Reduce inspection costs with acceptance sampling

Regardless of your industry, you have to monitor quality to avoid heavy losses in time, money, and good will. While there are a number of methods, including control charts, available to protect you and your customers from poor quality, these methods are not always possible or appropriate.

In such cases you might think that you have to inspect every part you receive or ship to ensure quality, but 100 per cent inspection is impractical, as well as expensive and time consuming.

Acceptance sampling is a practical, affordable alternative to costly 100 per cent inspection. It offers an efficient way to assess the quality of an entire lot of product and to decide whether to accept or reject it.

Acceptance sampling plans
An acceptance sampling plan tells you how many units to sample from a lot or shipment and how many defects you can allow in that sample. If you discover more than the allowed number of defects in the sample, you simply reject the entire lot.

When you create an acceptance sampling plan, you specify the worst quality that you will accept on a regular basis (referred to as AQL) and the quality level that you will reject (referred to as RQL). Set your standards too low, and you risk wasting money on a lot of poor quality. Set your standards too high, and you could alienate your suppliers by rejecting acceptable lots.

With AQL and RQL values, and your statistical software package of choice, you can calculate the sampling requirements that match the risks you are willing to take. In this article, we will use Minitab Statistical Software to create acceptance sampling plans.

Creating a plan
Suppose you work for a company that manufactures kitchen appliances. You have many different suppliers providing parts to your line for appliance assembly. For this example, we will focus on one part, the appliance light bulb.

Because incoming light bulbs can be defective, you want to develop a sampling plan to make decisions regarding entire lots of bulbs without having to inspect every single light bulb your company receives. Although it is ideal to have zero defects, some defects are inevitable.

You and your light bulb supplier decide on quality levels and risks that allow some defects while maintaining profitability for both of you.

You decide that the worst quality you are willing to accept on a regular basis is 0.65 per cent defective (AQL) and the quality that you want to reject most of the time is 5.5 per cent defective (RQL).

The producer’s risk, also known as alpha, is the risk you will reject a good lot, while the consumer’s risk, or beta, is the risk you will accept a poor lot. We will use a producer’s risk of 0.05 and a consumer’s risk of 0.10.

It is important to work closely with your suppliers in determining your own AQL, RQL, and risk levels. For instance, some quality practitioners may find the values of 0.65 percent for AQL and 5.5 percent for RQL too high for their application. However, in our light bulb example, we know that all light bulbs are checked upon installation, so we are willing to accept more defective bulbs during manufacturing.

Your sampling plan is simple. Based on the Minitab results shown in Fig. 1, you plan to randomly sample 96 light bulbs from the shipment. If you find two or fewer defective bulbs, you will accept the entire lot of bulbs. Otherwise, the entire lot of bulbs will be rejected.

The Operating Characteristic Curve (OC Curve) – which is illustrated in Fig. 2 – shows you the probability that you will accept lots with various levels of quality.

With this acceptance sampling plan, you will accept lots that average 0.65 per cent defective (AQL) about 98 per cent of the time, and lots that average
5.5 per cent (RQL) only 10 per cent of the time.

**Comparing plans**

The suggested sampling plan is a good starting point, but other people who are involved in the sampling procedure may want to adjust the sample size and acceptance number. In cases like the scenarios described below, you can easily generate multiple plans at the same time and compare OC Curves to find the best plan:

- **More convenient sample size:** The inspectors find it most convenient to inspect 10 bulbs at a time because of their test fixture. They want you to change the sample size from 96 to 90.
- **Smaller sample size:** Looking to save time, your supervisor suggests taking a much smaller sample. He wants you to reduce the sample size from 96 to 50.
- **Larger acceptance number:** Your supplier is nervous that his shipments will be unfairly rejected. He wants you to raise the acceptance number and accept at least 10 defective bulbs before returning an entire lot.

The original sampling plan can easily be compared with the three new scenarios using Minitab.

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**Fig. 2.** The OC Curve shows the probability of accepting a lot at various quality levels.

The black line on the OC Curve shown in Fig. 3 represents your original sample plan with a sample size of 96 (n) and an acceptance number of 2 (c).

The red line represents a relatively small departure from the original plan, showing a negligible reduction.
By sharing this OC curve with your supervisor, you can point out that the resulting consumer risk is much too high for you to consider reducing your sample size to 50.

The OC curve can also be shown to your supplier to prove that the resulting consumer risk is much too high for you to consider raising your acceptance number to 10.

Perhaps you will evaluate other acceptance numbers between 2 and 10.

**Putting it to use**

Acceptance sampling plans alone will not magically improve or control your processes. Instead, they offer a useful tool to reduce your inspection costs by providing statistically valid procedures to accept or reject incoming material or final product. They also allow you to easily create and compare various plans to communicate with your team members.

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