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Math 330 - Project 2
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Project 2

Original Plan

Our plan is to run water filling stations continuously through individual person operators. At 5 minute intervals samples are going to be taken from the filling station for measurement. The bottles filled are the samples taken from the station for measurement. We will collect 10 samples with a size of 5 each. Being tasked with collecting data in relation to water filling stations and how accurate they are. With the data we will collect we can see and even calculate multiple things with some of such items being the UCL, LCL, Cl and several charts such as X and R. These charts give us the ability to do many things with the main advantage of being able to see how our data falls. Is our data being affected by special causes causing it to be out of control or is it within control limits? How might we improve our process to tighten out control limits?

Data

	1	2	3	4	5		Mean	Range	St. Dev.
1	352	353	354	362	363		356.8	11	5.263079
2	360	374	351	360	355		360	23	8.689074
3	356	346	347	341	353		348.6	15	5.94138
4	353	371	359	364	351		359.6	20	8.173127
5	367	355	350	345	348		353	22	8.631338
6	346	363	357	363	363		358.4	17	7.402702
7	356	354	349	353	354		353.2	7	2.588436
8	348	353	353	348	364		353.2	16	6.534524
9	358	351	352	350	354		353	8	3.162278
10	365	361	347	346	352		354.2	19	8.467585
							M.O.M	M.O.R	M.O.S
							355	15.8	6.485352

Figure 1: Data Collection

Figure 1 describes all the data we collected. With 10 samples of size 5 we collected 50 total data points. With all these data points we can compute many important items such as the Mean, Range and Standard Deviation. Along with those we were able to find the Mean of Mean (M.O.M), Mean of Range (M.O.R) and Mean of Standard Deviation (M.O.S). With an overall Mean of 355g, a standard deviation of 6.49 and a range of 15.8g and shows our data is common. Now with all the collected data we can calculate our control limits and see if our process is in or out of control.

X-BAR	LCL	CL	UCL
356.8	345.8834	355	364.1166
360	345.8834	355	364.1166
348.6	345.8834	355	364.1166
359.6	345.8834	355	364.1166
353	345.8834	355	364.1166
358.4	345.8834	355	364.1166
353.2	345.8834	355	364.1166
353.2	345.8834	355	364.1166
353	345.8834	355	364.1166

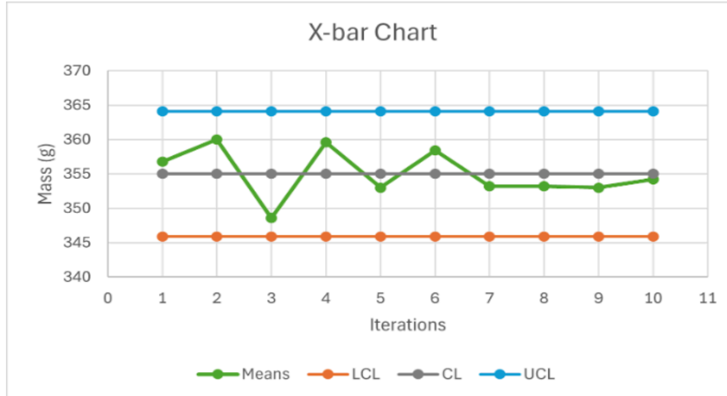

Figure 2: X-Bar Chart

R-BAR	LCL	CL	UCL
11	0	15.8	33.4012
23	0	15.8	33.4012
15	0	15.8	33.4012
20	0	15.8	33.4012
22	0	15.8	33.4012
17	0	15.8	33.4012
7	0	15.8	33.4012
16	0	15.8	33.4012
8	0	15.8	33.4012

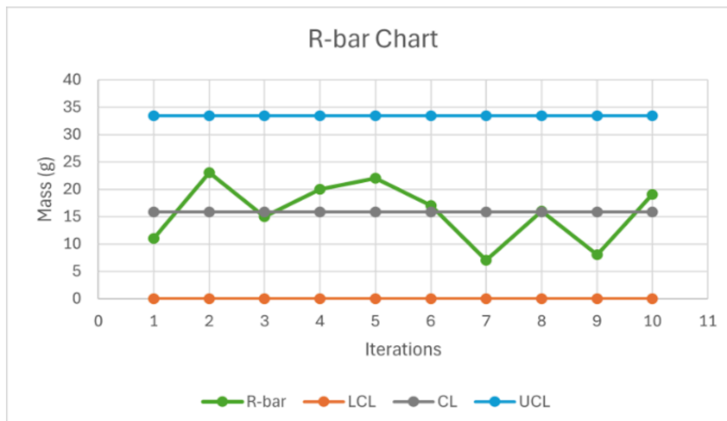

Figure 3: R-Bar Chart

Calculations

Using excel it's easy to calculate all the values that we need for this table. Simply using the equations $X(double\ bar) \pm A_2 R(bar), D_4 R(bar),\ D_3 R(bar)$ we are able to calculate the LCL, UCL for both charts with the mean just being the overall mean gathered.

Improvement Plan

Using both the X-Bar (Range) Chart and our R-Bar Chart, we can conclude that our water filling station was operating within proper control limits as no points were outside the upper and lower control limits in place from the center line. The control limits we have calculated do seem to be a bit too wide due to variation in the results which resulted in widespread means of water mass from each sample batch taken. After evaluating our process, we concluded there were still special causes happening within our operation; primarily, operator error of the individual filling up the water bottles and relying on their accuracy and precision to fill the water bottles exactly to the designated line before measuring the mass of the bottle. A simple solution to remove this special cause is to automate this function with a system that autofills the water bottles and relies on a sensor to cut off pouring the water once it has reached a certain mass.