Manufacturing Dataset

This dataset contains information related to a manufacturing process, offering insights into various process parameters and product quality. In this Markdown cell, we will provide a brief overview of the dataset's structure and its key components.

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
df = pd.read_csv('Practice-1 Manufacturing.csv')
df.head()
```

Out[2]:

	Temperature (°C)	Pressure (kPa)	Temperature x Pressure	Material Fusion Metric	Material Transformation Metric	Quality Rating
0	209.762701	8.050855	1688.769167	44522.217074	9.229576e+06	99.999971
1	243.037873	15.812068	3842.931469	63020.764997	1.435537e+07	99.985703
2	220.552675	7.843130	1729.823314	49125.950249	1.072839e+07	99.999758
3	208.976637	23.786089	4970.736918	57128.881547	9.125702e+06	99.999975
4	184.730960	15.797812	2918.345014	38068.201283	6.303792e+06	100.000000

In [3]:
```
df.shape
```

Out[3]: (3957, 6)

In [4]:
```
# sns.pairplot(df)
```

In [5]:
```
from statsmodels.stats.outliers_influence import variance_inflation_factor

def calc_vif(X):
    vif = pd.DataFrame()
    vif["VIF"] = [variance_inflation_factor(X.values, i) for i in range(X.shape[1])]
    return (vif)
```

In [6]:
```
x = df.drop('Quality Rating', axis=1)
calc_vif(x)
```

Out[6]:

	VIF
0	113.050204
1	49.349434
2	72.745768
3	764.593283
4	219.003134

In [7]:
```
x.shape
```

Out[7]: (3957, 5)

In [8]:
```
y = df['Quality Rating']
y.shape
```

Out[8]: (3957,)

In [9]:
```
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)
```

In [10]:
```
from sklearn.preprocessing import PolynomialFeatures
poly = PolynomialFeatures(degree=3)
X_train_poly = poly.fit_transform(x_train)
X_test_poly = poly.fit_transform(x_test)
```

In [11]:
```
X_train_poly.shape, X_test_poly.shape
```

Out[11]: ((3165, 56), (792, 56))

In [12]:
```
y_train = np.array(y_train).reshape(-1,)
```

In [13]:
```
y_train.shape
```

Out[13]: (3165,)

In [14]:
```python
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(X_train_poly, y_train)
```

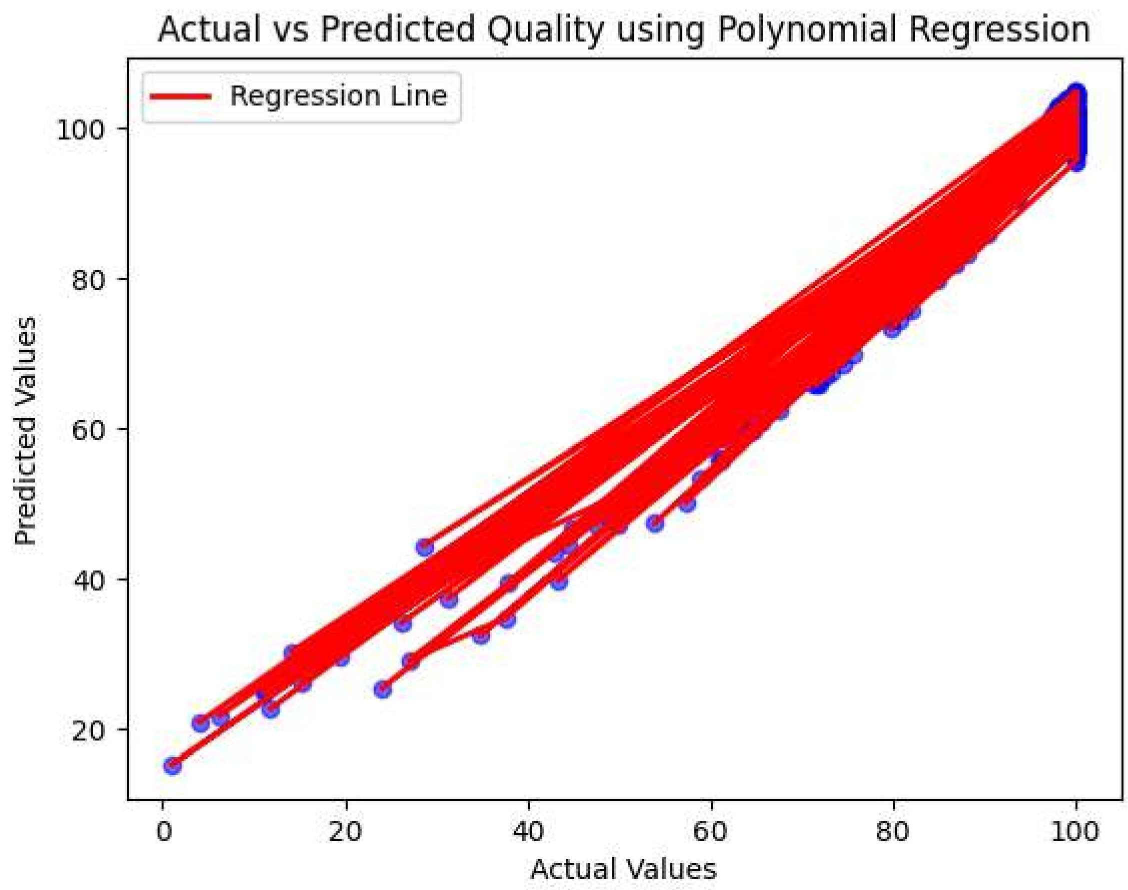
Out[14]:
```
▾ LinearRegression

LinearRegression()
```

In [15]:
```python
y_pred = model.predict(X_test_poly)
```

In [16]:
```python
from sklearn import metrics
meanAbErr = metrics.mean_absolute_error(y_test, y_pred)
meanSqErr = metrics.mean_squared_error(y_test, y_pred)
rootMeanSqErr = metrics.root_mean_squared_error(y_test, y_pred)
print('R squared: {:.2f}'.format(metrics.r2_score(y_test, y_pred)))
print('Mean Absolute Error:', meanAbErr)
print('Mean Squared Error:', meanSqErr)
print('Root Mean Squared Error:', rootMeanSqErr)
```

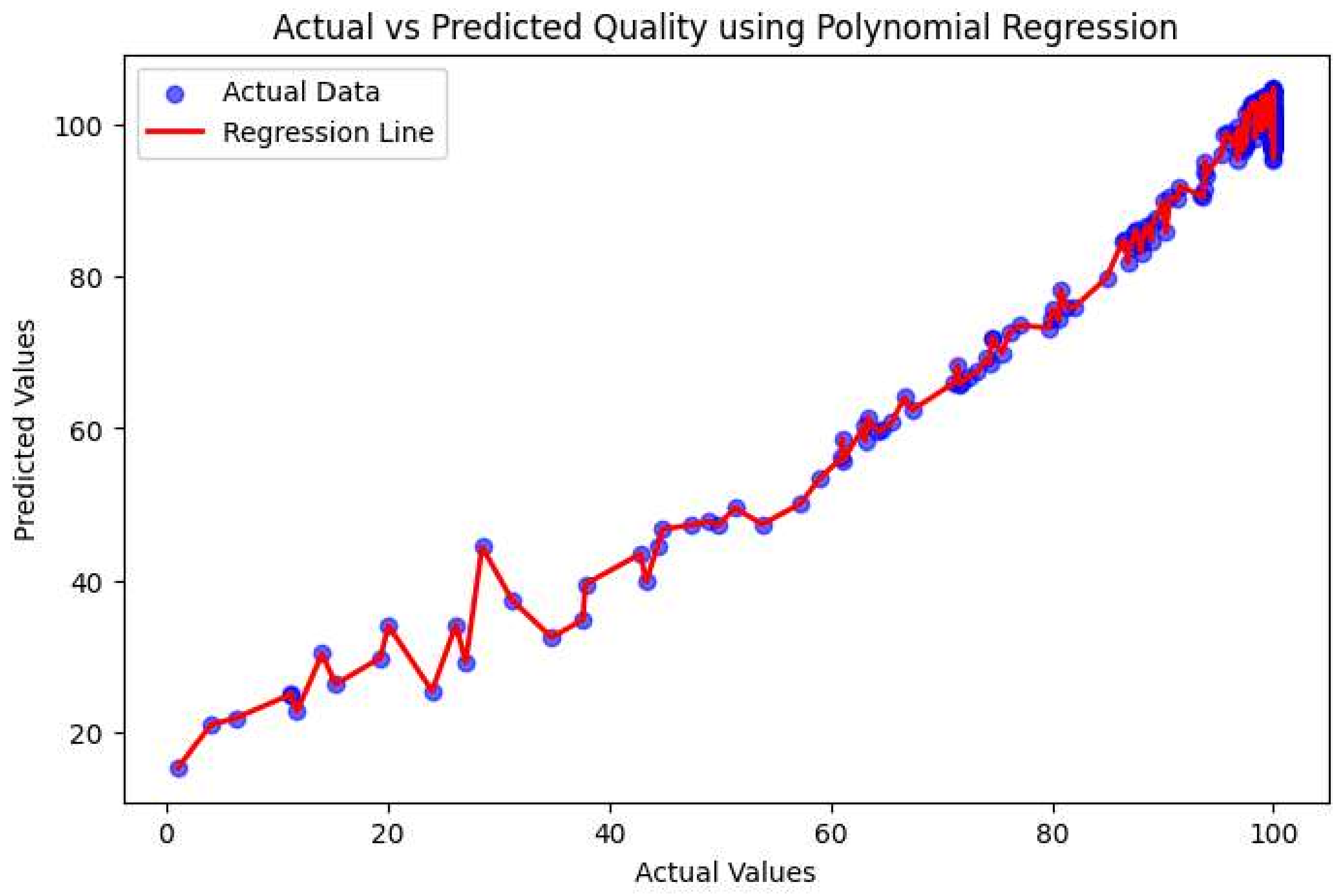
```
R squared: 0.97
Mean Absolute Error: 1.7253835831358035
Mean Squared Error: 6.978844408019494
Root Mean Squared Error: 2.6417502546644136
```

In [17]:
```python
plt.scatter(y_test, y_pred, color='blue', alpha=0.6)
plt.plot(y_test, y_pred, color='red', linewidth=2, label='Regression Line')
plt.title("Actual vs Predicted Quality using Polynomial Regression")
plt.xlabel('Actual Values')
plt.ylabel('Predicted Values')
plt.legend()
plt.show()
```



In [18]:
```python
sorted_idx = np.argsort(y_test)
y_test_sorted = np.array(y_test)[sorted_idx]
y_pred_sorted = y_pred[sorted_idx]
```

In [19]:
```python
plt.figure(figsize=(8,5))
plt.scatter(y_test, y_pred, color='blue', alpha=0.6, label="Actual Data")
plt.plot(y_test_sorted, y_pred_sorted, color='red', linewidth=2, label="Regression Line")
plt.title("Actual vs Predicted Quality using Polynomial Regression")
plt.xlabel('Actual Values')
plt.ylabel('Predicted Values')
plt.legend()
plt.show()
```


Actual vs Predicted Quality using Polynomial Regression
Actual Data
Regression Line
Predicted Values
Actual Values
100
80
60
40
20
0
20
40
60
80
100

In [ ]: