1. Specifications for the density of dustless chalk used in classrooms is 3.5 ± 1.5. (The unit of measure is grams per centimeter2, or g/cm2.) A random sample of 100 pieces of chalk was selected and the density of each piece in the sample was recorded. The sample average was equal to 3.6 and the sample standard deviation was equal to 0.75. A histogram of the sample data is given below

a. How many pieces of chalk in the sample are considered defective (not within the specifications)?

(a) Number of defective pieces

To compute the defective chalks, we first find the Upper Specification Limit (USL): 3.5 + 1.5 = 5.0 g/cm², and the Lower Specification Limit (LSL): 3.5 - 1.5 = 2.0 g/cm²Therefore, we need to determine how many bits of chalk fall beyond the allowed range (between 2.0 g/cm² and 5.0 g/cm²). Looking at the histogram, we observe that there are two pieces below 2.0 and five parts over 5.0. Hence, **there are 7 faulty bits of chalk.**

b. Using your response to the above question, what is the dpmo value for this process?

(b) DPMO (Defects per Million Opportunities):

DPMO = (Number of Defects / Total Opportunities) × 1,000,000

(7 / 100) * 1,000,000 = **70,000**

c. According to the concepts of Six-Sigma Quality, what is the quality level for this process? (Use the conversion table provided.)

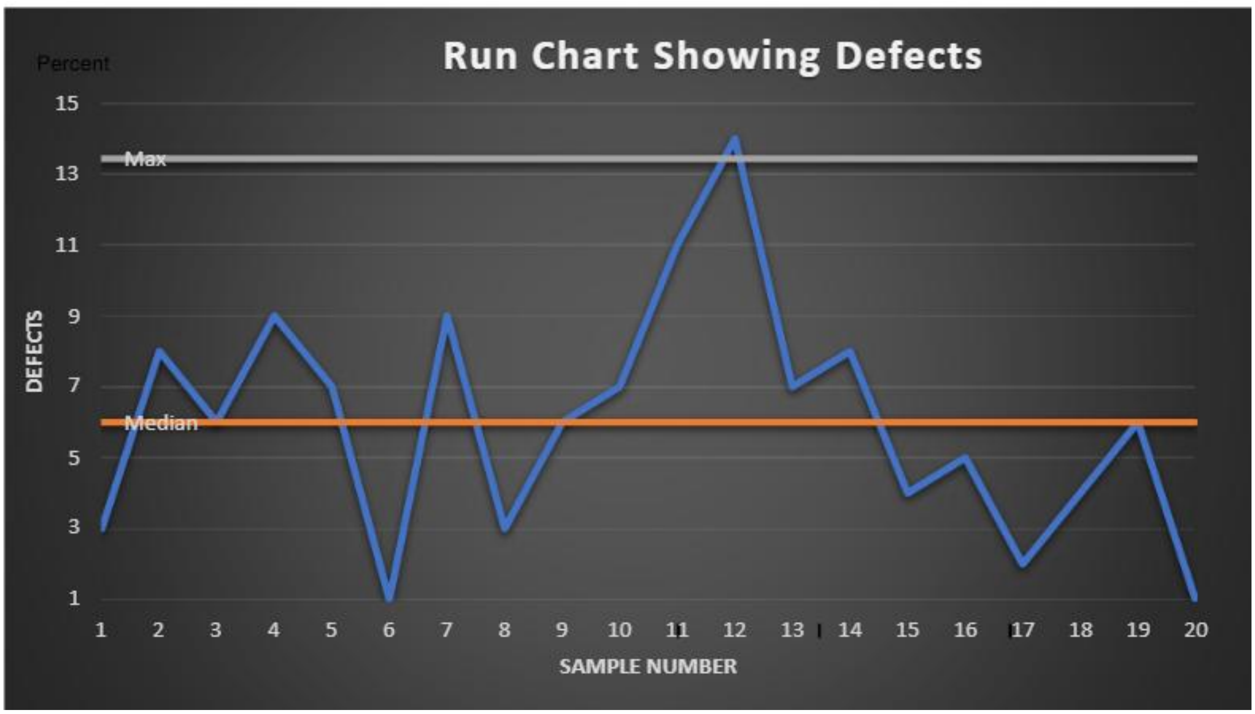
(c) Six-Sigma Quality Level:

Approximately 3 sigma with 1.5σ.

2. The number of defects found in 20 samples of 100 Frost Ice-cream Company flavors taken on a daily basis from a production line over a five-week period is given below.

a. Plot these data on a run chart, computing the average value (center line).

(a) Run Chart:



Average defects = sum of defects / number of samples

121 / 20 = **6.05**

b. According to the concepts of Six-Sigma Quality, what the quality level for this process? (Use the conversion table provided.)

(b) Six-Sigma Quality Level:

DPMO = (121 / (20 * 100)) * 1,000,000 = **60,500 corresponds to approximately 3 Sigma Level with off-centering of 1.5 sigma.**

c. Do you suspect that any special causes are present? Why?

(c) Special Causes:

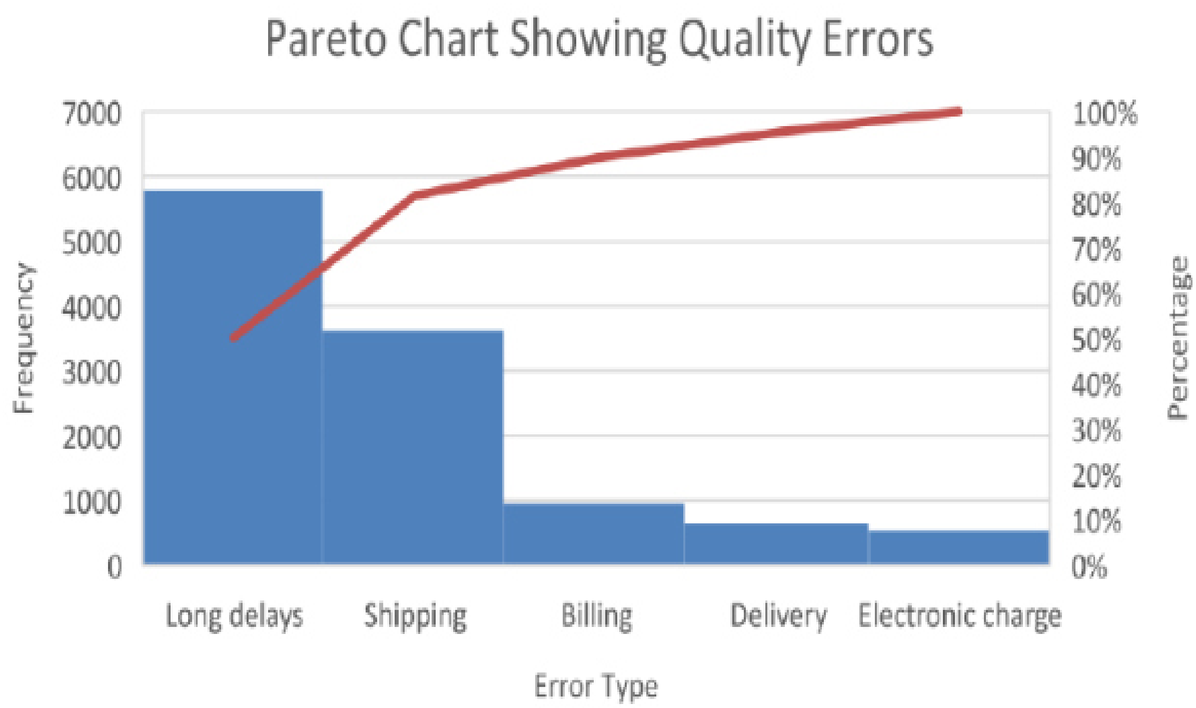
Yes, special causes may be present if there are significant deviations or trends in the run chart. But based on the facts supplied, there doesn't seem to be any obvious indication of particular reasons. The variance in faults among the 20 samples appears to follow a consistent pattern without any odd spikes or decreases in defect frequency that would reflect an external cause. According to Six Sigma concepts, special causes are commonly recognized when there is an anomalous deviation or trend in the data. In this situation, the defect counts remain within a reasonable range of variation. Therefore, it may be argued that no special factors are immediately evident in the data

3. Analysis of customer complaints at Flash Apparel Company revealed errors in five categories. Data is provided below

a. Construct a Pareto diagram for these data.

b. What conclusions can you reach?

(a) Pareto Diagram:



(b) Conclusion:

The Pareto Principle (80/20 rule) applies:

- **Long Delays** and **Shipping Errors** are the most significant contributors (81.5%). Focus on improving these two areas for the greatest impact.

4. A machine produces rubber tubing of a set length: as the conveyor moves the tube, a blade cuts it at regular intervals. The customer specification for the tube length is 1026 mm, +/- 10 mm. However, there is an inconsistency in the cut length of the rubber tubes produced, so data is sampled measuring the conveyor speed and cut length. The results are showed in the table below

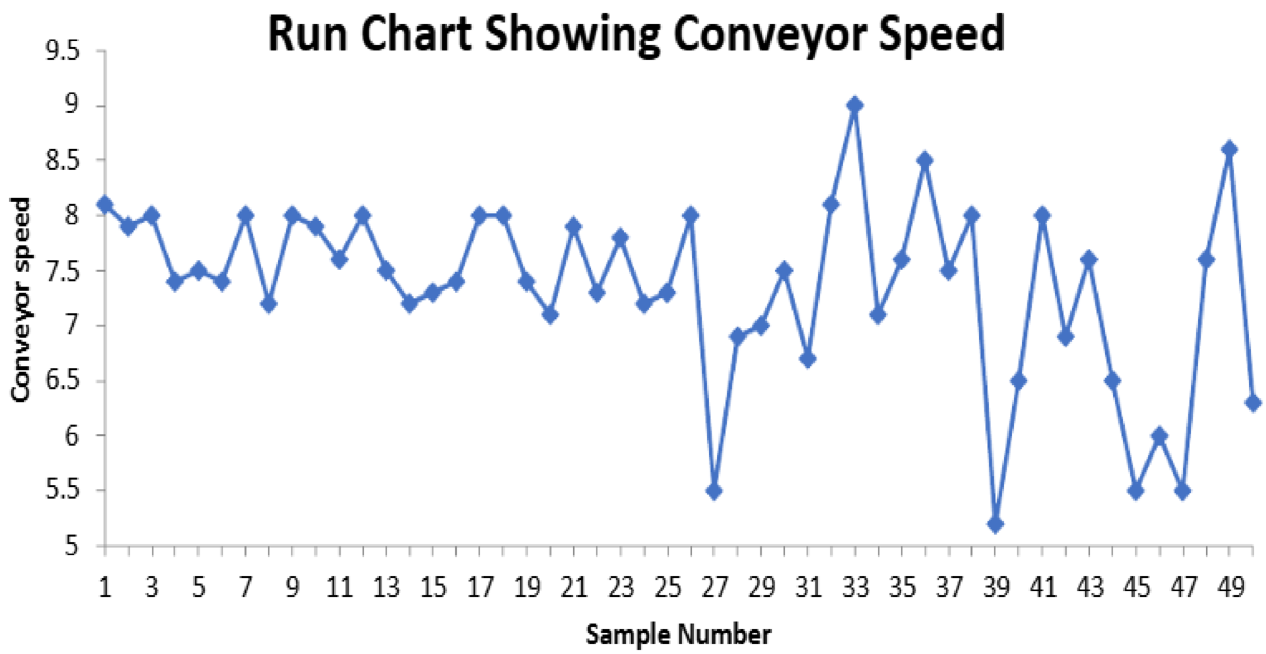
a. Construct a run chart for this data. What conclusions can you reach?

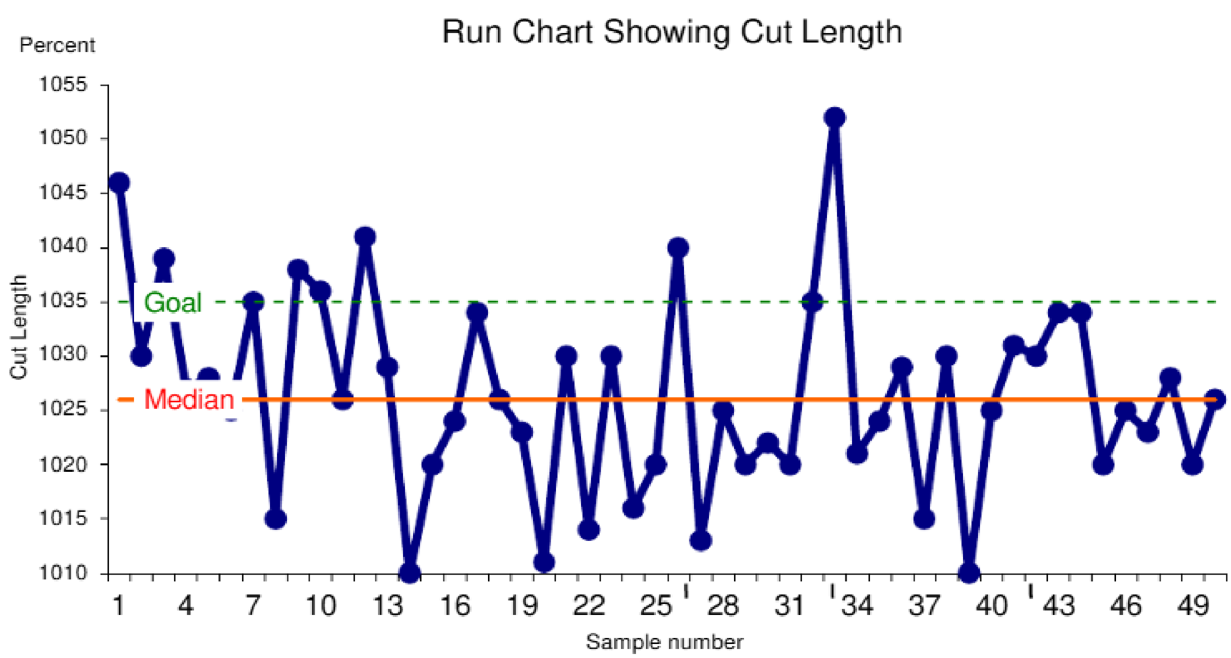
b. According to the concepts of Six-Sigma Quality, what the quality level for this process? (Use the conversion table provided.)

c. Construct a scatter diagram for the data provided. What conclusions can you reach?

d. What recommendations would you make to improve this process?

(a) Run Chart:


Run Chart Showing Conveyor Speed
Conveyor speed
Sample Number
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49


Run Chart Showing Cut Length
Percent
Cut Length
Sample number
Goal
Median
1055
1050
1045
1040
1035
1030
1025
1020
1015
1010
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49

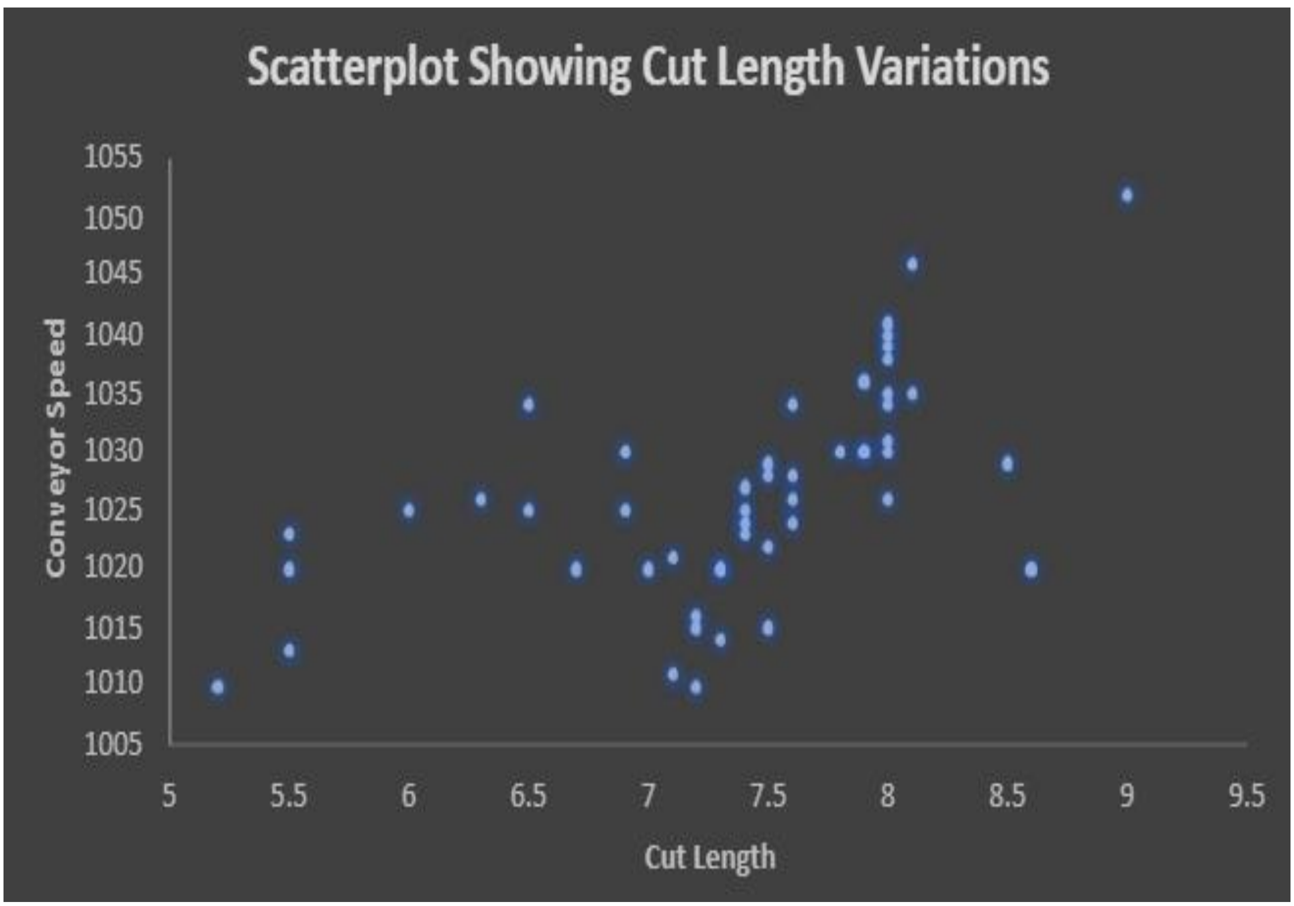
Conclusion:

It seems that special cause variations are present. It is believed that the conveyor speed is a prevalent cause fluctuation. A run chart for the conveyor speed shows that it varies considerably (we do not have specifications so we cannot deduce how many times it is outside of conformance), but a preliminary look at the two run charts does not seem to shown a strong relationship between the two.

(b) Six-Sigma Quality Level:

DPMO = 13 / 50 * 1,000,000 = **260,000; approximately 2.1 sigma.**

(c) Scatter Diagram:



Based on the scatterplot, it seems prudent to further investigate the relationship between these variables, potentially through additional analysis or experimentation, before concluding that simply controlling the conveyor speed will resolve the issue. The run charts indicating fluctuating speeds suggest there may be other factors at play that should be considered.

(d) Recommendations:

To fully understand and improve this manufacturing process, it would be beneficial to take a more comprehensive approach. First, additional variables beyond just conveyor speed should be measured to identify the root causes of the speed variations observed in the run charts. Stratifying the data by factors like operator and shift could help pinpoint any special causes leading to the fluctuations. Once the source of the speed variations is identified, a new set of samples should be measured to determine if the tube lengths are consistently within the specified tolerances or if there are other special causes driving variability in the cut lengths. By expanding the analysis to consider a broader set of potential influential factors, the underlying issues can be more effectively addressed to bring the process into a state of better control.