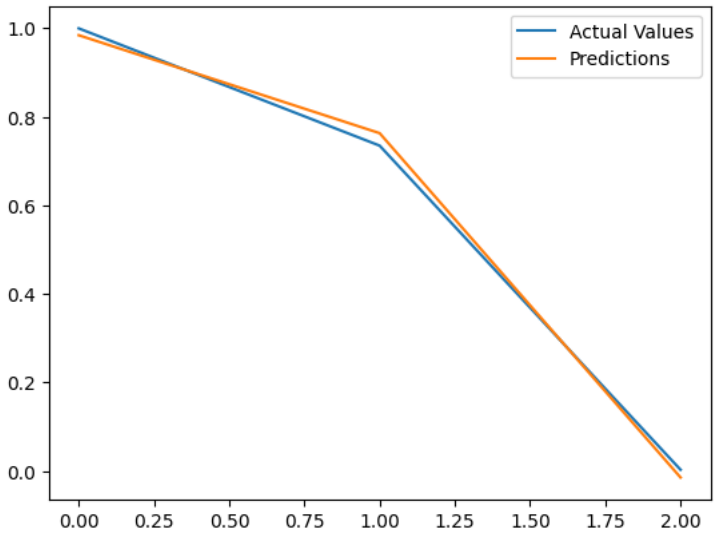
Evaluation model

```
mae = mean_absolute_error(y_data_original, predictions_original)
rmse = np.sqrt(mean_squared_error(y_data_original, predictions_original))

print(f'MAE LSTM: {mae}')
print(f'RMSE LSTM: {rmse}')
```

```
MAE LSTM: 0.044519704182942675
RMSE LSTM: 0.0461618310576511
```

```
train_loss = model_lstm.evaluate(x_data, y_data, verbose=0)
print(f'Training Loss: {train_loss}')

predictions = model_lstm.predict(x_data)

plt.plot(y_data, label='Actual Values')
plt.plot(predictions, label='Predictions')
plt.legend()
plt.show()
```

```
Training Loss: 0.000445959361968562
1/1 [==============================] - 0s 33ms/step
```



Conclusion

Pada kelima pemodelan tingkat pengangguran diperoleh:

1.
   - MAE Moving Average: 1.0113991769547317
   - RMSE Moving Average: 1.118677913133318
2.
   - MAE Exponential Smoothing: 0.22694174108274337
   - RMSE Exponential Smoothing: 0.2406782397314199
3.
   - MAE SARIMAX: 4.052962962962962
   - RMSE SARIMAX: 5.845098013027069
4.
   - MAE ARIMA: 3.9294957106343396

- RMSE ARIMA: 5.81513577241923

5. - MAE LSTM: 0.044519704182942675
   - RMSE LSTM: 0.0461618310576511

Dari kelima algoritma di atas, LSTM adalah yang paling cocok untuk apply model to machine learning. Hal ini karena LSTM memiliki MAE yang paling kecil, yaitu 0.044519704182942675. MAE yang kecil menunjukkan bahwa LSTM memiliki error yang kecil, sehingga LSTM lebih akurat dalam memprediksitingkat pengagguran untuk peluang kerja di Jawa Barat.

Secara umum, dalam konteks evaluasi model, nilai MAE dan RMSE yang lebih kecil menunjukkan bahwa model memiliki kinerja yang lebih baik. Model LSTM memberikan tingkat error yang sangat rendah, menunjukkan bahwa model ini mampu menangkap pola dan tren dengan baik pada data waktu yang kompleks.

Implement Model to Machine Learning

Model yg akan digunakan adalah Long Short-Term Memory (LSTM)

```
path4='/content/drive/MyDrive/DataProject/data_before_2018-2022.xlsx'
load_data4=pd.read_excel(path4)
load_data4
data_pred=pd.DataFrame(load_data4)
data_pred
```

1 to 5 of 5 entries Filter

index	tahun	mean_tingkat_pengangguran	total_jumlah_lowongan_kerja	total_jumlah_penduduk
0	2018	7.87037037037037	8498	20779888
1	2019	7.794074074074074	10068	21902958
2	2020	9.979999999999999	4509	21674854
3	2021	9.40111111111111	143707	22313481
4	2022	7.801111111111111	169005	23452568

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
data_pred.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5 entries, 0 to 4
Data columns (total 4 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tahun                       5 non-null      int64
 1   mean_tingkat_pengangguran   5 non-null      float64
 2   total_jumlah_lowongan_kerja 5 non-null      int64
 3   total_jumlah_penduduk       5 non-null      int64
dtypes: float64(1), int64(3)
memory usage: 288.0 bytes
```

```
data_pred.loc[:, "total_jumlah_lowongan_kerja"]
```

```
0      8498
1     10068
2      4509
3    143707
4    169005
Name: total_jumlah_lowongan_kerja, dtype: int64
```

PREDIKSI TINGKAT PENGANGGURAN

```
time_steps = 2
steps_ahead = 12
future_predictions = []

current_data = x_data[-1]
for _ in range(steps_ahead):
    current_data_reshaped = current_data.reshape(1, time_steps, 1)
    next_prediction_scaled = model_lstm.predict(current_data_reshaped)
    future_predictions.append(next_prediction_scaled[0, 0])
    current_data = np.append(current_data[1:], next_prediction_scaled[0, 0])

future_predictions_original_pengangguran = scaler.inverse_transform(np.array(future_predictions).reshape(-1, 1))

print("Prediksi Tingkat Pengangguran 1 Tahun ke Depan:")
print(future_predictions_original_pengangguran)
```

```
1/1 [==============================] - 0s 23ms/step
1/1 [==============================] - 0s 19ms/step
1/1 [==============================] - 0s 20ms/step
1/1 [==============================] - 0s 26ms/step
1/1 [==============================] - 0s 32ms/step
1/1 [==============================] - 0s 23ms/step
1/1 [==============================] - 0s 22ms/step
1/1 [==============================] - 0s 23ms/step
1/1 [==============================] - 0s 23ms/step
1/1 [==============================] - 0s 22ms/step
1/1 [==============================] - 0s 23ms/step
1/1 [==============================] - 0s 34ms/step
Prediksi Tingkat Pengangguran 1 Tahun ke Depan:
[[7.762847 ]
 [8.575511 ]
 [9.852571 ]
 [8.7959   ]
 [7.9829736]
 [9.052284 ]
 [9.527851 ]
 [8.465825 ]
 [8.312522 ]
 [9.27032  ]
 [9.172595 ]
 [8.3659   ]]
```

PREDIKSI JUMLAH LOWONGAN KERJA

```
jumlah_lowongan_kerja = [8498, 10068, 4509, 143707, 169005]

scaler_lowongan = MinMaxScaler(feature_range=(0, 1))
scaled_data_lowongan = scaler_lowongan.fit_transform(np.array(jumlah_lowongan_kerja).reshape(-1, 1))

x_data_lowongan, y_data_lowongan = create_dataset(scaled_data_lowongan, time_steps)
x_data_lowongan = np.reshape(x_data_lowongan, (x_data_lowongan.shape[0], x_data_lowongan.shape[1], 1))

model_lstm_lowongan = Sequential()
model_lstm_lowongan.add(LSTM(units=50, return_sequences=True, input_shape=(x_data_lowongan.shape[1], 1)))
model_lstm_lowongan.add(LSTM(units=50))
model_lstm_lowongan.add(Dense(units=1))
model_lstm_lowongan.compile(optimizer='adam', loss='mean_squared_error')

model_lstm_lowongan.fit(x_data_lowongan, y_data_lowongan, epochs=50, batch_size=1, verbose=2)

predictions_lowongan = model_lstm_lowongan.predict(x_data_lowongan)

predictions_original_lowongan = scaler_lowongan.inverse_transform(predictions_lowongan.reshape(-1, 1))
y_data_original_lowongan = scaler_lowongan.inverse_transform(y_data_lowongan.reshape(-1, 1))
```

```
Epoch 1/50
3/3 - 5s - loss: 0.5685 - 5s/epoch - 2s/step
Epoch 2/50
3/3 - 0s - loss: 0.5499 - 32ms/epoch - 11ms/step
Epoch 3/50
3/3 - 0s - loss: 0.5341 - 96ms/epoch - 32ms/step
Epoch 4/50
3/3 - 0s - loss: 0.5136 - 35ms/epoch - 12ms/step
Epoch 5/50
3/3 - 0s - loss: 0.4889 - 44ms/epoch - 15ms/step
Epoch 6/50
3/3 - 0s - loss: 0.4759 - 50ms/epoch - 17ms/step
Epoch 7/50
3/3 - 0s - loss: 0.4535 - 49ms/epoch - 16ms/step
Epoch 8/50
3/3 - 0s - loss: 0.4287 - 36ms/epoch - 12ms/step
Epoch 9/50
3/3 - 0s - loss: 0.4015 - 31ms/epoch - 10ms/step
Epoch 10/50
3/3 - 0s - loss: 0.3715 - 42ms/epoch - 14ms/step
Epoch 11/50
3/3 - 0s - loss: 0.3554 - 48ms/epoch - 16ms/step
Epoch 12/50
3/3 - 0s - loss: 0.3291 - 28ms/epoch - 9ms/step
Epoch 13/50
3/3 - 0s - loss: 0.2993 - 23ms/epoch - 8ms/step
Epoch 14/50
3/3 - 0s - loss: 0.2673 - 33ms/epoch - 11ms/step
Epoch 15/50
3/3 - 0s - loss: 0.2489 - 31ms/epoch - 10ms/step
Epoch 16/50
3/3 - 0s - loss: 0.2168 - 54ms/epoch - 18ms/step
Epoch 17/50
3/3 - 0s - loss: 0.2104 - 43ms/epoch - 14ms/step
Epoch 18/50
3/3 - 0s - loss: 0.1860 - 31ms/epoch - 10ms/step
Epoch 19/50
```

```
3/3 - 0s - loss: 0.1694 - 58ms/epoch - 19ms/step
Epoch 20/50
3/3 - 0s - loss: 0.1687 - 33ms/epoch - 11ms/step
Epoch 21/50
3/3 - 0s - loss: 0.1667 - 39ms/epoch - 13ms/step
Epoch 22/50
3/3 - 0s - loss: 0.1704 - 44ms/epoch - 15ms/step
Epoch 23/50
3/3 - 0s - loss: 0.1683 - 41ms/epoch - 14ms/step
Epoch 24/50
3/3 - 0s - loss: 0.1648 - 33ms/epoch - 11ms/step
Epoch 25/50
3/3 - 0s - loss: 0.1637 - 49ms/epoch - 16ms/step
Epoch 26/50
3/3 - 0s - loss: 0.1631 - 38ms/epoch - 13ms/step
Epoch 27/50
3/3 - 0s - loss: 0.1618 - 55ms/epoch - 18ms/step
Epoch 28/50
3/3 - 0s - loss: 0.1604 - 35ms/epoch - 12ms/step
Epoch 29/50
3/3 - 0s - loss: 0.1590 - 76ms/epoch - 25ms/step
```

```
steps_ahead_lowongan = 12
future_predictions_lowongan = []

current_data_lowongan = x_data_lowongan[-1]
for _ in range(steps_ahead_lowongan):
    current_data_reshaped_lowongan = current_data_lowongan.reshape(1, time_steps_lowongan, 1)
    next_prediction_scaled_lowongan = model_lstm_lowongan.predict(current_data_reshaped_lowongan)
    future_predictions_lowongan.append(next_prediction_scaled_lowongan[0, 0])
    current_data_lowongan = np.append(current_data_lowongan[1:], next_prediction_scaled_lowongan[0, 0])

future_predictions_original_lowongan = scaler_lowongan.inverse_transform(np.array(future_predictions_lowongan).reshape(-1, 1))

pd.options.display.float_format = '{:,.0f}'.format

print("Prediksi Jumlah Lowongan Kerja 1 Tahun ke Depan:")
print(future_predictions_original_lowongan)
```

```
1/1 [==============================] - 0s 39ms/step
1/1 [==============================] - 0s 45ms/step
1/1 [==============================] - 0s 58ms/step
1/1 [==============================] - 0s 87ms/step
1/1 [==============================] - 0s 35ms/step
1/1 [==============================] - 0s 29ms/step
1/1 [==============================] - 0s 107ms/step
1/1 [==============================] - 0s 57ms/step
1/1 [==============================] - 0s 74ms/step
1/1 [==============================] - 0s 40ms/step
1/1 [==============================] - 0s 43ms/step
1/1 [==============================] - 0s 32ms/step
Prediksi Jumlah Lowongan Kerja 1 Tahun ke Depan:
[[ 140361.73]
 [ 261546.  ]
 [ 318028.3 ]
 [ 476519.3 ]
 [ 611574.06]
 [ 810810.94]
 [ 959869.25]
 [1087875.9 ]
 [1156830.1 ]
 [1198797.6 ]
 [1218045.1 ]
 [1228283.6 ]]
```

```
bulan = [
    'Januari',
    'Februari',
    'Maret',
    'April',
    'Mei',
    'Juni',
    'Juli',
    'Agustus',
    'September',
    'Oktober',
    'November',
    'Desember'
]
```

```
df_prediksi = pd.DataFrame({
    'Tahun': [2023 + i for i in range(steps_ahead)],
    'Tingkat Pengangguran': future_predictions_original_pengangguran.flatten(),
    'Jumlah Lowongan Pekerjaan': future_predictions_original_lowongan.flatten()
})
```

```
df_prediksi
```

1 to 12 of 12 entries Filter

index	Tahun	Tingkat Pengangguran	Jumlah Lowongan Pekerjaan
0	2023	7.762846946716309	140361.734375
1	2024	8.57551097869873	261546.0
2	2025	9.852570533752441	318028.3125
3	2026	8.795900344848633	476519.3125
4	2027	7.982973575592041	611574.0625
5	2028	9.052284240722656	810810.9375
6	2029	9.527851104736328	959869.25
7	2030	8.465825080871582	1087875.875
8	2031	8.312521934509277	1156830.125
9	2032	9.270319938659668	1198797.625
10	2033	9.172595024108887	1218045.125
11	2034	8.365900039672852	1228283.625

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df_prediksi['Bulan'] = [bulan[i % len(bulan)] for i in range(len(df_prediksi))]
df_prediksi['Jumlah Lowongan Pekerjaan'] = future_predictions_original_lowongan.flatten()
df_prediksi = df_prediksi[['Bulan', 'Tingkat Pengangguran', 'Jumlah Lowongan Pekerjaan']]
df_prediksi
```

1 to 12 of 12 entries Filter

index	Bulan	Tingkat Pengangguran	Jumlah Lowongan Pekerjaan
0	Januari	7.762846946716309	140361.734375
1	Februari	8.57551097869873	261546.0
2	Maret	9.852570533752441	318028.3125
3	April	8.795900344848633	476519.3125
4	Mei	7.982973575592041	611574.0625
5	Juni	9.052284240722656	810810.9375
6	Juli	9.527851104736328	959869.25
7	Agustus	8.465825080871582	1087875.875
8	September	8.312521934509277	1156830.125
9	Oktober	9.270319938659668	1198797.625
10	November	9.172595024108887	1218045.125
11	Desember	8.365900039672852	1228283.625

Show 25 per page

Like what you see? Visit the data table notebook to learn more about interactive tables.

```
df_prediksi_jenis_pekerjaan = pd.DataFrame({
    'Bulan': [bulan[i % len(bulan)] for i in range(len(df_prediksi))],
    'Tingkat Pengangguran': df_prediksi['Tingkat Pengangguran'],
    'Jumlah Lowongan Pekerjaan': df_prediksi['Jumlah Lowongan Pekerjaan']
})

def predict_jenis_pekerjaan(tingkat_pengangguran):
    jenis_pekerjaan = [
        "TENAGA PROFESIONAL, TEKNISI DAN YANG SEJENIS",
        "TENAGA KEPEMIMPINAN DAN KETATALAKSANAAN",
        "TENAGA TATA USAHA DAN YANG SEJENIS",
        "TENAGA USAHA PENJUALAN",
        "TENAGA USAHA JASA",
        "TENAGA USAHA PERTANIAN, KEHUTANAN, PERBURUAN, DAN PERIKANAN",
        "TENAGA PRODUKSI, OPERATOR ALAT-ALAT ANGKUTAN DAN PEKERJA KASAR, LAINNYA"
    ]

    if tingkat_pengangguran < 8:
        return jenis_pekerjaan[0]
    elif tingkat_pengangguran < 9:
        return jenis_pekerjaan[3]
    else:
        return jenis_pekerjaan[5]

df_prediksi_jenis_pekerjaan['Jenis Pekerjaan'] = df_prediksi_jenis_pekerjaan['Tingkat Pengangguran'].apply(predict_jenis_pekerjaan)

df_prediksi_jenis_pekerjaan
```

1 to 12 of 12 entries Filter

index	Bulan	Tingkat Pengangguran	Jumlah Lowongan Pekerjaan	Jenis Pekerjaan
0	Januari	7.762846946716309	140361.734375	TENAGA PROFESIONAL, TEKNISI DAN YANG SEJENIS
1	Februari	8.57551097869873	261546.0	TENAGA USAHA PENJUALAN
2	Maret	9.852570533752441	318028.3125	TENAGA USAHA PERTANIAN, KEHUTANAN, PERBURUAN, DAN PERIKANAN
3	April	8.795900344848633	476519.3125	TENAGA USAHA PENJUALAN
4	Mei	7.982973575592041	611574.0625	TENAGA PROFESIONAL, TEKNISI DAN YANG SEJENIS
5	Juni	9.052284240722656	810810.9375	TENAGA USAHA PERTANIAN, KEHUTANAN, PERBURUAN, DAN PERIKANAN
6	Juli	9.527851104736328	959869.25	TENAGA USAHA PERTANIAN, KEHUTANAN, PERBURUAN, DAN PERIKANAN
7	Agustus	8.465825080871582	1087875.875	TENAGA USAHA PENJUALAN
8	September	8.312521934509277	1156830.125	TENAGA USAHA PENJUALAN
9	Oktober	9.270319938659668	1198797.625	TENAGA USAHA PERTANIAN, KEHUTANAN, PERBURUAN, DAN PERIKANAN
10	November	9.172595024108887	1218045.125	TENAGA USAHA PERTANIAN, KEHUTANAN, PERBURUAN, DAN PERIKANAN
11	Desember	8.365900039672852	1228283.625	TENAGA USAHA PENJUALAN

```
# df_prediksi_jenis_pekerjaan.to_excel('/content/drive/MyDrive/DataProject/data_after.xlsx', index=False)
```

Like what you see? Visit the data table notebook to learn more about interactive tables.