Fujiyama Electronics, Inc. has been having difficulties with circuit boards purchased from an outside supplier. Unacceptable variability occurs between two drilled holes that are supposed to be 5 cm apart on the circuit boards. Twenty-five samples of four boards each were taken from shipments sent by the supplier as shown in the data listed in the part a).

1. Construct ‾x - and R-charts for these data.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | **Observations** |  |  |
| **Sample** |  | **1** | **2** | **3** | **4** |
|  |  |  |  |  |  |
| 1 |  | 4.92 | 4.26 | 4.94 | 4.29 |
| 2 |  | 4.65 | 5.54 | 5.00 | 5.42 |
| 3 |  | 5.77 | 5.26 | 4.76 | 4.79 |
| 4 |  | 6.25 | 4.88 | 5.66 | 4.44 |
| 5 |  | 5.27 | 5.41 | 6.02 | 4.91 |
| 6 |  | 5.22 | 5.38 | 5.08 | 4.65 |
| 7 |  | 5.47 | 4.68 | 4.56 | 4.70 |
| 8 |  | 5.71 | 4.54 | 4.17 | 4.87 |
| 9 |  | 5.24 | 5.58 | 4.72 | 5.41 |
| 10 |  | 4.42 | 5.18 | 4.79 | 4.73 |
| 11 |  | 5.14 | 4.26 | 4.71 | 5.48 |
| 12 |  | 4.92 | 5.78 | 5.50 | 5.05 |
| 13 |  | 5.79 | 3.83 | 4.30 | 4.78 |
| 14 |  | 4.92 | 4.80 | 4.75 | 5.59 |
| 15 |  | 5.68 | 5.74 | 4.65 | 5.20 |
| 16 |  | 5.43 | 4.81 | 5.27 | 4.96 |
| 17 |  | 4.79 | 6.04 | 4.47 | 5.18 |
| 18 |  | 4.43 | 5.08 | 3.69 | 6.43 |
| 19 |  | 6.35 | 5.95 | 6.29 | 5.89 |
| 20 |  | 5.03 | 4.66 | 5.25 | 4.46 |
| 21 |  | 6.32 | 6.09 | 5.57 | 5.91 |
| 22 |  | 4.30 | 5.47 | 4.27 | 4.34 |
| 23 |  | 6.07 | 4.97 | 5.51 | 5.02 |
| 24 |  | 5.11 | 4.90 | 5.91 | 4.66 |
| 25 |  | 4.50 | 5.24 | 4.86 | 4.35 |

b. If the supplier’s plant quality manager admitted that they were experiencing quality problems for shipments 18, 19, and 21, how would that affect your control chart? Show this adjustment on revised ‾x - and R-charts for these data.

c. Ten more observations were taken, as shown in the second table in the worksheet. Using the revised ‾x - and R-charts from part (b), comment on what the chart shows after extending it with the new data.

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| --- | --- | --- | --- | --- | --- |
|  |  |  | **Observations** | |  |
| **Sample** |  | **1** | **2** | **3** | **4** |
|  |  |  |  |  |  |
| 1 |  | 4.92 | 5.54 | 5.00 | 5.42 |
| 2 |  | 4.65 | 5.14 | 4.26 | 4.71 |
| 3 |  | 5.78 | 5.50 | 5.05 | 4.79 |
| 4 |  | 5.95 | 3.83 | 4.30 | 4.44 |
| 5 |  | 4.92 | 4.80 | 4.75 | 5.59 |
| 6 |  | 5.68 | 5.74 | 4.65 | 4.65 |
| 7 |  | 4.78 | 5.79 | 5.20 | 4.70 |
| 8 |  | 4.43 | 4.81 | 5.27 | 4.87 |
| 9 |  | 6.04 | 4.47 | 5.18 | 5.41 |
| 10 |  | 4.96 | 5.18 | 5.48 | 4.73 |