You recently collected 30 days’ worth of data from our large batch reactors. These large batches have resulted in us equipping the reactor to take 5 samples from different locations for concentration measurements. In order for us to continue running this scaled-up process, we require that you analyze these data.

Recall that these reactors were run targeting a minimum of 70% conversion. You will get a data set of 5 measurements each from the last 30 days of run data.

Please look at the production data for the last 30 days. We would like you to develop an $\bar{x} - S$ control chart and plot it. Please include LCL, UCL, LSL, and USL. You should also calculate process capability indices $C_P$ and $C_{PK}$. Finally, please identify any potential special causes of variation and explain why you think they are special causes. Repeat the capability calculations after you have eliminated these runs until they only represent common causes.

In addition to the $\bar{x} - S$ control chart, one of our senior engineers mentioned using a $\bar{x} - R$ chart at a previous employer. Please include LCL, UCL, LSL, and USL. You should also calculate process capability indices $C_P$ and $C_{PK}$. Management is very interested in comparing these two charts to determine which one to use in future production. Along with this $\bar{x} - R$ chart, please include any pros/cons of using an $\bar{x} - R$ vs $\bar{x} - S$ chart to track our production.

In the interest of saving time and money, a new executive has also suggested tracking an “individuals” control chart, using only the first concentration data point each day. Please create a control chart, including LCL, UCL, LSL, and USL, and calculate $C_P$ and $C_{PK}$. Include a brief summary of the pros/cons of using this chart compared to an $\bar{x} - R$ or $\bar{x} - S$ control chart.

Please provide a software file where you plot the control charts for the month you analyzed to TEACH [https://secure.engr.oregonstate.edu:8000/] and report your calculated values of initial $C_P$ and $C_{PK}$, identify the days associated with special causes and describe how you determined them, and then also submit revised $C_P$ and $C_{PK}$ calculations.