1b

April 16, 2025

0.1 Link Video:

https://drive.google.com/drive/folders/1a7F6lFDEGwWEoJ6NkuPZC8TTIlLlhv6L?usp=sharing

1 LIBRARY

[161]:
```
# import libraries
import pandas as pd
import numpy as np
from tqdm import tqdm
import seaborn as sns
from matplotlib import pyplot as plt
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import RobustScaler
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split, cross_val_score,␣
 ↪GridSearchCV
# model
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers, Model
from tensorflow.keras.metrics import RootMeanSquaredError
from tensorflow.keras.callbacks import EarlyStopping
from sklearn.metrics import r2_score
from tensorflow.keras.layers import Input, Dense, Dropout
from tensorflow.keras import regularizers

from sklearn.linear_model import LinearRegression,Ridge,Lasso
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error
from sklearn.neighbors import KNeighborsRegressor
from sklearn.tree import DecisionTreeRegressor
from tensorflow import keras
import tensorflow as tf
```

About dataset - date: Date of the assessment - day: Day of the Week - quarter: The quarter of the year when the data was recorded (e.g., Quarter1, Quarter2) - Team Code: A unique identifier for

the team. - smv: Standard Minute Value, a measure of the time allocated for a task. - wip: Work In Progress, the number of products that are unfinished. - over_time: The amount of overtime worked, measured in minutes. - incentive: The incentive provided to the workers, measured in USD. - idle_time: The amount of time workers were idle, measured in minutes. - idle_men: The number of workers who were idle. - no_of_style_change: The number of style changes that occurred. - no_of_workers: The total number of workers. - productivity_score: The productivity score of the team, measured as a percentage.

2 EDA

[162]:
```
# read
df = pd.read_parquet('dataset_1B.parquet')
df.head()
```

[162]:

	date	quarter	day	Team Code	smv	wip	over_time	incentive	idle_time	idle_men	no_of_style_change	no_of_workers	productivity_score
0	1/1/2015	Quarter1	Thursday	8	26.16	1108.0	7080	98	0.0	0	0	59.0	94.073
1	1/1/2015	Quarter1	Thursday	1	3.94	NaN	960	0	0.0	0	0	8.0	88.650
2	1/1/2015	Quarter1	Thursday	11	11.41	968.0	3660	50	0.0	0	0	30.5	80.057
3	1/1/2015	Quarter1	Thursday	12	11.41	968.0	3660	50	0.0	0	0	30.5	80.057
4	1/1/2015	Quarter1	Thursday	6	25.90	1170.0	1920	50	0.0	0	0	56.0	80.038

[163]:
```
# checking missing values
def check_missing_values(df):
    result = []
    for col in df.columns:
        # count NaN
        nan_count = df[col].isnull().sum()

        # count "NA / white space / None / NULL (string)"
        na_count = (df[col] == "NA").sum()
        empty_count = (df[col] == "").sum()
        other_placeholder_count = (df[col].isin(["None", "NULL"])).sum()
```

```
        # total missing values
        total_missing = nan_count + na_count + empty_count +␣
↪other_placeholder_count

        # percentage misisng values
        total_percentage = (total_missing / len(df)) * 100

        # results
        result.append({
            "Column": col,
            "NaN Count": nan_count,
            "'NA' Count": na_count,
            "Empty Strings Count": empty_count,
            "Other Placeholders Count": other_placeholder_count,
            "Total Missing (%)": total_percentage
        })
    detailed_missing_df = pd.DataFrame(result)

    # sort
    return detailed_missing_df.sort_values(by="Total Missing (%)",␣
↪ascending=False)

detailed_missing_df = check_missing_values(df)
detailed_missing_df
```

[163]:

	Column	NaN Count	'NA' Count	Empty Strings Count	Other Placeholders Count	Total Missing (%)
5	wip	506	0	0	0	42.272348
1	quarter	0	0	0	0	0.000000
2	day	0	0	0	0	0.000000
3	Team Code	0	0	0	0	0.000000
0	date	0	0	0	0	0.000000
4	smv	0	0	0	0	0.000000
6	over_time	0	0	0	0	0.000000
7	incentive	0	0	0	0	0.000000
8	idle_time	0	0	0	0	0.000000
9	idle_men	0	0	0	0	0.000000
10	no_of_style_change	0	0	0	0	0.000000
11	no_of_workers	0	0	0	0	0.000000
12	productivity_score	0	0	0	0	0.000000

```
6                       0           0.000000
7                       0           0.000000
8                       0           0.000000
9                       0           0.000000
10                      0           0.000000
11                      0           0.000000
12                      0           0.000000
```

2.1 Check Missing Value and Duplicate

[164]:
```
# dimension of dataset
dim = df.shape
print(f'The dataset has {dim[0]} rows and {dim[1]} columns')
```

```
The dataset has 1197 rows and 13 columns
```

[165]:
```
# show header of dataset
df.columns
```

[165]:
```
Index(['date', 'quarter', 'day', 'Team Code', 'smv', 'wip', 'over_time',
       'incentive', 'idle_time', 'idle_men', 'no_of_style_change',
       'no_of_workers', 'productivity_score'],
      dtype='object')
```

[166]:
```
# show info of each the data
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1197 entries, 0 to 1196
Data columns (total 13 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   date                 1197 non-null   object 
 1   quarter              1197 non-null   object 
 2   day                  1197 non-null   object 
 3   Team Code            1197 non-null   int64  
 4   smv                  1197 non-null   float64
 5   wip                  691 non-null    float64
 6   over_time            1197 non-null   int64  
 7   incentive            1197 non-null   int64  
 8   idle_time            1197 non-null   float64
 9   idle_men             1197 non-null   int64  
 10  no_of_style_change   1197 non-null   int64  
 11  no_of_workers        1197 non-null   float64
 12  productivity_score   1197 non-null   float64
dtypes: float64(5), int64(5), object(3)
memory usage: 121.7+ KB
```

2.2 Check Unique Value

[167]:
```
# show unique values for each variables
def unique_value_details(df):
    result = []
    for col in df.columns:
        unique_count = df[col].nunique()
        unique_preview = df[col].dropna().unique()[:5]  # Show up to 5 unique␣
 ↪values as a preview

        result.append({
            "Column": col,
            "Unique Count": unique_count,
            "Unique Values (Preview)": unique_preview
        })
    unique_details_df = pd.DataFrame(result)

    # sort
    unique_details_df = unique_details_df.sort_values(by="Unique Count",␣
 ↪ascending=False)
    return unique_details_df

unique_details_df = unique_value_details(df)
unique_details_df
```

[167]:

	Column	Unique Count	Unique Values (Preview)
12	productivity_score	803	[94.073, 88.65, 80.057, 80.038, 80.012]
5	wip	548	[1108.0, 968.0, 1170.0, 984.0, 795.0]
6	over_time	143	[7080, 960, 3660, 1920, 6720]
0	date	118	[1/1/2015, 2016-01-01, 1/3/2015, 2016-01-03, 1…
4	smv	70	[26.16, 3.94, 11.41, 25.9, 28.08]
11	no_of_workers	66	[59.0, 8.0, 30.5, 56.0, 57.5]
7	incentive	48	
3	Team Code	12	
8	idle_time	12	
9	idle_men	10	
2	day	6	
1	quarter	5	
10	no_of_style_change	3	

```
7                                  [98, 0, 50, 38, 45]
3                                    [8, 1, 11, 12, 6]
8                    [0.0, 90.0, 150.0, 270.0, 300.0]
9                                  [0, 10, 15, 45, 37]
2       [Thursday, Saturday, Sunday, Monday, Tuesday]
1   [Quarter1, Quarter2, Quarter3, Quarter4, Quart…
10                                           [0, 1, 2]
```

Anomaly in the day where there is no friday, so its basicly is not normal because its commonly does in sunday, so we will check the corelation with the date column, if there is some unrelated corelation with the dataset

Beside the assumption error in day, there is some error imputation at quarter column, which is quarter 5, maybe the solution is corelate of with the date column

firstly validate between / and - format into: 4 digit to front 2 digit with value more than 12 and less than 32 into behind 2 digit with value less than 13 into middle

after that change / format into - so it be iso format

3 Preprocessing

3.1 Handle feature

Handle Date Columns

[168]:
```python
def fix_date_manually(date_val):
    if pd.isnull(date_val):
        return None

    date_str = str(date_val)

    # ISO format
    if '-' in date_str:
        parts = date_str.split('-')
        if len(parts) == 3 and len(parts[0]) == 4:
            try:
                year, month, day = map(int, parts)
                return f"{year:04d}-{month:02d}-{day:02d}"
            except ValueError:
                return None

    # USA format
    if '/' in date_str:
        parts = date_str.split('/')
        if len(parts) != 3:
            return None

        try:
            part1, part2, part3 = map(int, parts)
```

```
        except ValueError:
            return None

        # 4 digit for year
        if 1000 <= part3 <= 9999:
            year = part3
            if part1 <= 12 and part2 > 12:
                month, day = part1, part2
            elif part2 <= 12 and part1 > 12:
                day, month = part1, part2
            elif part1 <= 12 and part2 <= 12:
                month, day = part1, part2
            else:
                return None

            return f"{year:04d}-{month:02d}-{day:02d}"

    return None

# Apply to the date column
df['date'] = df['date'].apply(fix_date_manually)
```

now lets validate the standardized_date is the in the right format of YYYY-MM-DD not YYYY-DD-MM with matching it with the day and quarter column

what i want to do is to transform date column into ISO format which is YYYY-MM-DD, but the problem with the dataset is the date column include other format which is MM/DD/YYYY, now what i want to do is to checking if the Month and Day is in the place of the format it should be by validate if the number is contain 4 digit like 2016,2018 and others it determined as year, and if the number is more than 12 which is exceed month number it should be determined as day

[169]:
```
df.head()
```

[169]:

	date	quarter	day	Team Code	smv	wip	over_time	incentive	idle_time	idle_men	no_of_style_change	no_of_workers	productivity_score
0	2015-01-01	Quarter1	Thursday	8	26.16	1108.0	7080	98	0.0	0	0	59.0	
1	2015-01-01	Quarter1	Thursday	1	3.94	NaN	960	0	0.0	0	0	8.0	
2	2015-01-01	Quarter1	Thursday	11	11.41	968.0	3660	50	0.0	0	0	30.5	
3	2015-01-01	Quarter1	Thursday	12	11.41	968.0	3660	50	0.0	0	0	30.5	
4	2015-01-01	Quarter1	Thursday	6	25.90	1170.0	1920	50	0.0	0	0	56.0	

```
0              94.073
1              88.650
2              80.057
3              80.057
4              80.038
```

[170]:
```
# konversi into datetime
df['date'] = pd.to_datetime(df['date'], errors='coerce')
df['actual_day'] = df['date'].dt.day_name()
df['day_match'] = (
    df['actual_day'].str.lower().str.strip() == df['day'].str.lower().str.
 ↪strip()
)
# checking result
mismatch = df[df['day_match'] == False][['date', 'day', 'actual_day']]
mismatch.head()
```

[170]:
```
         date       day actual_day
8  2016-01-01  Thursday     Friday
9  2016-01-01  Thursday     Friday
13 2016-01-01  Thursday     Friday
14 2016-01-01  Thursday     Friday
16 2016-01-01  Thursday     Friday
```

[171]:
```
# fix mismatch result
df.loc[~df['day_match'], 'day'] = df.loc[~df['day_match'], 'actual_day']
```

[172]:
```
# df[df['quarter'] == 'Quarter5']
df['day_match'] = (
    df['actual_day'].str.lower().str.strip() == df['day'].str.lower().str.
 ↪strip()
)
print("Mismatch day and actual_day:", (~df['day_match']).sum())
```

```
Mismatch day and actual_day: 0
```

now lets extract year and month from date column

[173]:
```
# extract year and column from date column
df['year'] = df['date'].dt.year
df['month'] = df['date'].dt.month
```

[174]:
```
df.head()
```

[174]:
```
        date   quarter       day  Team Code    smv     wip  over_time  \
0 2015-01-01  Quarter1  Thursday          8  26.16  1108.0       7080
1 2015-01-01  Quarter1  Thursday          1   3.94     NaN        960
2 2015-01-01  Quarter1  Thursday         11  11.41   968.0       3660
```

```
3 2015-01-01  Quarter1  Thursday         12  11.41   968.0       3660
4 2015-01-01  Quarter1  Thursday          6  25.90  1170.0       1920

   incentive  idle_time  idle_men  no_of_style_change  no_of_workers  \
0         98        0.0         0                   0           59.0
1          0        0.0         0                   0            8.0
2         50        0.0         0                   0           30.5
3         50        0.0         0                   0           30.5
4         50        0.0         0                   0           56.0

   productivity_score actual_day  day_match  year  month
0              94.073   Thursday       True  2015      1
1              88.650   Thursday       True  2015      1
2              80.057   Thursday       True  2015      1
3              80.057   Thursday       True  2015      1
4              80.038   Thursday       True  2015      1
```

checking if there is idle_men where more than no_of_workers

[175]:
```
# checking if there is  idle_men where more than no_of_workers
df[df['idle_men'] > df['no_of_workers']]
```

[175]:
```
           date   quarter        day  Team Code    smv     wip  over_time  \
66   2016-01-05  Quarter1    Tuesday          9   2.90     NaN       1920
79   2016-01-05  Quarter1    Tuesday          3  19.87   944.0       6600
503  2015-01-29  Quarter5   Thursday          6   2.90     NaN       1200
610  2015-02-04  Quarter1  Wednesday          6  18.79   941.0       3360
697  2016-02-10  Quarter2  Wednesday          2  22.52  1512.0          0

     incentive  idle_time  idle_men  no_of_style_change  no_of_workers  \
66           0        0.0         0                   0           -8.0
79          45        0.0         0                   0          -55.0
503          0        0.0         0                   0          -10.0
610         30        0.0         0                   0          -33.0
697         88        0.0         0                   0          -57.0

     productivity_score actual_day  day_match  year  month
66               82.083    Tuesday       True  2016      1
79               75.024    Tuesday       True  2016      1
503              89.900   Thursday       True  2015      1
610              70.071  Wednesday       True  2015      2
697              89.998  Wednesday       True  2016      2
```

3.1.1 Handle Quarter Columns

[176]:
```
def get_quarter_from_date_string(date_str):
    if pd.isnull(date_str):
        return None

    # Convert to string in case it's a datetime object
    date_str = str(date_str).strip()

    try:
        # Extract the month part (after first dash, before second dash)
        month_part = date_str.split("-")[1]

        # Map to quarters
        if month_part in ['01', '02', '03']:
            return "Quarter1"
        elif month_part in ['04', '05', '06']:
            return "Quarter2"
        elif month_part in ['07', '08', '09']:
            return "Quarter3"
        elif month_part in ['10', '11', '12']:
            return "Quarter4"
        else:
            return None
    except:
        return None

# Apply to your DataFrame
df['quarter_calculated'] = df['date'].apply(get_quarter_from_date_string)

# Optional: Check value counts
print(df['quarter_calculated'].value_counts())
```

```
quarter_calculated
Quarter1    1197
Name: count, dtype: int64
```

[177]:
```
df.head()
```

[177]:

	date	quarter	day	Team Code	smv	wip	over_time	incentive	idle_time	idle_men	no_of_style_change	no_of_workers
0	2015-01-01	Quarter1	Thursday	8	26.16	1108.0	7080	98	0.0	0	0	59.0
1	2015-01-01	Quarter1	Thursday	1	3.94	NaN	960					
2	2015-01-01	Quarter1	Thursday	11	11.41	968.0	3660					
3	2015-01-01	Quarter1	Thursday	12	11.41	968.0	3660					
4	2015-01-01	Quarter1	Thursday	6	25.90	1170.0	1920					

```
1          0        0.0         0                  0           8.0
2         50        0.0         0                  0          30.5
3         50        0.0         0                  0          30.5
4         50        0.0         0                  0          56.0

   productivity_score actual_day  day_match  year  month quarter_calculated
0              94.073   Thursday       True  2015      1            Quarter1
1              88.650   Thursday       True  2015      1            Quarter1
2              80.057   Thursday       True  2015      1            Quarter1
3              80.057   Thursday       True  2015      1            Quarter1
4              80.038   Thursday       True  2015      1            Quarter1
```

[178]:
```
print("Earliest date:", df['date'].min())
print("Latest date:", df['date'].max())
```

```
Earliest date: 2015-01-01 00:00:00
Latest date: 2016-03-10 00:00:00
```

Its turn out that the quarter is only in quarter 1 which is january until march

3.1.2 Handle Other Columns

[179]:
```
# show all value counts of team code
df.describe()
```

[179]:
```
                                date    Team Code          smv           wip  \
count                           1197  1197.000000  1197.000000    691.000000
mean   2015-07-05 16:49:19.398496256     6.426901    15.062172   1190.465991
min              2015-01-01 00:00:00     1.000000     2.900000      7.000000
25%              2015-01-31 00:00:00     3.000000     3.940000    774.500000
50%              2015-03-02 00:00:00     6.000000    15.260000   1039.000000
75%              2016-01-27 00:00:00     9.000000    24.260000   1252.500000
max              2016-03-10 00:00:00    12.000000    54.560000  23122.000000
std                              NaN     3.463963    10.943219   1837.455001

          over_time    incentive    idle_time     idle_men  \
count   1197.000000  1197.000000  1197.000000  1197.000000
mean    4567.460317    38.210526     0.730159     0.369256
min        0.000000     0.000000     0.000000     0.000000
25%     1440.000000     0.000000     0.000000     0.000000
50%     3960.000000     0.000000     0.000000     0.000000
75%     6960.000000    50.000000     0.000000     0.000000
max    25920.000000  3600.000000   300.000000    45.000000
std     3348.823563   160.182643    12.709757     3.268987

       no_of_style_change  no_of_workers  productivity_score         year  \
count         1197.000000    1197.000000         1197.000000  1197.000000
mean             0.150376      34.337510           73.367040  2015.414369
```

```
min              0.000000     -57.000000         -100.000000  2015.000000
25%              0.000000       9.000000           65.030000  2015.000000
50%              0.000000      34.000000           77.333000  2015.000000
75%              0.000000      57.000000           85.025000  2016.000000
max              2.000000      89.000000          112.044000  2016.000000
std              0.427848      22.617043           18.154945     0.492819
```

```
             month
count  1197.000000
mean      1.717627
min       1.000000
25%       1.000000
50%       2.000000
75%       2.000000
max       3.000000
std       0.737526
```

from the describe, we could see there is no_of_workers have negative value, which its not possible, so we will make it into positive by absolute

[180]:
```
# absolute the no_of_workers
df['no_of_workers'] = df['no_of_workers'].abs()
```

productivity score has negative and more than 100% productivity so we will handle it

[181]:
```
# show rows with minus productivity score and exceed 100% productivity_score␣
 ↪and show rows with team code = 10
df[
    (df['productivity_score'] < 0) |
    (df['productivity_score'] > 100) |
    (df['Team Code'] == 10)
]
# show rows with max productivity_score in team code 10
df[df['Team Code'] == 10].sort_values(by='productivity_score', ascending=False).
 ↪head()
```

[181]:
```
          date   quarter        day  Team Code    smv     wip  over_time  \
620 2015-02-05  Quarter1   Thursday         10  22.52  1039.0       6720
601 2015-02-04  Quarter1  Wednesday         10  22.52  1108.0       6720
582 2015-02-03  Quarter1    Tuesday         10  22.52  1188.0       6720
438 2015-01-26  Quarter4     Monday         10   3.94     NaN       3780
458 2015-01-27  Quarter4    Tuesday         10   3.94     NaN       1440

     incentive  idle_time  idle_men  no_of_style_change  no_of_workers  \
620        113        0.0         0                   0           56.0
601        113        0.0         0                   0           56.0
582         90        0.0         0                   0           56.0
438          0        0.0         0                   0           21.0
```

```
458          0        0.0         0                   0           12.0

     productivity_score actual_day  day_match  year  month quarter_calculated
620             100.000   Thursday       True  2015      2           Quarter1
601             100.000  Wednesday       True  2015      2           Quarter1
582             100.000    Tuesday       True  2015      2           Quarter1
438              99.779     Monday       True  2015      1           Quarter1
458              97.953    Tuesday       True  2015      1           Quarter1
```

i decide to absolute the negative value in rows with percentage productivity

[182]:
```
# absolute negative productivity
df.loc[df['productivity_score'] < 0, 'productivity_score'] =␣
 ↪df['productivity_score'].abs()
```

lets show where overtime does but idle time is still there, because logicly if they do overtime there should be no idle time

[183]:
```
# lets show where overtime does but idle time is still there, because logicly␣
 ↪if they do overtime there should be no idle time
df[
    (df['over_time'] > 0) &
    (df['idle_time'] > 0)
]
```

[183]:
```
           date   quarter        day  Team Code    smv     wip  over_time  \
615  2015-02-04  Quarter1  Wednesday          5  30.10   326.0       5820
617  2015-02-04  Quarter1  Wednesday          4  30.10   287.0       6060
650  2016-02-07  Quarter1     Sunday          7  24.26   658.0       6960
654  2015-02-07  Quarter1   Saturday          8  24.26   652.0       6840
775  2015-02-15  Quarter3     Sunday          8  30.10   507.0       5880
798  2015-02-16  Quarter3     Monday          8  30.10     7.0       7080
841  2016-02-18  Quarter3   Thursday         10  19.68  1119.0       5640
843  2016-02-18  Quarter3   Thursday          8  29.40   962.0       4560
848  2015-02-19  Quarter3   Thursday          5  30.10   276.0        600
880  2015-02-22  Quarter4     Sunday          7  30.10   627.0       6960
882  2015-02-22  Quarter4     Sunday          5  30.10   450.0       5700
1001 2015-03-01  Quarter1     Sunday          7  30.10   934.0       6960
1046 2016-03-02  Quarter1  Wednesday          2  15.28   157.0       5400
1085 2015-03-05  Quarter1   Thursday          7  30.10   834.0       1200

      incentive  idle_time  idle_men  no_of_style_change  no_of_workers  \
615           0       90.0        10                   0           58.5
617          23      150.0        15                   0           55.5
650           0      270.0        45                   0           58.0
654           0      300.0        37                   0           57.0
775          40        2.0        10                   1           59.0
798          27        2.0        10                   2           59.0
```

841	0	8.0	35	1	47.0
843	0	4.5	30	2	57.0
848	63	3.5	15	0	59.5
880	0	3.5	20	1	58.0
882	0	4.5	25	0	60.0
1001	0	3.5	15	0	58.0
1046	0	6.5	30	1	45.0
1085	0	4.0	40	0	59.0

	productivity_score	actual_day	day_match	year	month	quarter_calculated
615	65.083	Wednesday	True	2015	2	Quarter1
617	35.071	Wednesday	True	2015	2	Quarter1
650	66.227	Sunday	True	2016	2	Quarter1
654	36.532	Saturday	True	2015	2	Quarter1
775	70.057	Sunday	True	2015	2	Quarter1
798	62.197	Monday	True	2015	2	Quarter1
841	30.357	Thursday	True	2016	2	Quarter1
843	25.140	Thursday	True	2016	2	Quarter1
848	79.998	Thursday	True	2015	2	Quarter1
880	39.355	Sunday	True	2015	2	Quarter1
882	30.750	Sunday	True	2015	2	Quarter1
1001	57.951	Sunday	True	2015	3	Quarter1
1046	30.277	Wednesday	True	2016	3	Quarter1
1085	36.605	Thursday	True	2015	3	Quarter1

[184]:
```
# logicly there is no idletime if there is overtime
df.loc[df['over_time'] > 0, 'idle_time'] = 0
```

[185]:
```
# lets show where overtime does but idle time is still there, because logicly␣
 ↪if they do overtime there should be no idle time
df[
    (df['over_time'] > 0) &
    (df['idle_time'] > 0)
]
```

[185]:
```
Empty DataFrame
Columns: [date, quarter, day, Team Code, smv, wip, over_time, incentive,
idle_time, idle_men, no_of_style_change, no_of_workers, productivity_score,
actual_day, day_match, year, month, quarter_calculated]
Index: []
```

3.2 Drop Column unused

[186]:
```
# drop column
df = df.drop(columns=[
    'date',
    'day_match',
```

```
    'actual_day',
    'quarter',
    'quarter_calculated',
    'wip'])
```

for date column we drop because we already extract and validate column day and month, then we drop day_match and actual_day because its not needed, quarter and quarter_calculated not needed because all the quarter is equal to 1

and at the end we are droping wip columns because there is 42% missing value, because of that we will drop the missing value because it will be lead into bias if we try to do imputation

3.3 Check Distribution

[187]:
```
df.info()
```

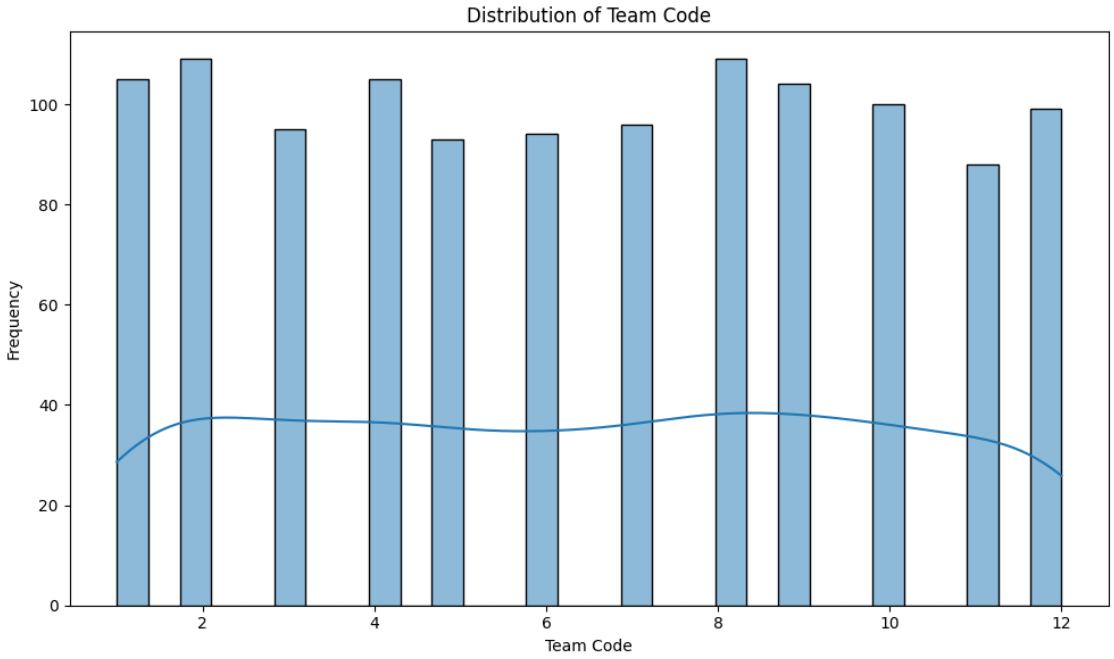
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1197 entries, 0 to 1196
Data columns (total 12 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   day                  1197 non-null   object 
 1   Team Code            1197 non-null   int64  
 2   smv                  1197 non-null   float64
 3   over_time            1197 non-null   int64  
 4   incentive            1197 non-null   int64  
 5   idle_time            1197 non-null   float64
 6   idle_men             1197 non-null   int64  
 7   no_of_style_change   1197 non-null   int64  
 8   no_of_workers        1197 non-null   float64
 9   productivity_score   1197 non-null   float64
 10  year                 1197 non-null   int32  
 11  month                1197 non-null   int32  
dtypes: float64(4), int32(2), int64(5), object(1)
memory usage: 103.0+ KB
```

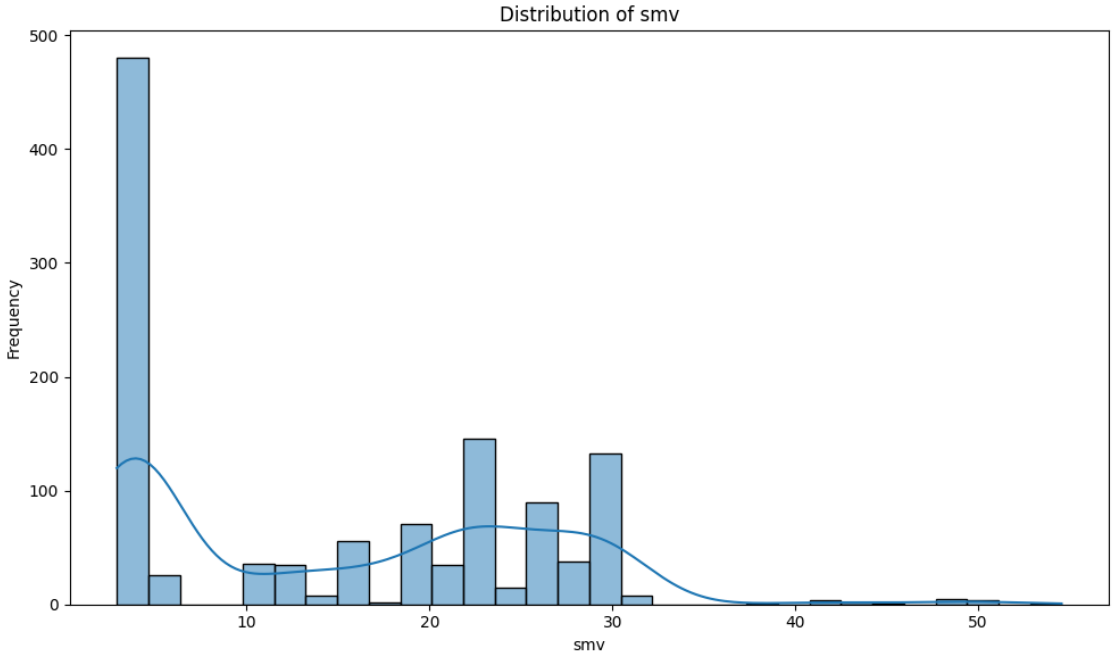
[188]:
```
# seperate numerical and categorical
numerical_columns = df.select_dtypes(include=['float64', 'int64'])
categorical_columns = df.select_dtypes(include=['object'])
```

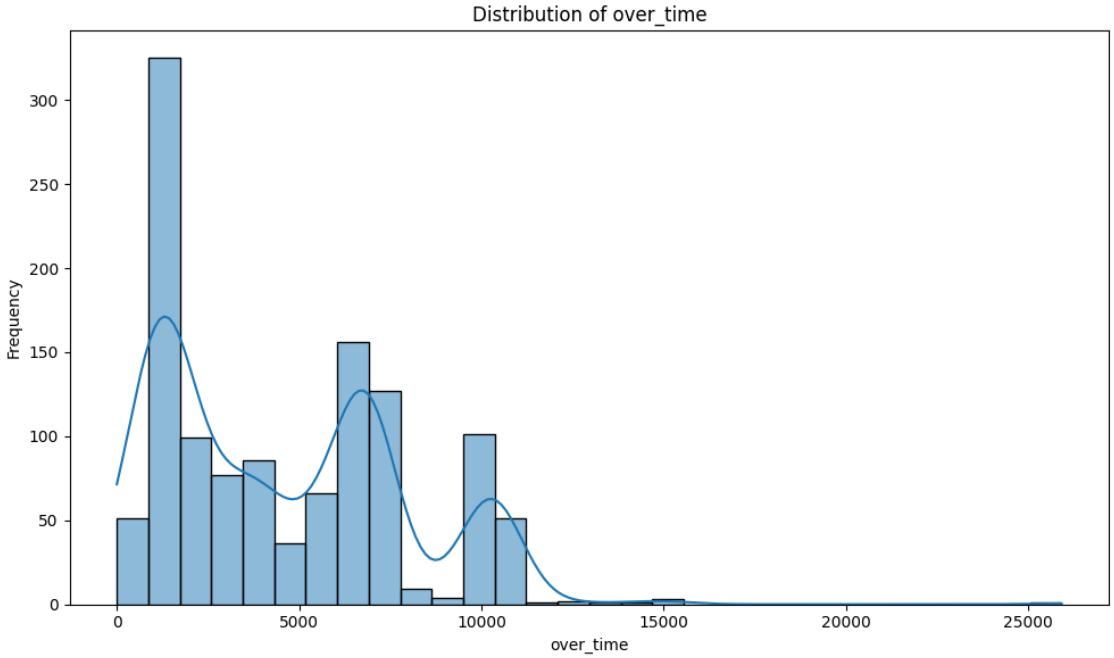
[189]:
```
# Check distribution of numerical features
for col in numerical_columns:
    plt.figure(figsize=(10, 6))
    sns.histplot(df[col], kde=True, bins=30)
    plt.title(f'Distribution of {col}')
    plt.xlabel(col)
    plt.ylabel("Frequency")
    plt.tight_layout()
```

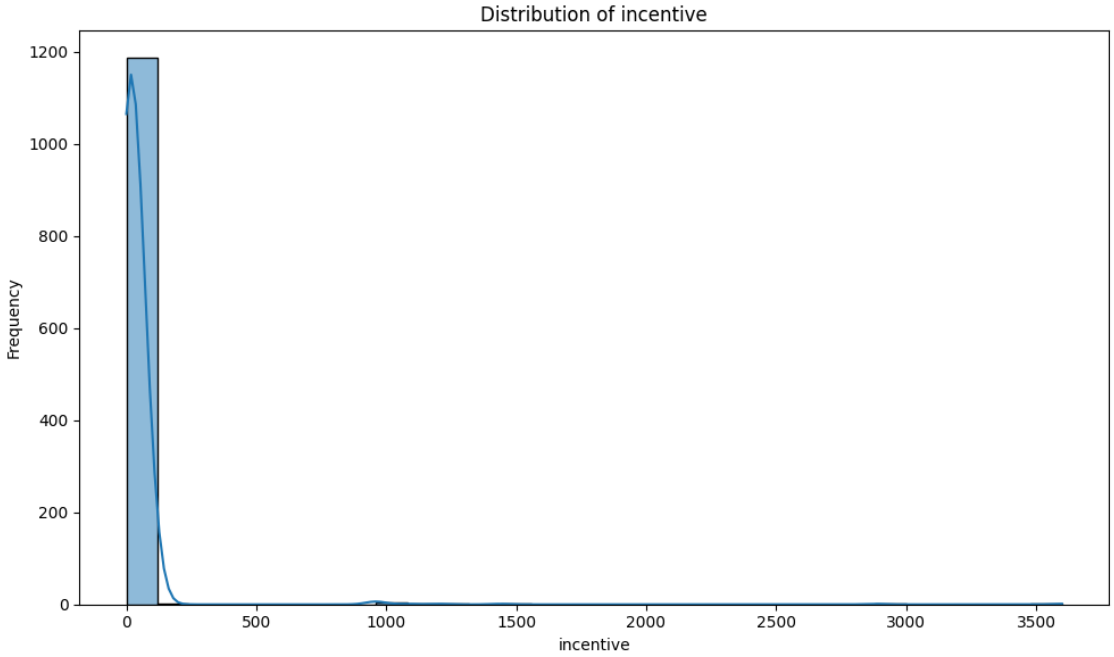
```
    plt.show()

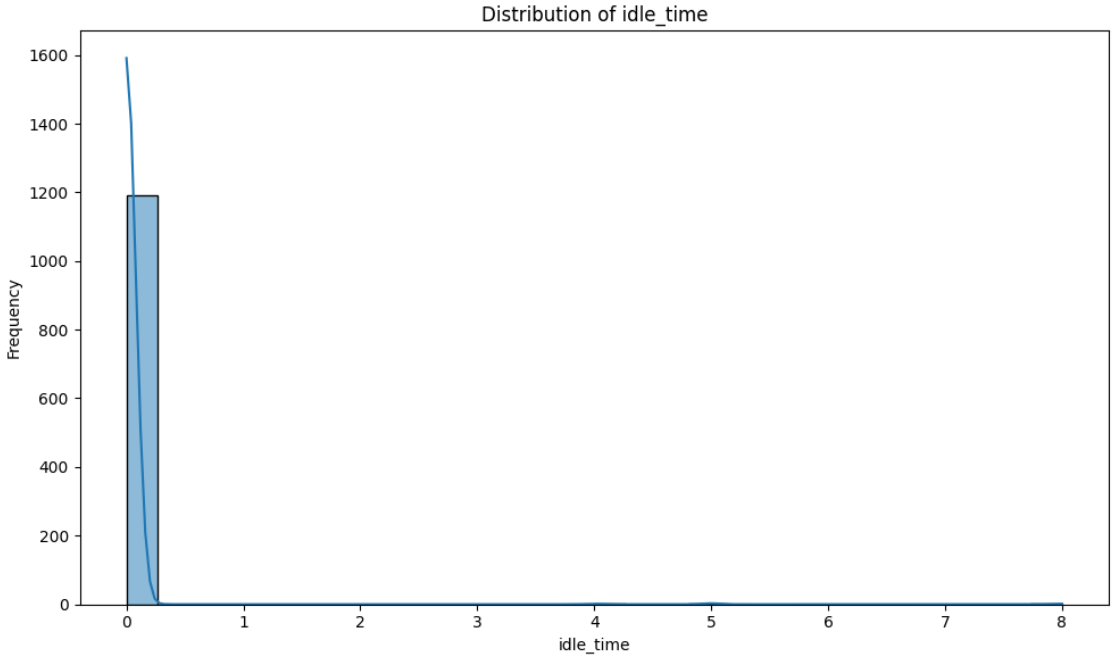
# Check distribution of categorical features
for col in categorical_columns:
    plt.figure(figsize=(10, 6))
    sns.countplot(data=df, x=col, order=df[col].value_counts().index)
    plt.title(f'Distribution of {col}')
    plt.xlabel(col)
    plt.ylabel("Count")
    plt.xticks(rotation=45)
    plt.tight_layout()
    plt.show()
```

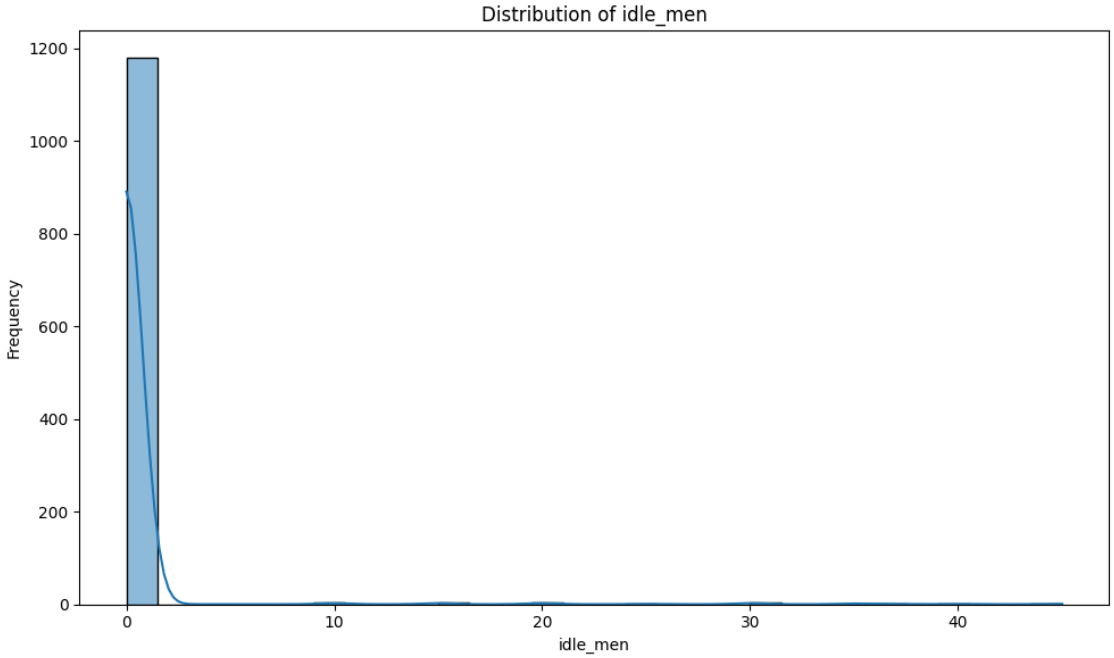


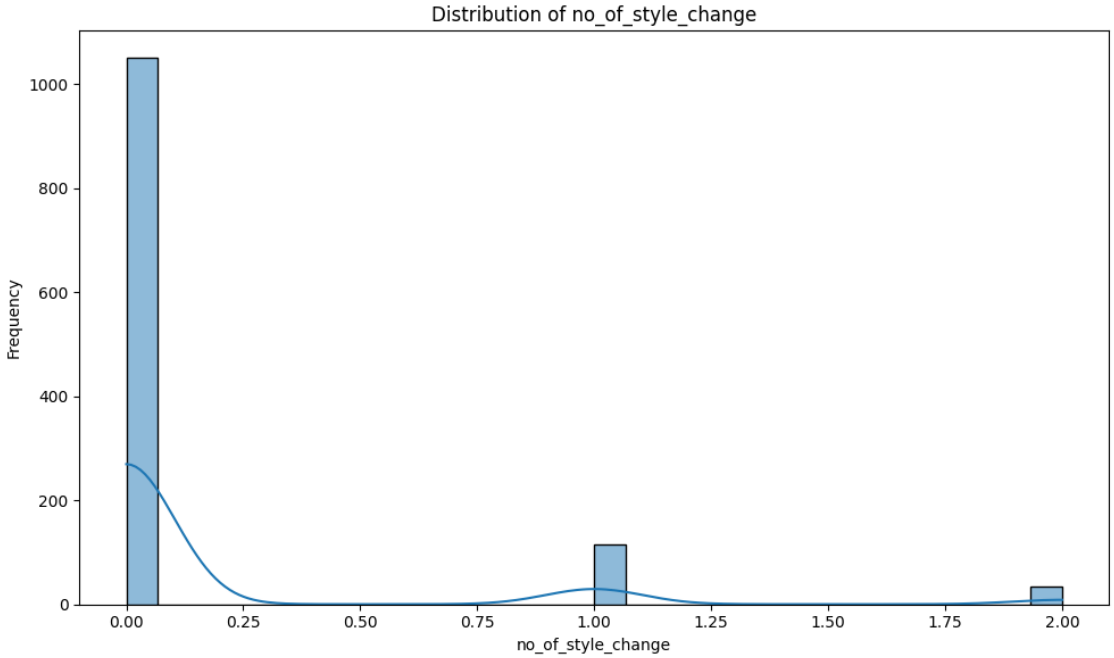

Distribution of smv
Frequency
smv
0
100
200
300
400
500
10
20
30
40
50

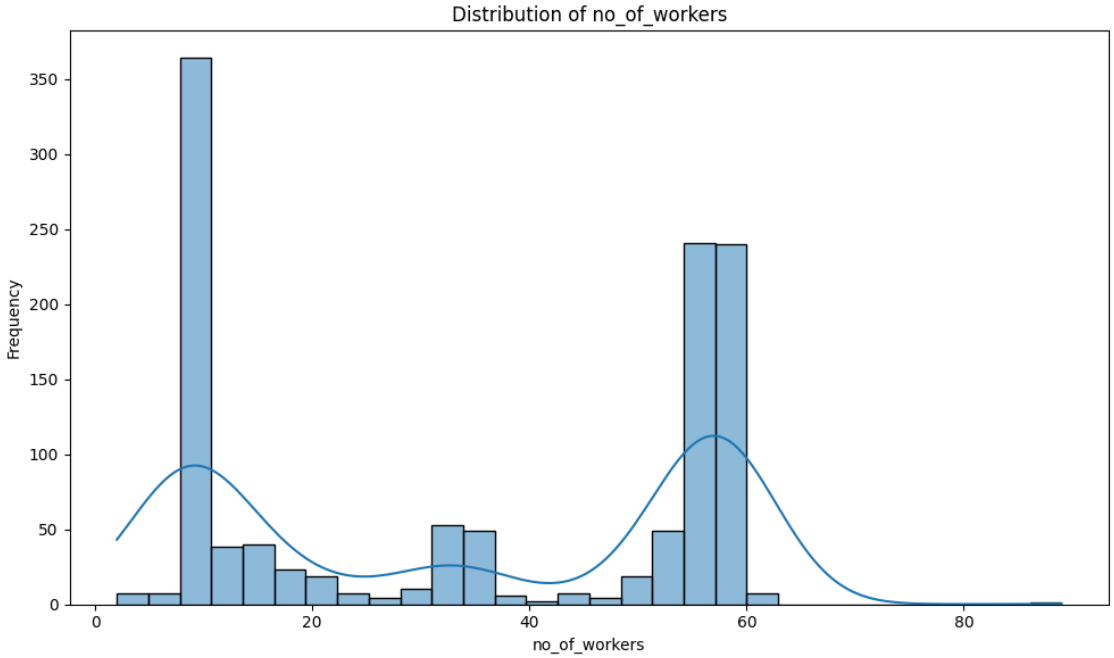

Distribution of over_time
Frequency
over_time
0
50
100
150
200
250
300
0
5000
10000
15000
20000
25000

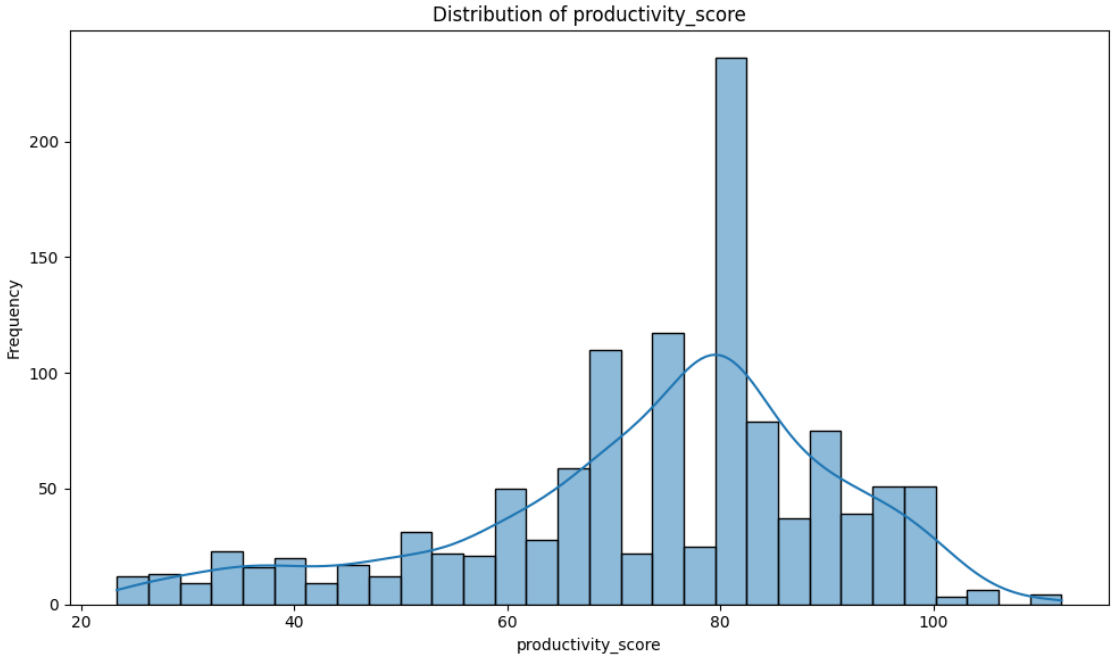

Distribution of incentive
Frequency
incentive
0
200
400
600
800
1000
1200
0
500
1000
1500
2000
2500
3000
3500

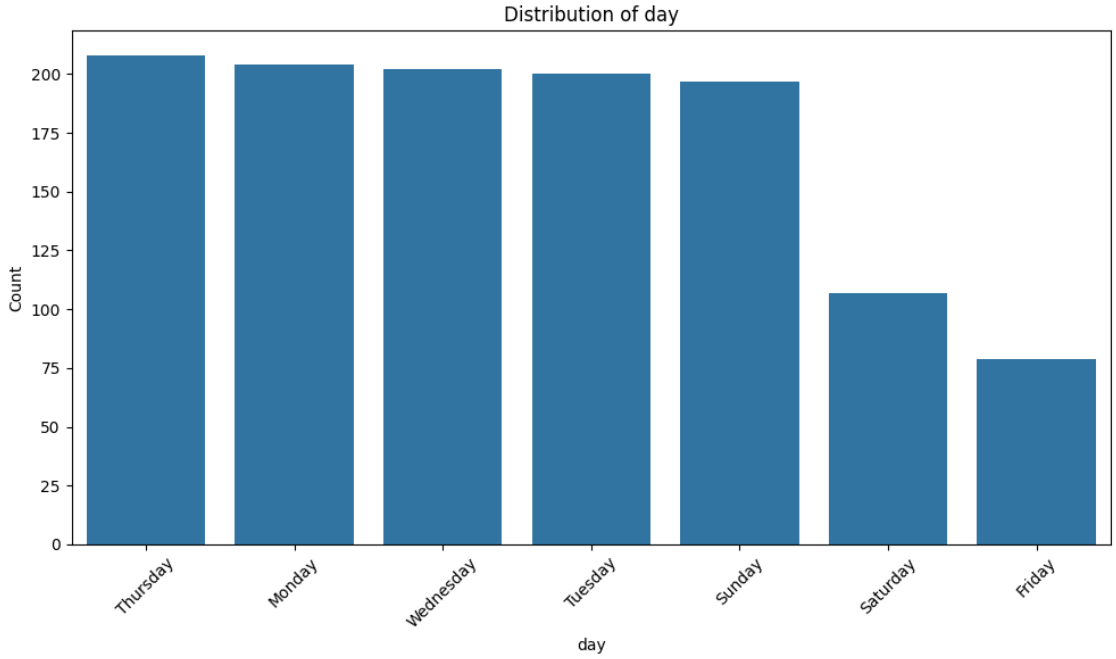

Distribution of idle_time
Frequency
idle_time
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6
7
8


Distribution of idle_men
Frequency
idle_men
0
200
400
600
800
1000
1200
0
10
20
30
40


Distribution of no_of_style_change
Frequency
no_of_style_change
0
200
400
600
800
1000
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


Distribution of no_of_workers
Frequency
no_of_workers
0
50
100
150
200
250
300
350
0
20
40
60
80


Distribution of productivity_score
Frequency
productivity_score
0
50
100
150
200
20
40
60
80
100



3.4 Encode

because the categorical column is mostly date such as: day and month so lets just use ordinal encode

[190]:
```
# one hot encode for day column using OneHotEncode
# Encode 'day' column

ohe_enc = OneHotEncoder(sparse_output=False, handle_unknown='ignore')
one_hot_encoded = ohe_enc.fit_transform(df[['day']])
one_hot_df = pd.DataFrame(one_hot_encoded, columns=ohe_enc.
 ↪get_feature_names_out(['day']))
df = pd.concat([df.reset_index(drop=True), one_hot_df], axis=1)
df = df.drop(columns=['day'])
```

[191]:
```
df.head()
```

[191]:

	Team Code	smv	over_time	incentive	idle_time	idle_men	\
0	8	26.16	7080	98	0.0	0	
1	1	3.94	960	0	0.0	0	
2	11	11.41	3660	50	0.0	0	
3	12	11.41	3660	50	0.0	0	
4	6	25.90	1920	50	0.0	0	

	no_of_style_change	no_of_workers	productivity_score	year	month	\
0	0	59.0	94.073	2015	1	

```
1                    0            8.0              88.650  2015       1
2                    0           30.5              80.057  2015       1
3                    0           30.5              80.057  2015       1
4                    0           56.0              80.038  2015       1

   day_Friday  day_Monday  day_Saturday  day_Sunday  day_Thursday  \
0         0.0         0.0           0.0         0.0           1.0
1         0.0         0.0           0.0         0.0           1.0
2         0.0         0.0           0.0         0.0           1.0
3         0.0         0.0           0.0         0.0           1.0
4         0.0         0.0           0.0         0.0           1.0

   day_Tuesday  day_Wednesday
0          0.0            0.0
1          0.0            0.0
2          0.0            0.0
3          0.0            0.0
4          0.0            0.0
```

4 Spliting

[192]:
```
# split dataset
X = df.drop(columns=['productivity_score'])
y = df['productivity_score']

# split 70/30
X_temp, X_test, y_temp, y_test = train_test_split(X, y, test_size=0.3,␣
 ↪random_state=42)

# split 30% into 20% test and 10% validation
X_train, X_cv, y_train, y_cv = train_test_split(X_temp, y_temp, test_size=2/3,␣
 ↪random_state=42)
```

4.1 Scaling

[193]:
```
# because its not normaly distributed, we are gonna split scaling with␣
 ↪RobustScaler for all columns
scaler = RobustScaler()

scaler.fit(X_train)

X_train = scaler.transform(X_train)
X_cv = scaler.transform(X_cv)
X_test = scaler.transform(X_test)
```

[194]:
```
print(X_train)
```

```
[[-0.16666667  0.67577413  0.54347826 …  1.          0.
   0.        ]
 [ 0.         -0.56284153 -0.45652174 …  0.          0.
   0.        ]
 [ 0.83333333 -0.50591985 -0.55434783 …  1.          0.
   0.        ]
 …
 [ 0.16666667  0.4845173   1.125      …  1.          0.
   0.        ]
 [-0.5        -0.50591985 -0.39130435 …  0.          0.
   0.        ]
 [ 0.83333333 -0.17531876 -0.09782609 …  0.          0.
   0.        ]]
```

5 Base Modelling

using relu activation to make it looks like graph with minumum number equal to 0

5.1 Sequential Model

5.1.1 Configure Model Neuron, Activation Layer

[195]:
```
# sequential model
n = X_train.shape[1]
n

base_model_sequential = keras.Sequential([
    layers.Dense(n * 2, activation='relu', input_shape=(n,)),
    layers.Dense(n * 2, activation='relu'),
    layers.Dense(1)
])
```

```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/dense.py:87:
UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When
using Sequential models, prefer using an `Input(shape)` object as the first
layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

5.1.2 Compile and evaluation

[196]:
```
# compile model
base_model_sequential.compile(
    optimizer='adam', #cara model belajar
    loss='mse', #semakin rendah makin bagus
    metrics=['mae', 'mse', RootMeanSquaredError(name = 'rmse')] #semakin rendah␣
 ↪makin bagus
```

```
)
base_model_sequential.summary()
```

Model: "sequential_5"

Layer (type)	Output Shape	Param #
dense_39 (Dense)	(None, 34)	612
dense_40 (Dense)	(None, 34)	1,190
dense_41 (Dense)	(None, 1)	35

Total params: 1,837 (7.18 KB)

Trainable params: 1,837 (7.18 KB)

Non-trainable params: 0 (0.00 B)

5.1.3 Fit Model Sequential

[197]:
```
X_train.shape
```

[197]: (279, 17)

[198]:
```
callbacks = EarlyStopping(monitor='val_loss',
                          patience=20,
                          restore_best_weights=True)


history = base_model_sequential.fit(
    X_train, y_train,
    validation_data=(X_cv, y_cv),
    epochs=300,
    callbacks = [callbacks],
    batch_size=32,
    verbose=1
)
```

```
Epoch 1/300
9/9             2s 73ms/step - loss:
5741.5684 - mae: 73.5949 - mse: 5741.5684 - rmse: 75.7715 - val_loss: 5572.6514
```

```
- val_mae: 72.5579 - val_mse: 5572.6514 - val_rmse: 74.6502
Epoch 2/300
9/9             1s 22ms/step - loss:
5596.0308 - mae: 72.8796 - mse: 5596.0308 - rmse: 74.8034 - val_loss: 5528.0601
- val_mae: 72.2423 - val_mse: 5528.0601 - val_rmse: 74.3509
Epoch 3/300
9/9             0s 20ms/step - loss:
5547.4854 - mae: 72.2370 - mse: 5547.4854 - rmse: 74.4786 - val_loss: 5474.7808
- val_mae: 71.8627 - val_mse: 5474.7808 - val_rmse: 73.9918
Epoch 4/300
9/9             0s 32ms/step - loss:
5614.9116 - mae: 72.8928 - mse: 5614.9116 - rmse: 74.9279 - val_loss: 5409.1714
- val_mae: 71.3915 - val_mse: 5409.1714 - val_rmse: 73.5471
Epoch 5/300
9/9             0s 22ms/step - loss:
5693.9712 - mae: 73.5348 - mse: 5693.9712 - rmse: 75.4526 - val_loss: 5326.0801
- val_mae: 70.7896 - val_mse: 5326.0801 - val_rmse: 72.9800
Epoch 6/300
9/9             0s 14ms/step - loss:
5524.0791 - mae: 72.0141 - mse: 5524.0791 - rmse: 74.3178 - val_loss: 5220.6782
- val_mae: 70.0167 - val_mse: 5220.6782 - val_rmse: 72.2543
Epoch 7/300
9/9             0s 16ms/step - loss:
5236.2979 - mae: 70.0805 - mse: 5236.2979 - rmse: 72.3607 - val_loss: 5084.2485
- val_mae: 68.9965 - val_mse: 5084.2485 - val_rmse: 71.3039
Epoch 8/300
9/9             0s 16ms/step - loss:
5202.1201 - mae: 69.0656 - mse: 5202.1201 - rmse: 72.1207 - val_loss: 4911.6807
- val_mae: 67.7062 - val_mse: 4911.6807 - val_rmse: 70.0834
Epoch 9/300
9/9             0s 15ms/step - loss:
4885.3403 - mae: 66.9716 - mse: 4885.3403 - rmse: 69.8872 - val_loss: 4704.1211
- val_mae: 66.1372 - val_mse: 4704.1211 - val_rmse: 68.5866
Epoch 10/300
9/9             0s 14ms/step - loss:
4758.6719 - mae: 66.3478 - mse: 4758.6719 - rmse: 68.9769 - val_loss: 4473.5864
- val_mae: 64.3330 - val_mse: 4473.5864 - val_rmse: 66.8849
Epoch 11/300
9/9             0s 15ms/step - loss:
4475.7539 - mae: 64.0042 - mse: 4475.7539 - rmse: 66.8907 - val_loss: 4202.7280
- val_mae: 62.1459 - val_mse: 4202.7280 - val_rmse: 64.8285
Epoch 12/300
9/9             0s 15ms/step - loss:
4331.1748 - mae: 63.1757 - mse: 4331.1748 - rmse: 65.8056 - val_loss: 3940.8123
- val_mae: 59.9567 - val_mse: 3940.8123 - val_rmse: 62.7759
Epoch 13/300
9/9             0s 15ms/step - loss:
3919.9814 - mae: 59.7675 - mse: 3919.9814 - rmse: 62.5870 - val_loss: 3655.5923
```

```
- val_mae: 57.4864 - val_mse: 3655.5923 - val_rmse: 60.4615
Epoch 14/300
9/9             0s 16ms/step - loss:
3691.3062 - mae: 57.7952 - mse: 3691.3062 - rmse: 60.7458 - val_loss: 3334.3757
- val_mae: 54.5590 - val_mse: 3334.3757 - val_rmse: 57.7441
Epoch 15/300
9/9             0s 14ms/step - loss:
3491.1152 - mae: 56.1349 - mse: 3491.1152 - rmse: 59.0773 - val_loss: 3010.4744
- val_mae: 51.4485 - val_mse: 3010.4744 - val_rmse: 54.8678
Epoch 16/300
9/9             0s 15ms/step - loss:
3189.6956 - mae: 52.3895 - mse: 3189.6956 - rmse: 56.4477 - val_loss: 2683.7087
- val_mae: 48.1371 - val_mse: 2683.7087 - val_rmse: 51.8045
Epoch 17/300
9/9             0s 16ms/step - loss:
2914.2400 - mae: 49.6243 - mse: 2914.2400 - rmse: 53.9561 - val_loss: 2354.6584
- val_mae: 44.6840 - val_mse: 2354.6584 - val_rmse: 48.5248
Epoch 18/300
9/9             0s 13ms/step - loss:
2320.2842 - mae: 44.0203 - mse: 2320.2842 - rmse: 48.1573 - val_loss: 2016.2189
- val_mae: 40.9183 - val_mse: 2016.2189 - val_rmse: 44.9023
Epoch 19/300
9/9             0s 15ms/step - loss:
2112.1826 - mae: 41.4652 - mse: 2112.1826 - rmse: 45.9562 - val_loss: 1711.8102
- val_mae: 37.3315 - val_mse: 1711.8102 - val_rmse: 41.3740
Epoch 20/300
9/9             0s 16ms/step - loss:
1855.8357 - mae: 37.5518 - mse: 1855.8357 - rmse: 43.0553 - val_loss: 1441.6481
- val_mae: 33.8661 - val_mse: 1441.6481 - val_rmse: 37.9690
Epoch 21/300
9/9             0s 16ms/step - loss:
1562.6608 - mae: 35.1949 - mse: 1562.6608 - rmse: 39.5151 - val_loss: 1205.1733
- val_mae: 30.5521 - val_mse: 1205.1733 - val_rmse: 34.7156
Epoch 22/300
9/9             0s 13ms/step - loss:
1243.8446 - mae: 29.2144 - mse: 1243.8446 - rmse: 35.2098 - val_loss: 1037.2018
- val_mae: 28.0789 - val_mse: 1037.2018 - val_rmse: 32.2056
Epoch 23/300
9/9             0s 16ms/step - loss:
1040.3065 - mae: 27.4008 - mse: 1040.3065 - rmse: 32.2409 - val_loss: 898.5174 -
val_mae: 25.9588 - val_mse: 898.5174 - val_rmse: 29.9753
Epoch 24/300
9/9             0s 16ms/step - loss:
903.0043 - mae: 25.4917 - mse: 903.0043 - rmse: 30.0098 - val_loss: 799.7321 -
val_mae: 24.2584 - val_mse: 799.7321 - val_rmse: 28.2795
Epoch 25/300
9/9             0s 14ms/step - loss:
841.6722 - mae: 24.7213 - mse: 841.6722 - rmse: 29.0062 - val_loss: 737.8853 -
```

```
val_mae: 23.1004 - val_mse: 737.8853 - val_rmse: 27.1640
Epoch 26/300
9/9             0s 16ms/step - loss:
821.8387 - mae: 23.3750 - mse: 821.8387 - rmse: 28.6398 - val_loss: 696.5895 -
val_mae: 22.2716 - val_mse: 696.5895 - val_rmse: 26.3930
Epoch 27/300
9/9             0s 15ms/step - loss:
645.8293 - mae: 21.8352 - mse: 645.8293 - rmse: 25.4076 - val_loss: 662.2593 -
val_mae: 21.5198 - val_mse: 662.2593 - val_rmse: 25.7344
Epoch 28/300
9/9             0s 15ms/step - loss:
645.9822 - mae: 20.9432 - mse: 645.9822 - rmse: 25.3821 - val_loss: 638.1397 -
val_mae: 21.0038 - val_mse: 638.1397 - val_rmse: 25.2614
Epoch 29/300
9/9             0s 15ms/step - loss:
599.8027 - mae: 20.5538 - mse: 599.8027 - rmse: 24.4884 - val_loss: 615.1369 -
val_mae: 20.5156 - val_mse: 615.1369 - val_rmse: 24.8020
Epoch 30/300
9/9             0s 16ms/step - loss:
563.2746 - mae: 19.7578 - mse: 563.2746 - rmse: 23.7096 - val_loss: 595.5479 -
val_mae: 20.1136 - val_mse: 595.5479 - val_rmse: 24.4039
Epoch 31/300
9/9             0s 14ms/step - loss:
499.6629 - mae: 18.8139 - mse: 499.6629 - rmse: 22.3338 - val_loss: 577.2104 -
val_mae: 19.7176 - val_mse: 577.2104 - val_rmse: 24.0252
Epoch 32/300
9/9             0s 15ms/step - loss:
562.8716 - mae: 19.6101 - mse: 562.8716 - rmse: 23.6792 - val_loss: 560.8455 -
val_mae: 19.3880 - val_mse: 560.8455 - val_rmse: 23.6822
Epoch 33/300
9/9             0s 14ms/step - loss:
456.9871 - mae: 17.9093 - mse: 456.9871 - rmse: 21.3734 - val_loss: 544.7484 -
val_mae: 19.0412 - val_mse: 544.7484 - val_rmse: 23.3398
Epoch 34/300
9/9             0s 17ms/step - loss:
480.2182 - mae: 17.9802 - mse: 480.2182 - rmse: 21.9096 - val_loss: 529.3929 -
val_mae: 18.7642 - val_mse: 529.3929 - val_rmse: 23.0085
Epoch 35/300
9/9             0s 16ms/step - loss:
438.7361 - mae: 17.5186 - mse: 438.7361 - rmse: 20.9427 - val_loss: 513.9252 -
val_mae: 18.4544 - val_mse: 513.9252 - val_rmse: 22.6699
Epoch 36/300
9/9             0s 16ms/step - loss:
449.1853 - mae: 17.9828 - mse: 449.1853 - rmse: 21.1758 - val_loss: 499.2708 -
val_mae: 18.1234 - val_mse: 499.2708 - val_rmse: 22.3444
Epoch 37/300
9/9             0s 14ms/step - loss:
415.0856 - mae: 16.9337 - mse: 415.0856 - rmse: 20.3708 - val_loss: 486.1523 -
```

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val_mae: 17.8409 - val_mse: 486.1523 - val_rmse: 22.0489
Epoch 38/300
9/9             0s 15ms/step - loss:
387.7706 - mae: 16.1264 - mse: 387.7706 - rmse: 19.6655 - val_loss: 472.8643 -
val_mae: 17.5660 - val_mse: 472.8643 - val_rmse: 21.7454
Epoch 39/300
9/9             0s 16ms/step - loss:
399.7903 - mae: 16.5730 - mse: 399.7903 - rmse: 19.9908 - val_loss: 460.7879 -
val_mae: 17.2982 - val_mse: 460.7879 - val_rmse: 21.4660
Epoch 40/300
9/9             0s 14ms/step - loss:
331.7831 - mae: 15.0372 - mse: 331.7831 - rmse: 18.1660 - val_loss: 449.7896 -
val_mae: 17.0336 - val_mse: 449.7896 - val_rmse: 21.2082
Epoch 41/300
9/9             0s 16ms/step - loss:
367.5224 - mae: 15.8077 - mse: 367.5224 - rmse: 19.1659 - val_loss: 438.6319 -
val_mae: 16.7430 - val_mse: 438.6319 - val_rmse: 20.9435
Epoch 42/300
9/9             0s 16ms/step - loss:
337.9048 - mae: 15.2799 - mse: 337.9048 - rmse: 18.3718 - val_loss: 427.5429 -
val_mae: 16.5170 - val_mse: 427.5429 - val_rmse: 20.6771
Epoch 43/300
9/9             0s 13ms/step - loss:
368.7532 - mae: 16.2280 - mse: 368.7532 - rmse: 19.1905 - val_loss: 417.3152 -
val_mae: 16.2967 - val_mse: 417.3152 - val_rmse: 20.4283
Epoch 44/300
9/9             0s 16ms/step - loss:
307.1243 - mae: 14.4595 - mse: 307.1243 - rmse: 17.4801 - val_loss: 407.6827 -
val_mae: 16.0649 - val_mse: 407.6827 - val_rmse: 20.1912
Epoch 45/300
9/9             0s 15ms/step - loss:
318.8720 - mae: 14.4878 - mse: 318.8720 - rmse: 17.8483 - val_loss: 398.5580 -
val_mae: 15.8259 - val_mse: 398.5580 - val_rmse: 19.9639
Epoch 46/300
9/9             0s 14ms/step - loss:
307.0531 - mae: 14.6775 - mse: 307.0531 - rmse: 17.5219 - val_loss: 389.5114 -
val_mae: 15.5817 - val_mse: 389.5114 - val_rmse: 19.7360
Epoch 47/300
9/9             0s 14ms/step - loss:
275.9228 - mae: 13.3057 - mse: 275.9228 - rmse: 16.6051 - val_loss: 381.7786 -
val_mae: 15.3918 - val_mse: 381.7786 - val_rmse: 19.5392
Epoch 48/300
9/9             0s 17ms/step - loss:
270.3936 - mae: 13.1709 - mse: 270.3936 - rmse: 16.4295 - val_loss: 373.6653 -
val_mae: 15.2031 - val_mse: 373.6653 - val_rmse: 19.3304
Epoch 49/300
9/9             0s 14ms/step - loss:
269.3883 - mae: 12.9408 - mse: 269.3883 - rmse: 16.3998 - val_loss: 366.0625 -
```

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val_mae: 15.0335 - val_mse: 366.0625 - val_rmse: 19.1328
Epoch 50/300
9/9             0s 17ms/step - loss:
278.8400 - mae: 13.3674 - mse: 278.8400 - rmse: 16.6865 - val_loss: 358.5770 -
val_mae: 14.8111 - val_mse: 358.5770 - val_rmse: 18.9361
Epoch 51/300
9/9             0s 14ms/step - loss:
262.0504 - mae: 13.1016 - mse: 262.0504 - rmse: 16.1729 - val_loss: 352.0717 -
val_mae: 14.6439 - val_mse: 352.0717 - val_rmse: 18.7636
Epoch 52/300
9/9             0s 14ms/step - loss:
253.9917 - mae: 13.0878 - mse: 253.9917 - rmse: 15.9333 - val_loss: 345.3736 -
val_mae: 14.5227 - val_mse: 345.3736 - val_rmse: 18.5842
Epoch 53/300
9/9             0s 15ms/step - loss:
233.5085 - mae: 12.2405 - mse: 233.5085 - rmse: 15.2738 - val_loss: 339.8286 -
val_mae: 14.3649 - val_mse: 339.8286 - val_rmse: 18.4344
Epoch 54/300
9/9             0s 16ms/step - loss:
264.3591 - mae: 13.0110 - mse: 264.3591 - rmse: 16.2358 - val_loss: 333.8725 -
val_mae: 14.2551 - val_mse: 333.8725 - val_rmse: 18.2722
Epoch 55/300
9/9             0s 15ms/step - loss:
250.6009 - mae: 12.6079 - mse: 250.6009 - rmse: 15.8210 - val_loss: 328.7575 -
val_mae: 14.0897 - val_mse: 328.7575 - val_rmse: 18.1317
Epoch 56/300
9/9             0s 16ms/step - loss:
272.1807 - mae: 13.1823 - mse: 272.1807 - rmse: 16.4408 - val_loss: 324.4251 -
val_mae: 13.9710 - val_mse: 324.4251 - val_rmse: 18.0118
Epoch 57/300
9/9             0s 16ms/step - loss:
224.9785 - mae: 11.8565 - mse: 224.9785 - rmse: 14.9913 - val_loss: 319.4076 -
val_mae: 13.8297 - val_mse: 319.4076 - val_rmse: 17.8720
Epoch 58/300
9/9             0s 16ms/step - loss:
236.5602 - mae: 12.1508 - mse: 236.5602 - rmse: 15.3775 - val_loss: 315.0742 -
val_mae: 13.7369 - val_mse: 315.0742 - val_rmse: 17.7503
Epoch 59/300
9/9             0s 15ms/step - loss:
227.6058 - mae: 11.6615 - mse: 227.6058 - rmse: 15.0789 - val_loss: 311.0590 -
val_mae: 13.6238 - val_mse: 311.0590 - val_rmse: 17.6369
Epoch 60/300
9/9             0s 16ms/step - loss:
220.4002 - mae: 11.7470 - mse: 220.4002 - rmse: 14.8447 - val_loss: 307.3911 -
val_mae: 13.4866 - val_mse: 307.3911 - val_rmse: 17.5326
Epoch 61/300
9/9             0s 32ms/step - loss:
221.3597 - mae: 11.5570 - mse: 221.3597 - rmse: 14.8740 - val_loss: 303.3928 -
```

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val_mae: 13.3754 - val_mse: 303.3928 - val_rmse: 17.4182
Epoch 62/300
9/9             0s 30ms/step - loss:
221.8777 - mae: 11.7839 - mse: 221.8777 - rmse: 14.8892 - val_loss: 300.3304 -
val_mae: 13.2861 - val_mse: 300.3304 - val_rmse: 17.3300
Epoch 63/300
9/9             0s 18ms/step - loss:
220.1612 - mae: 11.5524 - mse: 220.1612 - rmse: 14.8321 - val_loss: 297.1172 -
val_mae: 13.2201 - val_mse: 297.1172 - val_rmse: 17.2371
Epoch 64/300
9/9             0s 29ms/step - loss:
206.3984 - mae: 11.1451 - mse: 206.3984 - rmse: 14.3657 - val_loss: 294.1295 -
val_mae: 13.1379 - val_mse: 294.1295 - val_rmse: 17.1502
Epoch 65/300
9/9             0s 29ms/step - loss:
184.7455 - mae: 10.4986 - mse: 184.7455 - rmse: 13.5669 - val_loss: 290.9035 -
val_mae: 13.0580 - val_mse: 290.9035 - val_rmse: 17.0559
Epoch 66/300
9/9             0s 31ms/step - loss:
196.3672 - mae: 10.7594 - mse: 196.3672 - rmse: 14.0028 - val_loss: 287.9384 -
val_mae: 12.9680 - val_mse: 287.9384 - val_rmse: 16.9687
Epoch 67/300
9/9             0s 24ms/step - loss:
210.0607 - mae: 11.0031 - mse: 210.0607 - rmse: 14.4712 - val_loss: 285.1714 -
val_mae: 12.9076 - val_mse: 285.1714 - val_rmse: 16.8870
Epoch 68/300
9/9             0s 30ms/step - loss:
177.4727 - mae: 10.3700 - mse: 177.4727 - rmse: 13.2895 - val_loss: 282.7178 -
val_mae: 12.8504 - val_mse: 282.7178 - val_rmse: 16.8142
Epoch 69/300
9/9             0s 14ms/step - loss:
203.3672 - mae: 10.8604 - mse: 203.3672 - rmse: 14.2351 - val_loss: 280.4150 -
val_mae: 12.7889 - val_mse: 280.4150 - val_rmse: 16.7456
Epoch 70/300
9/9             0s 15ms/step - loss:
189.5389 - mae: 10.5793 - mse: 189.5389 - rmse: 13.7658 - val_loss: 278.4818 -
val_mae: 12.6939 - val_mse: 278.4818 - val_rmse: 16.6878
Epoch 71/300
9/9             0s 15ms/step - loss:
188.5449 - mae: 10.3881 - mse: 188.5449 - rmse: 13.7157 - val_loss: 276.8604 -
val_mae: 12.6502 - val_mse: 276.8604 - val_rmse: 16.6391
Epoch 72/300
9/9             0s 16ms/step - loss:
204.7301 - mae: 10.9209 - mse: 204.7301 - rmse: 14.3032 - val_loss: 274.4798 -
val_mae: 12.6299 - val_mse: 274.4798 - val_rmse: 16.5674
Epoch 73/300
9/9             0s 15ms/step - loss:
183.2837 - mae: 10.2388 - mse: 183.2837 - rmse: 13.5333 - val_loss: 272.5579 -
```

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val_mae: 12.5810 - val_mse: 272.5579 - val_rmse: 16.5093
Epoch 74/300
9/9             0s 16ms/step - loss:
191.6570 - mae: 10.4948 - mse: 191.6570 - rmse: 13.8229 - val_loss: 270.8751 -
val_mae: 12.5075 - val_mse: 270.8751 - val_rmse: 16.4583
Epoch 75/300
9/9             0s 16ms/step - loss:
169.6403 - mae: 10.0047 - mse: 169.6403 - rmse: 13.0136 - val_loss: 268.7950 -
val_mae: 12.4750 - val_mse: 268.7950 - val_rmse: 16.3950
Epoch 76/300
9/9             0s 14ms/step - loss:
171.4918 - mae: 9.9601 - mse: 171.4918 - rmse: 13.0784 - val_loss: 267.4557 -
val_mae: 12.4521 - val_mse: 267.4557 - val_rmse: 16.3541
Epoch 77/300
9/9             0s 16ms/step - loss:
187.4772 - mae: 10.4741 - mse: 187.4772 - rmse: 13.6913 - val_loss: 265.5424 -
val_mae: 12.4218 - val_mse: 265.5424 - val_rmse: 16.2955
Epoch 78/300
9/9             0s 15ms/step - loss:
202.6915 - mae: 10.6768 - mse: 202.6915 - rmse: 14.2083 - val_loss: 263.7174 -
val_mae: 12.3919 - val_mse: 263.7174 - val_rmse: 16.2394
Epoch 79/300
9/9             0s 15ms/step - loss:
170.8567 - mae: 10.0482 - mse: 170.8567 - rmse: 13.0688 - val_loss: 262.5941 -
val_mae: 12.3374 - val_mse: 262.5941 - val_rmse: 16.2048
Epoch 80/300
9/9             0s 14ms/step - loss:
145.5457 - mae: 9.2475 - mse: 145.5457 - rmse: 12.0129 - val_loss: 261.2690 -
val_mae: 12.2897 - val_mse: 261.2690 - val_rmse: 16.1638
Epoch 81/300
9/9             0s 15ms/step - loss:
176.1722 - mae: 10.0122 - mse: 176.1722 - rmse: 13.2700 - val_loss: 259.9183 -
val_mae: 12.2645 - val_mse: 259.9183 - val_rmse: 16.1220
Epoch 82/300
9/9             0s 14ms/step - loss:
185.5740 - mae: 10.2793 - mse: 185.5740 - rmse: 13.6172 - val_loss: 258.3645 -
val_mae: 12.2466 - val_mse: 258.3645 - val_rmse: 16.0737
Epoch 83/300
9/9             0s 16ms/step - loss:
195.4393 - mae: 10.5392 - mse: 195.4393 - rmse: 13.9525 - val_loss: 256.9097 -
val_mae: 12.2245 - val_mse: 256.9097 - val_rmse: 16.0284
Epoch 84/300
9/9             0s 16ms/step - loss:
175.2502 - mae: 10.1169 - mse: 175.2502 - rmse: 13.2325 - val_loss: 255.9007 -
val_mae: 12.1922 - val_mse: 255.9007 - val_rmse: 15.9969
Epoch 85/300
9/9             0s 16ms/step - loss:
186.1060 - mae: 10.4093 - mse: 186.1060 - rmse: 13.6239 - val_loss: 254.7672 -
```

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val_mae: 12.1630 - val_mse: 254.7672 - val_rmse: 15.9614
Epoch 86/300
9/9             0s 15ms/step - loss:
168.0327 - mae: 10.0278 - mse: 168.0327 - rmse: 12.9571 - val_loss: 253.6835 -
val_mae: 12.1013 - val_mse: 253.6835 - val_rmse: 15.9274
Epoch 87/300
9/9             0s 13ms/step - loss:
191.2937 - mae: 10.7591 - mse: 191.2937 - rmse: 13.8169 - val_loss: 252.4679 -
val_mae: 12.0908 - val_mse: 252.4679 - val_rmse: 15.8892
Epoch 88/300
9/9             0s 14ms/step - loss:
173.3313 - mae: 10.0700 - mse: 173.3313 - rmse: 13.1580 - val_loss: 251.0027 -
val_mae: 12.0633 - val_mse: 251.0027 - val_rmse: 15.8431
Epoch 89/300
9/9             0s 15ms/step - loss:
187.7526 - mae: 10.4010 - mse: 187.7526 - rmse: 13.6702 - val_loss: 250.4744 -
val_mae: 12.0397 - val_mse: 250.4744 - val_rmse: 15.8264
Epoch 90/300
9/9             0s 14ms/step - loss:
165.5434 - mae: 9.9040 - mse: 165.5434 - rmse: 12.8630 - val_loss: 249.8499 -
val_mae: 11.9884 - val_mse: 249.8499 - val_rmse: 15.8066
Epoch 91/300
9/9             0s 14ms/step - loss:
177.3665 - mae: 10.0606 - mse: 177.3665 - rmse: 13.3094 - val_loss: 248.9275 -
val_mae: 11.9962 - val_mse: 248.9275 - val_rmse: 15.7774
Epoch 92/300
9/9             0s 14ms/step - loss:
186.0045 - mae: 10.4796 - mse: 186.0045 - rmse: 13.6019 - val_loss: 247.8370 -
val_mae: 11.9723 - val_mse: 247.8370 - val_rmse: 15.7428
Epoch 93/300
9/9             0s 15ms/step - loss:
166.5578 - mae: 9.8326 - mse: 166.5578 - rmse: 12.8938 - val_loss: 246.6869 -
val_mae: 11.9522 - val_mse: 246.6869 - val_rmse: 15.7063
Epoch 94/300
9/9             0s 13ms/step - loss:
168.2340 - mae: 9.6815 - mse: 168.2340 - rmse: 12.9558 - val_loss: 245.8215 -
val_mae: 11.9418 - val_mse: 245.8215 - val_rmse: 15.6787
Epoch 95/300
9/9             0s 16ms/step - loss:
158.5753 - mae: 9.5016 - mse: 158.5753 - rmse: 12.5856 - val_loss: 245.1755 -
val_mae: 11.9170 - val_mse: 245.1755 - val_rmse: 15.6581
Epoch 96/300
9/9             0s 16ms/step - loss:
165.1484 - mae: 9.6612 - mse: 165.1484 - rmse: 12.8487 - val_loss: 244.2674 -
val_mae: 11.8857 - val_mse: 244.2674 - val_rmse: 15.6291
Epoch 97/300
9/9             0s 14ms/step - loss:
156.2542 - mae: 9.3530 - mse: 156.2542 - rmse: 12.4644 - val_loss: 243.4115 -
```

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val_mae: 11.8627 - val_mse: 243.4115 - val_rmse: 15.6017
Epoch 98/300
9/9             0s 15ms/step - loss:
166.1543 - mae: 9.7284 - mse: 166.1543 - rmse: 12.8791 - val_loss: 242.1570 -
val_mae: 11.8477 - val_mse: 242.1570 - val_rmse: 15.5614
Epoch 99/300
9/9             0s 14ms/step - loss:
185.3102 - mae: 10.3255 - mse: 185.3102 - rmse: 13.5517 - val_loss: 241.5507 -
val_mae: 11.8281 - val_mse: 241.5507 - val_rmse: 15.5419
Epoch 100/300
9/9             0s 13ms/step - loss:
159.5772 - mae: 9.6465 - mse: 159.5772 - rmse: 12.6242 - val_loss: 242.1113 -
val_mae: 11.8055 - val_mse: 242.1113 - val_rmse: 15.5599
Epoch 101/300
9/9             0s 15ms/step - loss:
150.8014 - mae: 9.3115 - mse: 150.8014 - rmse: 12.2686 - val_loss: 241.0314 -
val_mae: 11.7981 - val_mse: 241.0314 - val_rmse: 15.5252
Epoch 102/300
9/9             0s 16ms/step - loss:
158.4198 - mae: 9.4487 - mse: 158.4198 - rmse: 12.5850 - val_loss: 240.0954 -
val_mae: 11.7899 - val_mse: 240.0954 - val_rmse: 15.4950
Epoch 103/300
9/9             0s 15ms/step - loss:
174.9567 - mae: 9.9164 - mse: 174.9567 - rmse: 13.2002 - val_loss: 239.2745 -
val_mae: 11.7852 - val_mse: 239.2745 - val_rmse: 15.4685
Epoch 104/300
9/9             0s 14ms/step - loss:
150.5439 - mae: 9.1924 - mse: 150.5439 - rmse: 12.2552 - val_loss: 238.7299 -
val_mae: 11.7513 - val_mse: 238.7299 - val_rmse: 15.4509
Epoch 105/300
9/9             0s 16ms/step - loss:
160.8457 - mae: 9.5850 - mse: 160.8457 - rmse: 12.6807 - val_loss: 238.0685 -
val_mae: 11.7205 - val_mse: 238.0685 - val_rmse: 15.4295
Epoch 106/300
9/9             0s 17ms/step - loss:
154.4839 - mae: 9.2893 - mse: 154.4839 - rmse: 12.4227 - val_loss: 237.1735 -
val_mae: 11.7210 - val_mse: 237.1735 - val_rmse: 15.4004
Epoch 107/300
9/9             0s 16ms/step - loss:
151.9922 - mae: 9.2741 - mse: 151.9922 - rmse: 12.3003 - val_loss: 237.1698 -
val_mae: 11.6952 - val_mse: 237.1698 - val_rmse: 15.4003
Epoch 108/300
9/9             0s 14ms/step - loss:
170.9397 - mae: 9.7926 - mse: 170.9397 - rmse: 13.0668 - val_loss: 236.1795 -
val_mae: 11.6949 - val_mse: 236.1795 - val_rmse: 15.3681
Epoch 109/300
9/9             0s 13ms/step - loss:
133.6024 - mae: 8.8031 - mse: 133.6024 - rmse: 11.5257 - val_loss: 236.2710 -
```

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val_mae: 11.6654 - val_mse: 236.2710 - val_rmse: 15.3711
Epoch 110/300
9/9             0s 16ms/step - loss:
159.2856 - mae: 9.4596 - mse: 159.2856 - rmse: 12.6078 - val_loss: 235.5302 -
val_mae: 11.6692 - val_mse: 235.5302 - val_rmse: 15.3470
Epoch 111/300
9/9             0s 18ms/step - loss:
146.2619 - mae: 9.0969 - mse: 146.2619 - rmse: 12.0914 - val_loss: 234.7701 -
val_mae: 11.6565 - val_mse: 234.7701 - val_rmse: 15.3222
Epoch 112/300
9/9             0s 13ms/step - loss:
156.6537 - mae: 9.6096 - mse: 156.6537 - rmse: 12.5125 - val_loss: 234.1539 -
val_mae: 11.6316 - val_mse: 234.1539 - val_rmse: 15.3021
Epoch 113/300
9/9             0s 16ms/step - loss:
152.0522 - mae: 9.2078 - mse: 152.0522 - rmse: 12.3254 - val_loss: 233.2635 -
val_mae: 11.6322 - val_mse: 233.2635 - val_rmse: 15.2730
Epoch 114/300
9/9             0s 15ms/step - loss:
175.9934 - mae: 10.0343 - mse: 175.9934 - rmse: 13.2450 - val_loss: 233.3619 -
val_mae: 11.6142 - val_mse: 233.3619 - val_rmse: 15.2762
Epoch 115/300
9/9             0s 14ms/step - loss:
139.2385 - mae: 8.9067 - mse: 139.2385 - rmse: 11.7887 - val_loss: 232.7783 -
val_mae: 11.5689 - val_mse: 232.7783 - val_rmse: 15.2571
Epoch 116/300
9/9             0s 14ms/step - loss:
139.4325 - mae: 9.0412 - mse: 139.4325 - rmse: 11.7791 - val_loss: 232.5168 -
val_mae: 11.5672 - val_mse: 232.5168 - val_rmse: 15.2485
Epoch 117/300
9/9             0s 16ms/step - loss:
156.1486 - mae: 9.4619 - mse: 156.1486 - rmse: 12.4815 - val_loss: 231.6339 -
val_mae: 11.5618 - val_mse: 231.6339 - val_rmse: 15.2195
Epoch 118/300
9/9             0s 16ms/step - loss:
157.4163 - mae: 9.5116 - mse: 157.4163 - rmse: 12.5334 - val_loss: 231.2736 -
val_mae: 11.5667 - val_mse: 231.2736 - val_rmse: 15.2077
Epoch 119/300
9/9             0s 15ms/step - loss:
168.3282 - mae: 9.9017 - mse: 168.3282 - rmse: 12.9557 - val_loss: 230.8308 -
val_mae: 11.5428 - val_mse: 230.8308 - val_rmse: 15.1931
Epoch 120/300
9/9             0s 29ms/step - loss:
146.7449 - mae: 9.2405 - mse: 146.7449 - rmse: 12.1076 - val_loss: 230.4997 -
val_mae: 11.5261 - val_mse: 230.4997 - val_rmse: 15.1822
Epoch 121/300
9/9             0s 29ms/step - loss:
153.3909 - mae: 9.3393 - mse: 153.3909 - rmse: 12.3814 - val_loss: 229.9513 -
```

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val_mae: 11.5113 - val_mse: 229.9513 - val_rmse: 15.1641
Epoch 122/300
9/9             0s 29ms/step - loss:
135.8456 - mae: 8.7889 - mse: 135.8456 - rmse: 11.6500 - val_loss: 229.8352 -
val_mae: 11.4799 - val_mse: 229.8352 - val_rmse: 15.1603
Epoch 123/300
9/9             0s 20ms/step - loss:
130.9210 - mae: 8.7818 - mse: 130.9210 - rmse: 11.4167 - val_loss: 229.1794 -
val_mae: 11.4756 - val_mse: 229.1794 - val_rmse: 15.1387
Epoch 124/300
9/9             0s 20ms/step - loss:
140.0074 - mae: 8.8567 - mse: 140.0074 - rmse: 11.8247 - val_loss: 228.5538 -
val_mae: 11.4862 - val_mse: 228.5538 - val_rmse: 15.1180
Epoch 125/300
9/9             0s 31ms/step - loss:
145.7254 - mae: 9.1702 - mse: 145.7254 - rmse: 12.0658 - val_loss: 227.7929 -
val_mae: 11.4765 - val_mse: 227.7929 - val_rmse: 15.0928
Epoch 126/300
9/9             0s 30ms/step - loss:
141.7859 - mae: 8.8222 - mse: 141.7859 - rmse: 11.8961 - val_loss: 227.9043 -
val_mae: 11.4590 - val_mse: 227.9043 - val_rmse: 15.0965
Epoch 127/300
9/9             0s 30ms/step - loss:
141.9347 - mae: 9.1107 - mse: 141.9347 - rmse: 11.9109 - val_loss: 227.5555 -
val_mae: 11.4423 - val_mse: 227.5555 - val_rmse: 15.0849
Epoch 128/300
9/9             0s 21ms/step - loss:
151.8380 - mae: 9.1943 - mse: 151.8380 - rmse: 12.3130 - val_loss: 227.1720 -
val_mae: 11.4411 - val_mse: 227.1720 - val_rmse: 15.0722
Epoch 129/300
9/9             0s 14ms/step - loss:
140.6573 - mae: 9.0375 - mse: 140.6573 - rmse: 11.8522 - val_loss: 226.2006 -
val_mae: 11.4538 - val_mse: 226.2006 - val_rmse: 15.0400
Epoch 130/300
9/9             0s 16ms/step - loss:
178.0697 - mae: 10.1766 - mse: 178.0697 - rmse: 13.2522 - val_loss: 225.7089 -
val_mae: 11.4234 - val_mse: 225.7089 - val_rmse: 15.0236
Epoch 131/300
9/9             0s 15ms/step - loss:
136.3212 - mae: 8.7731 - mse: 136.3212 - rmse: 11.6701 - val_loss: 225.6643 -
val_mae: 11.3871 - val_mse: 225.6643 - val_rmse: 15.0221
Epoch 132/300
9/9             0s 14ms/step - loss:
149.3158 - mae: 9.3514 - mse: 149.3158 - rmse: 12.2039 - val_loss: 226.0607 -
val_mae: 11.3832 - val_mse: 226.0607 - val_rmse: 15.0353
Epoch 133/300
9/9             0s 15ms/step - loss:
135.0612 - mae: 8.6461 - mse: 135.0612 - rmse: 11.6159 - val_loss: 225.8183 -
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val_mae: 11.3755 - val_mse: 225.8183 - val_rmse: 15.0273
Epoch 134/300
9/9            0s 16ms/step - loss:
145.4124 - mae: 8.9130 - mse: 145.4124 - rmse: 12.0327 - val_loss: 224.8246 -
val_mae: 11.3704 - val_mse: 224.8246 - val_rmse: 14.9942
Epoch 135/300
9/9            0s 16ms/step - loss:
134.6585 - mae: 8.7437 - mse: 134.6585 - rmse: 11.5897 - val_loss: 224.2215 -
val_mae: 11.3579 - val_mse: 224.2215 - val_rmse: 14.9740
Epoch 136/300
9/9            0s 15ms/step - loss:
155.1048 - mae: 9.4778 - mse: 155.1048 - rmse: 12.4343 - val_loss: 224.4420 -
val_mae: 11.3566 - val_mse: 224.4420 - val_rmse: 14.9814
Epoch 137/300
9/9            0s 16ms/step - loss:
141.5913 - mae: 8.9285 - mse: 141.5913 - rmse: 11.8981 - val_loss: 223.7999 -
val_mae: 11.3470 - val_mse: 223.7999 - val_rmse: 14.9599
Epoch 138/300
9/9            0s 14ms/step - loss:
155.1254 - mae: 9.5247 - mse: 155.1254 - rmse: 12.4484 - val_loss: 223.2904 -
val_mae: 11.3440 - val_mse: 223.2904 - val_rmse: 14.9429
Epoch 139/300
9/9            0s 15ms/step - loss:
137.2316 - mae: 8.8178 - mse: 137.2316 - rmse: 11.7114 - val_loss: 223.0884 -
val_mae: 11.3209 - val_mse: 223.0884 - val_rmse: 14.9361
Epoch 140/300
9/9            0s 16ms/step - loss:
146.2227 - mae: 9.1736 - mse: 146.2227 - rmse: 12.0889 - val_loss: 223.1389 -
val_mae: 11.3103 - val_mse: 223.1389 - val_rmse: 14.9378
Epoch 141/300
9/9            0s 16ms/step - loss:
130.0827 - mae: 8.6854 - mse: 130.0827 - rmse: 11.3957 - val_loss: 222.7416 -
val_mae: 11.3116 - val_mse: 222.7416 - val_rmse: 14.9245
Epoch 142/300
9/9            0s 18ms/step - loss:
143.0668 - mae: 9.0380 - mse: 143.0668 - rmse: 11.9564 - val_loss: 222.2807 -
val_mae: 11.2942 - val_mse: 222.2807 - val_rmse: 14.9091
Epoch 143/300
9/9            0s 14ms/step - loss:
136.7839 - mae: 8.8645 - mse: 136.7839 - rmse: 11.6748 - val_loss: 222.0447 -
val_mae: 11.3032 - val_mse: 222.0447 - val_rmse: 14.9012
Epoch 144/300
9/9            0s 15ms/step - loss:
145.2380 - mae: 9.0485 - mse: 145.2380 - rmse: 12.0369 - val_loss: 221.6322 -
val_mae: 11.2792 - val_mse: 221.6322 - val_rmse: 14.8873
Epoch 145/300
9/9            0s 15ms/step - loss:
154.6521 - mae: 9.3215 - mse: 154.6521 - rmse: 12.4160 - val_loss: 221.4161 -
```

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val_mae: 11.2929 - val_mse: 221.4161 - val_rmse: 14.8801
Epoch 146/300
9/9             0s 16ms/step - loss:
136.7099 - mae: 8.7223 - mse: 136.7099 - rmse: 11.6897 - val_loss: 221.3857 -
val_mae: 11.2778 - val_mse: 221.3857 - val_rmse: 14.8790
Epoch 147/300
9/9             0s 17ms/step - loss:
137.3514 - mae: 8.8118 - mse: 137.3514 - rmse: 11.7132 - val_loss: 220.6283 -
val_mae: 11.2724 - val_mse: 220.6283 - val_rmse: 14.8536
Epoch 148/300
9/9             0s 15ms/step - loss:
129.2102 - mae: 8.5840 - mse: 129.2102 - rmse: 11.3328 - val_loss: 220.7852 -
val_mae: 11.2719 - val_mse: 220.7852 - val_rmse: 14.8588
Epoch 149/300
9/9             0s 15ms/step - loss:
161.5168 - mae: 9.3895 - mse: 161.5168 - rmse: 12.6455 - val_loss: 220.5816 -
val_mae: 11.2551 - val_mse: 220.5816 - val_rmse: 14.8520
Epoch 150/300
9/9             0s 16ms/step - loss:
158.5929 - mae: 9.2803 - mse: 158.5929 - rmse: 12.5709 - val_loss: 219.9189 -
val_mae: 11.2550 - val_mse: 219.9189 - val_rmse: 14.8297
Epoch 151/300
9/9             0s 16ms/step - loss:
123.0714 - mae: 8.2844 - mse: 123.0714 - rmse: 11.0669 - val_loss: 219.9937 -
val_mae: 11.2426 - val_mse: 219.9937 - val_rmse: 14.8322
Epoch 152/300
9/9             0s 16ms/step - loss:
138.3872 - mae: 8.9904 - mse: 138.3872 - rmse: 11.7604 - val_loss: 219.7232 -
val_mae: 11.2343 - val_mse: 219.7232 - val_rmse: 14.8231
Epoch 153/300
9/9             0s 15ms/step - loss:
139.6572 - mae: 9.1408 - mse: 139.6572 - rmse: 11.8145 - val_loss: 219.5672 -
val_mae: 11.2189 - val_mse: 219.5672 - val_rmse: 14.8178
Epoch 154/300
9/9             0s 14ms/step - loss:
155.6402 - mae: 9.3363 - mse: 155.6402 - rmse: 12.4254 - val_loss: 218.9844 -
val_mae: 11.2418 - val_mse: 218.9844 - val_rmse: 14.7981
Epoch 155/300
9/9             0s 16ms/step - loss:
137.8481 - mae: 8.8593 - mse: 137.8481 - rmse: 11.7387 - val_loss: 218.4811 -
val_mae: 11.2165 - val_mse: 218.4811 - val_rmse: 14.7811
Epoch 156/300
9/9             0s 16ms/step - loss:
140.5363 - mae: 8.8136 - mse: 140.5363 - rmse: 11.8512 - val_loss: 217.9753 -
val_mae: 11.2146 - val_mse: 217.9753 - val_rmse: 14.7640
Epoch 157/300
9/9             0s 14ms/step - loss:
148.9807 - mae: 9.0359 - mse: 148.9807 - rmse: 12.1852 - val_loss: 217.7965 -
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val_mae: 11.2109 - val_mse: 217.7965 - val_rmse: 14.7579
Epoch 158/300
9/9            0s 15ms/step - loss:
124.5098 - mae: 8.3060 - mse: 124.5098 - rmse: 11.1446 - val_loss: 218.3510 -
val_mae: 11.1818 - val_mse: 218.3510 - val_rmse: 14.7767
Epoch 159/300
9/9            0s 15ms/step - loss:
154.2005 - mae: 9.5364 - mse: 154.2005 - rmse: 12.3513 - val_loss: 217.9971 -
val_mae: 11.1532 - val_mse: 217.9971 - val_rmse: 14.7647
Epoch 160/300
9/9            0s 15ms/step - loss:
139.2689 - mae: 9.0546 - mse: 139.2689 - rmse: 11.7884 - val_loss: 217.1905 -
val_mae: 11.1998 - val_mse: 217.1905 - val_rmse: 14.7374
Epoch 161/300
9/9            0s 16ms/step - loss:
132.1570 - mae: 8.8352 - mse: 132.1570 - rmse: 11.4832 - val_loss: 216.5874 -
val_mae: 11.1929 - val_mse: 216.5874 - val_rmse: 14.7169
Epoch 162/300
9/9            0s 16ms/step - loss:
136.0048 - mae: 8.8030 - mse: 136.0048 - rmse: 11.6395 - val_loss: 216.7636 -
val_mae: 11.1903 - val_mse: 216.7636 - val_rmse: 14.7229
Epoch 163/300
9/9            0s 16ms/step - loss:
121.6712 - mae: 8.5749 - mse: 121.6712 - rmse: 11.0138 - val_loss: 217.0105 -
val_mae: 11.1627 - val_mse: 217.0105 - val_rmse: 14.7313
Epoch 164/300
9/9            0s 14ms/step - loss:
103.7308 - mae: 7.7963 - mse: 103.7308 - rmse: 10.1395 - val_loss: 216.8100 -
val_mae: 11.1265 - val_mse: 216.8100 - val_rmse: 14.7245
Epoch 165/300
9/9            0s 13ms/step - loss:
158.7534 - mae: 9.2639 - mse: 158.7534 - rmse: 12.5660 - val_loss: 215.8941 -
val_mae: 11.1774 - val_mse: 215.8941 - val_rmse: 14.6933
Epoch 166/300
9/9            0s 16ms/step - loss:
126.2621 - mae: 8.2966 - mse: 126.2621 - rmse: 11.2233 - val_loss: 215.9715 -
val_mae: 11.1667 - val_mse: 215.9715 - val_rmse: 14.6960
Epoch 167/300
9/9            0s 16ms/step - loss:
130.5486 - mae: 8.6808 - mse: 130.5486 - rmse: 11.4141 - val_loss: 215.5601 -
val_mae: 11.1598 - val_mse: 215.5601 - val_rmse: 14.6820
Epoch 168/300
9/9            0s 16ms/step - loss:
124.4121 - mae: 8.5159 - mse: 124.4121 - rmse: 11.1441 - val_loss: 215.1905 -
val_mae: 11.1179 - val_mse: 215.1905 - val_rmse: 14.6694
Epoch 169/300
9/9            0s 15ms/step - loss:
147.3485 - mae: 9.1413 - mse: 147.3485 - rmse: 12.1242 - val_loss: 215.1225 -
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val_mae: 11.1555 - val_mse: 215.1225 - val_rmse: 14.6671
Epoch 170/300
9/9             0s 14ms/step - loss:
126.1877 - mae: 8.5220 - mse: 126.1877 - rmse: 11.2021 - val_loss: 214.7074 -
val_mae: 11.1059 - val_mse: 214.7074 - val_rmse: 14.6529
Epoch 171/300
9/9             0s 16ms/step - loss:
118.4258 - mae: 8.4038 - mse: 118.4258 - rmse: 10.8623 - val_loss: 214.8712 -
val_mae: 11.1021 - val_mse: 214.8712 - val_rmse: 14.6585
Epoch 172/300
9/9             0s 16ms/step - loss:
134.8955 - mae: 8.6980 - mse: 134.8955 - rmse: 11.6130 - val_loss: 214.4533 -
val_mae: 11.1412 - val_mse: 214.4533 - val_rmse: 14.6442
Epoch 173/300
9/9             0s 14ms/step - loss:
132.6511 - mae: 8.5493 - mse: 132.6511 - rmse: 11.5118 - val_loss: 214.5321 -
val_mae: 11.1235 - val_mse: 214.5321 - val_rmse: 14.6469
Epoch 174/300
9/9             0s 16ms/step - loss:
126.4089 - mae: 8.6446 - mse: 126.4089 - rmse: 11.2380 - val_loss: 214.2653 -
val_mae: 11.0958 - val_mse: 214.2653 - val_rmse: 14.6378
Epoch 175/300
9/9             0s 14ms/step - loss:
141.4703 - mae: 8.8659 - mse: 141.4703 - rmse: 11.8848 - val_loss: 213.4910 -
val_mae: 11.1354 - val_mse: 213.4910 - val_rmse: 14.6113
Epoch 176/300
9/9             0s 17ms/step - loss:
139.8476 - mae: 8.9377 - mse: 139.8476 - rmse: 11.8163 - val_loss: 213.4719 -
val_mae: 11.0799 - val_mse: 213.4719 - val_rmse: 14.6107
Epoch 177/300
9/9             0s 30ms/step - loss:
136.6752 - mae: 8.7391 - mse: 136.6752 - rmse: 11.6849 - val_loss: 213.5176 -
val_mae: 11.0958 - val_mse: 213.5176 - val_rmse: 14.6122
Epoch 178/300
9/9             0s 30ms/step - loss:
124.5468 - mae: 8.3879 - mse: 124.5468 - rmse: 11.1451 - val_loss: 213.5687 -
val_mae: 11.0742 - val_mse: 213.5687 - val_rmse: 14.6140
Epoch 179/300
9/9             0s 29ms/step - loss:
154.7793 - mae: 9.4216 - mse: 154.7793 - rmse: 12.3751 - val_loss: 213.4975 -
val_mae: 11.0749 - val_mse: 213.4975 - val_rmse: 14.6116
Epoch 180/300
9/9             0s 19ms/step - loss:
115.3345 - mae: 8.0496 - mse: 115.3345 - rmse: 10.7278 - val_loss: 212.8835 -
val_mae: 11.0746 - val_mse: 212.8835 - val_rmse: 14.5905
Epoch 181/300
9/9             0s 29ms/step - loss:
121.0924 - mae: 8.3436 - mse: 121.0924 - rmse: 10.9871 - val_loss: 212.4948 -
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val_mae: 11.0815 - val_mse: 212.4948 - val_rmse: 14.5772
Epoch 182/300
9/9            0s 30ms/step - loss:
128.9996 - mae: 8.6604 - mse: 128.9996 - rmse: 11.3505 - val_loss: 212.0907 -
val_mae: 11.0773 - val_mse: 212.0907 - val_rmse: 14.5633
Epoch 183/300
9/9            0s 31ms/step - loss:
118.8101 - mae: 8.3161 - mse: 118.8101 - rmse: 10.8907 - val_loss: 211.9452 -
val_mae: 11.0567 - val_mse: 211.9452 - val_rmse: 14.5583
Epoch 184/300
9/9            0s 16ms/step - loss:
129.1284 - mae: 8.5387 - mse: 129.1284 - rmse: 11.3533 - val_loss: 212.2436 -
val_mae: 11.0675 - val_mse: 212.2436 - val_rmse: 14.5686
Epoch 185/300
9/9            0s 17ms/step - loss:
127.5265 - mae: 8.3174 - mse: 127.5265 - rmse: 11.2731 - val_loss: 211.8114 -
val_mae: 11.0754 - val_mse: 211.8114 - val_rmse: 14.5537
Epoch 186/300
9/9            0s 16ms/step - loss:
139.9722 - mae: 8.8026 - mse: 139.9722 - rmse: 11.8092 - val_loss: 211.5326 -
val_mae: 11.0428 - val_mse: 211.5326 - val_rmse: 14.5442
Epoch 187/300
9/9            0s 16ms/step - loss:
113.9775 - mae: 7.9580 - mse: 113.9775 - rmse: 10.6341 - val_loss: 212.0421 -
val_mae: 11.0329 - val_mse: 212.0421 - val_rmse: 14.5617
Epoch 188/300
9/9            0s 17ms/step - loss:
140.4507 - mae: 8.8597 - mse: 140.4507 - rmse: 11.8352 - val_loss: 210.9836 -
val_mae: 11.0413 - val_mse: 210.9836 - val_rmse: 14.5253
Epoch 189/300
9/9            0s 17ms/step - loss:
119.0664 - mae: 8.1138 - mse: 119.0664 - rmse: 10.8966 - val_loss: 211.0782 -
val_mae: 11.0549 - val_mse: 211.0782 - val_rmse: 14.5285
Epoch 190/300
9/9            0s 17ms/step - loss:
125.2237 - mae: 8.3339 - mse: 125.2237 - rmse: 11.1865 - val_loss: 210.3885 -
val_mae: 11.0306 - val_mse: 210.3885 - val_rmse: 14.5048
Epoch 191/300
9/9            0s 14ms/step - loss:
126.6706 - mae: 8.2319 - mse: 126.6706 - rmse: 11.2396 - val_loss: 210.9021 -
val_mae: 10.9839 - val_mse: 210.9021 - val_rmse: 14.5225
Epoch 192/300
9/9            0s 17ms/step - loss:
110.1604 - mae: 7.8875 - mse: 110.1604 - rmse: 10.4563 - val_loss: 211.0526 -
val_mae: 10.9879 - val_mse: 211.0526 - val_rmse: 14.5276
Epoch 193/300
9/9            0s 17ms/step - loss:
124.8754 - mae: 8.4580 - mse: 124.8754 - rmse: 11.1672 - val_loss: 209.9601 -
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val_mae: 11.0167 - val_mse: 209.9601 - val_rmse: 14.4900
Epoch 194/300
9/9            0s 17ms/step - loss:
136.7487 - mae: 8.8858 - mse: 136.7487 - rmse: 11.6618 - val_loss: 209.6497 -
val_mae: 11.0123 - val_mse: 209.6497 - val_rmse: 14.4793
Epoch 195/300
9/9            0s 16ms/step - loss:
107.9229 - mae: 7.7635 - mse: 107.9229 - rmse: 10.3558 - val_loss: 209.8596 -
val_mae: 11.0118 - val_mse: 209.8596 - val_rmse: 14.4865
Epoch 196/300
9/9            0s 16ms/step - loss:
120.2818 - mae: 8.3999 - mse: 120.2818 - rmse: 10.9520 - val_loss: 208.9721 -
val_mae: 10.9965 - val_mse: 208.9721 - val_rmse: 14.4559
Epoch 197/300
9/9            0s 15ms/step - loss:
133.9727 - mae: 8.7186 - mse: 133.9727 - rmse: 11.5627 - val_loss: 209.4492 -
val_mae: 10.9801 - val_mse: 209.4492 - val_rmse: 14.4724
Epoch 198/300
9/9            0s 16ms/step - loss:
124.9715 - mae: 8.2223 - mse: 124.9715 - rmse: 11.1666 - val_loss: 209.4203 -
val_mae: 11.0018 - val_mse: 209.4203 - val_rmse: 14.4714
Epoch 199/300
9/9            0s 16ms/step - loss:
129.6906 - mae: 8.5418 - mse: 129.6906 - rmse: 11.3763 - val_loss: 209.8246 -
val_mae: 11.0150 - val_mse: 209.8246 - val_rmse: 14.4853
Epoch 200/300
9/9            0s 14ms/step - loss:
113.0242 - mae: 7.9051 - mse: 113.0242 - rmse: 10.6002 - val_loss: 209.1630 -
val_mae: 11.0042 - val_mse: 209.1630 - val_rmse: 14.4625
Epoch 201/300
9/9            0s 16ms/step - loss:
114.1902 - mae: 8.2596 - mse: 114.1902 - rmse: 10.6617 - val_loss: 208.2637 -
val_mae: 10.9711 - val_mse: 208.2637 - val_rmse: 14.4313
Epoch 202/300
9/9            0s 17ms/step - loss:
136.6509 - mae: 8.8535 - mse: 136.6509 - rmse: 11.6832 - val_loss: 207.8498 -
val_mae: 10.9980 - val_mse: 207.8498 - val_rmse: 14.4170
Epoch 203/300
9/9            0s 15ms/step - loss:
137.8934 - mae: 8.8344 - mse: 137.8934 - rmse: 11.7125 - val_loss: 207.5807 -
val_mae: 10.9823 - val_mse: 207.5807 - val_rmse: 14.4077
Epoch 204/300
9/9            0s 17ms/step - loss:
128.9400 - mae: 8.6117 - mse: 128.9400 - rmse: 11.3404 - val_loss: 208.2364 -
val_mae: 10.9382 - val_mse: 208.2364 - val_rmse: 14.4304
Epoch 205/300
9/9            0s 16ms/step - loss:
121.1060 - mae: 8.2225 - mse: 121.1060 - rmse: 10.9891 - val_loss: 208.2306 -
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val_mae: 10.9480 - val_mse: 208.2306 - val_rmse: 14.4302
Epoch 206/300
9/9             0s 16ms/step - loss:
128.7937 - mae: 8.5018 - mse: 128.7937 - rmse: 11.3373 - val_loss: 207.9457 -
val_mae: 10.9363 - val_mse: 207.9457 - val_rmse: 14.4203
Epoch 207/300
9/9             0s 16ms/step - loss:
117.2608 - mae: 8.1058 - mse: 117.2608 - rmse: 10.8235 - val_loss: 207.6285 -
val_mae: 10.9494 - val_mse: 207.6285 - val_rmse: 14.4093
Epoch 208/300
9/9             0s 15ms/step - loss:
118.3750 - mae: 8.2895 - mse: 118.3750 - rmse: 10.8477 - val_loss: 207.0350 -
val_mae: 10.9335 - val_mse: 207.0350 - val_rmse: 14.3887
Epoch 209/300
9/9             0s 16ms/step - loss:
110.5904 - mae: 7.9840 - mse: 110.5904 - rmse: 10.5013 - val_loss: 207.3977 -
val_mae: 10.9491 - val_mse: 207.3977 - val_rmse: 14.4013
Epoch 210/300
9/9             0s 16ms/step - loss:
131.1627 - mae: 8.5395 - mse: 131.1627 - rmse: 11.4324 - val_loss: 206.8278 -
val_mae: 10.9296 - val_mse: 206.8278 - val_rmse: 14.3815
Epoch 211/300
9/9             0s 16ms/step - loss:
120.5909 - mae: 8.3852 - mse: 120.5909 - rmse: 10.9771 - val_loss: 206.8682 -
val_mae: 10.9353 - val_mse: 206.8682 - val_rmse: 14.3829
Epoch 212/300
9/9             0s 16ms/step - loss:
131.6832 - mae: 8.4601 - mse: 131.6832 - rmse: 11.4635 - val_loss: 206.5892 -
val_mae: 10.9438 - val_mse: 206.5892 - val_rmse: 14.3732
Epoch 213/300
9/9             0s 16ms/step - loss:
114.1333 - mae: 7.9714 - mse: 114.1333 - rmse: 10.6724 - val_loss: 206.3360 -
val_mae: 10.9261 - val_mse: 206.3360 - val_rmse: 14.3644
Epoch 214/300
9/9             0s 15ms/step - loss:
128.0829 - mae: 8.3920 - mse: 128.0829 - rmse: 11.2901 - val_loss: 206.2452 -
val_mae: 10.9008 - val_mse: 206.2452 - val_rmse: 14.3612
Epoch 215/300
9/9             0s 15ms/step - loss:
128.4369 - mae: 8.4292 - mse: 128.4369 - rmse: 11.3112 - val_loss: 206.4987 -
val_mae: 10.9146 - val_mse: 206.4987 - val_rmse: 14.3701
Epoch 216/300
9/9             0s 17ms/step - loss:
132.6953 - mae: 8.5027 - mse: 132.6953 - rmse: 11.4942 - val_loss: 206.1156 -
val_mae: 10.9012 - val_mse: 206.1156 - val_rmse: 14.3567
Epoch 217/300
9/9             0s 15ms/step - loss:
118.2260 - mae: 8.0210 - mse: 118.2260 - rmse: 10.8681 - val_loss: 205.2336 -
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val_mae: 10.9013 - val_mse: 205.2336 - val_rmse: 14.3260
Epoch 218/300
9/9             0s 16ms/step - loss:
115.4584 - mae: 8.1716 - mse: 115.4584 - rmse: 10.7376 - val_loss: 205.9161 -
val_mae: 10.8989 - val_mse: 205.9161 - val_rmse: 14.3498
Epoch 219/300
9/9             0s 14ms/step - loss:
101.8740 - mae: 7.5668 - mse: 101.8740 - rmse: 10.0722 - val_loss: 205.3537 -
val_mae: 10.8776 - val_mse: 205.3537 - val_rmse: 14.3302
Epoch 220/300
9/9             0s 15ms/step - loss:
136.1514 - mae: 8.8323 - mse: 136.1514 - rmse: 11.6549 - val_loss: 205.0278 -
val_mae: 10.9252 - val_mse: 205.0278 - val_rmse: 14.3188
Epoch 221/300
9/9             0s 16ms/step - loss:
120.6012 - mae: 8.2820 - mse: 120.6012 - rmse: 10.9763 - val_loss: 205.0883 -
val_mae: 10.8999 - val_mse: 205.0883 - val_rmse: 14.3209
Epoch 222/300
9/9             0s 14ms/step - loss:
118.0295 - mae: 8.2255 - mse: 118.0295 - rmse: 10.8577 - val_loss: 204.7054 -
val_mae: 10.8783 - val_mse: 204.7054 - val_rmse: 14.3075
Epoch 223/300
9/9             0s 14ms/step - loss:
117.3896 - mae: 8.3000 - mse: 117.3896 - rmse: 10.8264 - val_loss: 204.8108 -
val_mae: 10.8743 - val_mse: 204.8108 - val_rmse: 14.3112
Epoch 224/300
9/9             0s 14ms/step - loss:
134.0771 - mae: 8.7370 - mse: 134.0771 - rmse: 11.5583 - val_loss: 204.8344 -
val_mae: 10.8523 - val_mse: 204.8344 - val_rmse: 14.3120
Epoch 225/300
9/9             0s 15ms/step - loss:
129.1801 - mae: 8.4797 - mse: 129.1801 - rmse: 11.3510 - val_loss: 204.6246 -
val_mae: 10.8634 - val_mse: 204.6246 - val_rmse: 14.3047
Epoch 226/300
9/9             0s 16ms/step - loss:
116.5406 - mae: 8.0359 - mse: 116.5406 - rmse: 10.7609 - val_loss: 204.3540 -
val_mae: 10.8560 - val_mse: 204.3540 - val_rmse: 14.2952
Epoch 227/300
9/9             0s 14ms/step - loss:
127.4814 - mae: 8.5369 - mse: 127.4814 - rmse: 11.2619 - val_loss: 204.6563 -
val_mae: 10.8684 - val_mse: 204.6563 - val_rmse: 14.3058
Epoch 228/300
9/9             0s 14ms/step - loss:
117.9639 - mae: 8.2658 - mse: 117.9639 - rmse: 10.8520 - val_loss: 203.9219 -
val_mae: 10.8662 - val_mse: 203.9219 - val_rmse: 14.2801
Epoch 229/300
9/9             0s 30ms/step - loss:
127.9447 - mae: 8.3680 - mse: 127.9447 - rmse: 11.2952 - val_loss: 203.6538 -
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val_mae: 10.8871 - val_mse: 203.6538 - val_rmse: 14.2707
Epoch 230/300
9/9             0s 30ms/step - loss:
114.5766 - mae: 8.1015 - mse: 114.5766 - rmse: 10.7026 - val_loss: 203.9932 -
val_mae: 10.8407 - val_mse: 203.9932 - val_rmse: 14.2826
Epoch 231/300
9/9             0s 29ms/step - loss:
108.9829 - mae: 7.8690 - mse: 108.9829 - rmse: 10.4289 - val_loss: 204.2319 -
val_mae: 10.8461 - val_mse: 204.2319 - val_rmse: 14.2910
Epoch 232/300
9/9             0s 19ms/step - loss:
111.0046 - mae: 7.9881 - mse: 111.0046 - rmse: 10.5302 - val_loss: 203.5580 -
val_mae: 10.8402 - val_mse: 203.5580 - val_rmse: 14.2674
Epoch 233/300
9/9             0s 26ms/step - loss:
111.3964 - mae: 7.8490 - mse: 111.3964 - rmse: 10.5433 - val_loss: 202.9931 -
val_mae: 10.8370 - val_mse: 202.9931 - val_rmse: 14.2476
Epoch 234/300
9/9             0s 31ms/step - loss:
119.7804 - mae: 8.2517 - mse: 119.7804 - rmse: 10.9406 - val_loss: 202.8902 -
val_mae: 10.8513 - val_mse: 202.8902 - val_rmse: 14.2440
Epoch 235/300
9/9             0s 30ms/step - loss:
97.9052 - mae: 7.3964 - mse: 97.9052 - rmse: 9.8504 - val_loss: 204.3082 -
val_mae: 10.8151 - val_mse: 204.3082 - val_rmse: 14.2936
Epoch 236/300
9/9             0s 16ms/step - loss:
107.9442 - mae: 7.8327 - mse: 107.9442 - rmse: 10.3532 - val_loss: 203.5486 -
val_mae: 10.8749 - val_mse: 203.5486 - val_rmse: 14.2670
Epoch 237/300
9/9             0s 15ms/step - loss:
124.4304 - mae: 8.5240 - mse: 124.4304 - rmse: 11.1483 - val_loss: 202.3458 -
val_mae: 10.8359 - val_mse: 202.3458 - val_rmse: 14.2248
Epoch 238/300
9/9             0s 14ms/step - loss:
125.1388 - mae: 8.3476 - mse: 125.1388 - rmse: 11.1785 - val_loss: 202.5828 -
val_mae: 10.8594 - val_mse: 202.5828 - val_rmse: 14.2332
Epoch 239/300
9/9             0s 17ms/step - loss:
111.1554 - mae: 7.8639 - mse: 111.1554 - rmse: 10.5373 - val_loss: 202.7777 -
val_mae: 10.8285 - val_mse: 202.7777 - val_rmse: 14.2400
Epoch 240/300
9/9             0s 17ms/step - loss:
131.5486 - mae: 8.4530 - mse: 131.5486 - rmse: 11.4464 - val_loss: 202.7392 -
val_mae: 10.8009 - val_mse: 202.7392 - val_rmse: 14.2387
Epoch 241/300
9/9             0s 17ms/step - loss:
118.0555 - mae: 8.2004 - mse: 118.0555 - rmse: 10.8621 - val_loss: 202.3841 -
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val_mae: 10.7973 - val_mse: 202.3841 - val_rmse: 14.2262
Epoch 242/300
9/9             0s 19ms/step - loss:
134.8796 - mae: 8.6729 - mse: 134.8796 - rmse: 11.5513 - val_loss: 202.0663 -
val_mae: 10.8143 - val_mse: 202.0663 - val_rmse: 14.2150
Epoch 243/300
9/9             0s 16ms/step - loss:
111.6659 - mae: 7.9456 - mse: 111.6659 - rmse: 10.5624 - val_loss: 201.4316 -
val_mae: 10.8180 - val_mse: 201.4316 - val_rmse: 14.1927
Epoch 244/300
9/9             0s 14ms/step - loss:
112.4524 - mae: 8.0488 - mse: 112.4524 - rmse: 10.6013 - val_loss: 201.9489 -
val_mae: 10.8013 - val_mse: 201.9489 - val_rmse: 14.2109
Epoch 245/300
9/9             0s 16ms/step - loss:
105.7002 - mae: 7.6996 - mse: 105.7002 - rmse: 10.2739 - val_loss: 201.5713 -
val_mae: 10.8049 - val_mse: 201.5713 - val_rmse: 14.1976
Epoch 246/300
9/9             0s 14ms/step - loss:
117.0272 - mae: 8.2577 - mse: 117.0272 - rmse: 10.8085 - val_loss: 201.1845 -
val_mae: 10.8309 - val_mse: 201.1845 - val_rmse: 14.1840
Epoch 247/300
9/9             0s 16ms/step - loss:
111.4799 - mae: 8.0093 - mse: 111.4799 - rmse: 10.5552 - val_loss: 201.6962 -
val_mae: 10.8165 - val_mse: 201.6962 - val_rmse: 14.2020
Epoch 248/300
9/9             0s 16ms/step - loss:
113.9902 - mae: 8.0764 - mse: 113.9902 - rmse: 10.6755 - val_loss: 201.8393 -
val_mae: 10.7775 - val_mse: 201.8393 - val_rmse: 14.2070
Epoch 249/300
9/9             0s 16ms/step - loss:
124.0101 - mae: 8.2425 - mse: 124.0101 - rmse: 11.1275 - val_loss: 201.1156 -
val_mae: 10.8045 - val_mse: 201.1156 - val_rmse: 14.1815
Epoch 250/300
9/9             0s 14ms/step - loss:
118.0407 - mae: 8.1857 - mse: 118.0407 - rmse: 10.8410 - val_loss: 199.8209 -
val_mae: 10.8022 - val_mse: 199.8209 - val_rmse: 14.1358
Epoch 251/300
9/9             0s 17ms/step - loss:
97.5377 - mae: 7.4392 - mse: 97.5377 - rmse: 9.8269 - val_loss: 200.9074 -
val_mae: 10.7834 - val_mse: 200.9074 - val_rmse: 14.1742
Epoch 252/300
9/9             0s 14ms/step - loss:
115.3013 - mae: 8.1822 - mse: 115.3013 - rmse: 10.7308 - val_loss: 200.6694 -
val_mae: 10.7678 - val_mse: 200.6694 - val_rmse: 14.1658
Epoch 253/300
9/9             0s 16ms/step - loss:
112.4789 - mae: 7.8956 - mse: 112.4789 - rmse: 10.6030 - val_loss: 200.0158 -
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val_mae: 10.7939 - val_mse: 200.0158 - val_rmse: 14.1427
Epoch 254/300
9/9             0s 14ms/step - loss:
95.3179 - mae: 7.3790 - mse: 95.3179 - rmse: 9.7185 - val_loss: 200.3435 -
val_mae: 10.7662 - val_mse: 200.3435 - val_rmse: 14.1543
Epoch 255/300
9/9             0s 16ms/step - loss:
104.4061 - mae: 7.7347 - mse: 104.4061 - rmse: 10.2050 - val_loss: 200.4656 -
val_mae: 10.7637 - val_mse: 200.4656 - val_rmse: 14.1586
Epoch 256/300
9/9             0s 16ms/step - loss:
114.8184 - mae: 8.0064 - mse: 114.8184 - rmse: 10.7042 - val_loss: 199.8273 -
val_mae: 10.7832 - val_mse: 199.8273 - val_rmse: 14.1360
Epoch 257/300
9/9             0s 16ms/step - loss:
104.7320 - mae: 7.7201 - mse: 104.7320 - rmse: 10.2267 - val_loss: 199.6490 -
val_mae: 10.7474 - val_mse: 199.6490 - val_rmse: 14.1297
Epoch 258/300
9/9             0s 14ms/step - loss:
105.8028 - mae: 7.6479 - mse: 105.8028 - rmse: 10.2805 - val_loss: 200.2623 -
val_mae: 10.7378 - val_mse: 200.2623 - val_rmse: 14.1514
Epoch 259/300
9/9             0s 15ms/step - loss:
96.4431 - mae: 7.4251 - mse: 96.4431 - rmse: 9.7886 - val_loss: 199.6593 -
val_mae: 10.7502 - val_mse: 199.6593 - val_rmse: 14.1301
Epoch 260/300
9/9             0s 15ms/step - loss:
102.9011 - mae: 7.7631 - mse: 102.9011 - rmse: 10.1264 - val_loss: 199.3172 -
val_mae: 10.7416 - val_mse: 199.3172 - val_rmse: 14.1180
Epoch 261/300
9/9             0s 17ms/step - loss:
115.5559 - mae: 8.1980 - mse: 115.5559 - rmse: 10.7370 - val_loss: 199.0494 -
val_mae: 10.7538 - val_mse: 199.0494 - val_rmse: 14.1085
Epoch 262/300
9/9             0s 14ms/step - loss:
116.9772 - mae: 8.0736 - mse: 116.9772 - rmse: 10.8087 - val_loss: 199.4180 -
val_mae: 10.7881 - val_mse: 199.4180 - val_rmse: 14.1215
Epoch 263/300
9/9             0s 16ms/step - loss:
130.5227 - mae: 8.7492 - mse: 130.5227 - rmse: 11.4080 - val_loss: 198.6310 -
val_mae: 10.7331 - val_mse: 198.6310 - val_rmse: 14.0937
Epoch 264/300
9/9             0s 17ms/step - loss:
106.9645 - mae: 7.9113 - mse: 106.9645 - rmse: 10.3404 - val_loss: 199.4272 -
val_mae: 10.7143 - val_mse: 199.4272 - val_rmse: 14.1219
Epoch 265/300
9/9             0s 13ms/step - loss:
113.7604 - mae: 8.0136 - mse: 113.7604 - rmse: 10.6559 - val_loss: 198.7255 -
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val_mae: 10.7265 - val_mse: 198.7255 - val_rmse: 14.0970
Epoch 266/300
9/9             0s 16ms/step - loss:
109.7563 - mae: 7.8345 - mse: 109.7563 - rmse: 10.4670 - val_loss: 198.2010 -
val_mae: 10.7158 - val_mse: 198.2010 - val_rmse: 14.0784
Epoch 267/300
9/9             0s 15ms/step - loss:
99.5439 - mae: 7.4566 - mse: 99.5439 - rmse: 9.9205 - val_loss: 198.8392 -
val_mae: 10.7360 - val_mse: 198.8392 - val_rmse: 14.1010
Epoch 268/300
9/9             0s 17ms/step - loss:
93.4011 - mae: 7.2957 - mse: 93.4011 - rmse: 9.6191 - val_loss: 198.5291 -
val_mae: 10.6966 - val_mse: 198.5291 - val_rmse: 14.0900
Epoch 269/300
9/9             0s 14ms/step - loss:
97.2263 - mae: 7.3523 - mse: 97.2263 - rmse: 9.8390 - val_loss: 198.0863 -
val_mae: 10.7309 - val_mse: 198.0863 - val_rmse: 14.0743
Epoch 270/300
9/9             0s 16ms/step - loss:
112.5463 - mae: 7.9122 - mse: 112.5463 - rmse: 10.6049 - val_loss: 197.1453 -
val_mae: 10.7137 - val_mse: 197.1453 - val_rmse: 14.0408
Epoch 271/300
9/9             0s 16ms/step - loss:
100.3447 - mae: 7.5732 - mse: 100.3447 - rmse: 10.0079 - val_loss: 198.3814 -
val_mae: 10.7080 - val_mse: 198.3814 - val_rmse: 14.0848
Epoch 272/300
9/9             0s 16ms/step - loss:
105.3687 - mae: 7.8735 - mse: 105.3687 - rmse: 10.2503 - val_loss: 197.4283 -
val_mae: 10.6846 - val_mse: 197.4283 - val_rmse: 14.0509
Epoch 273/300
9/9             0s 17ms/step - loss:
107.2038 - mae: 7.7866 - mse: 107.2038 - rmse: 10.3260 - val_loss: 197.4714 -
val_mae: 10.7065 - val_mse: 197.4714 - val_rmse: 14.0525
Epoch 274/300
9/9             0s 14ms/step - loss:
114.4047 - mae: 8.1102 - mse: 114.4047 - rmse: 10.6916 - val_loss: 196.9756 -
val_mae: 10.6971 - val_mse: 196.9756 - val_rmse: 14.0348
Epoch 275/300
9/9             0s 16ms/step - loss:
104.0424 - mae: 7.5622 - mse: 104.0424 - rmse: 10.1814 - val_loss: 197.7862 -
val_mae: 10.7013 - val_mse: 197.7862 - val_rmse: 14.0636
Epoch 276/300
9/9             0s 17ms/step - loss:
106.8933 - mae: 7.9373 - mse: 106.8933 - rmse: 10.3350 - val_loss: 197.6222 -
val_mae: 10.6876 - val_mse: 197.6222 - val_rmse: 14.0578
Epoch 277/300
9/9             0s 16ms/step - loss:
103.6978 - mae: 7.6392 - mse: 103.6978 - rmse: 10.1554 - val_loss: 197.0177 -
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val_mae: 10.7123 - val_mse: 197.0177 - val_rmse: 14.0363
Epoch 278/300
9/9             0s 29ms/step - loss:
97.0024 - mae: 7.3698 - mse: 97.0024 - rmse: 9.8375 - val_loss: 197.5406 -
val_mae: 10.7258 - val_mse: 197.5406 - val_rmse: 14.0549
Epoch 279/300
9/9             0s 31ms/step - loss:
109.4401 - mae: 7.9207 - mse: 109.4401 - rmse: 10.4571 - val_loss: 196.9648 -
val_mae: 10.6531 - val_mse: 196.9648 - val_rmse: 14.0344
Epoch 280/300
9/9             0s 29ms/step - loss:
99.2134 - mae: 7.4492 - mse: 99.2134 - rmse: 9.9399 - val_loss: 197.3595 -
val_mae: 10.6921 - val_mse: 197.3595 - val_rmse: 14.0485
Epoch 281/300
9/9             0s 32ms/step - loss:
91.6561 - mae: 7.3824 - mse: 91.6561 - rmse: 9.5188 - val_loss: 195.9468 -
val_mae: 10.6631 - val_mse: 195.9468 - val_rmse: 13.9981
Epoch 282/300
9/9             1s 33ms/step - loss:
108.8279 - mae: 7.9269 - mse: 108.8279 - rmse: 10.4252 - val_loss: 196.5787 -
val_mae: 10.6821 - val_mse: 196.5787 - val_rmse: 14.0207
Epoch 283/300
9/9             0s 14ms/step - loss:
115.0853 - mae: 7.8797 - mse: 115.0853 - rmse: 10.7195 - val_loss: 196.8501 -
val_mae: 10.7038 - val_mse: 196.8501 - val_rmse: 14.0303
Epoch 284/300
9/9             0s 16ms/step - loss:
113.0831 - mae: 7.8859 - mse: 113.0831 - rmse: 10.6274 - val_loss: 196.4465 -
val_mae: 10.6858 - val_mse: 196.4465 - val_rmse: 14.0159
Epoch 285/300
9/9             0s 16ms/step - loss:
112.1747 - mae: 7.8927 - mse: 112.1747 - rmse: 10.5814 - val_loss: 195.7199 -
val_mae: 10.6451 - val_mse: 195.7199 - val_rmse: 13.9900
Epoch 286/300
9/9             0s 16ms/step - loss:
103.0453 - mae: 7.6015 - mse: 103.0453 - rmse: 10.1385 - val_loss: 195.7988 -
val_mae: 10.6441 - val_mse: 195.7988 - val_rmse: 13.9928
Epoch 287/300
9/9             0s 15ms/step - loss:
104.2997 - mae: 7.6909 - mse: 104.2997 - rmse: 10.2011 - val_loss: 195.8657 -
val_mae: 10.6576 - val_mse: 195.8657 - val_rmse: 13.9952
Epoch 288/300
9/9             0s 16ms/step - loss:
106.9838 - mae: 7.7910 - mse: 106.9838 - rmse: 10.3251 - val_loss: 195.7159 -
val_mae: 10.6826 - val_mse: 195.7159 - val_rmse: 13.9899
Epoch 289/300
9/9             0s 17ms/step - loss:
97.2369 - mae: 7.5192 - mse: 97.2369 - rmse: 9.8440 - val_loss: 196.1929 -
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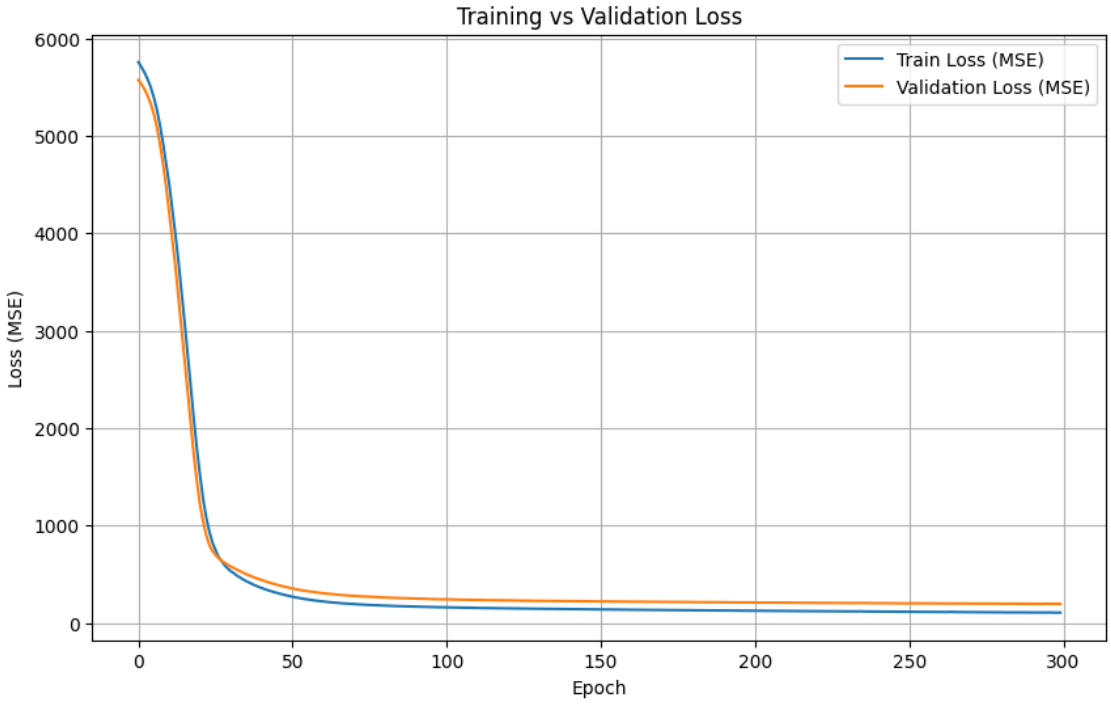
val_mae: 10.6547 - val_mse: 196.1929 - val_rmse: 14.0069
Epoch 290/300
9/9            0s 17ms/step - loss:
104.4846 - mae: 7.6648 - mse: 104.4846 - rmse: 10.2202 - val_loss: 195.0197 -
val_mae: 10.6503 - val_mse: 195.0197 - val_rmse: 13.9649
Epoch 291/300
9/9            0s 14ms/step - loss:
103.6361 - mae: 7.7400 - mse: 103.6361 - rmse: 10.1776 - val_loss: 195.4999 -
val_mae: 10.6475 - val_mse: 195.4999 - val_rmse: 13.9821
Epoch 292/300
9/9            0s 16ms/step - loss:
109.8708 - mae: 7.8715 - mse: 109.8708 - rmse: 10.4680 - val_loss: 195.5116 -
val_mae: 10.6420 - val_mse: 195.5116 - val_rmse: 13.9825
Epoch 293/300
9/9            0s 16ms/step - loss:
99.1817 - mae: 7.3461 - mse: 99.1817 - rmse: 9.9409 - val_loss: 194.3029 -
val_mae: 10.6652 - val_mse: 194.3029 - val_rmse: 13.9393
Epoch 294/300
9/9            0s 16ms/step - loss:
96.7118 - mae: 7.4186 - mse: 96.7118 - rmse: 9.8222 - val_loss: 194.4434 -
val_mae: 10.6090 - val_mse: 194.4434 - val_rmse: 13.9443
Epoch 295/300
9/9            0s 16ms/step - loss:
94.8831 - mae: 7.3833 - mse: 94.8831 - rmse: 9.7069 - val_loss: 195.8163 -
val_mae: 10.6382 - val_mse: 195.8163 - val_rmse: 13.9934
Epoch 296/300
9/9            0s 14ms/step - loss:
101.7510 - mae: 7.5245 - mse: 101.7510 - rmse: 10.0793 - val_loss: 195.0020 -
val_mae: 10.6204 - val_mse: 195.0020 - val_rmse: 13.9643
Epoch 297/300
9/9            0s 17ms/step - loss:
111.3403 - mae: 7.9263 - mse: 111.3403 - rmse: 10.5474 - val_loss: 194.8320 -
val_mae: 10.7077 - val_mse: 194.8320 - val_rmse: 13.9582
Epoch 298/300
9/9            0s 14ms/step - loss:
105.9854 - mae: 7.6172 - mse: 105.9854 - rmse: 10.2810 - val_loss: 194.7205 -
val_mae: 10.6430 - val_mse: 194.7205 - val_rmse: 13.9542
Epoch 299/300
9/9            0s 14ms/step - loss:
110.4074 - mae: 7.8900 - mse: 110.4074 - rmse: 10.5028 - val_loss: 195.3881 -
val_mae: 10.6011 - val_mse: 195.3881 - val_rmse: 13.9781
Epoch 300/300
9/9            0s 14ms/step - loss:
116.7902 - mae: 7.9758 - mse: 116.7902 - rmse: 10.7951 - val_loss: 194.2115 -
val_mae: 10.6297 - val_mse: 194.2115 - val_rmse: 13.9360
```

5.1.4 Loss Plot

[199]:
```
# Plot loss
plt.figure(figsize=(10, 6))
plt.plot(history.history['loss'], label='Train Loss (MSE)')
plt.plot(history.history['val_loss'], label='Validation Loss (MSE)')
plt.title('Training vs Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss (MSE)')
plt.legend()
plt.grid(True)
plt.show()
```



5.1.5 R2 Model Sequential

[200]:
```
# show R2
y_pred = base_model_sequential.predict(X_test)
r2_score(y_test, y_pred)
```

```
12/12              0s 6ms/step
```

[200]:
```
0.2507309708192178
```

5.2 Functional Model

5.2.1 Configure Model Neuron, Activation Layer

[201]:
```
input = layers.Input(shape=(n,))
x = Dense(n*3, activation='relu')(input)
x = Dense(n*3, activation='relu')(x)
x = Dense(n*3, activation='relu')(x)
output = Dense(1)(x)

base_model_functional = Model(inputs=input, outputs=output)
```

5.2.2 Compile and evaluation

[202]:
```
base_model_functional.compile(
    optimizer='adam',
    loss='mse',
    metrics=['mae', 'mse', RootMeanSquaredError(name='rmse')]
)

base_model_functional.summary()
```

```
Model: "functional_10"
```

Layer (type)	Output Shape	Param #
input_layer_11 (InputLayer)	(None, 17)	0
dense_42 (Dense)	(None, 51)	918
dense_43 (Dense)	(None, 51)	2,652
dense_44 (Dense)	(None, 51)	2,652
dense_45 (Dense)	(None, 1)	52

```
Total params: 6,274 (24.51 KB)

Trainable params: 6,274 (24.51 KB)

Non-trainable params: 0 (0.00 B)
```

5.2.3 Fit Model Functional

[203]:
```
callbacks = EarlyStopping(monitor='val_loss',
                          patience=20,
                          restore_best_weights=True)

history = base_model_functional.fit(
    X_train, y_train,
    validation_data=(X_cv, y_cv),
    epochs=300,
    callbacks=[callbacks],
    batch_size=32,
    verbose=1
)
```

```
Epoch 1/300
9/9             2s 43ms/step - loss:
5665.6685 - mae: 73.2143 - mse: 5665.6685 - rmse: 75.2622 - val_loss: 5602.1260
- val_mae: 72.7502 - val_mse: 5602.1260 - val_rmse: 74.8474
Epoch 2/300
9/9             0s 15ms/step - loss:
5790.0474 - mae: 74.1380 - mse: 5790.0474 - rmse: 76.0905 - val_loss: 5524.0361
- val_mae: 72.1897 - val_mse: 5524.0361 - val_rmse: 74.3239
Epoch 3/300
9/9             0s 16ms/step - loss:
5740.2944 - mae: 73.5420 - mse: 5740.2944 - rmse: 75.7583 - val_loss: 5410.1069
- val_mae: 71.3573 - val_mse: 5410.1069 - val_rmse: 73.5534
Epoch 4/300
9/9             0s 16ms/step - loss:
5610.1138 - mae: 72.5465 - mse: 5610.1138 - rmse: 74.8923 - val_loss: 5225.5259
- val_mae: 70.0198 - val_mse: 5225.5259 - val_rmse: 72.2878
Epoch 5/300
9/9             0s 14ms/step - loss:
5248.2827 - mae: 70.1817 - mse: 5248.2827 - rmse: 72.4442 - val_loss: 4924.0005
- val_mae: 67.7667 - val_mse: 4924.0005 - val_rmse: 70.1712
Epoch 6/300
9/9             0s 15ms/step - loss:
4913.7197 - mae: 67.7277 - mse: 4913.7197 - rmse: 70.0966 - val_loss: 4485.1802
- val_mae: 64.4434 - val_mse: 4485.1802 - val_rmse: 66.9715
Epoch 7/300
9/9             0s 16ms/step - loss:
4571.3726 - mae: 65.3342 - mse: 4571.3726 - rmse: 67.6022 - val_loss: 3892.8083
- val_mae: 59.6383 - val_mse: 3892.8083 - val_rmse: 62.3924
Epoch 8/300
9/9             0s 14ms/step - loss:
3953.7852 - mae: 60.1413 - mse: 3953.7852 - rmse: 62.8751 - val_loss: 3283.4409
- val_mae: 54.1436 - val_mse: 3283.4409 - val_rmse: 57.3013
Epoch 9/300
```

```
9/9             0s 16ms/step - loss:
3474.8269 - mae: 55.1208 - mse: 3474.8269 - rmse: 58.9257 - val_loss: 2660.2173
- val_mae: 47.9629 - val_mse: 2660.2173 - val_rmse: 51.5773
Epoch 10/300
9/9             0s 16ms/step - loss:
2624.6472 - mae: 47.2971 - mse: 2624.6472 - rmse: 51.2191 - val_loss: 1942.8118
- val_mae: 40.0181 - val_mse: 1942.8118 - val_rmse: 44.0773
Epoch 11/300
9/9             0s 14ms/step - loss:
2004.6649 - mae: 39.9203 - mse: 2004.6649 - rmse: 44.7618 - val_loss: 1335.9847
- val_mae: 32.2773 - val_mse: 1335.9847 - val_rmse: 36.5511
Epoch 12/300
9/9             0s 15ms/step - loss:
1287.5726 - mae: 29.9080 - mse: 1287.5726 - rmse: 35.8725 - val_loss: 932.8356 -
val_mae: 26.2465 - val_mse: 932.8356 - val_rmse: 30.5424
Epoch 13/300
9/9             0s 16ms/step - loss:
1239.3350 - mae: 27.3792 - mse: 1239.3350 - rmse: 35.0153 - val_loss: 771.8151 -
val_mae: 23.0398 - val_mse: 771.8151 - val_rmse: 27.7816
Epoch 14/300
9/9             0s 15ms/step - loss:
859.6194 - mae: 23.9720 - mse: 859.6194 - rmse: 29.2584 - val_loss: 699.5584 -
val_mae: 21.2720 - val_mse: 699.5584 - val_rmse: 26.4492
Epoch 15/300
9/9             0s 14ms/step - loss:
608.2136 - mae: 20.3207 - mse: 608.2136 - rmse: 24.6572 - val_loss: 646.9252 -
val_mae: 20.3375 - val_mse: 646.9252 - val_rmse: 25.4347
Epoch 16/300
9/9             0s 16ms/step - loss:
564.7706 - mae: 19.6520 - mse: 564.7706 - rmse: 23.7572 - val_loss: 589.6279 -
val_mae: 19.5030 - val_mse: 589.6279 - val_rmse: 24.2823
Epoch 17/300
9/9             0s 16ms/step - loss:
454.1581 - mae: 17.1689 - mse: 454.1581 - rmse: 21.3079 - val_loss: 541.3007 -
val_mae: 18.7713 - val_mse: 541.3007 - val_rmse: 23.2659
Epoch 18/300
9/9             0s 15ms/step - loss:
412.3647 - mae: 16.8223 - mse: 412.3647 - rmse: 20.2973 - val_loss: 501.7206 -
val_mae: 18.0015 - val_mse: 501.7206 - val_rmse: 22.3991
Epoch 19/300
9/9             0s 16ms/step - loss:
394.3697 - mae: 16.2192 - mse: 394.3697 - rmse: 19.8488 - val_loss: 464.8417 -
val_mae: 17.2153 - val_mse: 464.8417 - val_rmse: 21.5602
Epoch 20/300
9/9             0s 22ms/step - loss:
345.4673 - mae: 15.3673 - mse: 345.4673 - rmse: 18.5769 - val_loss: 434.5657 -
val_mae: 16.5231 - val_mse: 434.5657 - val_rmse: 20.8462
Epoch 21/300
```

```
9/9             0s 31ms/step - loss:
367.8264 - mae: 15.5888 - mse: 367.8264 - rmse: 19.1569 - val_loss: 407.4550 -
val_mae: 16.0004 - val_mse: 407.4550 - val_rmse: 20.1855
Epoch 22/300
9/9             0s 29ms/step - loss:
316.0435 - mae: 14.4014 - mse: 316.0435 - rmse: 17.7700 - val_loss: 385.5384 -
val_mae: 15.3782 - val_mse: 385.5384 - val_rmse: 19.6351
Epoch 23/300
9/9             0s 29ms/step - loss:
295.2965 - mae: 13.7533 - mse: 295.2965 - rmse: 17.1166 - val_loss: 365.6880 -
val_mae: 14.8855 - val_mse: 365.6880 - val_rmse: 19.1230
Epoch 24/300
9/9             0s 30ms/step - loss:
279.0787 - mae: 13.0286 - mse: 279.0787 - rmse: 16.6886 - val_loss: 347.2088 -
val_mae: 14.5075 - val_mse: 347.2088 - val_rmse: 18.6335
Epoch 25/300
9/9             0s 30ms/step - loss:
252.2897 - mae: 12.8543 - mse: 252.2897 - rmse: 15.8800 - val_loss: 332.1557 -
val_mae: 14.1050 - val_mse: 332.1557 - val_rmse: 18.2251
Epoch 26/300
9/9             0s 32ms/step - loss:
253.9376 - mae: 12.4545 - mse: 253.9376 - rmse: 15.9022 - val_loss: 318.7140 -
val_mae: 13.7919 - val_mse: 318.7140 - val_rmse: 17.8526
Epoch 27/300
9/9             0s 16ms/step - loss:
223.4398 - mae: 11.6184 - mse: 223.4398 - rmse: 14.9443 - val_loss: 308.1439 -
val_mae: 13.4540 - val_mse: 308.1439 - val_rmse: 17.5540
Epoch 28/300
9/9             0s 16ms/step - loss:
224.4188 - mae: 11.4631 - mse: 224.4188 - rmse: 14.9685 - val_loss: 296.2905 -
val_mae: 13.2756 - val_mse: 296.2905 - val_rmse: 17.2131
Epoch 29/300
9/9             0s 16ms/step - loss:
197.0791 - mae: 10.8753 - mse: 197.0791 - rmse: 14.0247 - val_loss: 287.3449 -
val_mae: 13.0113 - val_mse: 287.3449 - val_rmse: 16.9513
Epoch 30/300
9/9             0s 14ms/step - loss:
204.0019 - mae: 10.9428 - mse: 204.0019 - rmse: 14.2679 - val_loss: 281.3745 -
val_mae: 12.7394 - val_mse: 281.3745 - val_rmse: 16.7742
Epoch 31/300
9/9             0s 14ms/step - loss:
195.7213 - mae: 10.6086 - mse: 195.7213 - rmse: 13.9737 - val_loss: 273.2296 -
val_mae: 12.6082 - val_mse: 273.2296 - val_rmse: 16.5297
Epoch 32/300
9/9             0s 16ms/step - loss:
170.2171 - mae: 9.9309 - mse: 170.2171 - rmse: 13.0402 - val_loss: 267.4397 -
val_mae: 12.4529 - val_mse: 267.4397 - val_rmse: 16.3536
Epoch 33/300
```

```
9/9             0s 17ms/step - loss:
179.5665 - mae: 10.3712 - mse: 179.5665 - rmse: 13.3894 - val_loss: 262.3861 -
val_mae: 12.2987 - val_mse: 262.3861 - val_rmse: 16.1983
Epoch 34/300
9/9             0s 14ms/step - loss:
171.9722 - mae: 10.0923 - mse: 171.9722 - rmse: 13.1002 - val_loss: 256.4980 -
val_mae: 12.2405 - val_mse: 256.4980 - val_rmse: 16.0156
Epoch 35/300
9/9             0s 15ms/step - loss:
173.9773 - mae: 9.9506 - mse: 173.9773 - rmse: 13.1738 - val_loss: 253.1519 -
val_mae: 12.1034 - val_mse: 253.1519 - val_rmse: 15.9107
Epoch 36/300
9/9             0s 15ms/step - loss:
156.1359 - mae: 9.3953 - mse: 156.1359 - rmse: 12.4662 - val_loss: 249.5768 -
val_mae: 12.0602 - val_mse: 249.5768 - val_rmse: 15.7980
Epoch 37/300
9/9             0s 15ms/step - loss:
157.4502 - mae: 9.5522 - mse: 157.4502 - rmse: 12.5451 - val_loss: 246.4464 -
val_mae: 11.9260 - val_mse: 246.4464 - val_rmse: 15.6986
Epoch 38/300
9/9             0s 16ms/step - loss:
149.4035 - mae: 9.5172 - mse: 149.4035 - rmse: 12.2168 - val_loss: 244.6787 -
val_mae: 11.8372 - val_mse: 244.6787 - val_rmse: 15.6422
Epoch 39/300
9/9             0s 14ms/step - loss:
140.4099 - mae: 9.0657 - mse: 140.4099 - rmse: 11.8436 - val_loss: 239.4546 -
val_mae: 11.8728 - val_mse: 239.4546 - val_rmse: 15.4743
Epoch 40/300
9/9             0s 14ms/step - loss:
131.5963 - mae: 8.8026 - mse: 131.5963 - rmse: 11.4449 - val_loss: 236.5578 -
val_mae: 11.7417 - val_mse: 236.5578 - val_rmse: 15.3804
Epoch 41/300
9/9             0s 16ms/step - loss:
140.4819 - mae: 8.9588 - mse: 140.4819 - rmse: 11.8458 - val_loss: 235.3232 -
val_mae: 11.6582 - val_mse: 235.3232 - val_rmse: 15.3402
Epoch 42/300
9/9             0s 14ms/step - loss:
147.2089 - mae: 9.3282 - mse: 147.2089 - rmse: 12.1291 - val_loss: 231.9455 -
val_mae: 11.6430 - val_mse: 231.9455 - val_rmse: 15.2298
Epoch 43/300
9/9             0s 14ms/step - loss:
148.0259 - mae: 9.3045 - mse: 148.0259 - rmse: 12.1515 - val_loss: 229.5098 -
val_mae: 11.5198 - val_mse: 229.5098 - val_rmse: 15.1496
Epoch 44/300
9/9             0s 14ms/step - loss:
127.0440 - mae: 8.6597 - mse: 127.0440 - rmse: 11.2593 - val_loss: 228.0029 -
val_mae: 11.5020 - val_mse: 228.0029 - val_rmse: 15.0998
Epoch 45/300
```

```
9/9             0s 16ms/step - loss:
134.4360 - mae: 8.6791 - mse: 134.4360 - rmse: 11.5833 - val_loss: 225.6434 -
val_mae: 11.4507 - val_mse: 225.6434 - val_rmse: 15.0214
Epoch 46/300
9/9             0s 14ms/step - loss:
142.0304 - mae: 9.0903 - mse: 142.0304 - rmse: 11.9108 - val_loss: 223.0947 -
val_mae: 11.4118 - val_mse: 223.0947 - val_rmse: 14.9364
Epoch 47/300
9/9             0s 15ms/step - loss:
126.9619 - mae: 8.6369 - mse: 126.9619 - rmse: 11.2412 - val_loss: 221.6809 -
val_mae: 11.3477 - val_mse: 221.6809 - val_rmse: 14.8890
Epoch 48/300
9/9             0s 16ms/step - loss:
122.8851 - mae: 8.5259 - mse: 122.8851 - rmse: 11.0490 - val_loss: 219.7157 -
val_mae: 11.3233 - val_mse: 219.7157 - val_rmse: 14.8228
Epoch 49/300
9/9             0s 14ms/step - loss:
136.9836 - mae: 8.9027 - mse: 136.9836 - rmse: 11.6782 - val_loss: 217.8159 -
val_mae: 11.2462 - val_mse: 217.8159 - val_rmse: 14.7586
Epoch 50/300
9/9             0s 16ms/step - loss:
140.4265 - mae: 9.0600 - mse: 140.4265 - rmse: 11.8392 - val_loss: 215.8262 -
val_mae: 11.1835 - val_mse: 215.8262 - val_rmse: 14.6910
Epoch 51/300
9/9             0s 15ms/step - loss:
110.7930 - mae: 8.0058 - mse: 110.7930 - rmse: 10.5081 - val_loss: 215.5547 -
val_mae: 11.1434 - val_mse: 215.5547 - val_rmse: 14.6818
Epoch 52/300
9/9             0s 17ms/step - loss:
123.1910 - mae: 8.6541 - mse: 123.1910 - rmse: 11.0923 - val_loss: 211.7697 -
val_mae: 11.1087 - val_mse: 211.7697 - val_rmse: 14.5523
Epoch 53/300
9/9             0s 14ms/step - loss:
117.2304 - mae: 8.5194 - mse: 117.2304 - rmse: 10.8186 - val_loss: 209.8008 -
val_mae: 11.0427 - val_mse: 209.8008 - val_rmse: 14.4845
Epoch 54/300
9/9             0s 16ms/step - loss:
125.7255 - mae: 8.6055 - mse: 125.7255 - rmse: 11.2074 - val_loss: 209.2417 -
val_mae: 10.9881 - val_mse: 209.2417 - val_rmse: 14.4652
Epoch 55/300
9/9             0s 16ms/step - loss:
119.5204 - mae: 8.3143 - mse: 119.5204 - rmse: 10.9309 - val_loss: 207.4527 -
val_mae: 10.9892 - val_mse: 207.4527 - val_rmse: 14.4032
Epoch 56/300
9/9             0s 14ms/step - loss:
121.1774 - mae: 8.3630 - mse: 121.1774 - rmse: 11.0020 - val_loss: 205.8145 -
val_mae: 10.9720 - val_mse: 205.8145 - val_rmse: 14.3462
Epoch 57/300
```

```
9/9             0s 16ms/step - loss:
108.7323 - mae: 8.0056 - mse: 108.7323 - rmse: 10.4198 - val_loss: 205.0678 -
val_mae: 10.8934 - val_mse: 205.0678 - val_rmse: 14.3202
Epoch 58/300
9/9             0s 14ms/step - loss:
138.0295 - mae: 8.8153 - mse: 138.0295 - rmse: 11.7059 - val_loss: 203.9249 -
val_mae: 10.8790 - val_mse: 203.9249 - val_rmse: 14.2802
Epoch 59/300
9/9             0s 14ms/step - loss:
111.5700 - mae: 8.0538 - mse: 111.5700 - rmse: 10.5556 - val_loss: 201.2433 -
val_mae: 10.8452 - val_mse: 201.2433 - val_rmse: 14.1860
Epoch 60/300
9/9             0s 16ms/step - loss:
108.9186 - mae: 7.9290 - mse: 108.9186 - rmse: 10.4249 - val_loss: 200.5970 -
val_mae: 10.7983 - val_mse: 200.5970 - val_rmse: 14.1632
Epoch 61/300
9/9             0s 16ms/step - loss:
95.2141 - mae: 7.4709 - mse: 95.2141 - rmse: 9.7282 - val_loss: 199.2166 -
val_mae: 10.7761 - val_mse: 199.2166 - val_rmse: 14.1144
Epoch 62/300
9/9             0s 16ms/step - loss:
109.7030 - mae: 8.1933 - mse: 109.7030 - rmse: 10.4699 - val_loss: 197.1785 -
val_mae: 10.7220 - val_mse: 197.1785 - val_rmse: 14.0420
Epoch 63/300
9/9             0s 15ms/step - loss:
98.1479 - mae: 7.5174 - mse: 98.1479 - rmse: 9.8489 - val_loss: 196.5554 -
val_mae: 10.7417 - val_mse: 196.5554 - val_rmse: 14.0198
Epoch 64/300
9/9             0s 19ms/step - loss:
107.6366 - mae: 7.7388 - mse: 107.6366 - rmse: 10.3720 - val_loss: 195.4192 -
val_mae: 10.6999 - val_mse: 195.4192 - val_rmse: 13.9792
Epoch 65/300
9/9             0s 15ms/step - loss:
112.0954 - mae: 7.6927 - mse: 112.0954 - rmse: 10.5744 - val_loss: 193.9236 -
val_mae: 10.6429 - val_mse: 193.9236 - val_rmse: 13.9256
Epoch 66/300
9/9             0s 15ms/step - loss:
99.6437 - mae: 7.6381 - mse: 99.6437 - rmse: 9.9751 - val_loss: 193.7056 -
val_mae: 10.5905 - val_mse: 193.7056 - val_rmse: 13.9178
Epoch 67/300
9/9             0s 16ms/step - loss:
97.3729 - mae: 7.6533 - mse: 97.3729 - rmse: 9.8452 - val_loss: 192.0564 -
val_mae: 10.6236 - val_mse: 192.0564 - val_rmse: 13.8584
Epoch 68/300
9/9             0s 16ms/step - loss:
117.9840 - mae: 8.2517 - mse: 117.9840 - rmse: 10.8464 - val_loss: 191.2884 -
val_mae: 10.5633 - val_mse: 191.2884 - val_rmse: 13.8307
Epoch 69/300
```

```
9/9             0s 16ms/step - loss:
112.7737 - mae: 8.1841 - mse: 112.7737 - rmse: 10.6115 - val_loss: 190.0018 -
val_mae: 10.5400 - val_mse: 190.0018 - val_rmse: 13.7841
Epoch 70/300
9/9             0s 16ms/step - loss:
98.5462 - mae: 7.4697 - mse: 98.5462 - rmse: 9.9213 - val_loss: 188.7108 -
val_mae: 10.4877 - val_mse: 188.7108 - val_rmse: 13.7372
Epoch 71/300
9/9             0s 15ms/step - loss:
105.4386 - mae: 7.6383 - mse: 105.4386 - rmse: 10.2612 - val_loss: 187.2641 -
val_mae: 10.5331 - val_mse: 187.2641 - val_rmse: 13.6844
Epoch 72/300
9/9             0s 16ms/step - loss:
108.1729 - mae: 8.0943 - mse: 108.1729 - rmse: 10.3941 - val_loss: 187.7833 -
val_mae: 10.4437 - val_mse: 187.7833 - val_rmse: 13.7034
Epoch 73/300
9/9             0s 16ms/step - loss:
109.0315 - mae: 7.7291 - mse: 109.0315 - rmse: 10.4366 - val_loss: 185.4712 -
val_mae: 10.4376 - val_mse: 185.4712 - val_rmse: 13.6188
Epoch 74/300
9/9             0s 14ms/step - loss:
92.1683 - mae: 7.1989 - mse: 92.1683 - rmse: 9.5757 - val_loss: 185.5500 -
val_mae: 10.3753 - val_mse: 185.5500 - val_rmse: 13.6217
Epoch 75/300
9/9             0s 28ms/step - loss:
95.6438 - mae: 7.2831 - mse: 95.6438 - rmse: 9.7678 - val_loss: 183.7705 -
val_mae: 10.3903 - val_mse: 183.7705 - val_rmse: 13.5562
Epoch 76/300
9/9             0s 31ms/step - loss:
102.5061 - mae: 7.6425 - mse: 102.5061 - rmse: 10.1224 - val_loss: 184.9859 -
val_mae: 10.3761 - val_mse: 184.9859 - val_rmse: 13.6010
Epoch 77/300
9/9             0s 20ms/step - loss:
100.1400 - mae: 7.3730 - mse: 100.1400 - rmse: 10.0013 - val_loss: 182.6861 -
val_mae: 10.3237 - val_mse: 182.6861 - val_rmse: 13.5161
Epoch 78/300
9/9             0s 21ms/step - loss:
95.4523 - mae: 7.3818 - mse: 95.4523 - rmse: 9.7664 - val_loss: 181.7912 -
val_mae: 10.2840 - val_mse: 181.7912 - val_rmse: 13.4830
Epoch 79/300
9/9             0s 30ms/step - loss:
93.4410 - mae: 7.3941 - mse: 93.4410 - rmse: 9.6590 - val_loss: 182.6956 -
val_mae: 10.3296 - val_mse: 182.6956 - val_rmse: 13.5165
Epoch 80/300
9/9             0s 30ms/step - loss:
94.1414 - mae: 7.4486 - mse: 94.1414 - rmse: 9.6898 - val_loss: 180.7390 -
val_mae: 10.3002 - val_mse: 180.7390 - val_rmse: 13.4439
Epoch 81/300
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9/9             0s 22ms/step - loss:
102.5158 - mae: 7.7492 - mse: 102.5158 - rmse: 10.1101 - val_loss: 180.5574 -
val_mae: 10.1973 - val_mse: 180.5574 - val_rmse: 13.4372
Epoch 82/300
9/9             0s 26ms/step - loss:
91.0363 - mae: 7.2206 - mse: 91.0363 - rmse: 9.5246 - val_loss: 179.0463 -
val_mae: 10.2407 - val_mse: 179.0463 - val_rmse: 13.3808
Epoch 83/300
9/9             0s 20ms/step - loss:
100.4483 - mae: 7.5394 - mse: 100.4483 - rmse: 10.0078 - val_loss: 179.5959 -
val_mae: 10.1942 - val_mse: 179.5959 - val_rmse: 13.4013
Epoch 84/300
9/9             0s 17ms/step - loss:
86.1009 - mae: 6.9126 - mse: 86.1009 - rmse: 9.2745 - val_loss: 180.4019 -
val_mae: 10.2173 - val_mse: 180.4019 - val_rmse: 13.4314
Epoch 85/300
9/9             0s 15ms/step - loss:
86.4787 - mae: 6.9300 - mse: 86.4787 - rmse: 9.2825 - val_loss: 177.5536 -
val_mae: 10.1813 - val_mse: 177.5536 - val_rmse: 13.3249
Epoch 86/300
9/9             0s 16ms/step - loss:
99.4685 - mae: 7.3599 - mse: 99.4685 - rmse: 9.9488 - val_loss: 178.6871 -
val_mae: 10.1327 - val_mse: 178.6871 - val_rmse: 13.3674
Epoch 87/300
9/9             0s 14ms/step - loss:
97.8878 - mae: 7.1748 - mse: 97.8878 - rmse: 9.8825 - val_loss: 177.6847 -
val_mae: 10.1491 - val_mse: 177.6847 - val_rmse: 13.3298
Epoch 88/300
9/9             0s 16ms/step - loss:
100.2299 - mae: 7.3466 - mse: 100.2299 - rmse: 10.0050 - val_loss: 176.9478 -
val_mae: 10.1415 - val_mse: 176.9478 - val_rmse: 13.3022
Epoch 89/300
9/9             0s 14ms/step - loss:
85.8737 - mae: 6.9502 - mse: 85.8737 - rmse: 9.2659 - val_loss: 177.9544 -
val_mae: 10.1022 - val_mse: 177.9544 - val_rmse: 13.3400
Epoch 90/300
9/9             0s 16ms/step - loss:
90.1591 - mae: 7.0461 - mse: 90.1591 - rmse: 9.4908 - val_loss: 175.9983 -
val_mae: 10.0706 - val_mse: 175.9983 - val_rmse: 13.2664
Epoch 91/300
9/9             0s 17ms/step - loss:
71.8828 - mae: 6.2638 - mse: 71.8828 - rmse: 8.4395 - val_loss: 176.1238 -
val_mae: 10.1006 - val_mse: 176.1238 - val_rmse: 13.2712
Epoch 92/300
9/9             0s 15ms/step - loss:
74.6991 - mae: 6.3384 - mse: 74.6991 - rmse: 8.6111 - val_loss: 174.8125 -
val_mae: 10.0520 - val_mse: 174.8125 - val_rmse: 13.2217
Epoch 93/300
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9/9             0s 15ms/step - loss:
82.8718 - mae: 6.8254 - mse: 82.8718 - rmse: 9.0918 - val_loss: 174.9783 -
val_mae: 10.0274 - val_mse: 174.9783 - val_rmse: 13.2279
Epoch 94/300
9/9             0s 14ms/step - loss:
84.7068 - mae: 6.8695 - mse: 84.7068 - rmse: 9.2020 - val_loss: 174.2672 -
val_mae: 10.0265 - val_mse: 174.2672 - val_rmse: 13.2010
Epoch 95/300
9/9             0s 14ms/step - loss:
83.6074 - mae: 6.8143 - mse: 83.6074 - rmse: 9.1409 - val_loss: 175.2756 -
val_mae: 10.0218 - val_mse: 175.2756 - val_rmse: 13.2392
Epoch 96/300
9/9             0s 15ms/step - loss:
76.8300 - mae: 6.5750 - mse: 76.8300 - rmse: 8.7306 - val_loss: 174.0011 -
val_mae: 9.9853 - val_mse: 174.0011 - val_rmse: 13.1909
Epoch 97/300
9/9             0s 17ms/step - loss:
87.4995 - mae: 6.9222 - mse: 87.4995 - rmse: 9.3533 - val_loss: 173.6571 -
val_mae: 9.9967 - val_mse: 173.6571 - val_rmse: 13.1779
Epoch 98/300
9/9             0s 16ms/step - loss:
88.1478 - mae: 6.8341 - mse: 88.1478 - rmse: 9.3744 - val_loss: 174.7707 -
val_mae: 9.9751 - val_mse: 174.7707 - val_rmse: 13.2201
Epoch 99/300
9/9             0s 15ms/step - loss:
82.7848 - mae: 6.6905 - mse: 82.7848 - rmse: 9.0811 - val_loss: 173.3464 -
val_mae: 9.9644 - val_mse: 173.3464 - val_rmse: 13.1661
Epoch 100/300
9/9             0s 15ms/step - loss:
84.8925 - mae: 6.8868 - mse: 84.8925 - rmse: 9.2104 - val_loss: 173.2706 -
val_mae: 9.9523 - val_mse: 173.2706 - val_rmse: 13.1632
Epoch 101/300
9/9             0s 16ms/step - loss:
94.8961 - mae: 7.0798 - mse: 94.8961 - rmse: 9.6977 - val_loss: 174.4888 -
val_mae: 9.9371 - val_mse: 174.4888 - val_rmse: 13.2094
Epoch 102/300
9/9             0s 15ms/step - loss:
94.7282 - mae: 7.0868 - mse: 94.7282 - rmse: 9.6990 - val_loss: 172.9719 -
val_mae: 9.9775 - val_mse: 172.9719 - val_rmse: 13.1519
Epoch 103/300
9/9             0s 15ms/step - loss:
104.8930 - mae: 7.4277 - mse: 104.8930 - rmse: 10.1733 - val_loss: 173.3399 -
val_mae: 9.8871 - val_mse: 173.3399 - val_rmse: 13.1659
Epoch 104/300
9/9             0s 14ms/step - loss:
75.5458 - mae: 6.4812 - mse: 75.5458 - rmse: 8.6682 - val_loss: 174.0982 -
val_mae: 9.9932 - val_mse: 174.0982 - val_rmse: 13.1946
Epoch 105/300
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9/9             0s 16ms/step - loss:
85.6244 - mae: 6.8488 - mse: 85.6244 - rmse: 9.2513 - val_loss: 172.4102 -
val_mae: 9.8839 - val_mse: 172.4102 - val_rmse: 13.1305
Epoch 106/300
9/9             0s 14ms/step - loss:
74.1457 - mae: 6.5153 - mse: 74.1457 - rmse: 8.5899 - val_loss: 172.3058 -
val_mae: 9.8964 - val_mse: 172.3058 - val_rmse: 13.1265
Epoch 107/300
9/9             0s 15ms/step - loss:
84.7947 - mae: 6.7061 - mse: 84.7947 - rmse: 9.2069 - val_loss: 171.5498 -
val_mae: 9.8521 - val_mse: 171.5498 - val_rmse: 13.0977
Epoch 108/300
9/9             0s 16ms/step - loss:
96.1697 - mae: 7.2644 - mse: 96.1697 - rmse: 9.7969 - val_loss: 172.8321 -
val_mae: 9.8939 - val_mse: 172.8321 - val_rmse: 13.1466
Epoch 109/300
9/9             0s 16ms/step - loss:
85.8985 - mae: 6.7217 - mse: 85.8985 - rmse: 9.2623 - val_loss: 171.9415 -
val_mae: 9.8551 - val_mse: 171.9415 - val_rmse: 13.1126
Epoch 110/300
9/9             0s 15ms/step - loss:
75.1378 - mae: 6.4747 - mse: 75.1378 - rmse: 8.6517 - val_loss: 172.8345 -
val_mae: 9.8422 - val_mse: 172.8345 - val_rmse: 13.1467
Epoch 111/300
9/9             0s 16ms/step - loss:
101.1583 - mae: 6.8229 - mse: 101.1583 - rmse: 10.0202 - val_loss: 176.4642 -
val_mae: 10.1290 - val_mse: 176.4642 - val_rmse: 13.2840
Epoch 112/300
9/9             0s 16ms/step - loss:
91.1554 - mae: 7.1719 - mse: 91.1554 - rmse: 9.5408 - val_loss: 176.3921 -
val_mae: 9.8615 - val_mse: 176.3921 - val_rmse: 13.2813
Epoch 113/300
9/9             0s 16ms/step - loss:
80.2851 - mae: 6.5565 - mse: 80.2851 - rmse: 8.9464 - val_loss: 171.7453 -
val_mae: 9.9220 - val_mse: 171.7453 - val_rmse: 13.1052
Epoch 114/300
9/9             0s 16ms/step - loss:
84.8087 - mae: 6.8328 - mse: 84.8087 - rmse: 9.2026 - val_loss: 171.0307 -
val_mae: 9.8197 - val_mse: 171.0307 - val_rmse: 13.0779
Epoch 115/300
9/9             0s 15ms/step - loss:
74.8147 - mae: 6.3254 - mse: 74.8147 - rmse: 8.6261 - val_loss: 172.0999 -
val_mae: 9.8403 - val_mse: 172.0999 - val_rmse: 13.1187
Epoch 116/300
9/9             0s 16ms/step - loss:
70.3732 - mae: 6.1578 - mse: 70.3732 - rmse: 8.3719 - val_loss: 171.6063 -
val_mae: 9.8197 - val_mse: 171.6063 - val_rmse: 13.0999
Epoch 117/300
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9/9             0s 16ms/step - loss:
90.8458 - mae: 6.9655 - mse: 90.8458 - rmse: 9.4953 - val_loss: 170.0608 -
val_mae: 9.8497 - val_mse: 170.0608 - val_rmse: 13.0407
Epoch 118/300
9/9             0s 16ms/step - loss:
85.2794 - mae: 6.8831 - mse: 85.2794 - rmse: 9.2181 - val_loss: 171.2124 -
val_mae: 9.7856 - val_mse: 171.2124 - val_rmse: 13.0848
Epoch 119/300
9/9             0s 14ms/step - loss:
74.4918 - mae: 6.3389 - mse: 74.4918 - rmse: 8.6095 - val_loss: 172.3474 -
val_mae: 9.7902 - val_mse: 172.3474 - val_rmse: 13.1281
Epoch 120/300
9/9             0s 14ms/step - loss:
84.6713 - mae: 6.5495 - mse: 84.6713 - rmse: 9.1861 - val_loss: 171.0250 -
val_mae: 9.8426 - val_mse: 171.0250 - val_rmse: 13.0777
Epoch 121/300
9/9             0s 16ms/step - loss:
81.8113 - mae: 6.4827 - mse: 81.8113 - rmse: 9.0220 - val_loss: 170.5846 -
val_mae: 9.7593 - val_mse: 170.5846 - val_rmse: 13.0608
Epoch 122/300
9/9             0s 15ms/step - loss:
70.4106 - mae: 6.0808 - mse: 70.4106 - rmse: 8.3795 - val_loss: 170.8198 -
val_mae: 9.7958 - val_mse: 170.8198 - val_rmse: 13.0698
Epoch 123/300
9/9             0s 14ms/step - loss:
77.7659 - mae: 6.4995 - mse: 77.7659 - rmse: 8.8075 - val_loss: 171.4079 -
val_mae: 9.7655 - val_mse: 171.4079 - val_rmse: 13.0923
Epoch 124/300
9/9             0s 17ms/step - loss:
73.4813 - mae: 5.9511 - mse: 73.4813 - rmse: 8.5638 - val_loss: 169.5598 -
val_mae: 9.7718 - val_mse: 169.5598 - val_rmse: 13.0215
Epoch 125/300
9/9             0s 16ms/step - loss:
79.4601 - mae: 6.5477 - mse: 79.4601 - rmse: 8.9113 - val_loss: 170.6434 -
val_mae: 9.8182 - val_mse: 170.6434 - val_rmse: 13.0631
Epoch 126/300
9/9             0s 15ms/step - loss:
82.5379 - mae: 6.5967 - mse: 82.5379 - rmse: 9.0774 - val_loss: 171.9634 -
val_mae: 9.7662 - val_mse: 171.9634 - val_rmse: 13.1135
Epoch 127/300
9/9             0s 15ms/step - loss:
66.3241 - mae: 5.8950 - mse: 66.3241 - rmse: 8.0918 - val_loss: 170.0748 -
val_mae: 9.7625 - val_mse: 170.0748 - val_rmse: 13.0413
Epoch 128/300
9/9             0s 16ms/step - loss:
85.2012 - mae: 6.5002 - mse: 85.2012 - rmse: 9.2205 - val_loss: 169.8057 -
val_mae: 9.7603 - val_mse: 169.8057 - val_rmse: 13.0310
Epoch 129/300
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9/9             0s 16ms/step - loss:
69.0326 - mae: 6.1603 - mse: 69.0326 - rmse: 8.2731 - val_loss: 170.3687 -
val_mae: 9.7838 - val_mse: 170.3687 - val_rmse: 13.0525
Epoch 130/300
9/9             0s 14ms/step - loss:
72.4415 - mae: 6.1009 - mse: 72.4415 - rmse: 8.5093 - val_loss: 171.6061 -
val_mae: 9.7431 - val_mse: 171.6061 - val_rmse: 13.0999
Epoch 131/300
9/9             0s 14ms/step - loss:
73.5992 - mae: 6.2214 - mse: 73.5992 - rmse: 8.5703 - val_loss: 171.2691 -
val_mae: 9.7751 - val_mse: 171.2691 - val_rmse: 13.0870
Epoch 132/300
9/9             0s 23ms/step - loss:
73.0245 - mae: 6.0183 - mse: 73.0245 - rmse: 8.5207 - val_loss: 169.3687 -
val_mae: 9.7563 - val_mse: 169.3687 - val_rmse: 13.0142
Epoch 133/300
9/9             0s 30ms/step - loss:
79.4472 - mae: 6.6918 - mse: 79.4472 - rmse: 8.9102 - val_loss: 171.3638 -
val_mae: 9.7823 - val_mse: 171.3638 - val_rmse: 13.0906
Epoch 134/300
9/9             0s 29ms/step - loss:
71.8611 - mae: 6.0453 - mse: 71.8611 - rmse: 8.4615 - val_loss: 169.5205 -
val_mae: 9.7194 - val_mse: 169.5205 - val_rmse: 13.0200
Epoch 135/300
9/9             0s 19ms/step - loss:
79.0160 - mae: 6.3935 - mse: 79.0160 - rmse: 8.8762 - val_loss: 171.1284 -
val_mae: 9.7759 - val_mse: 171.1284 - val_rmse: 13.0816
Epoch 136/300
9/9             0s 29ms/step - loss:
73.7491 - mae: 6.1546 - mse: 73.7491 - rmse: 8.5811 - val_loss: 170.5445 -
val_mae: 9.7638 - val_mse: 170.5445 - val_rmse: 13.0593
Epoch 137/300
9/9             0s 30ms/step - loss:
75.2213 - mae: 6.3358 - mse: 75.2213 - rmse: 8.6716 - val_loss: 170.2371 -
val_mae: 9.7448 - val_mse: 170.2371 - val_rmse: 13.0475
Epoch 138/300
9/9             0s 31ms/step - loss:
78.4940 - mae: 6.4845 - mse: 78.4940 - rmse: 8.8490 - val_loss: 171.6419 -
val_mae: 9.7439 - val_mse: 171.6419 - val_rmse: 13.1012
Epoch 139/300
9/9             0s 32ms/step - loss:
69.2826 - mae: 6.0472 - mse: 69.2826 - rmse: 8.3207 - val_loss: 171.8749 -
val_mae: 9.7587 - val_mse: 171.8749 - val_rmse: 13.1101
Epoch 140/300
9/9             0s 14ms/step - loss:
74.4915 - mae: 6.1649 - mse: 74.4915 - rmse: 8.6263 - val_loss: 170.2165 -
val_mae: 9.6876 - val_mse: 170.2165 - val_rmse: 13.0467
Epoch 141/300
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9/9             0s 17ms/step - loss:
64.7606 - mae: 5.8613 - mse: 64.7606 - rmse: 8.0360 - val_loss: 170.1556 -
val_mae: 9.7370 - val_mse: 170.1556 - val_rmse: 13.0444
Epoch 142/300
9/9             0s 16ms/step - loss:
75.2539 - mae: 6.2344 - mse: 75.2539 - rmse: 8.6648 - val_loss: 170.1569 -
val_mae: 9.7248 - val_mse: 170.1569 - val_rmse: 13.0444
Epoch 143/300
9/9             0s 17ms/step - loss:
65.0045 - mae: 5.7153 - mse: 65.0045 - rmse: 8.0249 - val_loss: 170.6754 -
val_mae: 9.7317 - val_mse: 170.6754 - val_rmse: 13.0643
Epoch 144/300
9/9             0s 14ms/step - loss:
70.7086 - mae: 6.1048 - mse: 70.7086 - rmse: 8.3657 - val_loss: 170.1346 -
val_mae: 9.7001 - val_mse: 170.1346 - val_rmse: 13.0436
Epoch 145/300
9/9             0s 15ms/step - loss:
69.7752 - mae: 6.0225 - mse: 69.7752 - rmse: 8.3513 - val_loss: 170.3152 -
val_mae: 9.6979 - val_mse: 170.3152 - val_rmse: 13.0505
Epoch 146/300
9/9             0s 16ms/step - loss:
73.8966 - mae: 6.1259 - mse: 73.8966 - rmse: 8.5902 - val_loss: 171.3395 -
val_mae: 9.7132 - val_mse: 171.3395 - val_rmse: 13.0897
Epoch 147/300
9/9             0s 16ms/step - loss:
61.8370 - mae: 5.6315 - mse: 61.8370 - rmse: 7.8254 - val_loss: 170.7184 -
val_mae: 9.7472 - val_mse: 170.7184 - val_rmse: 13.0659
Epoch 148/300
9/9             0s 16ms/step - loss:
72.9060 - mae: 6.1665 - mse: 72.9060 - rmse: 8.5341 - val_loss: 169.0957 -
val_mae: 9.6813 - val_mse: 169.0957 - val_rmse: 13.0037
Epoch 149/300
9/9             0s 14ms/step - loss:
70.9755 - mae: 6.2289 - mse: 70.9755 - rmse: 8.4175 - val_loss: 171.8435 -
val_mae: 9.7135 - val_mse: 171.8435 - val_rmse: 13.1089
Epoch 150/300
9/9             0s 16ms/step - loss:
71.9831 - mae: 6.1598 - mse: 71.9831 - rmse: 8.4763 - val_loss: 169.2682 -
val_mae: 9.6696 - val_mse: 169.2682 - val_rmse: 13.0103
Epoch 151/300
9/9             0s 16ms/step - loss:
73.9945 - mae: 6.1434 - mse: 73.9945 - rmse: 8.5833 - val_loss: 170.5636 -
val_mae: 9.7324 - val_mse: 170.5636 - val_rmse: 13.0600
Epoch 152/300
9/9             0s 13ms/step - loss:
70.8555 - mae: 6.0244 - mse: 70.8555 - rmse: 8.4103 - val_loss: 171.3042 -
val_mae: 9.6768 - val_mse: 171.3042 - val_rmse: 13.0883
Epoch 153/300
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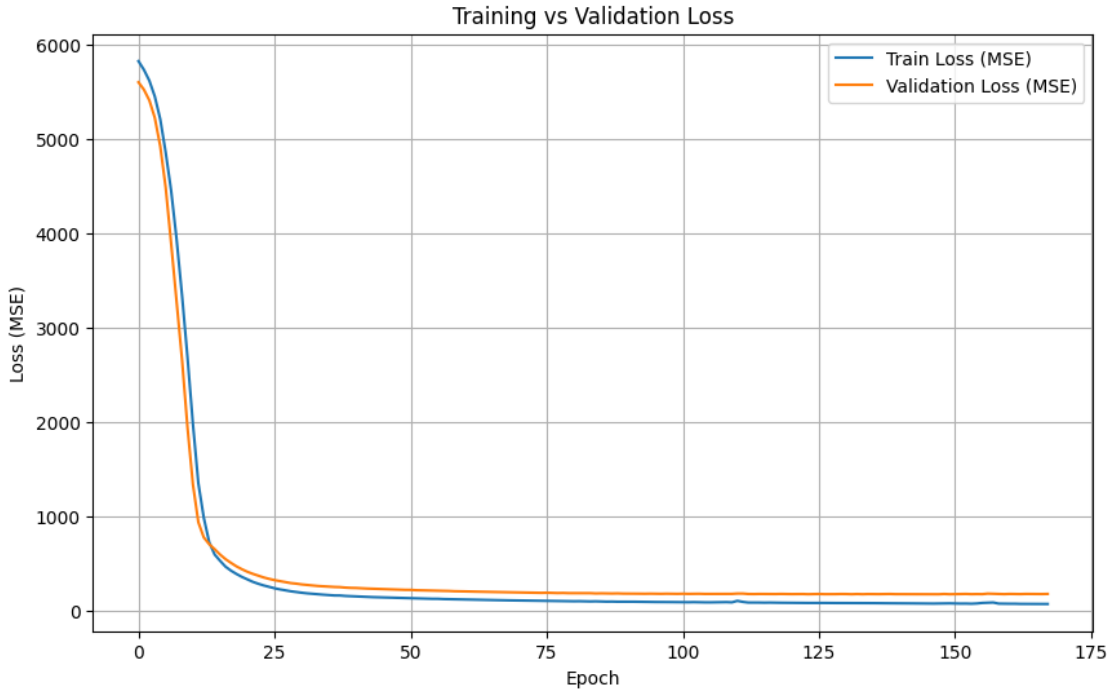
9/9             0s 16ms/step - loss:
72.3466 - mae: 6.3083 - mse: 72.3466 - rmse: 8.4982 - val_loss: 172.2766 -
val_mae: 9.7441 - val_mse: 172.2766 - val_rmse: 13.1254
Epoch 154/300
9/9             0s 14ms/step - loss:
65.5457 - mae: 5.6147 - mse: 65.5457 - rmse: 8.0714 - val_loss: 170.0413 -
val_mae: 9.6941 - val_mse: 170.0413 - val_rmse: 13.0400
Epoch 155/300
9/9             0s 16ms/step - loss:
67.6555 - mae: 5.9427 - mse: 67.6555 - rmse: 8.2114 - val_loss: 170.9943 -
val_mae: 9.7433 - val_mse: 170.9943 - val_rmse: 13.0765
Epoch 156/300
9/9             0s 14ms/step - loss:
79.3464 - mae: 6.5503 - mse: 79.3464 - rmse: 8.9043 - val_loss: 170.1555 -
val_mae: 9.6321 - val_mse: 170.1555 - val_rmse: 13.0444
Epoch 157/300
9/9             0s 15ms/step - loss:
74.3030 - mae: 6.2066 - mse: 74.3030 - rmse: 8.5927 - val_loss: 175.7811 -
val_mae: 9.9229 - val_mse: 175.7811 - val_rmse: 13.2582
Epoch 158/300
9/9             0s 15ms/step - loss:
81.2897 - mae: 6.4852 - mse: 81.2897 - rmse: 9.0074 - val_loss: 173.9463 -
val_mae: 9.7098 - val_mse: 173.9463 - val_rmse: 13.1889
Epoch 159/300
9/9             0s 16ms/step - loss:
71.5236 - mae: 6.2978 - mse: 71.5236 - rmse: 8.4549 - val_loss: 171.2817 -
val_mae: 9.8221 - val_mse: 171.2817 - val_rmse: 13.0875
Epoch 160/300
9/9             0s 16ms/step - loss:
78.5279 - mae: 6.3466 - mse: 78.5279 - rmse: 8.8394 - val_loss: 170.2600 -
val_mae: 9.6802 - val_mse: 170.2600 - val_rmse: 13.0484
Epoch 161/300
9/9             0s 16ms/step - loss:
64.0938 - mae: 5.8635 - mse: 64.0938 - rmse: 7.9948 - val_loss: 172.3861 -
val_mae: 9.6816 - val_mse: 172.3861 - val_rmse: 13.1296
Epoch 162/300
9/9             0s 14ms/step - loss:
69.5686 - mae: 6.0147 - mse: 69.5686 - rmse: 8.3330 - val_loss: 170.9947 -
val_mae: 9.7373 - val_mse: 170.9947 - val_rmse: 13.0765
Epoch 163/300
9/9             0s 15ms/step - loss:
57.4405 - mae: 5.3986 - mse: 57.4405 - rmse: 7.5538 - val_loss: 170.6640 -
val_mae: 9.6776 - val_mse: 170.6640 - val_rmse: 13.0638
Epoch 164/300
9/9             0s 18ms/step - loss:
66.7167 - mae: 5.8588 - mse: 66.7167 - rmse: 8.1584 - val_loss: 172.3326 -
val_mae: 9.7093 - val_mse: 172.3326 - val_rmse: 13.1276
Epoch 165/300
```

```
9/9             0s 15ms/step - loss:
66.7558 - mae: 5.8359 - mse: 66.7558 - rmse: 8.1633 - val_loss: 171.7034 -
val_mae: 9.6962 - val_mse: 171.7034 - val_rmse: 13.1036
Epoch 166/300
9/9             0s 17ms/step - loss:
69.4624 - mae: 5.9811 - mse: 69.4624 - rmse: 8.3198 - val_loss: 170.9689 -
val_mae: 9.6912 - val_mse: 170.9689 - val_rmse: 13.0755
Epoch 167/300
9/9             0s 17ms/step - loss:
61.9944 - mae: 5.7053 - mse: 61.9944 - rmse: 7.8666 - val_loss: 171.1694 -
val_mae: 9.6904 - val_mse: 171.1694 - val_rmse: 13.0832
Epoch 168/300
9/9             0s 16ms/step - loss:
78.0886 - mae: 6.2759 - mse: 78.0886 - rmse: 8.7933 - val_loss: 172.4107 -
val_mae: 9.7072 - val_mse: 172.4107 - val_rmse: 13.1305
```

5.2.4 Loss Plot

[204]:
```
# Plot loss
plt.figure(figsize=(10, 6))
plt.plot(history.history['loss'], label='Train Loss (MSE)')
plt.plot(history.history['val_loss'], label='Validation Loss (MSE)')
plt.title('Training vs Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss (MSE)')
plt.legend()
plt.grid(True)
plt.show()
```



5.2.5 R2 Model Functional

[205]:
```
# show R2
y_pred = base_model_functional.predict(X_test)
r2_score(y_test, y_pred)
```

```
12/12              0s 6ms/step
```

[205]: 0.35346509254253955

6 Modify Modelling

6.1 Sequential Model

6.1.1 Configure Model Neuron, Activation Layer

[206]:
```
# sequential model
n = X_train.shape[1]
n


modify_model_sequential = keras.Sequential([
    layers.Dense(n * 3, activation= 'relu', input_shape=(n,),␣
 ↪kernel_regularizer=regularizers.l2(0.001)),
```

```
    #layers.Dropout(0.3), #overfitting kalo crossed, underfitting kalo gap␣
 ↪terlalu jauh
    layers.Dense(n * 3, activation='relu', kernel_regularizer=regularizers.l2(0.
 ↪001)),
    layers.Dense(n * 3, activation='relu', kernel_regularizer=regularizers.l2(0.
 ↪001)),
    layers.Dense(1)
])
```

```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/dense.py:87:
UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When
using Sequential models, prefer using an `Input(shape)` object as the first
layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

6.1.2 Compile and evaluation

[207]:
```
optimizer = keras.optimizers.Adam(learning_rate=0.0005)

# compile model
modify_model_sequential.compile(
    optimizer=optimizer, #cara model belajar
    loss='mse', #semakin rendah makin bagus
    metrics=['mae', 'mse', RootMeanSquaredError(name = 'rmse')] #semakin rendah␣
 ↪makin bagus
)
modify_model_sequential.summary()
```

Model: "sequential_6"

Layer (type)	Output Shape	Param #
dense_46 (Dense)	(None, 51)	918
dense_47 (Dense)	(None, 51)	2,652
dense_48 (Dense)	(None, 51)	2,652
dense_49 (Dense)	(None, 1)	52

Total params: 6,274 (24.51 KB)

Trainable params: 6,274 (24.51 KB)

Non-trainable params: 0 (0.00 B)

6.1.3 Fit Model Sequential

[208]:
```
callbacks = EarlyStopping(monitor='val_loss',
                          patience=20,
                          restore_best_weights=True)


history = modify_model_sequential.fit(
    X_train, y_train,
    validation_data=(X_cv, y_cv),
    epochs=300,
    callbacks = [callbacks],
    batch_size=16,
    verbose=1
)
```

```
Epoch 1/300
18/18             2s 24ms/step -
loss: 5565.5225 - mae: 72.2573 - mse: 5565.3945 - rmse: 74.5743 - val_loss:
5550.3384 - val_mae: 72.3902 - val_mse: 5550.2109 - val_rmse: 74.4997
Epoch 2/300
18/18             0s 14ms/step -
loss: 5715.7729 - mae: 73.5409 - mse: 5715.6450 - rmse: 75.6003 - val_loss:
5450.4282 - val_mae: 71.6710 - val_mse: 5450.3008 - val_rmse: 73.8261
Epoch 3/300
18/18             0s 9ms/step - loss:
5443.9922 - mae: 71.1518 - mse: 5443.8633 - rmse: 73.7642 - val_loss: 5278.3750
- val_mae: 70.4045 - val_mse: 5278.2461 - val_rmse: 72.6515
Epoch 4/300
18/18             0s 9ms/step - loss:
5305.2124 - mae: 70.2018 - mse: 5305.0825 - rmse: 72.8217 - val_loss: 4979.9102
- val_mae: 68.1888 - val_mse: 4979.7788 - val_rmse: 70.5676
Epoch 5/300
18/18             0s 13ms/step -
loss: 5033.7363 - mae: 68.1108 - mse: 5033.6035 - rmse: 70.9094 - val_loss:
4499.1123 - val_mae: 64.4999 - val_mse: 4498.9766 - val_rmse: 67.0744
Epoch 6/300
18/18             0s 16ms/step -
loss: 4569.5942 - mae: 64.8057 - mse: 4569.4580 - rmse: 67.5813 - val_loss:
3911.4607 - val_mae: 59.7168 - val_mse: 3911.3208 - val_rmse: 62.5406
Epoch 7/300
18/18             1s 16ms/step -
loss: 4162.8770 - mae: 61.2618 - mse: 4162.7363 - rmse: 64.4774 - val_loss:
3352.8586 - val_mae: 54.7317 - val_mse: 3352.7161 - val_rmse: 57.9026
Epoch 8/300
```

```
18/18            0s 16ms/step -
loss: 3411.6472 - mae: 54.7983 - mse: 3411.5029 - rmse: 58.3882 - val_loss:
2636.9385 - val_mae: 47.6411 - val_mse: 2636.7908 - val_rmse: 51.3497
Epoch 9/300
18/18            0s 16ms/step -
loss: 2846.0413 - mae: 48.5016 - mse: 2845.8921 - rmse: 53.2499 - val_loss:
1977.2798 - val_mae: 40.3432 - val_mse: 1977.1272 - val_rmse: 44.4649
Epoch 10/300
18/18            0s 16ms/step -
loss: 2078.3606 - mae: 39.8540 - mse: 2078.2063 - rmse: 45.5725 - val_loss:
1409.9988 - val_mae: 33.1962 - val_mse: 1409.8412 - val_rmse: 37.5479
Epoch 11/300
18/18            1s 13ms/step -
loss: 1509.4877 - mae: 32.8810 - mse: 1509.3284 - rmse: 38.8260 - val_loss:
987.1081 - val_mae: 27.0960 - val_mse: 986.9456 - val_rmse: 31.4157
Epoch 12/300
18/18            0s 13ms/step -
loss: 1185.6010 - mae: 28.3589 - mse: 1185.4371 - rmse: 34.3058 - val_loss:
753.2828 - val_mae: 23.0761 - val_mse: 753.1158 - val_rmse: 27.4430
Epoch 13/300
18/18            0s 13ms/step -
loss: 785.6044 - mae: 22.0274 - mse: 785.4368 - rmse: 28.0042 - val_loss:
666.8114 - val_mae: 21.4168 - val_mse: 666.6420 - val_rmse: 25.8194
Epoch 14/300
18/18            0s 13ms/step -
loss: 688.3013 - mae: 21.5934 - mse: 688.1315 - rmse: 26.2260 - val_loss:
618.3855 - val_mae: 20.4071 - val_mse: 618.2144 - val_rmse: 24.8639
Epoch 15/300
18/18            0s 9ms/step - loss:
606.5519 - mae: 20.7031 - mse: 606.3804 - rmse: 24.5947 - val_loss: 579.1332 -
val_mae: 19.5734 - val_mse: 578.9611 - val_rmse: 24.0616
Epoch 16/300
18/18            0s 10ms/step -
loss: 505.4131 - mae: 18.4634 - mse: 505.2406 - rmse: 22.4700 - val_loss:
547.5940 - val_mae: 18.9520 - val_mse: 547.4210 - val_rmse: 23.3970
Epoch 17/300
18/18            0s 9ms/step - loss:
480.3126 - mae: 18.1908 - mse: 480.1394 - rmse: 21.8825 - val_loss: 519.0578 -
val_mae: 18.3666 - val_mse: 518.8842 - val_rmse: 22.7790
Epoch 18/300
18/18            0s 13ms/step -
loss: 421.7408 - mae: 16.9885 - mse: 421.5669 - rmse: 20.5230 - val_loss:
493.3155 - val_mae: 17.7908 - val_mse: 493.1411 - val_rmse: 22.2068
Epoch 19/300
18/18            0s 9ms/step - loss:
416.0283 - mae: 16.8302 - mse: 415.8539 - rmse: 20.3839 - val_loss: 466.9722 -
val_mae: 17.2924 - val_mse: 466.7976 - val_rmse: 21.6055
Epoch 20/300
```

```
18/18            0s 9ms/step - loss:
366.2000 - mae: 15.3217 - mse: 366.0252 - rmse: 19.0718 - val_loss: 444.7332 -
val_mae: 16.8002 - val_mse: 444.5581 - val_rmse: 21.0845
Epoch 21/300
18/18            0s 13ms/step -
loss: 352.7554 - mae: 15.2314 - mse: 352.5801 - rmse: 18.7685 - val_loss:
422.0664 - val_mae: 16.3526 - val_mse: 421.8911 - val_rmse: 20.5400
Epoch 22/300
18/18            0s 13ms/step -
loss: 335.8038 - mae: 14.5465 - mse: 335.6282 - rmse: 18.3096 - val_loss:
403.3689 - val_mae: 15.8337 - val_mse: 403.1929 - val_rmse: 20.0797
Epoch 23/300
18/18            0s 13ms/step -
loss: 309.8995 - mae: 14.1905 - mse: 309.7232 - rmse: 17.5890 - val_loss:
384.3194 - val_mae: 15.4161 - val_mse: 384.1430 - val_rmse: 19.5996
Epoch 24/300
18/18            0s 13ms/step -
loss: 304.0071 - mae: 14.1407 - mse: 303.8307 - rmse: 17.4184 - val_loss:
368.2117 - val_mae: 15.1645 - val_mse: 368.0353 - val_rmse: 19.1842
Epoch 25/300
18/18            0s 9ms/step - loss:
267.5003 - mae: 12.9838 - mse: 267.3236 - rmse: 16.3366 - val_loss: 353.3348 -
val_mae: 14.7276 - val_mse: 353.1577 - val_rmse: 18.7925
Epoch 26/300
18/18            0s 13ms/step -
loss: 276.3230 - mae: 13.0776 - mse: 276.1459 - rmse: 16.5823 - val_loss:
340.3597 - val_mae: 14.4235 - val_mse: 340.1825 - val_rmse: 18.4440
Epoch 27/300
18/18            0s 13ms/step -
loss: 260.8942 - mae: 12.8386 - mse: 260.7167 - rmse: 16.1358 - val_loss:
328.1536 - val_mae: 14.1285 - val_mse: 327.9759 - val_rmse: 18.1101
Epoch 28/300
18/18            0s 10ms/step -
loss: 254.4778 - mae: 12.8763 - mse: 254.3002 - rmse: 15.9400 - val_loss:
320.3870 - val_mae: 13.9969 - val_mse: 320.2090 - val_rmse: 17.8944
Epoch 29/300
18/18            0s 9ms/step - loss:
226.2964 - mae: 11.5280 - mse: 226.1183 - rmse: 14.9934 - val_loss: 310.3363 -
val_mae: 13.6499 - val_mse: 310.1578 - val_rmse: 17.6113
Epoch 30/300
18/18            0s 9ms/step - loss:
225.4276 - mae: 11.7693 - mse: 225.2489 - rmse: 14.9993 - val_loss: 301.7542 -
val_mae: 13.4013 - val_mse: 301.5753 - val_rmse: 17.3659
Epoch 31/300
18/18            0s 9ms/step - loss:
194.1334 - mae: 10.7763 - mse: 193.9546 - rmse: 13.8687 - val_loss: 292.5427 -
val_mae: 13.3358 - val_mse: 292.3639 - val_rmse: 17.0987
Epoch 32/300
```

```
18/18            0s 13ms/step -
loss: 204.2122 - mae: 10.9592 - mse: 204.0333 - rmse: 14.2503 - val_loss:
285.9490 - val_mae: 13.0115 - val_mse: 285.7696 - val_rmse: 16.9047
Epoch 33/300
18/18            0s 9ms/step - loss:
189.2832 - mae: 10.3912 - mse: 189.1036 - rmse: 13.6928 - val_loss: 278.9260 -
val_mae: 12.8752 - val_mse: 278.7462 - val_rmse: 16.6957
Epoch 34/300
18/18            0s 10ms/step -
loss: 187.4612 - mae: 10.2549 - mse: 187.2814 - rmse: 13.6798 - val_loss:
274.8891 - val_mae: 12.6651 - val_mse: 274.7089 - val_rmse: 16.5743
Epoch 35/300
18/18            0s 9ms/step - loss:
172.1490 - mae: 9.9738 - mse: 171.9687 - rmse: 13.0687 - val_loss: 267.9404 -
val_mae: 12.5566 - val_mse: 267.7602 - val_rmse: 16.3634
Epoch 36/300
18/18            0s 13ms/step -
loss: 194.2441 - mae: 10.9440 - mse: 194.0638 - rmse: 13.9250 - val_loss:
262.9950 - val_mae: 12.4421 - val_mse: 262.8144 - val_rmse: 16.2115
Epoch 37/300
18/18            0s 9ms/step - loss:
182.4670 - mae: 10.2648 - mse: 182.2864 - rmse: 13.4929 - val_loss: 259.0694 -
val_mae: 12.2926 - val_mse: 258.8885 - val_rmse: 16.0900
Epoch 38/300
18/18            0s 9ms/step - loss:
191.6542 - mae: 10.3001 - mse: 191.4733 - rmse: 13.8084 - val_loss: 255.8319 -
val_mae: 12.1713 - val_mse: 255.6507 - val_rmse: 15.9891
Epoch 39/300
18/18            0s 13ms/step -
loss: 176.9579 - mae: 10.0137 - mse: 176.7767 - rmse: 13.2899 - val_loss:
251.7095 - val_mae: 12.1231 - val_mse: 251.5283 - val_rmse: 15.8596
Epoch 40/300
18/18            0s 9ms/step - loss:
165.8285 - mae: 9.6827 - mse: 165.6471 - rmse: 12.7922 - val_loss: 247.2776 -
val_mae: 12.0386 - val_mse: 247.0961 - val_rmse: 15.7193
Epoch 41/300
18/18            0s 10ms/step -
loss: 162.9896 - mae: 9.6389 - mse: 162.8080 - rmse: 12.7508 - val_loss:
245.2973 - val_mae: 11.9187 - val_mse: 245.1154 - val_rmse: 15.6562
Epoch 42/300
18/18            0s 13ms/step -
loss: 183.8170 - mae: 10.4688 - mse: 183.6350 - rmse: 13.4896 - val_loss:
243.5964 - val_mae: 11.8137 - val_mse: 243.4140 - val_rmse: 15.6017
Epoch 43/300
18/18            0s 9ms/step - loss:
167.4278 - mae: 9.4365 - mse: 167.2455 - rmse: 12.9117 - val_loss: 238.8871 -
val_mae: 11.7447 - val_mse: 238.7046 - val_rmse: 15.4501
Epoch 44/300
```

```
18/18            0s 14ms/step -
loss: 144.3238 - mae: 9.0060 - mse: 144.1413 - rmse: 11.9896 - val_loss:
236.4234 - val_mae: 11.7487 - val_mse: 236.2409 - val_rmse: 15.3701
Epoch 45/300
18/18            0s 9ms/step - loss:
156.1651 - mae: 9.0557 - mse: 155.9825 - rmse: 12.4806 - val_loss: 234.2099 -
val_mae: 11.6514 - val_mse: 234.0271 - val_rmse: 15.2979
Epoch 46/300
18/18            0s 9ms/step - loss:
182.6304 - mae: 10.1798 - mse: 182.4477 - rmse: 13.4540 - val_loss: 231.8567 -
val_mae: 11.6778 - val_mse: 231.6740 - val_rmse: 15.2208
Epoch 47/300
18/18            0s 15ms/step -
loss: 140.8437 - mae: 8.8044 - mse: 140.6606 - rmse: 11.8578 - val_loss:
232.3043 - val_mae: 11.5434 - val_mse: 232.1210 - val_rmse: 15.2355
Epoch 48/300
18/18            0s 16ms/step -
loss: 152.7724 - mae: 9.2248 - mse: 152.5891 - rmse: 12.3465 - val_loss:
228.3962 - val_mae: 11.5791 - val_mse: 228.2130 - val_rmse: 15.1067
Epoch 49/300
18/18            1s 16ms/step -
loss: 129.8549 - mae: 8.5871 - mse: 129.6716 - rmse: 11.3512 - val_loss:
227.3841 - val_mae: 11.4925 - val_mse: 227.2006 - val_rmse: 15.0732
Epoch 50/300
18/18            1s 17ms/step -
loss: 126.6117 - mae: 8.5024 - mse: 126.4282 - rmse: 11.1960 - val_loss:
223.9889 - val_mae: 11.5172 - val_mse: 223.8055 - val_rmse: 14.9601
Epoch 51/300
18/18            0s 12ms/step -
loss: 135.3224 - mae: 8.9585 - mse: 135.1388 - rmse: 11.6186 - val_loss:
223.4126 - val_mae: 11.3828 - val_mse: 223.2286 - val_rmse: 14.9408
Epoch 52/300
18/18            0s 9ms/step - loss:
144.3481 - mae: 8.9717 - mse: 144.1641 - rmse: 11.9957 - val_loss: 221.0443 -
val_mae: 11.4327 - val_mse: 220.8603 - val_rmse: 14.8614
Epoch 53/300
18/18            0s 13ms/step -
loss: 135.5030 - mae: 8.8095 - mse: 135.3189 - rmse: 11.6131 - val_loss:
219.8378 - val_mae: 11.3167 - val_mse: 219.6533 - val_rmse: 14.8207
Epoch 54/300
18/18            0s 13ms/step -
loss: 152.2401 - mae: 9.3643 - mse: 152.0557 - rmse: 12.3083 - val_loss:
217.5397 - val_mae: 11.2853 - val_mse: 217.3552 - val_rmse: 14.7430
Epoch 55/300
18/18            0s 9ms/step - loss:
117.1445 - mae: 8.1903 - mse: 116.9598 - rmse: 10.7977 - val_loss: 216.5025 -
val_mae: 11.2418 - val_mse: 216.3177 - val_rmse: 14.7077
Epoch 56/300
```

```
18/18            0s 13ms/step -
loss: 144.0789 - mae: 9.4098 - mse: 143.8941 - rmse: 11.9845 - val_loss:
213.9061 - val_mae: 11.2321 - val_mse: 213.7211 - val_rmse: 14.6192
Epoch 57/300
18/18            0s 13ms/step -
loss: 132.4111 - mae: 8.9231 - mse: 132.2262 - rmse: 11.4808 - val_loss:
213.3751 - val_mae: 11.1656 - val_mse: 213.1898 - val_rmse: 14.6010
Epoch 58/300
18/18            0s 9ms/step - loss:
135.5034 - mae: 8.7571 - mse: 135.3180 - rmse: 11.6269 - val_loss: 211.3165 -
val_mae: 11.1404 - val_mse: 211.1310 - val_rmse: 14.5303
Epoch 59/300
18/18            0s 13ms/step -
loss: 134.9332 - mae: 8.7827 - mse: 134.7476 - rmse: 11.5868 - val_loss:
210.5792 - val_mae: 11.1131 - val_mse: 210.3934 - val_rmse: 14.5049
Epoch 60/300
18/18            0s 9ms/step - loss:
131.4252 - mae: 8.8447 - mse: 131.2397 - rmse: 11.4480 - val_loss: 208.7800 -
val_mae: 11.1028 - val_mse: 208.5942 - val_rmse: 14.4428
Epoch 61/300
18/18            0s 10ms/step -
loss: 131.9254 - mae: 8.7780 - mse: 131.7394 - rmse: 11.4694 - val_loss:
208.6121 - val_mae: 11.0732 - val_mse: 208.4259 - val_rmse: 14.4370
Epoch 62/300
18/18            0s 9ms/step - loss:
116.6765 - mae: 8.0975 - mse: 116.4902 - rmse: 10.7669 - val_loss: 207.1336 -
val_mae: 10.9877 - val_mse: 206.9471 - val_rmse: 14.3857
Epoch 63/300
18/18            0s 9ms/step - loss:
113.1564 - mae: 8.1686 - mse: 112.9701 - rmse: 10.6009 - val_loss: 204.0462 -
val_mae: 10.9958 - val_mse: 203.8599 - val_rmse: 14.2780
Epoch 64/300
18/18            0s 10ms/step -
loss: 128.5537 - mae: 8.4322 - mse: 128.3671 - rmse: 11.3222 - val_loss:
204.9383 - val_mae: 10.9707 - val_mse: 204.7513 - val_rmse: 14.3091
Epoch 65/300
18/18            0s 13ms/step -
loss: 118.5629 - mae: 8.3622 - mse: 118.3759 - rmse: 10.8538 - val_loss:
204.4500 - val_mae: 10.9110 - val_mse: 204.2628 - val_rmse: 14.2921
Epoch 66/300
18/18            0s 9ms/step - loss:
118.8905 - mae: 8.1870 - mse: 118.7034 - rmse: 10.8604 - val_loss: 201.5327 -
val_mae: 10.9712 - val_mse: 201.3457 - val_rmse: 14.1896
Epoch 67/300
18/18            0s 13ms/step -
loss: 135.7943 - mae: 9.0840 - mse: 135.6072 - rmse: 11.6223 - val_loss:
201.3587 - val_mae: 10.8353 - val_mse: 201.1712 - val_rmse: 14.1835
Epoch 68/300
```

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18/18            0s 13ms/step -
loss: 97.7021 - mae: 7.5560 - mse: 97.5144 - rmse: 9.7997 - val_loss: 199.6665 -
val_mae: 10.8345 - val_mse: 199.4790 - val_rmse: 14.1237
Epoch 69/300
18/18            0s 9ms/step - loss:
123.9042 - mae: 8.4892 - mse: 123.7167 - rmse: 11.1150 - val_loss: 198.7863 -
val_mae: 10.8446 - val_mse: 198.5986 - val_rmse: 14.0925
Epoch 70/300
18/18            0s 13ms/step -
loss: 132.7648 - mae: 8.7801 - mse: 132.5770 - rmse: 11.4712 - val_loss:
198.2423 - val_mae: 10.7661 - val_mse: 198.0541 - val_rmse: 14.0732
Epoch 71/300
18/18            0s 13ms/step -
loss: 122.0407 - mae: 8.5239 - mse: 121.8525 - rmse: 11.0354 - val_loss:
197.5026 - val_mae: 10.7542 - val_mse: 197.3142 - val_rmse: 14.0469
Epoch 72/300
18/18            0s 13ms/step -
loss: 142.2686 - mae: 8.9831 - mse: 142.0802 - rmse: 11.8904 - val_loss:
196.5623 - val_mae: 10.7094 - val_mse: 196.3736 - val_rmse: 14.0133
Epoch 73/300
18/18            0s 13ms/step -
loss: 106.5087 - mae: 7.9260 - mse: 106.3199 - rmse: 10.2890 - val_loss:
195.0967 - val_mae: 10.6868 - val_mse: 194.9077 - val_rmse: 13.9609
Epoch 74/300
18/18            0s 9ms/step - loss:
101.9959 - mae: 7.5479 - mse: 101.8068 - rmse: 10.0736 - val_loss: 194.0188 -
val_mae: 10.6494 - val_mse: 193.8296 - val_rmse: 13.9223
Epoch 75/300
18/18            0s 9ms/step - loss:
120.5604 - mae: 8.3563 - mse: 120.3711 - rmse: 10.9488 - val_loss: 192.0646 -
val_mae: 10.6425 - val_mse: 191.8752 - val_rmse: 13.8519
Epoch 76/300
18/18            0s 14ms/step -
loss: 104.6694 - mae: 7.5787 - mse: 104.4799 - rmse: 10.1617 - val_loss:
190.9031 - val_mae: 10.6031 - val_mse: 190.7133 - val_rmse: 13.8099
Epoch 77/300
18/18            0s 9ms/step - loss:
98.1794 - mae: 7.7503 - mse: 97.9895 - rmse: 9.8790 - val_loss: 189.9391 -
val_mae: 10.5570 - val_mse: 189.7489 - val_rmse: 13.7749
Epoch 78/300
18/18            0s 9ms/step - loss:
119.0184 - mae: 8.1957 - mse: 118.8282 - rmse: 10.8950 - val_loss: 189.5712 -
val_mae: 10.5215 - val_mse: 189.3805 - val_rmse: 13.7616
Epoch 79/300
18/18            0s 13ms/step -
loss: 104.6125 - mae: 7.9347 - mse: 104.4217 - rmse: 10.1855 - val_loss:
189.0208 - val_mae: 10.5515 - val_mse: 188.8299 - val_rmse: 13.7415
Epoch 80/300
```

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18/18            0s 9ms/step - loss:
105.5070 - mae: 7.8314 - mse: 105.3160 - rmse: 10.2525 - val_loss: 187.5060 -
val_mae: 10.4040 - val_mse: 187.3148 - val_rmse: 13.6863
Epoch 81/300
18/18            0s 9ms/step - loss:
140.0623 - mae: 8.9631 - mse: 139.8712 - rmse: 11.7607 - val_loss: 185.9382 -
val_mae: 10.4678 - val_mse: 185.7467 - val_rmse: 13.6289
Epoch 82/300
18/18            0s 13ms/step -
loss: 98.3769 - mae: 7.3311 - mse: 98.1852 - rmse: 9.8365 - val_loss: 185.2826 -
val_mae: 10.3993 - val_mse: 185.0907 - val_rmse: 13.6048
Epoch 83/300
18/18            0s 13ms/step -
loss: 97.6187 - mae: 7.6956 - mse: 97.4267 - rmse: 9.8515 - val_loss: 184.3934 -
val_mae: 10.3471 - val_mse: 184.2013 - val_rmse: 13.5721
Epoch 84/300
18/18            0s 9ms/step - loss:
97.4069 - mae: 7.4888 - mse: 97.2148 - rmse: 9.8455 - val_loss: 182.4533 -
val_mae: 10.3979 - val_mse: 182.2611 - val_rmse: 13.5004
Epoch 85/300
18/18            0s 9ms/step - loss:
101.7442 - mae: 7.5299 - mse: 101.5518 - rmse: 10.0707 - val_loss: 183.4058 -
val_mae: 10.3131 - val_mse: 183.2129 - val_rmse: 13.5356
Epoch 86/300
18/18            0s 9ms/step - loss:
101.5061 - mae: 7.5774 - mse: 101.3132 - rmse: 10.0621 - val_loss: 181.7920 -
val_mae: 10.2959 - val_mse: 181.5990 - val_rmse: 13.4759
Epoch 87/300
18/18            0s 10ms/step -
loss: 109.7174 - mae: 7.6860 - mse: 109.5244 - rmse: 10.4466 - val_loss:
181.5014 - val_mae: 10.2688 - val_mse: 181.3080 - val_rmse: 13.4651
Epoch 88/300
18/18            0s 13ms/step -
loss: 113.3760 - mae: 8.1439 - mse: 113.1825 - rmse: 10.5947 - val_loss:
180.8803 - val_mae: 10.3196 - val_mse: 180.6866 - val_rmse: 13.4420
Epoch 89/300
18/18            0s 13ms/step -
loss: 103.9188 - mae: 7.7570 - mse: 103.7250 - rmse: 10.1817 - val_loss:
181.3777 - val_mae: 10.2094 - val_mse: 181.1833 - val_rmse: 13.4604
Epoch 90/300
18/18            0s 16ms/step -
loss: 102.1878 - mae: 7.4478 - mse: 101.9935 - rmse: 10.0787 - val_loss:
182.0954 - val_mae: 10.4286 - val_mse: 181.9011 - val_rmse: 13.4871
Epoch 91/300
18/18            1s 16ms/step -
loss: 106.0398 - mae: 7.8273 - mse: 105.8453 - rmse: 10.2802 - val_loss:
180.7609 - val_mae: 10.1745 - val_mse: 180.5658 - val_rmse: 13.4375
Epoch 92/300
```

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18/18            1s 18ms/step -
loss: 102.4128 - mae: 7.8019 - mse: 102.2178 - rmse: 10.0645 - val_loss:
177.3683 - val_mae: 10.1847 - val_mse: 177.1735 - val_rmse: 13.3107
Epoch 93/300
18/18            0s 9ms/step - loss:
95.2001 - mae: 7.5012 - mse: 95.0051 - rmse: 9.6692 - val_loss: 176.9028 -
val_mae: 10.1512 - val_mse: 176.7075 - val_rmse: 13.2931
Epoch 94/300
18/18            0s 14ms/step -
loss: 105.5464 - mae: 7.8436 - mse: 105.3512 - rmse: 10.2444 - val_loss:
175.6137 - val_mae: 10.0975 - val_mse: 175.4181 - val_rmse: 13.2445
Epoch 95/300
18/18            0s 9ms/step - loss:
94.2512 - mae: 7.5599 - mse: 94.0554 - rmse: 9.6826 - val_loss: 175.6180 -
val_mae: 10.1184 - val_mse: 175.4221 - val_rmse: 13.2447
Epoch 96/300
18/18            0s 9ms/step - loss:
95.7089 - mae: 7.4795 - mse: 95.5131 - rmse: 9.7522 - val_loss: 174.4097 -
val_mae: 10.0740 - val_mse: 174.2137 - val_rmse: 13.1990
Epoch 97/300
18/18            0s 9ms/step - loss:
99.5299 - mae: 7.4119 - mse: 99.3336 - rmse: 9.9540 - val_loss: 173.9981 -
val_mae: 10.0617 - val_mse: 173.8017 - val_rmse: 13.1834
Epoch 98/300
18/18            0s 9ms/step - loss:
90.7248 - mae: 7.3088 - mse: 90.5283 - rmse: 9.5037 - val_loss: 174.6967 -
val_mae: 10.0413 - val_mse: 174.4999 - val_rmse: 13.2098
Epoch 99/300
18/18            0s 13ms/step -
loss: 92.1533 - mae: 7.1719 - mse: 91.9565 - rmse: 9.5680 - val_loss: 173.7741 -
val_mae: 10.0914 - val_mse: 173.5774 - val_rmse: 13.1749
Epoch 100/300
18/18            0s 9ms/step - loss:
103.4797 - mae: 7.4929 - mse: 103.2829 - rmse: 10.1477 - val_loss: 173.7823 -
val_mae: 10.0188 - val_mse: 173.5850 - val_rmse: 13.1752
Epoch 101/300
18/18            0s 13ms/step -
loss: 102.4721 - mae: 7.5387 - mse: 102.2748 - rmse: 10.0741 - val_loss:
172.3494 - val_mae: 9.9819 - val_mse: 172.1518 - val_rmse: 13.1207
Epoch 102/300
18/18            0s 9ms/step - loss:
90.6685 - mae: 7.2512 - mse: 90.4707 - rmse: 9.5058 - val_loss: 172.3968 -
val_mae: 9.9861 - val_mse: 172.1988 - val_rmse: 13.1225
Epoch 103/300
18/18            0s 9ms/step - loss:
88.0462 - mae: 6.9826 - mse: 87.8483 - rmse: 9.3533 - val_loss: 170.3900 -
val_mae: 9.9782 - val_mse: 170.1920 - val_rmse: 13.0458
Epoch 104/300
```

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18/18            0s 13ms/step -
loss: 93.3778 - mae: 7.3332 - mse: 93.1796 - rmse: 9.6338 - val_loss: 171.0271 -
val_mae: 9.9408 - val_mse: 170.8287 - val_rmse: 13.0701
Epoch 105/300
18/18            0s 9ms/step - loss:
82.8207 - mae: 6.9602 - mse: 82.6222 - rmse: 9.0494 - val_loss: 170.5504 -
val_mae: 9.9132 - val_mse: 170.3516 - val_rmse: 13.0519
Epoch 106/300
18/18            0s 10ms/step -
loss: 88.4503 - mae: 6.8803 - mse: 88.2515 - rmse: 9.3894 - val_loss: 169.3864 -
val_mae: 9.9267 - val_mse: 169.1875 - val_rmse: 13.0072
Epoch 107/300
18/18            0s 13ms/step -
loss: 95.6995 - mae: 7.3133 - mse: 95.5006 - rmse: 9.7629 - val_loss: 169.2235 -
val_mae: 9.8491 - val_mse: 169.0240 - val_rmse: 13.0009
Epoch 108/300
18/18            0s 9ms/step - loss:
89.8517 - mae: 7.1441 - mse: 89.6524 - rmse: 9.4629 - val_loss: 168.2459 -
val_mae: 9.8405 - val_mse: 168.0461 - val_rmse: 12.9633
Epoch 109/300
18/18            0s 9ms/step - loss:
86.3777 - mae: 6.9336 - mse: 86.1779 - rmse: 9.2721 - val_loss: 167.7525 -
val_mae: 9.8539 - val_mse: 167.5527 - val_rmse: 12.9442
Epoch 110/300
18/18            0s 9ms/step - loss:
94.9950 - mae: 7.4193 - mse: 94.7952 - rmse: 9.7208 - val_loss: 167.2960 -
val_mae: 9.8000 - val_mse: 167.0959 - val_rmse: 12.9266
Epoch 111/300
18/18            0s 9ms/step - loss:
104.4934 - mae: 7.7248 - mse: 104.2931 - rmse: 10.1836 - val_loss: 167.9632 -
val_mae: 9.8617 - val_mse: 167.7629 - val_rmse: 12.9523
Epoch 112/300
18/18            0s 13ms/step -
loss: 85.2882 - mae: 6.7964 - mse: 85.0877 - rmse: 9.2163 - val_loss: 167.4214 -
val_mae: 9.8105 - val_mse: 167.2206 - val_rmse: 12.9314
Epoch 113/300
18/18            0s 14ms/step -
loss: 94.4133 - mae: 7.2288 - mse: 94.2123 - rmse: 9.6990 - val_loss: 166.1471 -
val_mae: 9.7260 - val_mse: 165.9461 - val_rmse: 12.8820
Epoch 114/300
18/18            0s 13ms/step -
loss: 84.0732 - mae: 6.8938 - mse: 83.8723 - rmse: 9.1382 - val_loss: 166.0118 -
val_mae: 9.7461 - val_mse: 165.8106 - val_rmse: 12.8767
Epoch 115/300
18/18            0s 9ms/step - loss:
84.6324 - mae: 7.0330 - mse: 84.4308 - rmse: 9.1801 - val_loss: 168.1853 -
val_mae: 9.7914 - val_mse: 167.9836 - val_rmse: 12.9608
Epoch 116/300
```

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18/18            0s 10ms/step -
loss: 101.0940 - mae: 7.8352 - mse: 100.8924 - rmse: 10.0189 - val_loss:
165.7655 - val_mae: 9.6971 - val_mse: 165.5638 - val_rmse: 12.8672
Epoch 117/300
18/18            0s 13ms/step -
loss: 79.0226 - mae: 6.6845 - mse: 78.8211 - rmse: 8.8386 - val_loss: 165.7518 -
val_mae: 9.7598 - val_mse: 165.5499 - val_rmse: 12.8666
Epoch 118/300
18/18            0s 9ms/step - loss:
93.4112 - mae: 7.3061 - mse: 93.2092 - rmse: 9.6305 - val_loss: 165.3763 -
val_mae: 9.7108 - val_mse: 165.1739 - val_rmse: 12.8520
Epoch 119/300
18/18            0s 13ms/step -
loss: 96.0661 - mae: 7.3557 - mse: 95.8638 - rmse: 9.7731 - val_loss: 164.1408 -
val_mae: 9.6628 - val_mse: 163.9383 - val_rmse: 12.8038
Epoch 120/300
18/18            0s 9ms/step - loss:
92.5374 - mae: 7.3230 - mse: 92.3347 - rmse: 9.6008 - val_loss: 165.1571 -
val_mae: 9.6828 - val_mse: 164.9542 - val_rmse: 12.8435
Epoch 121/300
18/18            0s 13ms/step -
loss: 83.2802 - mae: 6.7603 - mse: 83.0772 - rmse: 9.1114 - val_loss: 163.7046 -
val_mae: 9.6522 - val_mse: 163.5014 - val_rmse: 12.7868
Epoch 122/300
18/18            0s 10ms/step -
loss: 83.3359 - mae: 6.5888 - mse: 83.1329 - rmse: 9.1135 - val_loss: 164.0029 -
val_mae: 9.6571 - val_mse: 163.7995 - val_rmse: 12.7984
Epoch 123/300
18/18            0s 10ms/step -
loss: 73.0156 - mae: 6.3815 - mse: 72.8122 - rmse: 8.4803 - val_loss: 164.3026 -
val_mae: 9.6661 - val_mse: 164.0988 - val_rmse: 12.8101
Epoch 124/300
18/18            0s 14ms/step -
loss: 85.8120 - mae: 7.0310 - mse: 85.6082 - rmse: 9.2506 - val_loss: 164.3576 -
val_mae: 9.6639 - val_mse: 164.1536 - val_rmse: 12.8122
Epoch 125/300
18/18            0s 13ms/step -
loss: 84.1066 - mae: 6.8515 - mse: 83.9026 - rmse: 9.1543 - val_loss: 163.2983 -
val_mae: 9.6103 - val_mse: 163.0940 - val_rmse: 12.7708
Epoch 126/300
18/18            0s 9ms/step - loss:
75.9108 - mae: 6.5250 - mse: 75.7064 - rmse: 8.6480 - val_loss: 164.3690 -
val_mae: 9.6429 - val_mse: 164.1643 - val_rmse: 12.8127
Epoch 127/300
18/18            0s 13ms/step -
loss: 87.5625 - mae: 6.9667 - mse: 87.3579 - rmse: 9.3369 - val_loss: 163.9427 -
val_mae: 9.6659 - val_mse: 163.7382 - val_rmse: 12.7960
Epoch 128/300
```

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18/18            0s 14ms/step -
loss: 70.7810 - mae: 6.3193 - mse: 70.5764 - rmse: 8.3644 - val_loss: 162.6536 -
val_mae: 9.5768 - val_mse: 162.4487 - val_rmse: 12.7455
Epoch 129/300
18/18            0s 16ms/step -
loss: 81.2147 - mae: 6.6199 - mse: 81.0098 - rmse: 8.9865 - val_loss: 163.3046 -
val_mae: 9.6026 - val_mse: 163.0995 - val_rmse: 12.7710
Epoch 130/300
18/18            1s 16ms/step -
loss: 96.8391 - mae: 7.3771 - mse: 96.6339 - rmse: 9.7949 - val_loss: 162.9889 -
val_mae: 9.5559 - val_mse: 162.7833 - val_rmse: 12.7587
Epoch 131/300
18/18            1s 17ms/step -
loss: 75.2744 - mae: 6.4533 - mse: 75.0690 - rmse: 8.6558 - val_loss: 163.5366 -
val_mae: 9.6463 - val_mse: 163.3311 - val_rmse: 12.7801
Epoch 132/300
18/18            1s 13ms/step -
loss: 79.4909 - mae: 6.6553 - mse: 79.2851 - rmse: 8.8778 - val_loss: 162.2951 -
val_mae: 9.5609 - val_mse: 162.0892 - val_rmse: 12.7314
Epoch 133/300
18/18            0s 9ms/step - loss:
77.3228 - mae: 6.5763 - mse: 77.1169 - rmse: 8.7548 - val_loss: 161.0347 -
val_mae: 9.5140 - val_mse: 160.8286 - val_rmse: 12.6818
Epoch 134/300
18/18            0s 9ms/step - loss:
90.4673 - mae: 7.0885 - mse: 90.2610 - rmse: 9.4672 - val_loss: 162.9503 -
val_mae: 9.6181 - val_mse: 162.7439 - val_rmse: 12.7571
Epoch 135/300
18/18            0s 13ms/step -
loss: 86.5345 - mae: 6.9963 - mse: 86.3279 - rmse: 9.2859 - val_loss: 161.6546 -
val_mae: 9.5391 - val_mse: 161.4480 - val_rmse: 12.7062
Epoch 136/300
18/18            0s 13ms/step -
loss: 85.6246 - mae: 6.9477 - mse: 85.4179 - rmse: 9.2124 - val_loss: 162.9382 -
val_mae: 9.5667 - val_mse: 162.7312 - val_rmse: 12.7566
Epoch 137/300
18/18            0s 13ms/step -
loss: 97.2779 - mae: 7.4362 - mse: 97.0708 - rmse: 9.8289 - val_loss: 162.3448 -
val_mae: 9.5567 - val_mse: 162.1375 - val_rmse: 12.7333
Epoch 138/300
18/18            0s 9ms/step - loss:
81.0592 - mae: 6.7447 - mse: 80.8518 - rmse: 8.9875 - val_loss: 161.2184 -
val_mae: 9.4362 - val_mse: 161.0109 - val_rmse: 12.6890
Epoch 139/300
18/18            0s 10ms/step -
loss: 77.9364 - mae: 6.6262 - mse: 77.7290 - rmse: 8.8059 - val_loss: 161.5517 -
val_mae: 9.5332 - val_mse: 161.3441 - val_rmse: 12.7021
Epoch 140/300
```

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18/18            0s 9ms/step - loss:
84.9666 - mae: 7.0301 - mse: 84.7589 - rmse: 9.1992 - val_loss: 162.2511 -
val_mae: 9.5051 - val_mse: 162.0431 - val_rmse: 12.7296
Epoch 141/300
18/18            0s 9ms/step - loss:
77.3477 - mae: 6.4055 - mse: 77.1396 - rmse: 8.7714 - val_loss: 162.5208 -
val_mae: 9.5630 - val_mse: 162.3126 - val_rmse: 12.7402
Epoch 142/300
18/18            0s 13ms/step -
loss: 77.6195 - mae: 6.6586 - mse: 77.4113 - rmse: 8.7902 - val_loss: 160.4764 -
val_mae: 9.4847 - val_mse: 160.2680 - val_rmse: 12.6597
Epoch 143/300
18/18            0s 14ms/step -
loss: 94.8318 - mae: 7.2772 - mse: 94.6233 - rmse: 9.6386 - val_loss: 161.2407 -
val_mae: 9.4929 - val_mse: 161.0318 - val_rmse: 12.6898
Epoch 144/300
18/18            0s 13ms/step -
loss: 88.4249 - mae: 7.0659 - mse: 88.2159 - rmse: 9.3849 - val_loss: 162.4213 -
val_mae: 9.4890 - val_mse: 162.2120 - val_rmse: 12.7362
Epoch 145/300
18/18            0s 10ms/step -
loss: 76.9316 - mae: 6.6316 - mse: 76.7223 - rmse: 8.7473 - val_loss: 162.7881 -
val_mae: 9.6644 - val_mse: 162.5791 - val_rmse: 12.7506
Epoch 146/300
18/18            0s 10ms/step -
loss: 81.5553 - mae: 6.8719 - mse: 81.3462 - rmse: 9.0085 - val_loss: 161.1484 -
val_mae: 9.4200 - val_mse: 160.9386 - val_rmse: 12.6862
Epoch 147/300
18/18            0s 10ms/step -
loss: 76.5193 - mae: 6.5050 - mse: 76.3094 - rmse: 8.6928 - val_loss: 161.7029 -
val_mae: 9.5679 - val_mse: 161.4930 - val_rmse: 12.7080
Epoch 148/300
18/18            0s 9ms/step - loss:
67.4522 - mae: 6.3608 - mse: 67.2421 - rmse: 8.1868 - val_loss: 160.9597 -
val_mae: 9.4989 - val_mse: 160.7495 - val_rmse: 12.6787
Epoch 149/300
18/18            0s 9ms/step - loss:
75.4992 - mae: 6.7262 - mse: 75.2891 - rmse: 8.6695 - val_loss: 161.2225 -
val_mae: 9.4733 - val_mse: 161.0118 - val_rmse: 12.6890
Epoch 150/300
18/18            0s 13ms/step -
loss: 74.4279 - mae: 6.5061 - mse: 74.2171 - rmse: 8.6090 - val_loss: 159.2077 -
val_mae: 9.3946 - val_mse: 158.9967 - val_rmse: 12.6094
Epoch 151/300
18/18            0s 14ms/step -
loss: 78.2955 - mae: 6.5974 - mse: 78.0845 - rmse: 8.8276 - val_loss: 160.9981 -
val_mae: 9.5438 - val_mse: 160.7872 - val_rmse: 12.6802
Epoch 152/300
```

```
18/18            0s 9ms/step - loss:
86.1358 - mae: 6.8745 - mse: 85.9247 - rmse: 9.2463 - val_loss: 162.2075 -
val_mae: 9.4296 - val_mse: 161.9957 - val_rmse: 12.7278
Epoch 153/300
18/18            0s 13ms/step -
loss: 75.3496 - mae: 6.7311 - mse: 75.1380 - rmse: 8.6498 - val_loss: 160.3292 -
val_mae: 9.4725 - val_mse: 160.1175 - val_rmse: 12.6538
Epoch 154/300
18/18            0s 13ms/step -
loss: 66.6669 - mae: 6.0790 - mse: 66.4551 - rmse: 8.0621 - val_loss: 160.2307 -
val_mae: 9.4146 - val_mse: 160.0186 - val_rmse: 12.6498
Epoch 155/300
18/18            0s 9ms/step - loss:
81.1157 - mae: 6.6668 - mse: 80.9035 - rmse: 8.9849 - val_loss: 160.5666 -
val_mae: 9.4623 - val_mse: 160.3544 - val_rmse: 12.6631
Epoch 156/300
18/18            0s 9ms/step - loss:
73.0613 - mae: 6.3767 - mse: 72.8490 - rmse: 8.5313 - val_loss: 159.5750 -
val_mae: 9.4269 - val_mse: 159.3625 - val_rmse: 12.6239
Epoch 157/300
18/18            0s 10ms/step -
loss: 67.6527 - mae: 6.1690 - mse: 67.4400 - rmse: 8.2054 - val_loss: 160.1657 -
val_mae: 9.4118 - val_mse: 159.9528 - val_rmse: 12.6472
Epoch 158/300
18/18            0s 10ms/step -
loss: 85.4811 - mae: 6.8800 - mse: 85.2682 - rmse: 9.2145 - val_loss: 159.6115 -
val_mae: 9.3817 - val_mse: 159.3983 - val_rmse: 12.6253
Epoch 159/300
18/18            0s 9ms/step - loss:
80.2201 - mae: 6.5648 - mse: 80.0069 - rmse: 8.9346 - val_loss: 159.6562 -
val_mae: 9.3596 - val_mse: 159.4426 - val_rmse: 12.6271
Epoch 160/300
18/18            0s 10ms/step -
loss: 71.1580 - mae: 6.2622 - mse: 70.9445 - rmse: 8.4164 - val_loss: 159.6889 -
val_mae: 9.4318 - val_mse: 159.4752 - val_rmse: 12.6283
Epoch 161/300
18/18            0s 9ms/step - loss:
65.9192 - mae: 6.0288 - mse: 65.7054 - rmse: 8.0427 - val_loss: 158.3711 -
val_mae: 9.4036 - val_mse: 158.1571 - val_rmse: 12.5761
Epoch 162/300
18/18            0s 9ms/step - loss:
79.7939 - mae: 6.5506 - mse: 79.5799 - rmse: 8.8881 - val_loss: 160.1011 -
val_mae: 9.3543 - val_mse: 159.8865 - val_rmse: 12.6446
Epoch 163/300
18/18            0s 13ms/step -
loss: 74.9483 - mae: 6.5991 - mse: 74.7336 - rmse: 8.5993 - val_loss: 159.1757 -
val_mae: 9.3853 - val_mse: 158.9609 - val_rmse: 12.6080
Epoch 164/300
```

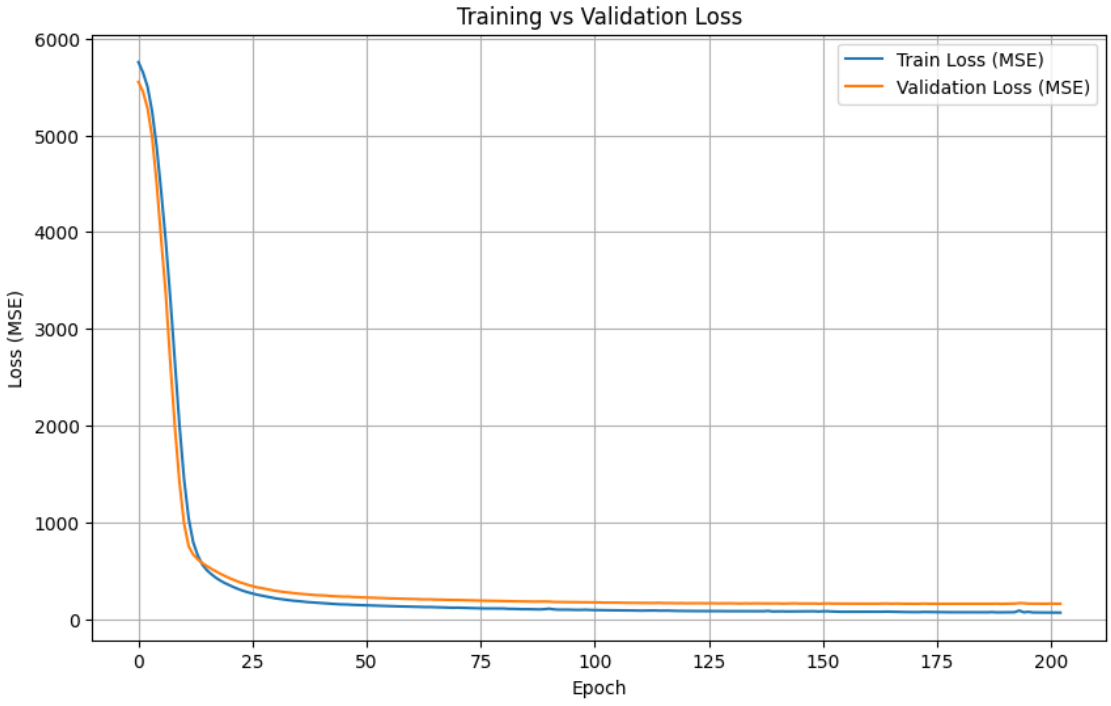
```
18/18            0s 13ms/step -
loss: 71.5456 - mae: 6.3161 - mse: 71.3307 - rmse: 8.4119 - val_loss: 160.9612 -
val_mae: 9.5410 - val_mse: 160.7462 - val_rmse: 12.6786
Epoch 165/300
18/18            0s 9ms/step - loss:
76.4397 - mae: 6.6027 - mse: 76.2245 - rmse: 8.7276 - val_loss: 161.2210 -
val_mae: 9.3641 - val_mse: 161.0054 - val_rmse: 12.6888
Epoch 166/300
18/18            0s 9ms/step - loss:
72.1129 - mae: 6.3292 - mse: 71.8973 - rmse: 8.4602 - val_loss: 159.4014 -
val_mae: 9.4946 - val_mse: 159.1861 - val_rmse: 12.6169
Epoch 167/300
18/18            0s 9ms/step - loss:
79.4691 - mae: 6.8283 - mse: 79.2533 - rmse: 8.8767 - val_loss: 160.6737 -
val_mae: 9.3791 - val_mse: 160.4575 - val_rmse: 12.6672
Epoch 168/300
18/18            0s 9ms/step - loss:
85.2117 - mae: 7.0512 - mse: 84.9956 - rmse: 9.1995 - val_loss: 159.1472 -
val_mae: 9.3981 - val_mse: 158.9308 - val_rmse: 12.6068
Epoch 169/300
18/18            0s 14ms/step -
loss: 66.8397 - mae: 6.0833 - mse: 66.6232 - rmse: 8.1305 - val_loss: 158.8061 -
val_mae: 9.4217 - val_mse: 158.5894 - val_rmse: 12.5932
Epoch 170/300
18/18            0s 16ms/step -
loss: 73.2315 - mae: 6.5305 - mse: 73.0147 - rmse: 8.5297 - val_loss: 159.3628 -
val_mae: 9.3983 - val_mse: 159.1457 - val_rmse: 12.6153
Epoch 171/300
18/18            1s 16ms/step -
loss: 73.2156 - mae: 6.3037 - mse: 72.9985 - rmse: 8.5177 - val_loss: 158.4177 -
val_mae: 9.3437 - val_mse: 158.2002 - val_rmse: 12.5778
Epoch 172/300
18/18            1s 16ms/step -
loss: 66.3695 - mae: 5.9308 - mse: 66.1521 - rmse: 8.0955 - val_loss: 158.6074 -
val_mae: 9.3252 - val_mse: 158.3895 - val_rmse: 12.5853
Epoch 173/300
18/18            0s 16ms/step -
loss: 70.7958 - mae: 6.1594 - mse: 70.5778 - rmse: 8.3852 - val_loss: 160.5193 -
val_mae: 9.5134 - val_mse: 160.3014 - val_rmse: 12.6610
Epoch 174/300
18/18            0s 11ms/step -
loss: 68.7798 - mae: 6.2900 - mse: 68.5618 - rmse: 8.2656 - val_loss: 159.0390 -
val_mae: 9.2875 - val_mse: 158.8203 - val_rmse: 12.6024
Epoch 175/300
18/18            0s 10ms/step -
loss: 72.0452 - mae: 6.3271 - mse: 71.8264 - rmse: 8.4548 - val_loss: 159.4760 -
val_mae: 9.3973 - val_mse: 159.2570 - val_rmse: 12.6197
Epoch 176/300
```

```
18/18            0s 9ms/step - loss:
66.8533 - mae: 6.0677 - mse: 66.6343 - rmse: 8.1546 - val_loss: 158.4422 -
val_mae: 9.3477 - val_mse: 158.2229 - val_rmse: 12.5787
Epoch 177/300
18/18            0s 13ms/step -
loss: 67.5008 - mae: 6.1219 - mse: 67.2816 - rmse: 8.1843 - val_loss: 158.4025 -
val_mae: 9.3486 - val_mse: 158.1830 - val_rmse: 12.5771
Epoch 178/300
18/18            0s 14ms/step -
loss: 64.0327 - mae: 5.7318 - mse: 63.8130 - rmse: 7.9652 - val_loss: 158.3135 -
val_mae: 9.3377 - val_mse: 158.0935 - val_rmse: 12.5735
Epoch 179/300
18/18            0s 10ms/step -
loss: 73.6844 - mae: 6.4804 - mse: 73.4643 - rmse: 8.5656 - val_loss: 158.8595 -
val_mae: 9.3235 - val_mse: 158.6391 - val_rmse: 12.5952
Epoch 180/300
18/18            0s 9ms/step - loss:
73.7943 - mae: 6.2739 - mse: 73.5740 - rmse: 8.5546 - val_loss: 158.4613 -
val_mae: 9.3082 - val_mse: 158.2405 - val_rmse: 12.5794
Epoch 181/300
18/18            0s 13ms/step -
loss: 80.5477 - mae: 6.4422 - mse: 80.3267 - rmse: 8.9483 - val_loss: 159.2160 -
val_mae: 9.3433 - val_mse: 158.9948 - val_rmse: 12.6093
Epoch 182/300
18/18            0s 11ms/step -
loss: 62.2681 - mae: 5.8297 - mse: 62.0468 - rmse: 7.8554 - val_loss: 159.2273 -
val_mae: 9.4004 - val_mse: 159.0059 - val_rmse: 12.6098
Epoch 183/300
18/18            0s 10ms/step -
loss: 62.8913 - mae: 5.9624 - mse: 62.6698 - rmse: 7.8792 - val_loss: 157.8533 -
val_mae: 9.3145 - val_mse: 157.6315 - val_rmse: 12.5551
Epoch 184/300
18/18            0s 10ms/step -
loss: 71.7334 - mae: 6.5737 - mse: 71.5115 - rmse: 8.4377 - val_loss: 159.1556 -
val_mae: 9.4228 - val_mse: 158.9336 - val_rmse: 12.6069
Epoch 185/300
18/18            0s 14ms/step -
loss: 77.0734 - mae: 6.5899 - mse: 76.8511 - rmse: 8.7576 - val_loss: 158.4113 -
val_mae: 9.3407 - val_mse: 158.1888 - val_rmse: 12.5773
Epoch 186/300
18/18            0s 13ms/step -
loss: 70.1732 - mae: 6.0500 - mse: 69.9506 - rmse: 8.3336 - val_loss: 159.2962 -
val_mae: 9.3375 - val_mse: 159.0733 - val_rmse: 12.6124
Epoch 187/300
18/18            0s 9ms/step - loss:
70.0506 - mae: 6.1257 - mse: 69.8278 - rmse: 8.3256 - val_loss: 159.0659 -
val_mae: 9.3081 - val_mse: 158.8426 - val_rmse: 12.6033
Epoch 188/300
```

```
18/18            0s 9ms/step - loss:
81.0837 - mae: 6.4600 - mse: 80.8601 - rmse: 8.9103 - val_loss: 158.8046 -
val_mae: 9.3348 - val_mse: 158.5807 - val_rmse: 12.5929
Epoch 189/300
18/18            0s 9ms/step - loss:
75.0781 - mae: 6.3447 - mse: 74.8540 - rmse: 8.6094 - val_loss: 159.7326 -
val_mae: 9.3611 - val_mse: 159.5084 - val_rmse: 12.6297
Epoch 190/300
18/18            0s 10ms/step -
loss: 72.8252 - mae: 6.2519 - mse: 72.6009 - rmse: 8.5096 - val_loss: 157.8989 -
val_mae: 9.3326 - val_mse: 157.6744 - val_rmse: 12.5568
Epoch 191/300
18/18            0s 9ms/step - loss:
79.0999 - mae: 6.6772 - mse: 78.8753 - rmse: 8.8738 - val_loss: 158.3473 -
val_mae: 9.3147 - val_mse: 158.1224 - val_rmse: 12.5747
Epoch 192/300
18/18            0s 14ms/step -
loss: 74.2348 - mae: 6.4213 - mse: 74.0098 - rmse: 8.5862 - val_loss: 159.4773 -
val_mae: 9.3400 - val_mse: 159.2519 - val_rmse: 12.6195
Epoch 193/300
18/18            0s 13ms/step -
loss: 74.1005 - mae: 6.2858 - mse: 73.8751 - rmse: 8.5848 - val_loss: 160.4350 -
val_mae: 9.2236 - val_mse: 160.2091 - val_rmse: 12.6574
Epoch 194/300
18/18            0s 13ms/step -
loss: 80.2076 - mae: 6.4719 - mse: 79.9818 - rmse: 8.9329 - val_loss: 165.5849 -
val_mae: 9.6528 - val_mse: 165.3588 - val_rmse: 12.8592
Epoch 195/300
18/18            0s 9ms/step - loss:
83.6973 - mae: 6.5625 - mse: 83.4708 - rmse: 9.1078 - val_loss: 164.0247 -
val_mae: 9.3195 - val_mse: 163.7977 - val_rmse: 12.7983
Epoch 196/300
18/18            0s 9ms/step - loss:
91.0614 - mae: 6.8703 - mse: 90.8346 - rmse: 9.5059 - val_loss: 160.0815 -
val_mae: 9.4496 - val_mse: 159.8548 - val_rmse: 12.6434
Epoch 197/300
18/18            0s 13ms/step -
loss: 66.9999 - mae: 6.0001 - mse: 66.7729 - rmse: 8.1482 - val_loss: 159.8501 -
val_mae: 9.2917 - val_mse: 159.6228 - val_rmse: 12.6342
Epoch 198/300
18/18            0s 10ms/step -
loss: 72.4200 - mae: 6.1510 - mse: 72.1927 - rmse: 8.4796 - val_loss: 159.4889 -
val_mae: 9.2593 - val_mse: 159.2611 - val_rmse: 12.6199
Epoch 199/300
18/18            0s 10ms/step -
loss: 69.1830 - mae: 6.3239 - mse: 68.9551 - rmse: 8.2992 - val_loss: 160.2101 -
val_mae: 9.3621 - val_mse: 159.9820 - val_rmse: 12.6484
Epoch 200/300
```

```
18/18             0s 13ms/step -
loss: 60.4349 - mae: 5.7098 - mse: 60.2066 - rmse: 7.7452 - val_loss: 158.5045 -
val_mae: 9.3177 - val_mse: 158.2761 - val_rmse: 12.5808
Epoch 201/300
18/18             0s 9ms/step - loss:
63.8294 - mae: 6.0140 - mse: 63.6010 - rmse: 7.9713 - val_loss: 160.8290 -
val_mae: 9.2783 - val_mse: 160.5999 - val_rmse: 12.6728
Epoch 202/300
18/18             0s 13ms/step -
loss: 63.3056 - mae: 5.8553 - mse: 63.0765 - rmse: 7.9144 - val_loss: 158.9485 -
val_mae: 9.3253 - val_mse: 158.7193 - val_rmse: 12.5984
Epoch 203/300
18/18             0s 13ms/step -
loss: 71.0786 - mae: 6.1468 - mse: 70.8491 - rmse: 8.3808 - val_loss: 158.9442 -
val_mae: 9.3380 - val_mse: 158.7146 - val_rmse: 12.5982
```

[209]:
```
# Plot loss
plt.figure(figsize=(10, 6))
plt.plot(history.history['loss'], label='Train Loss (MSE)')
plt.plot(history.history['val_loss'], label='Validation Loss (MSE)')
plt.title('Training vs Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss (MSE)')
plt.legend()
plt.grid(True)
plt.show()
```



6.1.4 R2 Model Sequential

[210]:
```
# show R2
y_pred = modify_model_sequential.predict(X_test)
r2_score(y_test, y_pred)
```

```
12/12             0s 7ms/step
```

[210]:
```
0.3723925688391976
```

6.2 Functional Model

6.2.1 Configure Model Neuron, Activation Layer

[211]:
```
input = layers.Input(shape=(n,))
x = Dense(n*4, activation='relu', kernel_regularizer=regularizers.l2(0.
 ↪001))(input)
x = Dense(n*4, activation='relu', kernel_regularizer=regularizers.l2(0.001))(x)
x = Dense(n*4, activation='relu', kernel_regularizer=regularizers.l2(0.001))(x)
x = Dense(n*4, activation='relu', kernel_regularizer=regularizers.l2(0.001))(x)
output = Dense(1)(x)

modify_model_functional = Model(inputs=input, outputs=output)
```

6.2.2 Compile and evaluation

[212]:
```
optimizer = keras.optimizers.Adam(learning_rate=0.0005)

# compile model
modify_model_functional.compile(
    optimizer=optimizer, #cara model belajar
    loss='mse', #semakin rendah makin bagus
    metrics=['mae', 'mse', RootMeanSquaredError(name = 'rmse')] #semakin rendah␣
 ↪makin bagus
)
modify_model_functional.summary()
```

```
Model: "functional_12"
```

Layer (type)	Output Shape	Param #
input_layer_13 (InputLayer)	(None, 17)	0

```
 dense_50 (Dense)                (None, 68)                1,224

 dense_51 (Dense)                (None, 68)                4,692

 dense_52 (Dense)                (None, 68)                4,692

 dense_53 (Dense)                (None, 68)                4,692

 dense_54 (Dense)                (None, 1)                    69


 Total params: 15,369 (60.04 KB)

 Trainable params: 15,369 (60.04 KB)

 Non-trainable params: 0 (0.00 B)
```

6.2.3 Fit Model Functional

[213]:
```
callbacks = EarlyStopping(monitor='val_loss',
                          patience=20,
                          restore_best_weights=True)

history = modify_model_functional.fit(
    X_train, y_train,
    validation_data=(X_cv, y_cv),
    epochs=300,
    callbacks=[callbacks],
    batch_size=16,
    verbose=1
)
```

```
Epoch 1/300
18/18             4s 87ms/step -
loss: 5745.7656 - mae: 73.6576 - mse: 5745.5386 - rmse: 75.7969 - val_loss:
5511.7808 - val_mae: 72.1238 - val_mse: 5511.5552 - val_rmse: 74.2398
Epoch 2/300
18/18             1s 10ms/step -
loss: 5394.2905 - mae: 71.2965 - mse: 5394.0649 - rmse: 73.4357 - val_loss:
5229.9194 - val_mae: 70.0652 - val_mse: 5229.6919 - val_rmse: 72.3166
Epoch 3/300
18/18             0s 11ms/step -
loss: 5309.6055 - mae: 70.3906 - mse: 5309.3784 - rmse: 72.8470 - val_loss:
4530.1445 - val_mae: 64.7616 - val_mse: 4529.9150 - val_rmse: 67.3046
Epoch 4/300
```

```
18/18            0s 10ms/step -
loss: 4611.1235 - mae: 64.5340 - mse: 4610.8936 - rmse: 67.8959 - val_loss:
3681.5613 - val_mae: 57.8044 - val_mse: 3681.3301 - val_rmse: 60.6740
Epoch 5/300
18/18            0s 10ms/step -
loss: 3832.4014 - mae: 57.4060 - mse: 3832.1694 - rmse: 61.8247 - val_loss:
3078.5330 - val_mae: 52.0816 - val_mse: 3078.2983 - val_rmse: 55.4824
Epoch 6/300
18/18            0s 14ms/step -
loss: 3433.3088 - mae: 53.5980 - mse: 3433.0740 - rmse: 58.5329 - val_loss:
2178.2734 - val_mae: 42.5278 - val_mse: 2178.0356 - val_rmse: 46.6694
Epoch 7/300
18/18            0s 10ms/step -
loss: 2762.5193 - mae: 44.9094 - mse: 2762.2803 - rmse: 52.4317 - val_loss:
1430.0265 - val_mae: 33.4545 - val_mse: 1429.7842 - val_rmse: 37.8125
Epoch 8/300
18/18            0s 10ms/step -
loss: 1750.0839 - mae: 33.4243 - mse: 1749.8403 - rmse: 41.7152 - val_loss:
888.4463 - val_mae: 25.8579 - val_mse: 888.1989 - val_rmse: 29.8027
Epoch 9/300
18/18            0s 10ms/step -
loss: 915.6025 - mae: 25.1791 - mse: 915.3541 - rmse: 30.2182 - val_loss:
754.7855 - val_mae: 22.6864 - val_mse: 754.5357 - val_rmse: 27.4688
Epoch 10/300
18/18            0s 13ms/step -
loss: 633.7397 - mae: 20.9205 - mse: 633.4899 - rmse: 25.1432 - val_loss:
678.7816 - val_mae: 21.5454 - val_mse: 678.5316 - val_rmse: 26.0486
Epoch 11/300
18/18            0s 10ms/step -
loss: 678.4366 - mae: 21.8211 - mse: 678.1868 - rmse: 26.0161 - val_loss:
616.0432 - val_mae: 20.3457 - val_mse: 615.7930 - val_rmse: 24.8152
Epoch 12/300
18/18            0s 10ms/step -
loss: 568.3005 - mae: 19.6133 - mse: 568.0501 - rmse: 23.8193 - val_loss:
555.8604 - val_mae: 19.0086 - val_mse: 555.6096 - val_rmse: 23.5714
Epoch 13/300
18/18            0s 10ms/step -
loss: 443.2333 - mae: 17.3427 - mse: 442.9825 - rmse: 21.0155 - val_loss:
500.4153 - val_mae: 18.0245 - val_mse: 500.1646 - val_rmse: 22.3644
Epoch 14/300
18/18            0s 15ms/step -
loss: 434.3522 - mae: 16.8990 - mse: 434.1013 - rmse: 20.8055 - val_loss:
456.2035 - val_mae: 17.0633 - val_mse: 455.9526 - val_rmse: 21.3530
Epoch 15/300
18/18            0s 10ms/step -
loss: 424.6801 - mae: 17.0072 - mse: 424.4293 - rmse: 20.5405 - val_loss:
418.6459 - val_mae: 16.2535 - val_mse: 418.3949 - val_rmse: 20.4547
Epoch 16/300
```

```
18/18            0s 14ms/step -
loss: 309.2010 - mae: 13.9951 - mse: 308.9498 - rmse: 17.5733 - val_loss:
384.1962 - val_mae: 15.4077 - val_mse: 383.9449 - val_rmse: 19.5945
Epoch 17/300
18/18            0s 10ms/step -
loss: 330.1353 - mae: 14.4146 - mse: 329.8839 - rmse: 18.1132 - val_loss:
357.3861 - val_mae: 14.7774 - val_mse: 357.1346 - val_rmse: 18.8980
Epoch 18/300
18/18            0s 10ms/step -
loss: 254.3587 - mae: 12.8419 - mse: 254.1070 - rmse: 15.9270 - val_loss:
333.5528 - val_mae: 14.1226 - val_mse: 333.3008 - val_rmse: 18.2565
Epoch 19/300
18/18            0s 14ms/step -
loss: 222.8403 - mae: 12.0176 - mse: 222.5883 - rmse: 14.9130 - val_loss:
311.0490 - val_mae: 13.5153 - val_mse: 310.7967 - val_rmse: 17.6294
Epoch 20/300
18/18            0s 10ms/step -
loss: 201.1799 - mae: 11.2038 - mse: 200.9277 - rmse: 14.1606 - val_loss:
296.5837 - val_mae: 13.3127 - val_mse: 296.3315 - val_rmse: 17.2143
Epoch 21/300
18/18            0s 14ms/step -
loss: 210.8712 - mae: 11.1632 - mse: 210.6187 - rmse: 14.4964 - val_loss:
283.6966 - val_mae: 12.8188 - val_mse: 283.4438 - val_rmse: 16.8358
Epoch 22/300
18/18            0s 10ms/step -
loss: 182.1154 - mae: 10.2257 - mse: 181.8628 - rmse: 13.4779 - val_loss:
270.3269 - val_mae: 12.5106 - val_mse: 270.0740 - val_rmse: 16.4339
Epoch 23/300
18/18            0s 10ms/step -
loss: 139.4092 - mae: 8.9007 - mse: 139.1562 - rmse: 11.6959 - val_loss:
261.2292 - val_mae: 12.2622 - val_mse: 260.9760 - val_rmse: 16.1548
Epoch 24/300
18/18            0s 10ms/step -
loss: 181.6650 - mae: 10.4668 - mse: 181.4118 - rmse: 13.4553 - val_loss:
251.2093 - val_mae: 12.0919 - val_mse: 250.9559 - val_rmse: 15.8416
Epoch 25/300
18/18            0s 14ms/step -
loss: 161.7153 - mae: 9.8779 - mse: 161.4619 - rmse: 12.7023 - val_loss:
245.6870 - val_mae: 11.9429 - val_mse: 245.4334 - val_rmse: 15.6663
Epoch 26/300
18/18            0s 10ms/step -
loss: 158.6436 - mae: 9.7296 - mse: 158.3899 - rmse: 12.5730 - val_loss:
238.9330 - val_mae: 11.8184 - val_mse: 238.6792 - val_rmse: 15.4492
Epoch 27/300
18/18            0s 10ms/step -
loss: 155.9995 - mae: 9.5079 - mse: 155.7457 - rmse: 12.4729 - val_loss:
234.7100 - val_mae: 11.6715 - val_mse: 234.4561 - val_rmse: 15.3120
Epoch 28/300
```

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18/18            0s 14ms/step -
loss: 173.8117 - mae: 9.9790 - mse: 173.5578 - rmse: 13.1008 - val_loss:
231.2225 - val_mae: 11.5432 - val_mse: 230.9682 - val_rmse: 15.1976
Epoch 29/300
18/18            0s 14ms/step -
loss: 168.2586 - mae: 9.7296 - mse: 168.0043 - rmse: 12.9412 - val_loss:
226.1137 - val_mae: 11.4413 - val_mse: 225.8593 - val_rmse: 15.0286
Epoch 30/300
18/18            0s 10ms/step -
loss: 121.7717 - mae: 8.4166 - mse: 121.5173 - rmse: 10.9944 - val_loss:
221.9490 - val_mae: 11.4700 - val_mse: 221.6947 - val_rmse: 14.8894
Epoch 31/300
18/18            0s 10ms/step -
loss: 145.4064 - mae: 9.2237 - mse: 145.1521 - rmse: 12.0383 - val_loss:
220.9558 - val_mae: 11.3062 - val_mse: 220.7013 - val_rmse: 14.8560
Epoch 32/300
18/18            0s 10ms/step -
loss: 132.7892 - mae: 8.8970 - mse: 132.5347 - rmse: 11.5062 - val_loss:
216.8958 - val_mae: 11.3090 - val_mse: 216.6413 - val_rmse: 14.7187
Epoch 33/300
18/18            0s 14ms/step -
loss: 139.3978 - mae: 9.0779 - mse: 139.1432 - rmse: 11.7710 - val_loss:
214.4562 - val_mae: 11.1728 - val_mse: 214.2016 - val_rmse: 14.6356
Epoch 34/300
18/18            0s 10ms/step -
loss: 135.1940 - mae: 8.8105 - mse: 134.9394 - rmse: 11.5912 - val_loss:
210.5193 - val_mae: 11.1318 - val_mse: 210.2645 - val_rmse: 14.5005
Epoch 35/300
18/18            0s 10ms/step -
loss: 135.6507 - mae: 8.7241 - mse: 135.3958 - rmse: 11.6227 - val_loss:
210.3315 - val_mae: 11.1037 - val_mse: 210.0766 - val_rmse: 14.4940
Epoch 36/300
18/18            0s 14ms/step -
loss: 120.7654 - mae: 8.4629 - mse: 120.5105 - rmse: 10.9634 - val_loss:
205.7893 - val_mae: 10.9867 - val_mse: 205.5344 - val_rmse: 14.3365
Epoch 37/300
18/18            0s 18ms/step -
loss: 111.0190 - mae: 7.9952 - mse: 110.7641 - rmse: 10.4923 - val_loss:
204.6641 - val_mae: 10.9341 - val_mse: 204.4092 - val_rmse: 14.2972
Epoch 38/300
18/18            1s 17ms/step -
loss: 116.3256 - mae: 8.0750 - mse: 116.0706 - rmse: 10.7594 - val_loss:
203.6991 - val_mae: 10.8387 - val_mse: 203.4437 - val_rmse: 14.2634
Epoch 39/300
18/18            1s 17ms/step -
loss: 105.9973 - mae: 7.5768 - mse: 105.7420 - rmse: 10.2710 - val_loss:
202.0196 - val_mae: 10.7731 - val_mse: 201.7642 - val_rmse: 14.2044
Epoch 40/300
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18/18            1s 14ms/step -
loss: 116.6262 - mae: 8.1806 - mse: 116.3708 - rmse: 10.7745 - val_loss:
199.8266 - val_mae: 10.7702 - val_mse: 199.5712 - val_rmse: 14.1270
Epoch 41/300
18/18            0s 11ms/step -
loss: 100.6079 - mae: 7.7010 - mse: 100.3523 - rmse: 9.9992 - val_loss: 199.8812
- val_mae: 11.0159 - val_mse: 199.6260 - val_rmse: 14.1289
Epoch 42/300
18/18            0s 14ms/step -
loss: 108.1521 - mae: 7.9142 - mse: 107.8968 - rmse: 10.3790 - val_loss:
198.5253 - val_mae: 10.5734 - val_mse: 198.2695 - val_rmse: 14.0808
Epoch 43/300
18/18            0s 14ms/step -
loss: 104.5937 - mae: 7.6297 - mse: 104.3379 - rmse: 10.1658 - val_loss:
195.3530 - val_mae: 10.7814 - val_mse: 195.0975 - val_rmse: 13.9677
Epoch 44/300
18/18            0s 10ms/step -
loss: 109.1032 - mae: 7.8443 - mse: 108.8476 - rmse: 10.4256 - val_loss:
193.4635 - val_mae: 10.5083 - val_mse: 193.2077 - val_rmse: 13.8999
Epoch 45/300
18/18            0s 10ms/step -
loss: 109.6051 - mae: 7.7580 - mse: 109.3494 - rmse: 10.4374 - val_loss:
191.5065 - val_mae: 10.5672 - val_mse: 191.2506 - val_rmse: 13.8293
Epoch 46/300
18/18            0s 10ms/step -
loss: 111.9468 - mae: 8.0764 - mse: 111.6908 - rmse: 10.5429 - val_loss:
190.6033 - val_mae: 10.4420 - val_mse: 190.3471 - val_rmse: 13.7966
Epoch 47/300
18/18            0s 14ms/step -
loss: 88.1586 - mae: 7.0286 - mse: 87.9025 - rmse: 9.3235 - val_loss: 190.7862 -
val_mae: 10.6351 - val_mse: 190.5301 - val_rmse: 13.8033
Epoch 48/300
18/18            0s 14ms/step -
loss: 103.3228 - mae: 7.8263 - mse: 103.0666 - rmse: 10.1444 - val_loss:
189.4351 - val_mae: 10.4065 - val_mse: 189.1788 - val_rmse: 13.7542
Epoch 49/300
18/18            0s 14ms/step -
loss: 95.8255 - mae: 7.6001 - mse: 95.5693 - rmse: 9.7693 - val_loss: 188.0367 -
val_mae: 10.4736 - val_mse: 187.7805 - val_rmse: 13.7033
Epoch 50/300
18/18            0s 10ms/step -
loss: 98.8701 - mae: 7.5027 - mse: 98.6139 - rmse: 9.9208 - val_loss: 187.2331 -
val_mae: 10.3716 - val_mse: 186.9767 - val_rmse: 13.6739
Epoch 51/300
18/18            0s 10ms/step -
loss: 86.8939 - mae: 7.0523 - mse: 86.6374 - rmse: 9.2699 - val_loss: 185.0432 -
val_mae: 10.3844 - val_mse: 184.7868 - val_rmse: 13.5936
Epoch 52/300
```

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18/18            0s 10ms/step -
loss: 91.0685 - mae: 7.2336 - mse: 90.8119 - rmse: 9.5171 - val_loss: 185.7881 -
val_mae: 10.2487 - val_mse: 185.5313 - val_rmse: 13.6210
Epoch 53/300
18/18            0s 10ms/step -
loss: 100.6551 - mae: 7.3776 - mse: 100.3984 - rmse: 10.0166 - val_loss:
184.7241 - val_mae: 10.3109 - val_mse: 184.4673 - val_rmse: 13.5819
Epoch 54/300
18/18            0s 10ms/step -
loss: 88.0627 - mae: 7.0649 - mse: 87.8059 - rmse: 9.3547 - val_loss: 182.9773 -
val_mae: 10.2755 - val_mse: 182.7204 - val_rmse: 13.5174
Epoch 55/300
18/18            0s 14ms/step -
loss: 93.3764 - mae: 7.2899 - mse: 93.1194 - rmse: 9.6411 - val_loss: 182.5715 -
val_mae: 10.2476 - val_mse: 182.3143 - val_rmse: 13.5024
Epoch 56/300
18/18            0s 14ms/step -
loss: 91.8168 - mae: 7.0715 - mse: 91.5597 - rmse: 9.5539 - val_loss: 182.3528 -
val_mae: 10.1426 - val_mse: 182.0956 - val_rmse: 13.4943
Epoch 57/300
18/18            0s 14ms/step -
loss: 83.9214 - mae: 6.8993 - mse: 83.6641 - rmse: 9.1090 - val_loss: 181.5515 -
val_mae: 10.2351 - val_mse: 181.2941 - val_rmse: 13.4645
Epoch 58/300
18/18            0s 11ms/step -
loss: 97.4791 - mae: 7.3707 - mse: 97.2217 - rmse: 9.8353 - val_loss: 179.9757 -
val_mae: 10.1144 - val_mse: 179.7183 - val_rmse: 13.4059
Epoch 59/300
18/18            0s 14ms/step -
loss: 90.0892 - mae: 7.0035 - mse: 89.8316 - rmse: 9.4309 - val_loss: 181.2680 -
val_mae: 10.0795 - val_mse: 181.0101 - val_rmse: 13.4540
Epoch 60/300
18/18            0s 10ms/step -
loss: 80.8585 - mae: 6.9029 - mse: 80.6006 - rmse: 8.9454 - val_loss: 181.7012 -
val_mae: 10.2409 - val_mse: 181.4432 - val_rmse: 13.4701
Epoch 61/300
18/18            0s 14ms/step -
loss: 95.5206 - mae: 7.4310 - mse: 95.2625 - rmse: 9.7558 - val_loss: 178.6969 -
val_mae: 10.0048 - val_mse: 178.4386 - val_rmse: 13.3581
Epoch 62/300
18/18            0s 10ms/step -
loss: 93.1307 - mae: 7.3430 - mse: 92.8727 - rmse: 9.6315 - val_loss: 178.9125 -
val_mae: 10.0966 - val_mse: 178.6542 - val_rmse: 13.3662
Epoch 63/300
18/18            0s 13ms/step -
loss: 80.9084 - mae: 6.6775 - mse: 80.6498 - rmse: 8.9676 - val_loss: 182.5561 -
val_mae: 10.4458 - val_mse: 182.2981 - val_rmse: 13.5018
Epoch 64/300
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18/18            0s 10ms/step -
loss: 90.8955 - mae: 7.3327 - mse: 90.6372 - rmse: 9.5151 - val_loss: 183.0394 -
val_mae: 9.9765 - val_mse: 182.7806 - val_rmse: 13.5196
Epoch 65/300
18/18            0s 10ms/step -
loss: 83.7012 - mae: 6.8521 - mse: 83.4425 - rmse: 9.1192 - val_loss: 180.5361 -
val_mae: 10.3344 - val_mse: 180.2778 - val_rmse: 13.4268
Epoch 66/300
18/18            0s 14ms/step -
loss: 88.4843 - mae: 7.0757 - mse: 88.2258 - rmse: 9.3727 - val_loss: 178.1305 -
val_mae: 9.9408 - val_mse: 177.8715 - val_rmse: 13.3368
Epoch 67/300
18/18            0s 14ms/step -
loss: 88.5683 - mae: 7.0659 - mse: 88.3094 - rmse: 9.3949 - val_loss: 176.1983 -
val_mae: 9.9920 - val_mse: 175.9391 - val_rmse: 13.2642
Epoch 68/300
18/18            0s 13ms/step -
loss: 81.8591 - mae: 6.7415 - mse: 81.5999 - rmse: 9.0243 - val_loss: 176.6703 -
val_mae: 9.9789 - val_mse: 176.4110 - val_rmse: 13.2820
Epoch 69/300
18/18            0s 10ms/step -
loss: 69.8454 - mae: 6.2111 - mse: 69.5860 - rmse: 8.2920 - val_loss: 176.4921 -
val_mae: 9.9777 - val_mse: 176.2326 - val_rmse: 13.2753
Epoch 70/300
18/18            0s 10ms/step -
loss: 97.4840 - mae: 7.3794 - mse: 97.2245 - rmse: 9.8323 - val_loss: 176.8476 -
val_mae: 9.9501 - val_mse: 176.5877 - val_rmse: 13.2886
Epoch 71/300
18/18            0s 10ms/step -
loss: 84.2781 - mae: 6.7378 - mse: 84.0179 - rmse: 9.1299 - val_loss: 178.2043 -
val_mae: 10.1099 - val_mse: 177.9445 - val_rmse: 13.3396
Epoch 72/300
18/18            0s 10ms/step -
loss: 103.0395 - mae: 7.7596 - mse: 102.7796 - rmse: 10.1002 - val_loss:
174.7811 - val_mae: 9.8621 - val_mse: 174.5208 - val_rmse: 13.2106
Epoch 73/300
18/18            0s 10ms/step -
loss: 86.5258 - mae: 6.9055 - mse: 86.2659 - rmse: 9.2829 - val_loss: 179.2820 -
val_mae: 9.8566 - val_mse: 179.0215 - val_rmse: 13.3799
Epoch 74/300
18/18            0s 14ms/step -
loss: 82.8233 - mae: 6.6814 - mse: 82.5629 - rmse: 9.0492 - val_loss: 175.6040 -
val_mae: 10.0594 - val_mse: 175.3437 - val_rmse: 13.2417
Epoch 75/300
18/18            0s 10ms/step -
loss: 71.7027 - mae: 6.2962 - mse: 71.4422 - rmse: 8.4295 - val_loss: 175.9155 -
val_mae: 9.9489 - val_mse: 175.6547 - val_rmse: 13.2535
Epoch 76/300
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18/18            0s 15ms/step -
loss: 81.8210 - mae: 6.8829 - mse: 81.5603 - rmse: 9.0197 - val_loss: 177.6470 -
val_mae: 9.8458 - val_mse: 177.3861 - val_rmse: 13.3186
Epoch 77/300
18/18            0s 17ms/step -
loss: 91.1302 - mae: 7.1984 - mse: 90.8693 - rmse: 9.5116 - val_loss: 177.1049 -
val_mae: 9.8471 - val_mse: 176.8435 - val_rmse: 13.2983
Epoch 78/300
18/18            1s 16ms/step -
loss: 86.7032 - mae: 7.0214 - mse: 86.4417 - rmse: 9.2862 - val_loss: 174.9011 -
val_mae: 9.9292 - val_mse: 174.6399 - val_rmse: 13.2151
Epoch 79/300
18/18            1s 18ms/step -
loss: 72.6802 - mae: 6.1632 - mse: 72.4187 - rmse: 8.4539 - val_loss: 177.0212 -
val_mae: 10.2182 - val_mse: 176.7602 - val_rmse: 13.2951
Epoch 80/300
18/18            0s 18ms/step -
loss: 81.2975 - mae: 6.9555 - mse: 81.0363 - rmse: 8.9910 - val_loss: 176.1832 -
val_mae: 9.8529 - val_mse: 175.9215 - val_rmse: 13.2635
Epoch 81/300
18/18            1s 14ms/step -
loss: 72.7709 - mae: 6.2353 - mse: 72.5091 - rmse: 8.5059 - val_loss: 174.0942 -
val_mae: 9.8867 - val_mse: 173.8324 - val_rmse: 13.1846
Epoch 82/300
18/18            0s 10ms/step -
loss: 80.1955 - mae: 6.7322 - mse: 79.9334 - rmse: 8.9297 - val_loss: 175.7393 -
val_mae: 9.9877 - val_mse: 175.4773 - val_rmse: 13.2468
Epoch 83/300
18/18            0s 10ms/step -
loss: 76.2385 - mae: 6.3949 - mse: 75.9765 - rmse: 8.7070 - val_loss: 173.9060 -
val_mae: 9.7550 - val_mse: 173.6436 - val_rmse: 13.1774
Epoch 84/300
18/18            0s 13ms/step -
loss: 70.4594 - mae: 6.2027 - mse: 70.1970 - rmse: 8.3357 - val_loss: 174.8410 -
val_mae: 9.7802 - val_mse: 174.5784 - val_rmse: 13.2128
Epoch 85/300
18/18            0s 14ms/step -
loss: 82.0888 - mae: 6.7343 - mse: 81.8261 - rmse: 9.0398 - val_loss: 172.5092 -
val_mae: 9.8442 - val_mse: 172.2466 - val_rmse: 13.1243
Epoch 86/300
18/18            0s 13ms/step -
loss: 81.1387 - mae: 6.5694 - mse: 80.8758 - rmse: 8.9732 - val_loss: 178.0262 -
val_mae: 10.0951 - val_mse: 177.7635 - val_rmse: 13.3328
Epoch 87/300
18/18            0s 10ms/step -
loss: 76.1342 - mae: 6.3729 - mse: 75.8713 - rmse: 8.6975 - val_loss: 173.6039 -
val_mae: 9.7118 - val_mse: 173.3406 - val_rmse: 13.1659
Epoch 88/300
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18/18            0s 14ms/step -
loss: 76.2911 - mae: 6.5562 - mse: 76.0279 - rmse: 8.7104 - val_loss: 176.4721 -
val_mae: 9.9560 - val_mse: 176.2088 - val_rmse: 13.2744
Epoch 89/300
18/18            0s 10ms/step -
loss: 88.6292 - mae: 6.9235 - mse: 88.3656 - rmse: 9.3837 - val_loss: 174.0491 -
val_mae: 9.7990 - val_mse: 173.7853 - val_rmse: 13.1828
Epoch 90/300
18/18            0s 10ms/step -
loss: 60.2727 - mae: 5.7620 - mse: 60.0091 - rmse: 7.7048 - val_loss: 175.4553 -
val_mae: 9.7434 - val_mse: 175.1912 - val_rmse: 13.2360
Epoch 91/300
18/18            0s 10ms/step -
loss: 64.5083 - mae: 5.8310 - mse: 64.2441 - rmse: 7.9205 - val_loss: 175.6059 -
val_mae: 9.8041 - val_mse: 175.3416 - val_rmse: 13.2417
Epoch 92/300
18/18            0s 10ms/step -
loss: 76.5177 - mae: 6.4286 - mse: 76.2533 - rmse: 8.7250 - val_loss: 174.4962 -
val_mae: 9.9178 - val_mse: 174.2321 - val_rmse: 13.1997
Epoch 93/300
18/18            0s 11ms/step -
loss: 71.1568 - mae: 5.9487 - mse: 70.8926 - rmse: 8.3624 - val_loss: 177.5457 -
val_mae: 9.7194 - val_mse: 177.2810 - val_rmse: 13.3147
Epoch 94/300
18/18            0s 10ms/step -
loss: 70.6827 - mae: 6.0123 - mse: 70.4180 - rmse: 8.3757 - val_loss: 173.4064 -
val_mae: 9.8121 - val_mse: 173.1417 - val_rmse: 13.1583
Epoch 95/300
18/18            0s 13ms/step -
loss: 78.2683 - mae: 6.2975 - mse: 78.0034 - rmse: 8.8235 - val_loss: 175.1981 -
val_mae: 9.9024 - val_mse: 174.9332 - val_rmse: 13.2262
Epoch 96/300
18/18            0s 10ms/step -
loss: 76.4311 - mae: 6.4283 - mse: 76.1660 - rmse: 8.6986 - val_loss: 173.2293 -
val_mae: 9.8263 - val_mse: 172.9641 - val_rmse: 13.1516
Epoch 97/300
18/18            0s 11ms/step -
loss: 72.4201 - mae: 6.4094 - mse: 72.1548 - rmse: 8.4867 - val_loss: 176.2251 -
val_mae: 9.6692 - val_mse: 175.9592 - val_rmse: 13.2650
Epoch 98/300
18/18            0s 14ms/step -
loss: 67.2427 - mae: 6.1253 - mse: 66.9769 - rmse: 8.1599 - val_loss: 176.8942 -
val_mae: 9.8501 - val_mse: 176.6285 - val_rmse: 13.2902
Epoch 99/300
18/18            0s 10ms/step -
loss: 68.3675 - mae: 6.2095 - mse: 68.1017 - rmse: 8.2336 - val_loss: 171.6986 -
val_mae: 9.6616 - val_mse: 171.4324 - val_rmse: 13.0932
Epoch 100/300
```

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18/18            0s 10ms/step -
loss: 84.0894 - mae: 6.8600 - mse: 83.8231 - rmse: 9.1280 - val_loss: 174.9676 -
val_mae: 9.8971 - val_mse: 174.7014 - val_rmse: 13.2175
Epoch 101/300
18/18            0s 11ms/step -
loss: 72.9868 - mae: 6.4591 - mse: 72.7204 - rmse: 8.5246 - val_loss: 173.6910 -
val_mae: 9.7562 - val_mse: 173.4243 - val_rmse: 13.1691
Epoch 102/300
18/18            0s 10ms/step -
loss: 78.1576 - mae: 6.3858 - mse: 77.8908 - rmse: 8.7901 - val_loss: 174.3311 -
val_mae: 9.7155 - val_mse: 174.0640 - val_rmse: 13.1933
Epoch 103/300
18/18            0s 10ms/step -
loss: 68.5410 - mae: 5.8804 - mse: 68.2739 - rmse: 8.2576 - val_loss: 172.8864 -
val_mae: 9.6886 - val_mse: 172.6190 - val_rmse: 13.1385
Epoch 104/300
18/18            0s 10ms/step -
loss: 74.8849 - mae: 6.4829 - mse: 74.6177 - rmse: 8.6356 - val_loss: 174.9214 -
val_mae: 9.6805 - val_mse: 174.6537 - val_rmse: 13.2157
Epoch 105/300
18/18            0s 12ms/step -
loss: 64.9396 - mae: 6.0500 - mse: 64.6719 - rmse: 8.0357 - val_loss: 173.6619 -
val_mae: 9.7655 - val_mse: 173.3942 - val_rmse: 13.1679
Epoch 106/300
18/18            0s 10ms/step -
loss: 72.9286 - mae: 6.4143 - mse: 72.6610 - rmse: 8.5074 - val_loss: 176.6337 -
val_mae: 9.6845 - val_mse: 176.3652 - val_rmse: 13.2803
Epoch 107/300
18/18            0s 14ms/step -
loss: 72.1769 - mae: 6.4655 - mse: 71.9086 - rmse: 8.4638 - val_loss: 176.6020 -
val_mae: 9.7044 - val_mse: 176.3334 - val_rmse: 13.2791
Epoch 108/300
18/18            0s 10ms/step -
loss: 74.8430 - mae: 6.3623 - mse: 74.5744 - rmse: 8.5980 - val_loss: 177.8790 -
val_mae: 9.7332 - val_mse: 177.6100 - val_rmse: 13.3270
Epoch 109/300
18/18            0s 14ms/step -
loss: 83.3066 - mae: 6.9393 - mse: 83.0375 - rmse: 9.0946 - val_loss: 174.0652 -
val_mae: 9.9257 - val_mse: 173.7967 - val_rmse: 13.1832
Epoch 110/300
18/18            0s 10ms/step -
loss: 71.0799 - mae: 6.3577 - mse: 70.8111 - rmse: 8.4048 - val_loss: 173.9041 -
val_mae: 9.8214 - val_mse: 173.6351 - val_rmse: 13.1771
Epoch 111/300
18/18            0s 10ms/step -
loss: 72.7951 - mae: 6.3288 - mse: 72.5261 - rmse: 8.5081 - val_loss: 175.3072 -
val_mae: 9.6535 - val_mse: 175.0376 - val_rmse: 13.2302
Epoch 112/300
```

```
18/18            0s 14ms/step -
loss: 66.9747 - mae: 5.9843 - mse: 66.7051 - rmse: 8.1477 - val_loss: 175.0726 -
val_mae: 9.7425 - val_mse: 174.8030 - val_rmse: 13.2213
Epoch 113/300
18/18            0s 11ms/step -
loss: 73.5737 - mae: 6.2007 - mse: 73.3041 - rmse: 8.5308 - val_loss: 178.0702 -
val_mae: 9.7012 - val_mse: 177.8000 - val_rmse: 13.3342
Epoch 114/300
18/18            0s 10ms/step -
loss: 73.4672 - mae: 6.2055 - mse: 73.1971 - rmse: 8.5501 - val_loss: 175.2521 -
val_mae: 9.6931 - val_mse: 174.9819 - val_rmse: 13.2281
Epoch 115/300
18/18            0s 13ms/step -
loss: 64.0800 - mae: 5.7847 - mse: 63.8097 - rmse: 7.9730 - val_loss: 174.4774 -
val_mae: 9.8450 - val_mse: 174.2069 - val_rmse: 13.1987
Epoch 116/300
18/18            0s 10ms/step -
loss: 65.6987 - mae: 6.0534 - mse: 65.4281 - rmse: 8.0730 - val_loss: 174.0784 -
val_mae: 9.7812 - val_mse: 173.8078 - val_rmse: 13.1836
Epoch 117/300
18/18            0s 14ms/step -
loss: 67.1419 - mae: 5.9705 - mse: 66.8712 - rmse: 8.1720 - val_loss: 176.3480 -
val_mae: 9.6864 - val_mse: 176.0767 - val_rmse: 13.2694
Epoch 118/300
18/18            0s 17ms/step -
loss: 70.2729 - mae: 6.1175 - mse: 70.0015 - rmse: 8.3605 - val_loss: 174.1917 -
val_mae: 9.7047 - val_mse: 173.9202 - val_rmse: 13.1879
Epoch 119/300
18/18            1s 17ms/step -
loss: 63.4468 - mae: 5.6695 - mse: 63.1752 - rmse: 7.9338 - val_loss: 173.9320 -
val_mae: 9.6263 - val_mse: 173.6602 - val_rmse: 13.1780
```

6.2.4 Loss Plot

[214]:
```python
# Plot loss
plt.figure(figsize=(10, 6))
plt.plot(history.history['loss'], label='Train Loss (MSE)')
plt.plot(history.history['val_loss'], label='Validation Loss (MSE)')
plt.title('Training vs Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss (MSE)')
plt.legend()
plt.grid(True)
plt.show()
```

6.2.5 R2 Model Functional

[215]:
```
# show R2
y_pred = modify_model_functional.predict(X_test)
r2_score(y_test, y_pred)
```

```
12/12            0s 13ms/step
```

[215]:
```
0.36435334781635953
```

7 Final Compare

[223]:
```
print("Base Model Sequential")
y_pred = base_model_sequential.predict(X_test)
print(r2_score(y_test, y_pred))

print("\nModify Model Sequential")
y_pred = modify_model_sequential.predict(X_test)
print(r2_score(y_test, y_pred))

print("\nBase Model Functional")
y_pred = base_model_functional.predict(X_test)
print(r2_score(y_test, y_pred))
```

```
print("\nModify Model Functional")
y_pred = modify_model_functional.predict(X_test)
print(r2_score(y_test, y_pred))
```

```
Base Model Sequential
12/12             0s 9ms/step
0.2507309708192178

Modify Model Sequential
12/12             0s 10ms/step
0.3723925688391976

Base Model Functional
12/12             0s 10ms/step
0.35346509254253955

Modify Model Functional
12/12             0s 6ms/step
0.36435334781635953
```

[ ]:
```
def evaluate_model(model, X_test, y_test, model_name):
    print(f"\n{model_name}")
    y_pred = model.predict(X_test)

    r2 = r2_score(y_test, y_pred)
    mae = mean_absolute_error(y_test, y_pred)
    rmse = np.sqrt(mean_squared_error(y_test, y_pred))

    print(f"R² Score: {r2:.4f}")
    print(f"MAE     : {mae:.4f}")
    print(f"RMSE    : {rmse:.4f}")

# Evaluate each model
evaluate_model(base_model_sequential, X_test, y_test, "Base Model Sequential")
evaluate_model(modify_model_sequential, X_test, y_test, "Modify Model␣
 ↪Sequential")
evaluate_model(base_model_functional, X_test, y_test, "Base Model Functional")
evaluate_model(modify_model_functional, X_test, y_test, "Modify Model␣
 ↪Functional")
```

```
Base Model Sequential
12/12             0s 6ms/step
R² Score: 0.2507
MAE     : 11.2833
RMSE    : 15.0116
```

```
Modify Model Sequential
12/12            0s 7ms/step
R² Score: 0.3724
MAE     : 10.0156
RMSE    : 13.7389

Base Model Functional
12/12            0s 6ms/step
R² Score: 0.3535
MAE     : 10.2416
RMSE    : 13.9445

Modify Model Functional
12/12            0s 5ms/step
R² Score: 0.3644
MAE     : 10.0701
RMSE    : 13.8266
```

from the evaluation results, the modified sequential model has the best evaluation from the other models with R^2 score of 0.3724, with 37% of the variance, and lowest MAE which is 10.0156, both based and modified for functional models perform better than base sequential model.