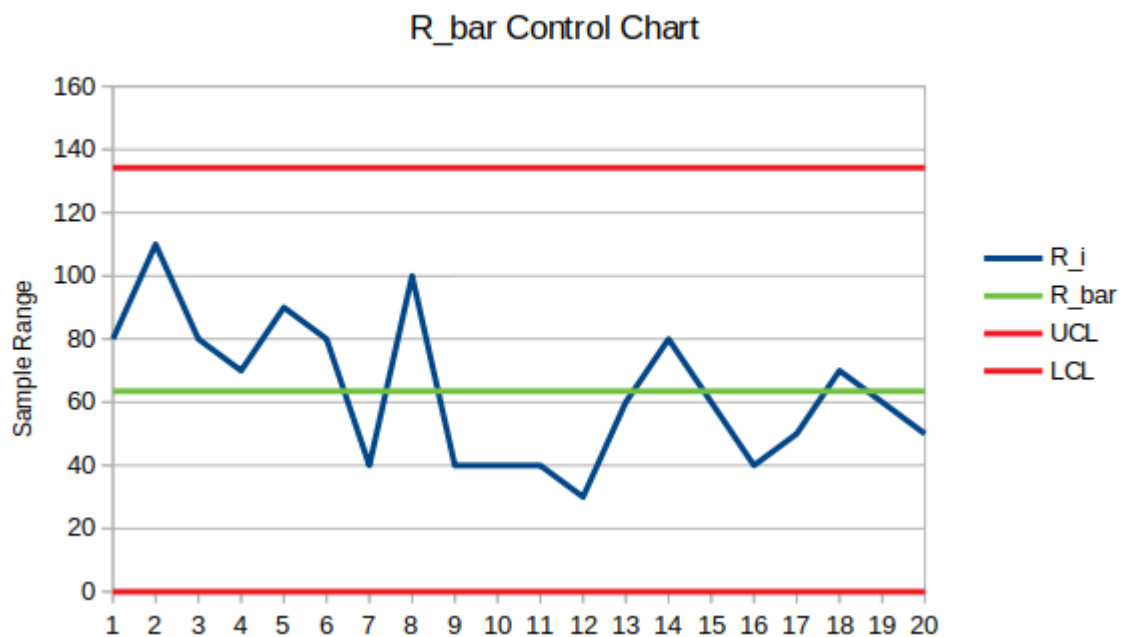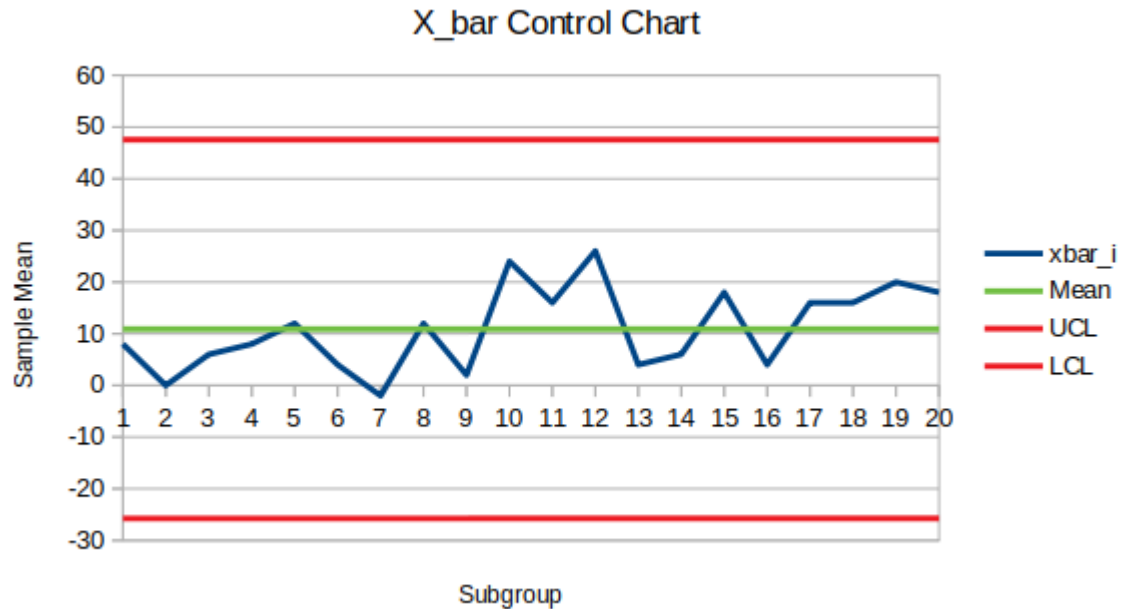1. See attached Word document.

2. See attached Word document.

3. We consider the Carbon Fiber data from the assignment file.

   (a) First, we construct the control charts for $\bar{x}$ and R. These charts follow,


Here, we see that the process values fall within the UCL and LCL values for both the $\bar{x}$ and R values. Aside from a possible gentle slope in the data, it appears to be performing within acceptable values, with fairly random variation point to point. So, we conclude that the process is likely in control.

   (b) Next, we perform the same analysis on the standard deviation values. The results follow,

x_bar Control Chart

s_bar Control Chart
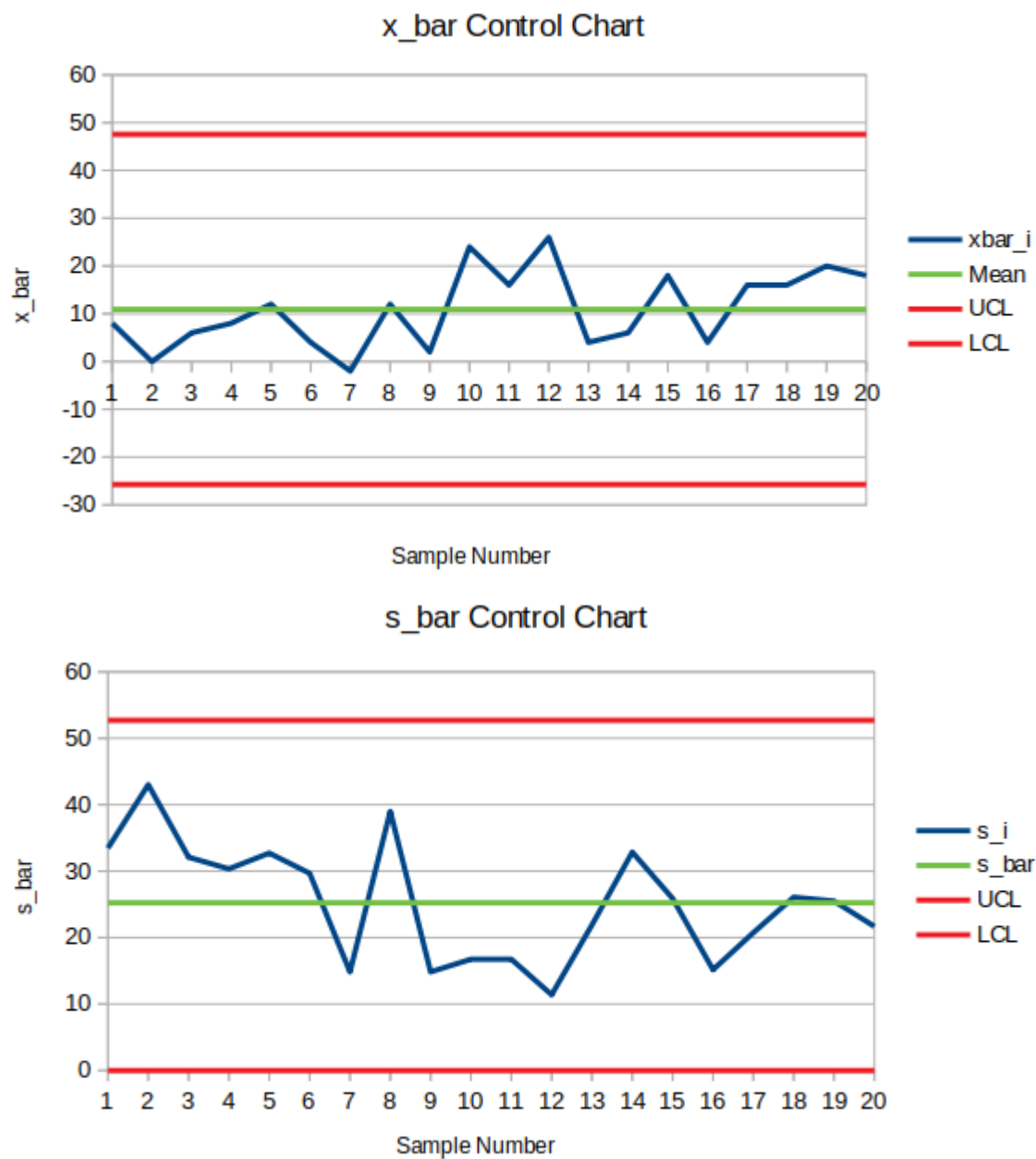
Here, we see that the process values fall within the UCL and LCL values for both the $\bar{x}$ and s values. Aside from a possible gentle slope in the data, it appears to be performing within acceptable values, with fairly random variation point to point. So, we conclude that it is likely in control.

4. We now consider the printed circuit board data. Again, we compute the $\bar{x}$ and R charts for the data, they follow,

xbar Control Chart

R_bar Control Chart
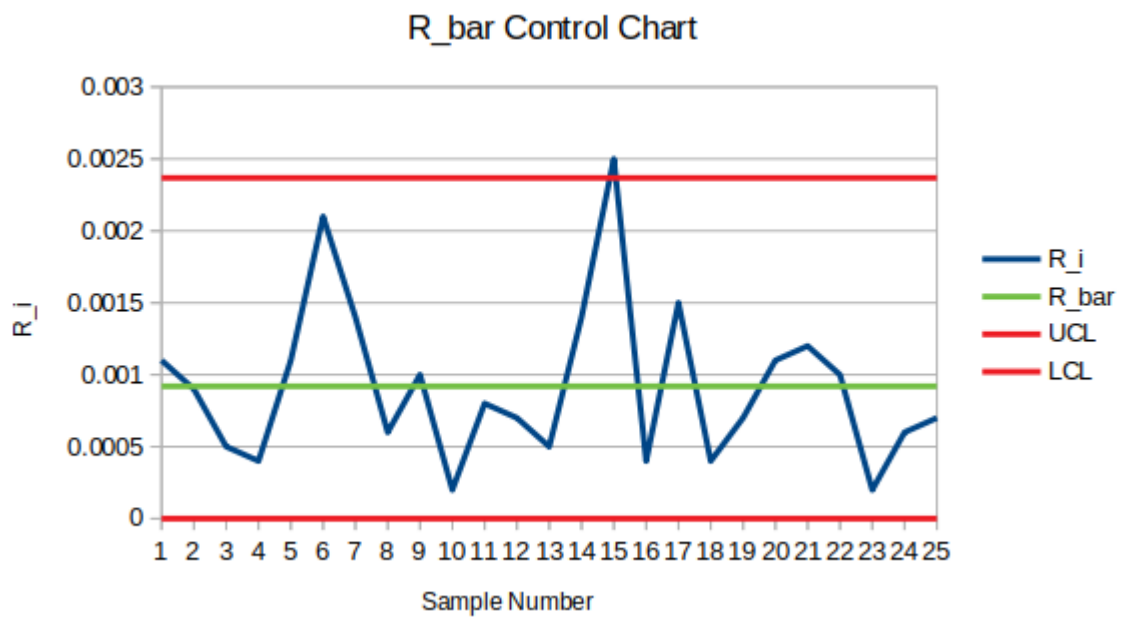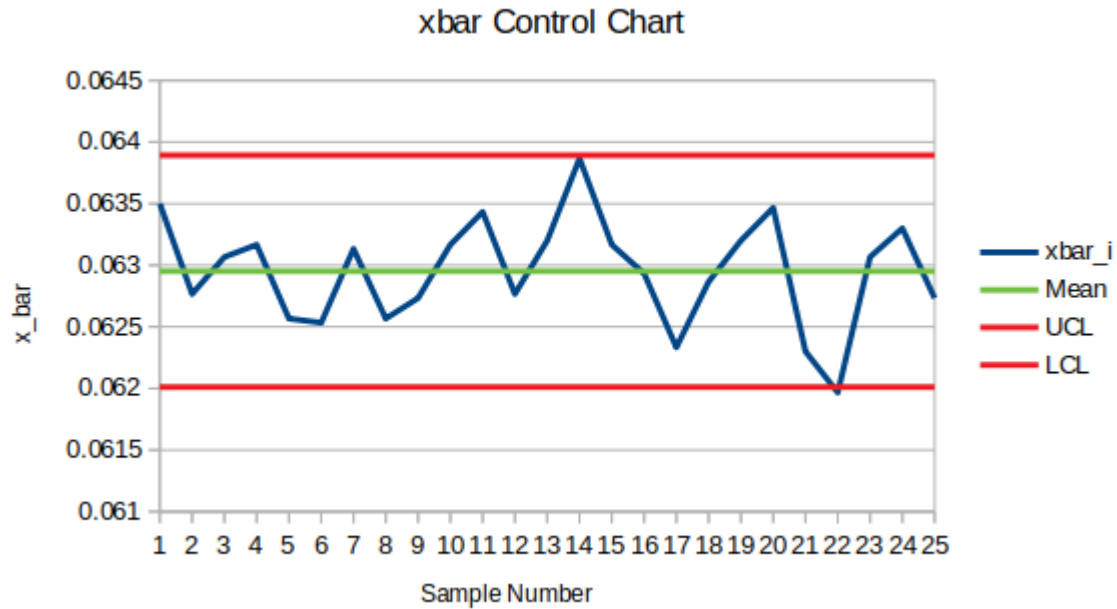
In this example, we see that the data has much more variance across sample. While almost all of the data falls within the bounds we have computed, we see that there are a few data points that fall on or over the boundary. Thus, we conclude that the data is somewhat outside of control. The process merits further analysis into improving the results in some way.

5. Finally, we consider the hospital data. Again, we compute the control charts for $\bar{x}$ and R.

X_bar Control Chart

R_bar Control Chart
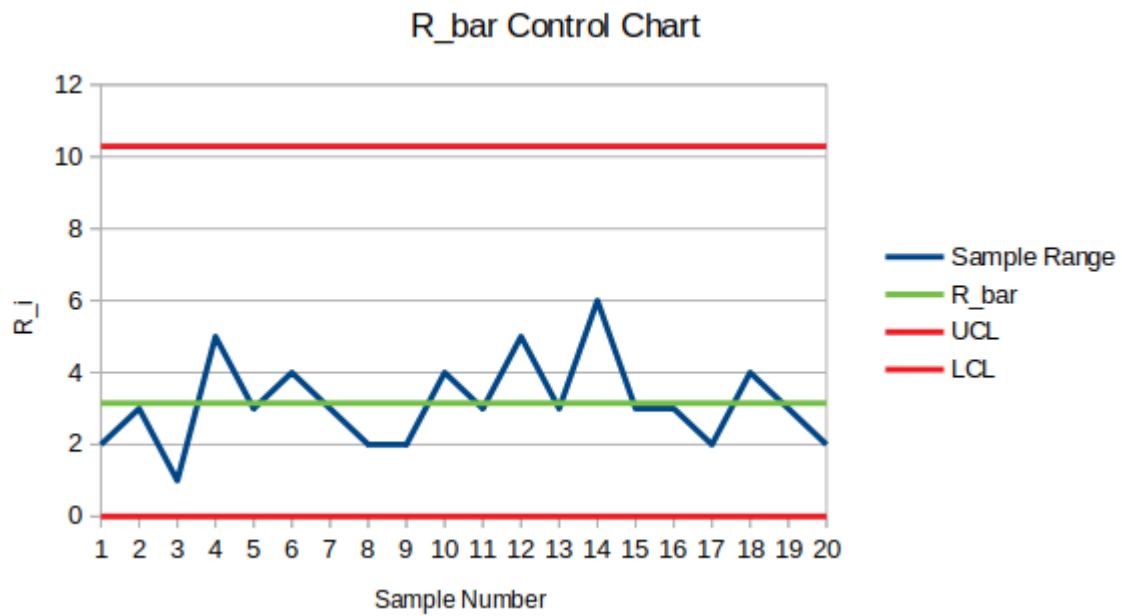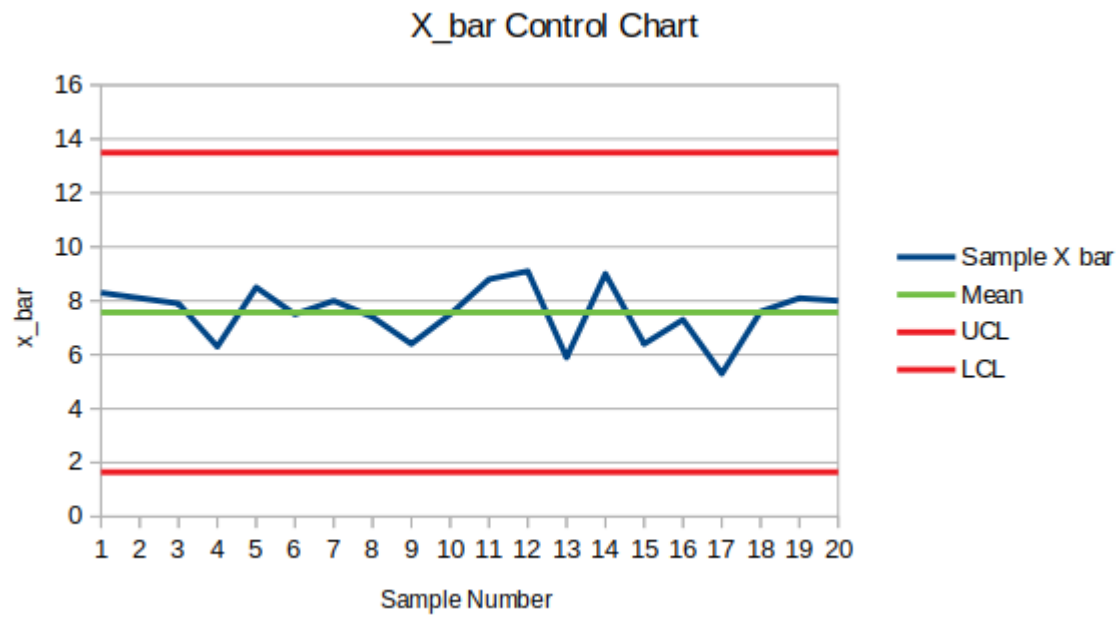
Here, we see that the data is falling well within the predicted limits, with random variation sample to sample. We conclude that the wait time is within SPC control limits.