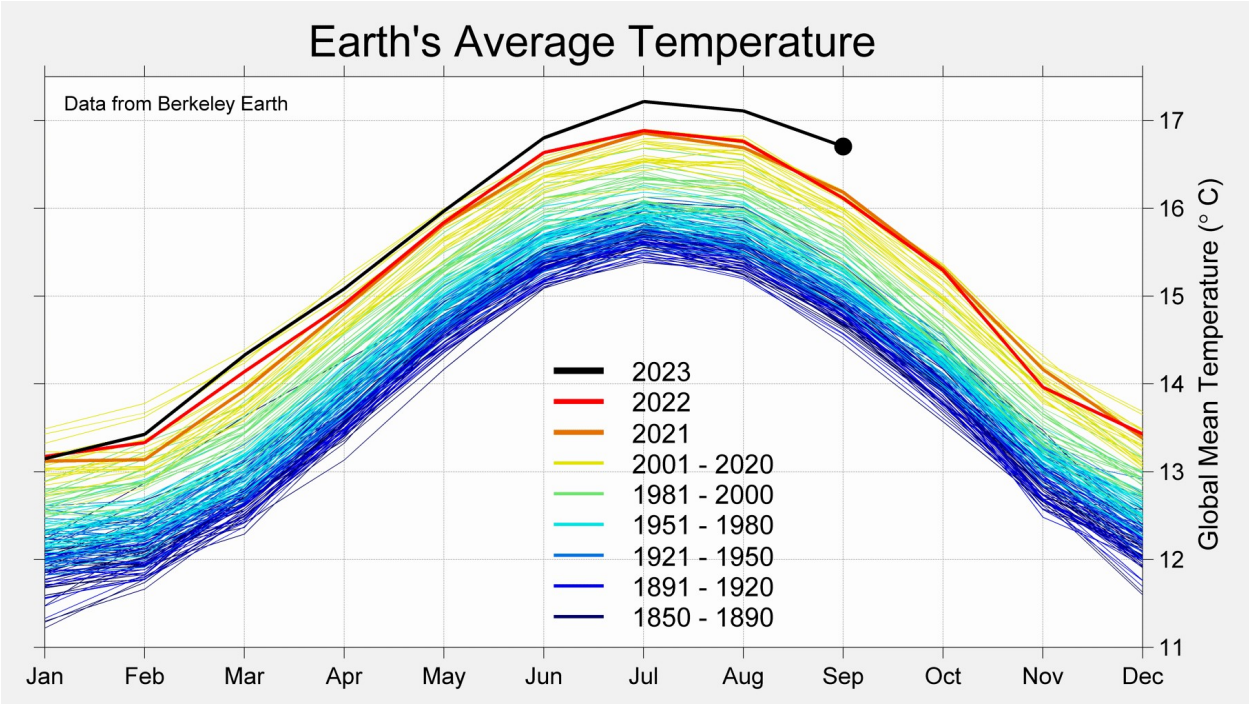



```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

data = pd.read_csv('Surface_Temperature.csv')

data.head()
```

```
   ObjectId                         Country ISO2 ISO3  \
0         1  Afghanistan, Islamic Rep. of   AF  AFG
1         2                       Albania   AL  ALB
2         3                       Algeria   DZ  DZA
3         4                American Samoa   AS  ASM
4         5     Andorra, Principality of   AD  AND

                                           Indicator
Unit  \
0  Temperature change with respect to a baseline ...  Degree Celsius

1  Temperature change with respect to a baseline ...  Degree Celsius

2  Temperature change with respect to a baseline ...  Degree Celsius

3  Temperature change with respect to a baseline ...  Degree Celsius

4  Temperature change with respect to a baseline ...  Degree Celsius
```

```
                                                Source CTS_Code  \
0  Food and Agriculture Organization of the Unite...     ECCS
1  Food and Agriculture Organization of the Unite...     ECCS
2  Food and Agriculture Organization of the Unite...     ECCS
3  Food and Agriculture Organization of the Unite...     ECCS
4  Food and Agriculture Organization of the Unite...     ECCS

                     CTS_Name  \
0  Surface Temperature Change
1  Surface Temperature Change
2  Surface Temperature Change
3  Surface Temperature Change
4  Surface Temperature Change

                                 CTS_Full_Descriptor  ...  F2013
F2014  \
0  Environment, Climate Change, Climate Indicator...  ...  1.281
0.456
1  Environment, Climate Change, Climate Indicator...  ...  1.333
1.198
2  Environment, Climate Change, Climate Indicator...  ...  1.192
1.690
3  Environment, Climate Change, Climate Indicator...  ...  1.257
1.170
4  Environment, Climate Change, Climate Indicator...  ...  0.831
1.946

   F2015  F2016  F2017  F2018  F2019  F2020  F2021  F2022
0  1.093  1.555  1.540  1.544  0.910  0.498  1.327  2.012
1  1.569  1.464  1.121  2.028  1.675  1.498  1.536  1.518
2  1.121  1.757  1.512  1.210  1.115  1.926  2.330  1.688
3  1.009  1.539  1.435  1.189  1.539  1.430  1.268  1.256
4  1.690  1.990  1.925  1.919  1.964  2.562  1.533  3.243

[5 rows x 72 columns]
```

```
columns_to_drop = [0,1,2,3,4,5,6,7,8,9]
data.drop(data.columns[columns_to_drop], axis=1, inplace = True)

data.columns = data.columns.str.strip()

data.head()
```

```
   F1961  F1962  F1963  F1964  F1965  F1966  F1967  F1968  F1969
F1970  ...  \
0 -0.113 -0.164  0.847 -0.764 -0.244  0.226 -0.371 -0.423 -0.539
0.813  ...
1  0.627  0.326  0.075 -0.166 -0.388  0.559 -0.074  0.081 -0.013 -
0.106  ...
2  0.164  0.114  0.077  0.250 -0.100  0.433 -0.026 -0.067  0.291
0.116  ...
```

```
3  0.079 -0.042  0.169 -0.140 -0.562  0.181 -0.368 -0.187  0.132 -
0.047  ...
4  0.736  0.112 -0.752  0.308 -0.490  0.415  0.637  0.018 -0.137
0.121  ...

   F2013  F2014  F2015  F2016  F2017  F2018  F2019  F2020  F2021
F2022
0  1.281  0.456  1.093  1.555  1.540  1.544  0.910  0.498  1.327
2.012
1  1.333  1.198  1.569  1.464  1.121  2.028  1.675  1.498  1.536
1.518
2  1.192  1.690  1.121  1.757  1.512  1.210  1.115  1.926  2.330
1.688
3  1.257  1.170  1.009  1.539  1.435  1.189  1.539  1.430  1.268
1.256
4  0.831  1.946  1.690  1.990  1.925  1.919  1.964  2.562  1.533
3.243

[5 rows x 62 columns]
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 225 entries, 0 to 224
Data columns (total 62 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   F1961   188 non-null    float64
 1   F1962   189 non-null    float64
 2   F1963   188 non-null    float64
 3   F1964   188 non-null    float64
 4   F1965   188 non-null    float64
 5   F1966   192 non-null    float64
 6   F1967   191 non-null    float64
 7   F1968   191 non-null    float64
 8   F1969   190 non-null    float64
 9   F1970   189 non-null    float64
 10  F1971   191 non-null    float64
 11  F1972   192 non-null    float64
 12  F1973   193 non-null    float64
 13  F1974   192 non-null    float64
 14  F1975   188 non-null    float64
 15  F1976   189 non-null    float64
 16  F1977   185 non-null    float64
 17  F1978   189 non-null    float64
 18  F1979   189 non-null    float64
 19  F1980   191 non-null    float64
 20  F1981   191 non-null    float64
 21  F1982   192 non-null    float64
 22  F1983   190 non-null    float64
```

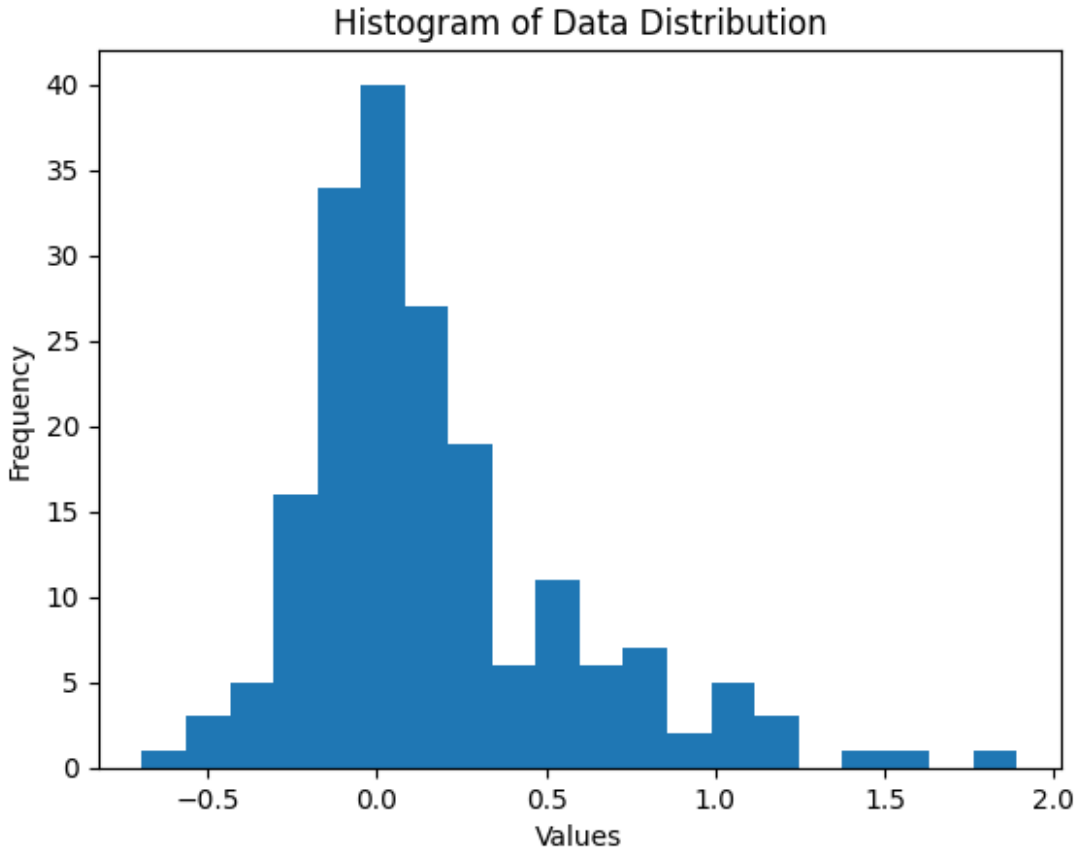
```
 23  F1984   188 non-null    float64
 24  F1985   188 non-null    float64
 25  F1986   190 non-null    float64
 26  F1987   190 non-null    float64
 27  F1988   190 non-null    float64
 28  F1989   190 non-null    float64
 29  F1990   189 non-null    float64
 30  F1991   188 non-null    float64
 31  F1992   208 non-null    float64
 32  F1993   209 non-null    float64
 33  F1994   208 non-null    float64
 34  F1995   210 non-null    float64
 35  F1996   210 non-null    float64
 36  F1997   207 non-null    float64
 37  F1998   210 non-null    float64
 38  F1999   209 non-null    float64
 39  F2000   209 non-null    float64
 40  F2001   208 non-null    float64
 41  F2002   212 non-null    float64
 42  F2003   214 non-null    float64
 43  F2004   213 non-null    float64
 44  F2005   212 non-null    float64
 45  F2006   215 non-null    float64
 46  F2007   217 non-null    float64
 47  F2008   212 non-null    float64
 48  F2009   212 non-null    float64
 49  F2010   215 non-null    float64
 50  F2011   217 non-null    float64
 51  F2012   215 non-null    float64
 52  F2013   216 non-null    float64
 53  F2014   216 non-null    float64
 54  F2015   216 non-null    float64
 55  F2016   213 non-null    float64
 56  F2017   214 non-null    float64
 57  F2018   213 non-null    float64
 58  F2019   213 non-null    float64
 59  F2020   212 non-null    float64
 60  F2021   213 non-null    float64
 61  F2022   213 non-null    float64
dtypes: float64(62)
memory usage: 109.1 KB
```

```
data.isnull().sum()
```

```
F1961    37
F1962    36
F1963    37
F1964    37
F1965    37
         ..
```

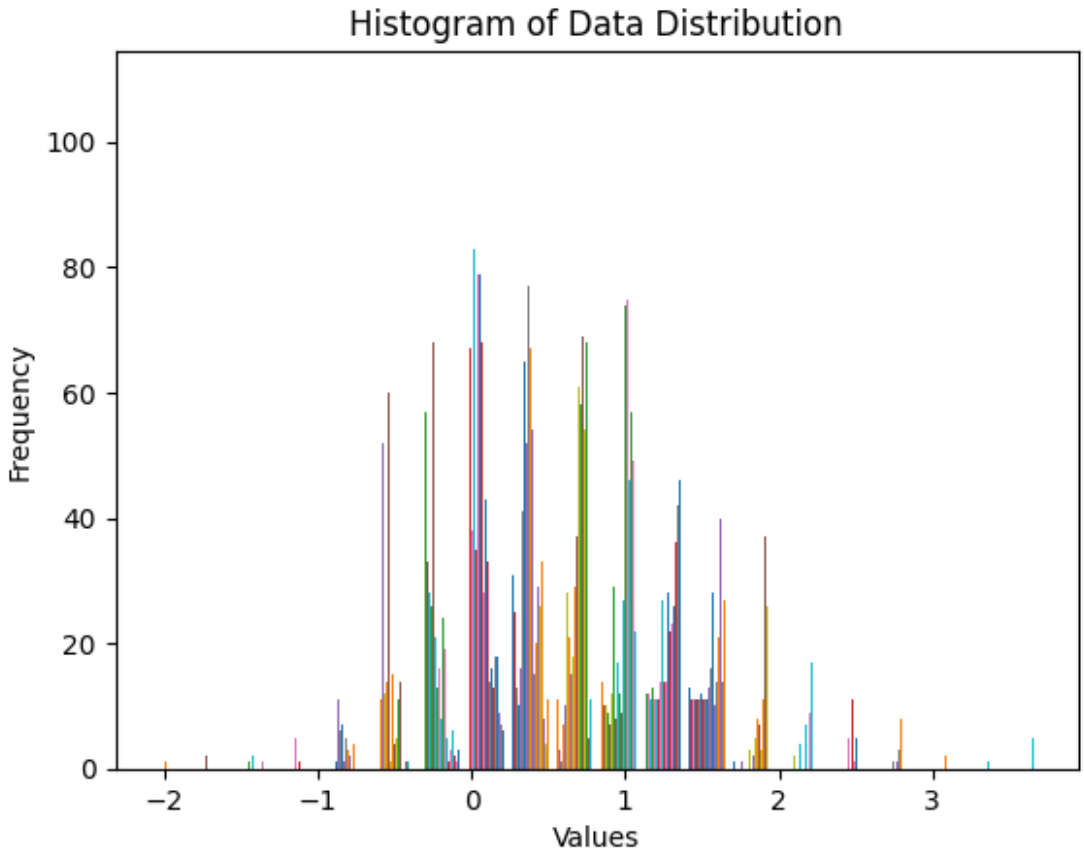
```
F2018    12
F2019    12
F2020    13
F2021    12
F2022    12
Length: 62, dtype: int64
```

```
import matplotlib.pyplot as plt

# Assuming 'data' is your numerical data
plt.hist(data['F1961'], bins=20)  # Adjust the number of bins as
needed
plt.xlabel('Values')
plt.ylabel('Frequency')
plt.title('Histogram of Data Distribution')
plt.show()
```




```
# Replace missing values in each row with the mean of that row
data = data.apply(lambda row: row.fillna(row.mean()), axis=1)

import matplotlib.pyplot as plt

# Assuming 'data' is your numerical data
```

```
plt.hist(data, bins=20)  # Adjust the number of bins as needed
plt.xlabel('Values')
plt.ylabel('Frequency')
plt.title('Histogram of Data Distribution')
plt.show()
```

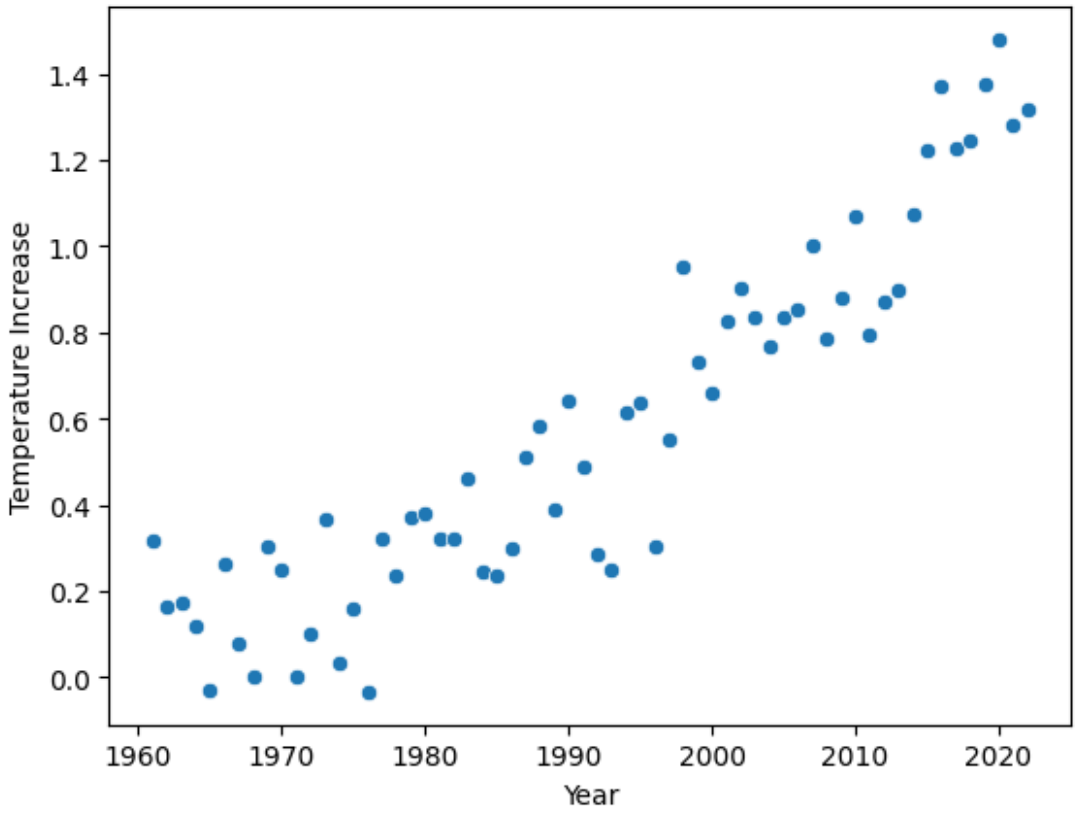



```
# Create a DataFrame with a column containing values from 1961 to 2021
years = list(range(1961, 2023))
temp_increase = data.mean()
data = pd.DataFrame({'Year': years,'Temperature Increase':
temp_increase.values})

data.head()
```

	Year	Temperature Increase
0	1961	0.316818
1	1962	0.164374
2	1963	0.172560
3	1964	0.119288
4	1965	-0.028827

```
sns.scatterplot(x='Year',y = 'Temperature Increase',data=data)
```

```
<Axes: xlabel='Year', ylabel='Temperature Increase'>
```

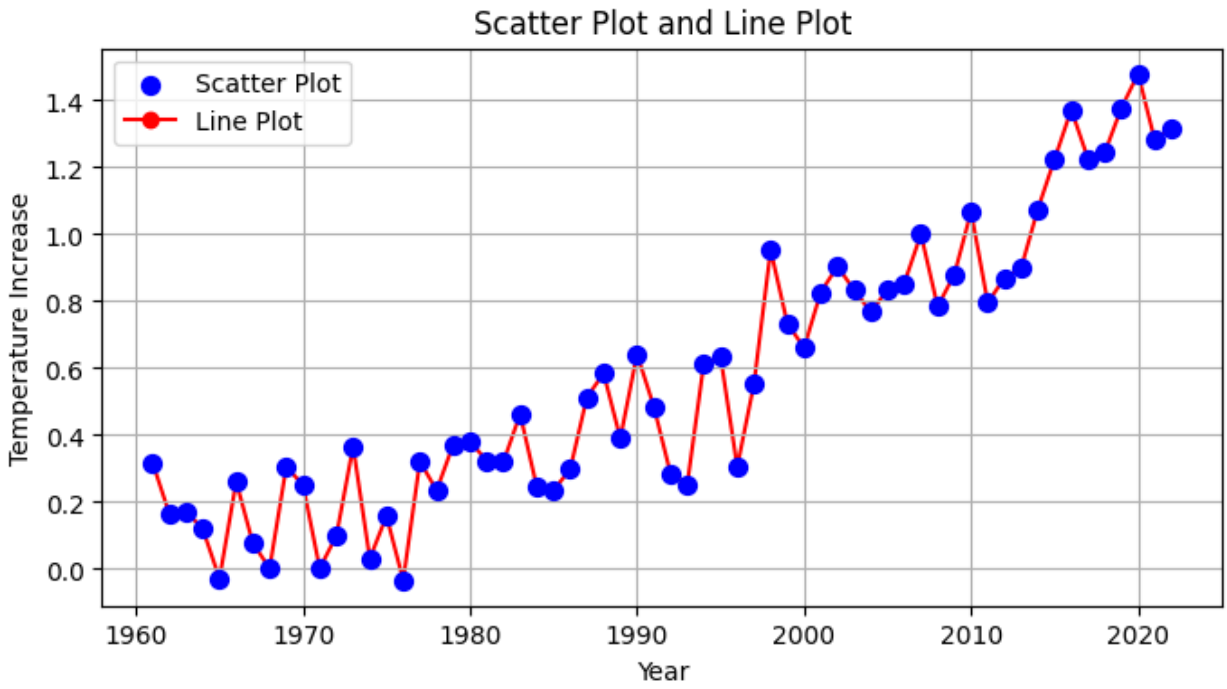



```
from sklearn.preprocessing import StandardScaler

data.head()
```

	Year	Temperature Increase
0	1961	0.316818
1	1962	0.164374
2	1963	0.172560
3	1964	0.119288
4	1965	-0.028827

```
import matplotlib.pyplot as plt
X = data['Year']
y = data['Temperature Increase']

# Scatter plot
plt.figure(figsize=(8, 4))
plt.scatter(X, y, color='blue', label='Scatter Plot', s=50, zorder=2)
# Increase marker size and set zorder

# Line plot
plt.plot(X, y, marker='o', linestyle='-', color='red', label='Line
```

```
Plot', zorder=1)

plt.title('Scatter Plot and Line Plot')
plt.xlabel('Year')
plt.ylabel('Temperature Increase')
plt.legend()
plt.grid()
plt.show()
```

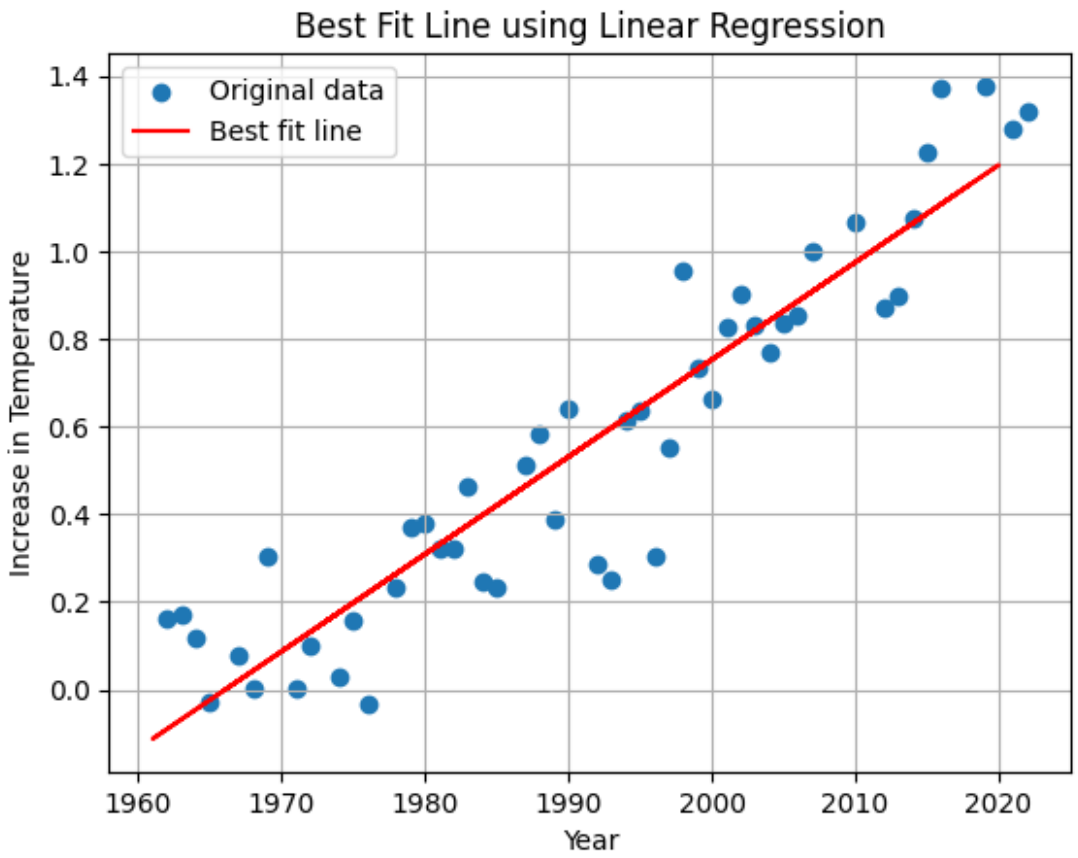



```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

model = LinearRegression()

X_train = np.array(X_train).reshape(-1, 1)
y_train = np.array(y_train).reshape(-1, 1)
X_test = np.array(X_test).reshape(-1, 1)
y_test = np.array(y_test).reshape(-1, 1)

model.fit(X_train,y_train)

LinearRegression()

y_pred = model.predict(X_test)
```

```
from sklearn.metrics import mean_absolute_error, mean_squared_error,
r2_score

# Calculate regression metrics
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
rmse = mean_squared_error(y_test, y_pred, squared=False)  # Compute
RMSE from MSE
r2 = r2_score(y_test, y_pred)

print("Mean Absolute Error (MAE):", mae)
print("Mean Squared Error (MSE):", mse)
print("Root Mean Squared Error (RMSE):", rmse)
print("R-squared (R2 Score):", r2)
```

```
Mean Absolute Error (MAE): 0.17291867302351666
Mean Squared Error (MSE): 0.04009176240246447
Root Mean Squared Error (RMSE): 0.2002292745890682
R-squared (R2 Score): 0.7651768531883528
```

```
# Plotting the original data points and the best fit line
plt.scatter(X_train, y_train, label='Original data')
plt.plot(X_test, y_pred, color='red', label='Best fit line')
plt.xlabel('Year')
plt.ylabel('Increase in Temperature')
plt.title('Best Fit Line using Linear Regression')
plt.legend()
plt.grid()
plt.show()

# Getting the coefficients (slope and intercept) of the best fit line
slope = model.coef_[0]
intercept = model.intercept_
print("Slop is = ",slope," and intercept is = ",intercept)
```




```
Slop is =  [0.02219216]  and intercept is =  [-43.63116921]
```

```
year_to_predict = 2024
year_to_predict = np.array(year_to_predict).reshape(-1, 1)

temp_increase = model.predict(year_to_predict)
print(temp_increase)
```

```
[[1.28576239]]
```

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, mean_absolute_error
import numpy as np

# Assuming 'data' is your DataFrame with columns 'Year' and
'Temperature Increase'
# Load your dataset or replace this with your data loading code
# data = pd.read_csv('your_dataset.csv')

# Split the data into features (X) and target variable (y)
X = data[['Year']]
```

```
y = data['Temperature Increase']

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Standardize the features by scaling
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Initialize and train the Linear Regression model
linear_model = LinearRegression()
linear_model.fit(X_train_scaled, y_train)

# Predict on the test set
y_pred = linear_model.predict(X_test_scaled)

# Calculate RMSE (Root Mean Squared Error)
rmse = np.sqrt(mean_squared_error(y_test, y_pred))
print(f"RMSE: {rmse:.4f}")

# Calculate MSE (Mean Squared Error)
mse = mean_squared_error(y_test, y_pred)
print(f"MSE: {mse:.4f}")

# Calculate MAE (Mean Absolute Error)
mae = mean_absolute_error(y_test, y_pred)
print(f"MAE: {mae:.4f}")
```

```
RMSE: 0.2002
MSE: 0.0401
MAE: 0.1729
```

```
from sklearn.linear_model import Ridge
from sklearn.metrics import mean_squared_error, mean_absolute_error
import numpy as np

# Assuming 'data' is your DataFrame with columns 'Year' and
'Temperature Increase'

# Combine the training and testing data for model training
X_all = pd.concat([X_train, X_test])
y_all = pd.concat([y_train, y_test])

# Standardize all the data (including the future year 2024)
X_all_scaled = scaler.fit_transform(X_all)

# Initialize and train the Ridge Regression model on all data
alpha_value = 1.0  # You can adjust the alpha value for regularization
ridge_model = Ridge(alpha=alpha_value)
```

```
ridge_model.fit(X_all_scaled, y_all)

# Predict the 'Temperature Increase' for the year 2024
temperature_2024_pred_ridge = ridge_model.predict(year_2024_scaled)

print(f"Predicted Temperature Increase in 2024 using Ridge Regression:
{temperature_2024_pred_ridge[0]:.4f}")

# Evaluate Ridge Regression model on the test set
y_pred_ridge = ridge_model.predict(X_test_scaled)

# Calculate RMSE (Root Mean Squared Error)
rmse_ridge = np.sqrt(mean_squared_error(y_test, y_pred_ridge))
print(f"RMSE (Ridge Regression): {rmse_ridge:.4f}")

# Calculate MSE (Mean Squared Error)
mse_ridge = mean_squared_error(y_test, y_pred_ridge)
print(f"MSE (Ridge Regression): {mse_ridge:.4f}")

# Calculate MAE (Mean Absolute Error)
mae_ridge = mean_absolute_error(y_test, y_pred_ridge)
print(f"MAE (Ridge Regression): {mae_ridge:.4f}")
```

```
Predicted Temperature Increase in 2024 using Ridge Regression: 1.2336
RMSE (Ridge Regression): 0.1898
MSE (Ridge Regression): 0.0360
MAE (Ridge Regression): 0.1656
```

```
# Create a DataFrame with the year 2024
year_2024 = pd.DataFrame({'Year': [2023]})

# Standardize the year 2024 data using the same scaler
year_2024_scaled = scaler.transform(year_2024)

# Predict the 'Temperature Increase' for the year 2024
temperature_2024_pred = linear_model.predict(year_2024_scaled)

print(f"Predicted Temperature Increase in 2024:
{temperature_2024_pred[0]:.2f}")
```

```
Predicted Temperature Increase in 2024: 1.24
```