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1 # v_cone_blender_downtime_analysis.py
2
3 import pandas as pd
4 import matplotlib.pyplot as plt
5
6 # -----
7 # 1. Data Simulation
8 # -----
9 data = pd.DataFrame({
10     'Event_ID': range(1, 21),
11     'Component': ['Motor', 'Actuator', 'Sensor', '
    Conveyor'] * 5,
12     'Downtime_Minutes': [45, 30, 20, 15, 60, 25, 10,
    5, 55, 40, 30, 20, 65, 35, 15, 10, 50, 45, 25, 15],
13     'Type': ['Unplanned', 'Unplanned', 'Preventive',
    'Preventive'] * 5
14 })
15
16 COST_PER_MIN = 500
17 data['Cost_Impact'] = data['Downtime_Minutes'] *
    COST_PER_MIN
18
19 # -----
20 # 2. Aggregated Pareto Data
21 # -----
22 agg = data.groupby('Component').agg({
23     'Downtime_Minutes': 'sum',
24     'Cost_Impact': 'sum',
25     'Event_ID': 'count'
26 }).rename(columns={'Event_ID': 'Event_Count'}).
    sort_values(by='Downtime_Minutes', ascending=False)
27
28 # Cumulative % for Pareto
29 agg['Cumulative_Downtime'] = agg['Downtime_Minutes'].
    cumsum()
30 agg['Cumulative_Percent'] = 100 * agg['
    Cumulative_Downtime'] / agg['Downtime_Minutes'].sum()
31
32 # -----
33 # 3. Plot Pareto Chart
34 # -----

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35 fig, ax1 = plt.subplots(figsize=(8, 5))
36
37 # Bar chart for Downtime
38 ax1.bar(agg.index, agg['Downtime_Minutes'], color='
    skyblue')
39 ax1.set_ylabel('Total Downtime (min)', color='blue')
40 ax1.tick_params(axis='y', labelcolor='blue')
41
42 # Line chart for cumulative %
43 ax2 = ax1.twinx()
44 ax2.plot(agg.index, agg['Cumulative_Percent'], color=
    'red', marker='o')
45 ax2.set_ylabel('Cumulative %', color='red')
46 ax2.tick_params(axis='y', labelcolor='red')
47 ax2.set_ylim(0, 110)
48
49 # Add grid and labels
50 plt.title("Pareto Chart - Downtime Duration by
    Component")
51 plt.grid(axis='y')
52 plt.tight_layout()
53 plt.show()
54
55 # -----
56 # 4. Display Key Metrics
57 # -----
58 print("\n--- Aggregated Downtime Data ---")
59 print(agg[['Downtime_Minutes', 'Event_Count', '
    Cost_Impact']])
60
61 top_contributors = agg[agg['Cumulative_Percent'] <=
    80].index.tolist()
62 print(f"\nKey Contributors to Downtime (≈80%): {' '.
    join(top_contributors)}")
63
64 total_loss = data['Cost_Impact'].sum()
65 print(f"\nEstimated Total Downtime Cost: ₹{total_loss
    :,.}")
66

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