Computer Science Technical Challenge

Not only do we hope to empower future consumers, but we also need to empower the team with real-time data to know how our bioreactors and cells are behaving. Glucose is one of our core metrics for assessing how the cells are behaving and producing in our in vitro bioreactor system. Because of this, it's foundational that we have a real-time dashboard to determine the health of our bioreactors and process through glucose data and other in-line sensing apparatus.

Your challenge has two parts and can be prepared as a document, slide deck, or alternative deliverable form that addresses the following:

Part 1: Sample Data Analysis & Glucose Monitoring System

- Attached you will find a spreadsheet of data from our daily glucose monitoring. Please analyze the raw data and determine what data should be included to build a dashboard. Please code to notice/remove outliers or bad data as much as possible. Cite any assumptions you may make as you assess the data.
- We operate bioreactors on a 90-day cycle. As of now, approximately 2 weeks of each 90 day cycle the glucose readings will vacillate between proliferation *stage I* (where the cells are growing rapidly), steady state *stage II* (where the cells reach contact inhibition and become still). Then the remaining approximate 75 days is lactogenic stimulation *stage III* (where the cells need a different blend of nutrients to make milk and are actively lactating).
- For our process, the bioreactor status progresses from a proliferative phase, wherein the cells initially proliferate to form a monolayer, to a steady state, wherein the cells stop proliferating due to contact inhibition. Once the steady state has been maintained for three consecutive readings, then the cells are stimulated with lactogenic media, after which the bioreactor enters the lactating phase which is maintained for the remainder of the run. (Note: the glucose consumption rate may spike aberrantly due to bacterial contamination of bioreactor irrespective of its status)
  Based on the data provided, please determine the phase of the bioreactors throughout the bioreactor run and report that status on the dashboard.

Part 2: Additional Data Visualization

- We aren't expecting to see your code or see an interactive web application, but expect data visualization. A screenshot of your results is fine, as long as it can be explained to a non-technical audience. Please cite what code language you used, and why.
- Other parameters you should consider showing how they would be monitored and shown are:
  - Temperature Sensing
  - Glucose levels (in media as well as product)
  - pH Levels (media)
  - O2 Levels (media)

- Days into run (Day of inoculation, Day of 1st prolactin dose, Sampling interval, Media change)
- Overall Status Indicator (Red, Yellow, Green)
- Protein content of product
- Lactose content of product

While we are excited to see how you think, solve problems, and move through ambiguity, please don't feel obligated to put in unnecessary hours for the 'perfect' deliverable. We would rather see good thought, thorough exploration, and an excellent presentation of how you approached the work. As you go along please document what assumptions you made, and what additional information would be helpful, and what lingering doubts you may have. We request that any resources you utilize you cite, however feel free to pull from industry knowledge, literature, contacts, and personal experience! Good luck!