Concepts of Statistica1 quality control

Statistica1 quality control (SQC) is the term used to describe the set of statistical tools used by quality professionals. Statistical quality control can be divided into three broad categories

1. Descriptive statistics are used to describe quality characteristics and relation-ships. Included are statistics such as the mean, standard deviation, the range, and a measure of the distribution of data.

2. Statistical process control (SPC)involves inspecting a random sample of the output from a process and deciding whether the process is producing products with characteristics that fall within a predetermined range. SPC answers the question of whether the process is functioning properly or not.

3. Acceptance sampling is the process of randomly inspecting a sample of goods and deciding whether to accept the entire lot based on the results. Acceptance sampling determines whether a batch of goods should be accepted or rejected.

Sources of variation: common and assignable causes

Common causes of variation are based on random causes that we cannot identify. These types of variation are unavoidable and are due to slight differences in processing

An important task in quality control is to find out the range of natural random variation in a process. For example, if the average bottle of a soft drink called Cocoa Fizz contains 16 ounces of liquid, we may determine that the amount of natural variation is between 15.8 and 16.2 ounces. If this were the case, we would monitor the production process to make sure that the amount stays within this range. If production goes out of this range bottles are found to contain on average 15.6 ounces this would lead us to believe that there is a problem with the process because the variation is greater than the natural random variation.

The second type of variation that can be observed involves variations where the causes can be precisely identified and eliminated. These are called assignable causes of variation. Examples of this type of variation are poor quality in raw materials, an employee who needs more training, or a machine in need of repair. In each of these examples the problem can be identified and corrected. Also, if the problem is allowed to persist, it will continue to create a problem in the quality of the product. In the ex-ample of the soft drink bottling operation, bottles filled with 15.6 ounces of liquid would signal a problem. The machine may need to be readjusted. This would be an assignable cause of variation. We can assign the variation to a particular cause (ma-chine needs to be readjusted) and we can correct the problem (readjust the machine).

Descriptive statistics

Descriptive statistics can be helpful in describing certain characteristics of a product and a process. The most important descriptive statistics are measures of central tendency such as the mean, measures of variability such as the standard deviation and range, and measures of the distribution of data. We first review these descriptive statistics and then see how we can measure their changes

The Mean

In the soft drink bottling example, we stated that the average bottle is filled with 16 ounces of liquid. The arithmetic average, or the mean ,is a statistic that measures the central tendency of a set of data. Knowing the central point of a set of data is highly important. Just think how important that number is when you receive test score To compute the mean we simply sum all the observations and divide by the total number of observations. The equation for computing the mean is

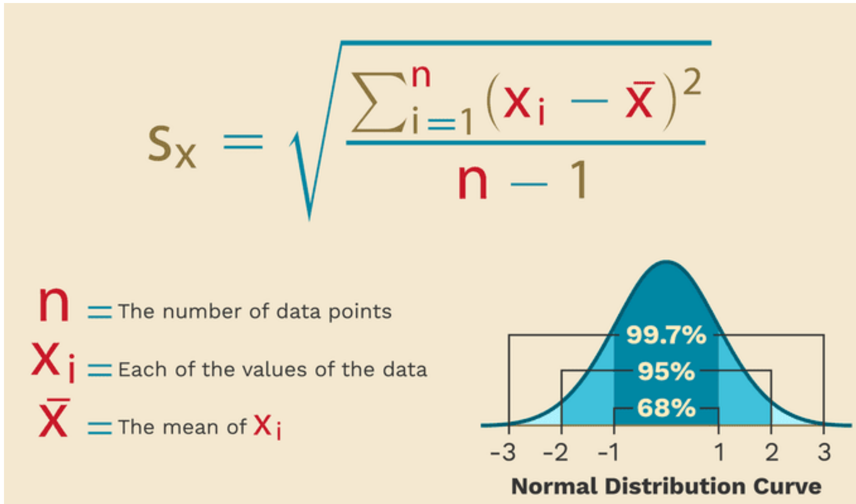

FIGURE 6-0 Equation for computing the mean

The Range and Standard Deviation

In the bottling example we also stated that the amount of natural variation in the bottling process is between 15.8 and 16.2 ounces. This information provides us with the amount of variability of the data. It tells us how spread out the data is around the mean. There are two measures that can be used to determine the amount of variation in the data. The first measure is the range, which is the difference between the largest and smallest observations. In our example, the range for natural variation is 0.4ounces.Another measure of variation is the standard deviation. The equation for computing the standard deviation is

$$s_x = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

n = The number of data points

$\bar{x}$ = The mean of the x_i

x_i = Each of the values of the data

Small values of the range and standard deviation mean that the observations are closely clustered around the mean. Large values of the range and standard deviation mean that the observations are spread out around the mean. Figure 6-1 illustrates the differences between a small and a large standard deviation for our bottling operation. You can see that the figure shows two distributions, both with a mean of 16 ounces. However, in the first distribution the standard deviation is large and the data are spread out far around the mean. In the second distribution the standard deviation is small and the data are clustered close to the mean.

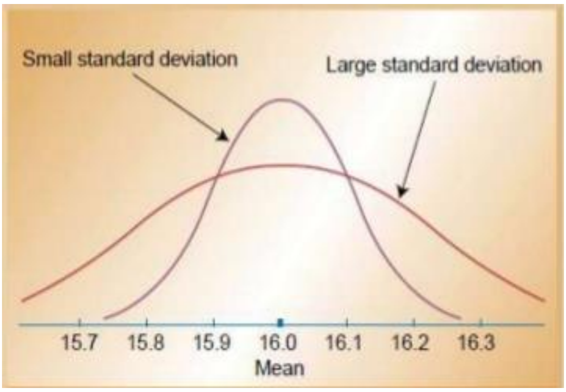

FIGURE 6-1 Normal distributions with varying standard deviations

Distribution of Data

A third descriptive statistic used to measure quality characteristics is the shape of the distribution of the observed data. When a distribution is symmetric, there are the same number of observations below and above the mean. This is what we commonly find when only normal variation is present in the data. When a disproportionate number of observations are either above or below the mean, we say that the data has a skewed distribution. Figure 6-2 shows symmetric and skewed distributions for the bottling operation.

References:

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