



Write Python code for statistical process control in steel manufacturing.



Statistical process control (SPC) is a set of statistical methods used to monitor and control a manufacturing process. In the steel manufacturing industry, SPC can be used to monitor variables such as temperature, pressure, and chemical composition. Here's an example Python code for implementing SPC in steel manufacturing:

python

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import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from scipy.stats import norm

# Define the data to be analyzed
data = pd.read_csv('steel_production_data.csv')
x = data['temperature'].values

# Calculate the mean and standard deviation of the data
mu = np.mean(x)
sigma = np.std(x)

# Set the control limits
upper_control_limit = mu + 3*sigma
lower_control_limit = mu - 3*sigma

# Plot the data with control limits
plt.plot(x)
plt.axhline(upper_control_limit, color='r', linestyle='--')
plt.axhline(lower_control_limit, color='r', linestyle='--')
plt.title('Temperature Control Chart')
plt.xlabel('Time')
plt.ylabel('Temperature')
plt.show()

# Calculate the number of data points outside the control limits
num_outside_limits = len(np.where((x > upper_control_limit) | (x < lower_control_limit)))

# Calculate the proportion of data points outside the control limits
proportion_outside_limits = num_outside_limits / len(x)

# Calculate the probability of observing the number of data points outside the control limits if the process is in control
p_value = 2 * (1 - norm.cdf(abs(num_outside_limits - len(x)*proportion_outside_limits)))

# Check if the process is out of control
if p_value < 0.05:
    print('The process is out of control.')
else:
    print('The process is in control.')
```

In this example, we import the necessary libraries, read in the data, calculate the mean and standard deviation, set the control limits, plot the data with the control limits, and calculate the number and proportion of data points outside the control limits. We also calculate the p-value, which tells us the probability of observing the number of data points outside the control limits if the process is in control. Finally, we check if the process is out of control based on the p-value. If the p-value is less than 0.05, we conclude that the process is out of control.

