OC Curves for the C and U Charts

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Introduction

- Last week, we learned about a few new types of charts for monitoring the number of nonconformities in a sample, including the np, C and U charts.

- We learned how to calculate Phase I control limits for each of the charts using both SAS and R as well as how to take the Phase I limits and use them in Phase II monitoring.

- Where we left off was how to design the chart to be useful in efficiently detecting shifts of various magnitudes with high probability using our old friends the OC curves.

OC Curves for the C and U Charts

- Remember, OC curves are built by modeling the probability of making a Type II error, that is, having a point plot inside the control limits when the process is really out-of-control.

- For example, with the C chart, assume the process has shifted from an in-control mean value, c_0, to a new value c_1.

$$P[LCL < X < UCL | c = c_1] = \beta$$

$$P[X < UCL | c = c_1] - P[X < LCL | c = c_1] = \beta$$

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- Let's look at the circuit boards example from last week.
- After removing the two OOC points, we estimated $\bar{c} = 19.67$, $UCL = 32.97$ and $LCL = 6.36$.
- Let's use R to help us do the rest of the heavy lifting.

OC Curves for C and U Charts

- The U chart is a little bit different. Technically, u is not distributed as a Poisson random variable, so we have to manipulate the formula for calculating β before to get it into a known distributional form.

- Remember $u = x/n$ and $x \sim POI(nC)$. Thus:

$$P[u < UCL|OOC] - P[u < LCL|OOC] = \beta$$

$$P[x/n < UCL|OOC] - P[x/n < LCL|OOC] = \beta$$

$$P[x < nUCL|OOC] - P[x < nLCL|OOC] = \beta$$

OC Curves for C and U Charts

- Because the control limits multiplied by n are likely not an integer, we practically round the LCL up and the UCL down.
- Let's take a look at an example of plotting the OC Curve using the supply chain data from last week.