PROJECT #1

OM 516 STEM/CREATE

Fall 2023

Topic: Statistical Process Control

Problem Description

Green-o-Plast, Inc. (GoP) produces plastics from more sustainable ways by using renewable resources and recycling various materials. One of their products is a dishwasher latch they provide to the appliance industry. For this particular product, they measure tensile strength at break in pounds per square inch (lb/in^2, or psi). The industry-wide specification for this product is 660 ± 35 psi. Too much strength means rigidity and shorter lifetime, hence there is an upper specification limit as well as a lower specification limit.

The product has enjoyed a steady demand and GoP runs a dedicated workstation to produce it. The station runs 7 days a week, 3 shifts per day. The process is cleaned and restarted every Monday morning, so every week is in a way independent. In an effort to start a Total Quality Management transformation, they have started to collect a single sample of 8 items from the station every shift. Data from the past 156 weeks are available. Based on an even longer history, GoP knows the process standard deviation is 10 psi.

Looking back at the past 156 weeks, GoP asks for your help to find when its process may have gone out of control.

Resources

- Data
  - All in a single ("Data.csv") file
  - Each team is asked to analyze one week of data as indicated in the first column (team 0 is the instructor), hence "week" and "team" are used interchangeably
- A Python library ("PublicFunctions.py") including functions you may need for the project.
- SPC rules to follow (https://asq.org/quality-resources/control-chart section "Out-of-control signals")
- Python
  - Install Anaconda (https://docs.anaconda.com/anaconda/install/)
  - Install Jupyter Notebook (https://jupyter.org/install)
- Power Point presentation template.

Tasks

1. Calculate the overall (from all 156 weeks) centerlines for both the sample mean and range.
2. Calculate the upper and lower control limits for both sample mean and range.
3. Draw the x-bar and R charts for the week assigned to your team. (The library can help you here.)
4. Using the ASQ's SPC rules (provided below for your convenience), identify all points where the process may have gone out of control.
    - The fifth rule is subject to interpretation, so provide a thorough discussion of any out-of-control points you identify this way.
5. Compute Cpk.

Python proficiency is a sought-after skill is today's job market, and this project is based on it to provide you with a learning opportunity in a controlled environment. However, you're by no means required to use Python to complete this project. If you prefer to use any other software (such as MS Excel), or no software at all, to complete the above-listed tasks, you certainly can. We just won't be able to provide additional sample solution templates.

ASQ Rules for Detecting Out-of-control Signals

The following are the rules. Examples are excluded for sake of brevity; you may refer to the ASQ website (https://asq.org/quality-resources/control-chart section "Out-of-control signals") for the examples and more information.

1. A single point outside the control limits.
2. Two out of three successive points are on the same side of the centerline and farther than 2 σ from it.
3. Four out of five successive points are on the same side of the centerline and farther than 1 σ from it.
4. A run of eight in a row are on the same side of the centerline. Or 10 out of 11, 12 out of 14, or 16 out of 20.
5. Obvious consistent or persistent patterns that suggest something unusual about your data and your process.

Deliverables

- Details of your work (i.e., Python notebook(s). If you used another software, files showing your work there. If you didn't use any software, then scanned images of your manual work.)
- Power Point presentation (which you may present to class during our discussion).
- TeamProject1 assignment on Blackboard where you can submit the two afore-mentioned files by the due date (11:59PM on 10/8/2023).
- Discussion in class (on 10/9/2023).