Advance Quality Engineering

Workshop II

MEEM-5650

Submitted by,

Team 7

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Executive Summary

This workshop focuses on identifying special causes affecting the operation that is used to manufacture a bronze bushing using statistical tools like control charts. It also encourages to take actions to eliminate these special causes and improving the process capability. For this, a sampling experiment is performed using TURSIM, an MS Excel based Visual Basic Program. This program simulates a single-point lathe turning operation to manufacture bronze bushing. The generated data is then analysed using control charts to identify the special causes affecting the process. After identifying these special causes and bring the process in statistical control process capability of the process is calculated. Further to improve the capability of the process corrective actions are taken.

The data generated shows the surface roughness on outside-diameter surface of the bronze bushing which is $70 \pm 15 microinches$ specification. Ten potential special causes which may influence this process of manufacturing the bronze bushes are provided and out of these ten causes only three influence the surface roughness on outside-diameter surface of bronze bushing.

Potential Special Causes	**Levels of variation**
Cutting Speed	1000 to 1100 fpm
Feed Rate	0.0080 to 0.0089 ipr
Setup Person	Samuel or Richard
Operator	Regura or Substitute
Tool Type	Nork-V, Cutgo-T, or Roved Cube
Tool Condition	Sharp or Dull
Depth-to-Shoulder	0.0997 to 0.1003 inches
Machine	Nacirema, Rex or Le-Lathe
Measuring Device	Talymeas 5 or Surfchek 3
Rake Angle	5 or 10 Degrees

The aim in this workshop is to identify these three special causes using $\bar{X}$ and R control charts. This is done by analysing the chart by applying the Shewhart's control chart rules. The rule violation points are then analysed and correlation between the violated sample points and the given ten factors is seen. This provides the statistical signals which helps in identifying the special causes.

We have found that the three special causes that affect the surface roughness of the outside-diameter surface of bronze bushing are tool condition, operator and machine. The tool condition is changed to sharp and regular operator is used for the samples. For machine we have collected different data for each machine to avoid error of mixing. Le- Lathe and Nacirema machine show statistical control and process capability study is performed for them. Rex machine does not show process under statistical control and further this machine needs to be analysed for any other special cause.

Introduction

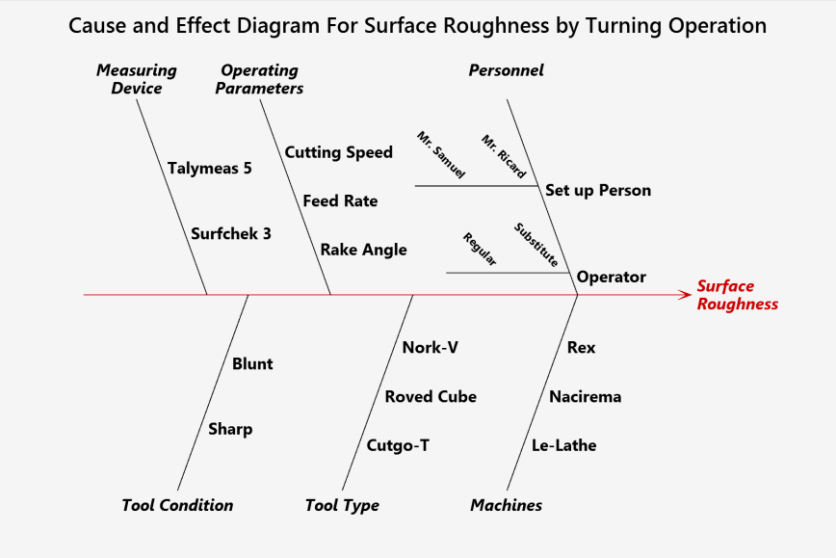
In this workshop we have performed a sampling experiment using TURNSIM software, which generates data of a single point lathe turning operation used to manufacture a bronze bushing. The data generated is of a surface roughness of the outside diameter surface which is within specification $70 \pm 15 microinches$. In this generated data they are ten potential special causes given out of which only three influence the operation of manufacturing. The data has 5 subgroups with 40 sample size which is a decent number of samples to get accurate results. E We have used the MINITAB software to generate control charts, which provides statistical signals to identify the special causes. TURNSIM operates in a way where one special causes are identified then it removes that special cause.

Procedure

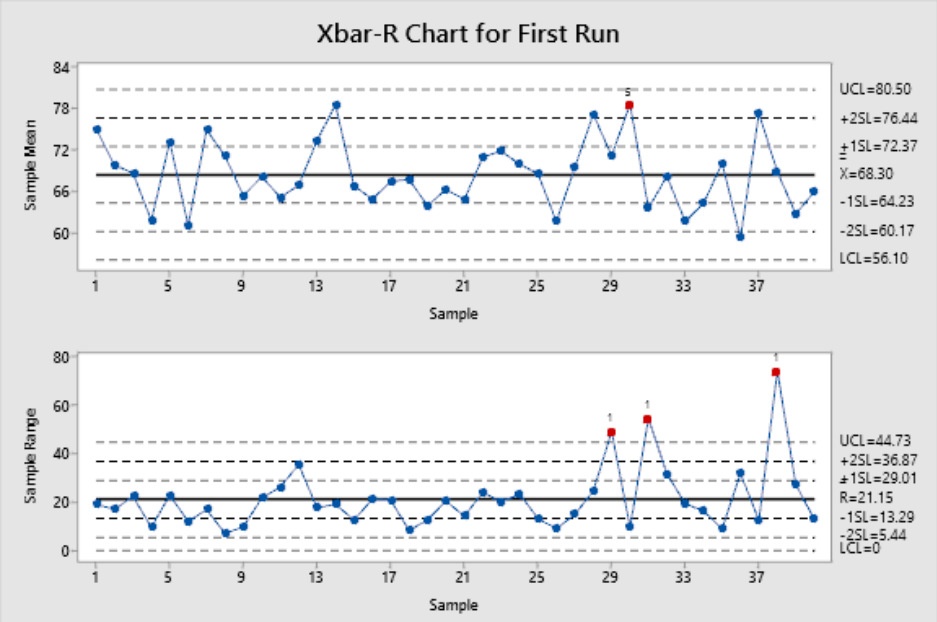
The general procedure employed to complete this workshop is as, In the first run, TURNSIM generates data of surface roughness with subgroup size five and user specified samples size. We have generated forty samples for all the times we have collected data. Then the $\bar{X}$ and R control charts are plot in MINITAB software and using statistical signals special causes are identified. When the first special cause is identified then while generating next data, TURNSIM ask's for identified special causes and entering them will disarm that causes if it is correct and generate the new data. This process is followed to identify all the three special causes. When these special causes are identified then for the controlled operation process capability study is performed. The values of percentage of products within specification, C_p and C_{pk} are found.

Trial – 1

Before starting our trial run we first narrowed down the parameters which could be the real potential cause for the increase in the roughness value, we eliminated the parameters that didn't have any relation with the surface roughness for example the Depth to shoulder ratio also the measuring instrument device which does not have any effect on the roughness value of the part machined. The cause and effect diagram helped in providing an overall mapping of all the parameters that could be a potential cause of the increase in surface roughness. We then simulated our first trial using TURNSIM software and plotted its $\bar{X}$ and R control charts.



Cause and Effect Diagram for Surface Roughness



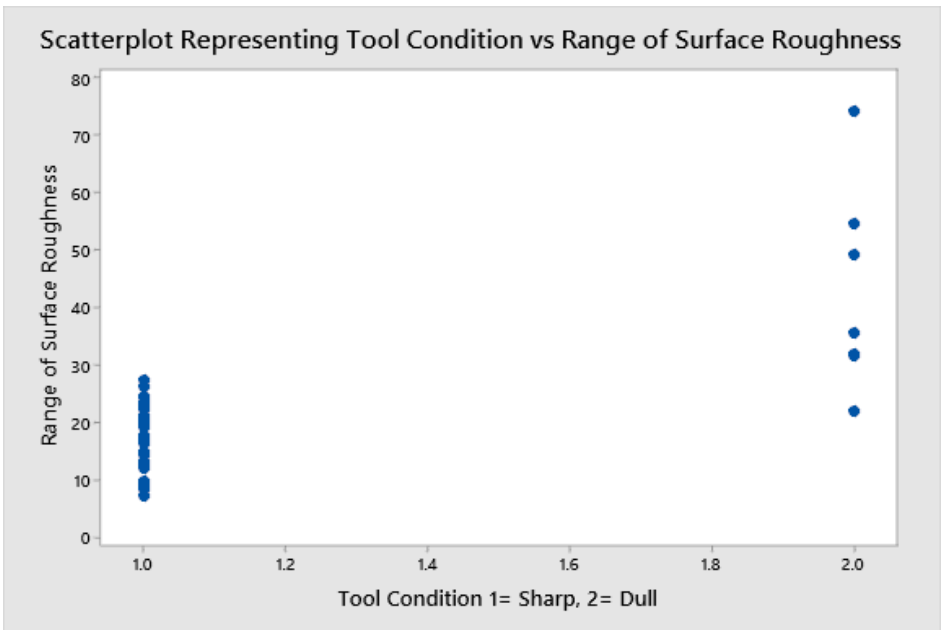
Test Results for $\bar{X}$ Chart for First Run

TEST 5. 2 out of 3 points more than 2 standard deviations from centre line (on one side of CL).
Test Failed at points: 30

Test Results for R Chart for First Run

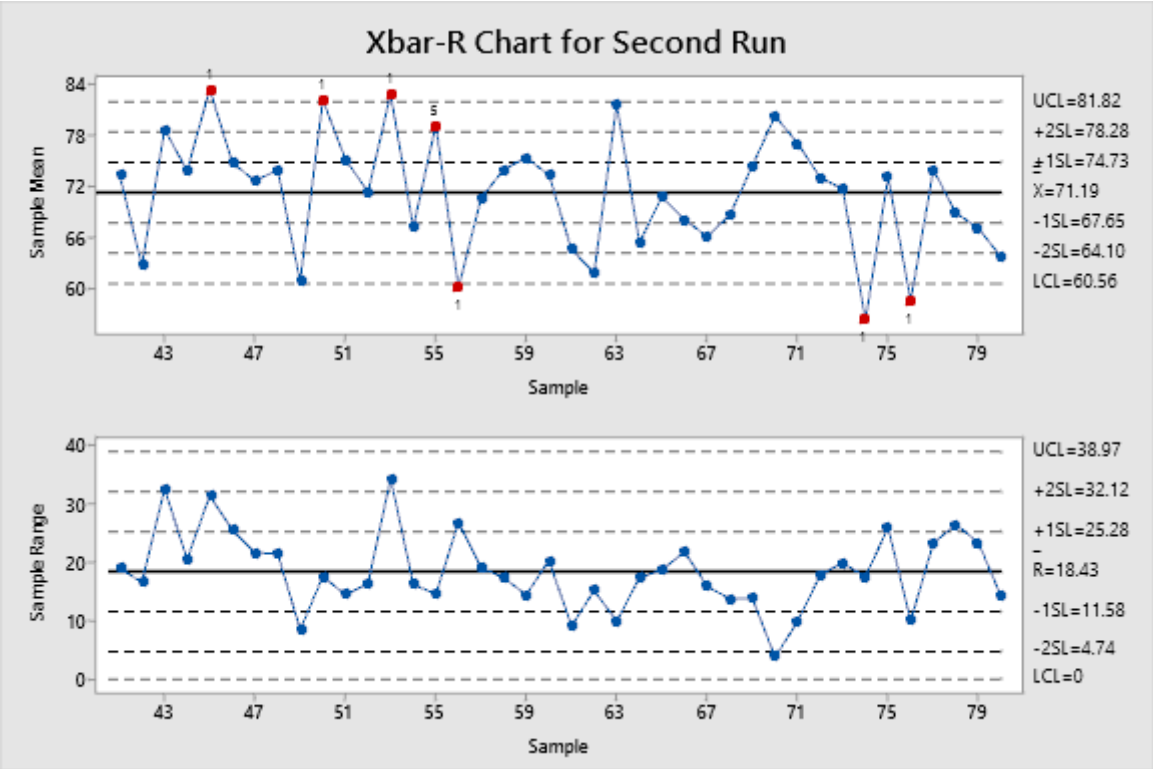
TEST 1. One point more than 3.00 standard deviations from centre line. Test Failed at points: 29, 31, 38.

It can be seen from the R chart that there is a presence of special cause in the process and when the special causes are tracked back to the data sheet it was clear that the reason for the violation was due to the tool condition it is a clear indication from the scatter plot that the range of the surface roughness increases when the tool is blunt while the range remains low when the tool is sharp. Thus, tool condition might be the potential special cause.



Trial – 2

For starting the second trail, the TURNSIM software takes input weather we have discovered any special cause in the process. As discussed earlier we have found that tool condition is a special cause in a process. Thus, we entered tool condition as identified special cause in a process and sample numbers equal to forty. The data generated then had only sharp tool condition and has eliminated the dull tool condition which led to source of special cause. Then we plotted the $\bar{X}$ and R control charts for the new data generated and applied the Shewhart's control chart rules to search for violations and statistical signals.

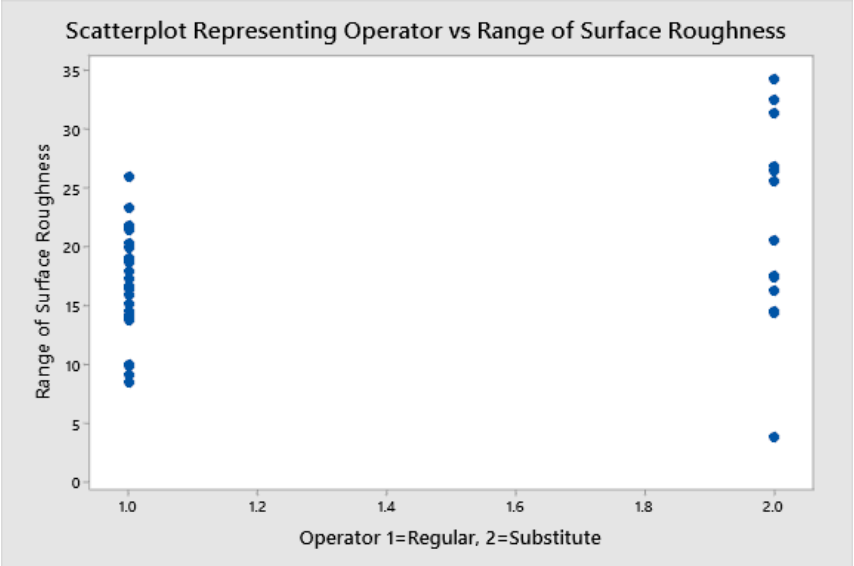


Test Results for $\bar{X}$ Chart for Second Run

TEST 1. One point more than 3.00 standard deviations from centre line. Test Failed at points: 45, 50, 53, 56, 74, 76

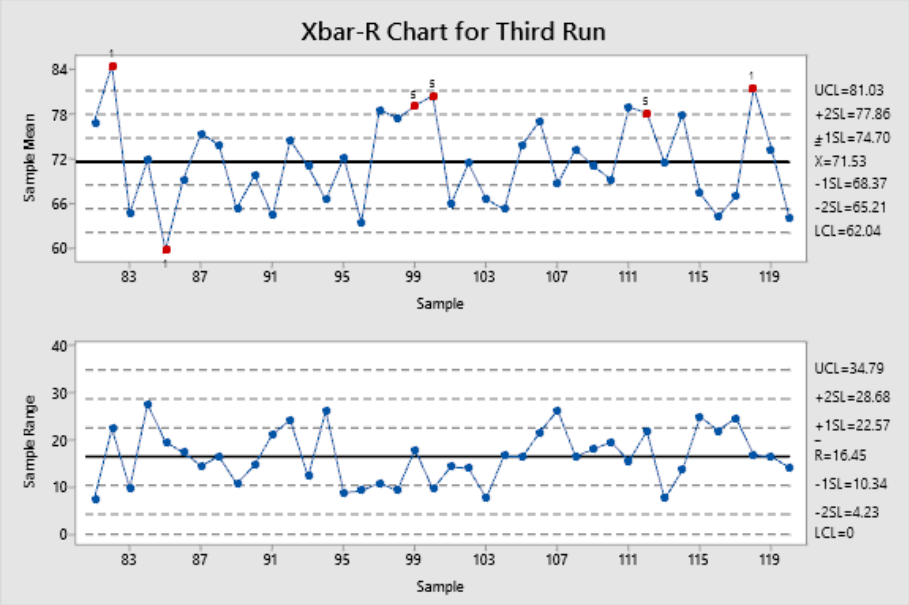
TEST 5. 2 out of 3 points more than 2 standard deviations from centre line (on one side of CL). Test Failed at points: 45, 55, 76

Tracking the violations in the above chart to the potential causes we can see that the violation were when there was a substitute worker employed for the process. We can also see the evidence to this in the scatter plot. Thus, we came to conclusion that operator can be the second potential special cause which influence the surface roughness of the outside diameter surface of the bronze bushing.



Trial – 3

For the third trial as mentioned above we have to first feed the identified special causes and the TURNSIM then disarms those special causes. We selected tool condition and operator as special causes. The sample was kept same as forty. The new data generated had all tool to be sharp and the operator to be regular. We then plotted the $\bar{X}$ and R control charts for the new data generated and applied the Shewhart's control chart rules to search for violations and statistical signals.

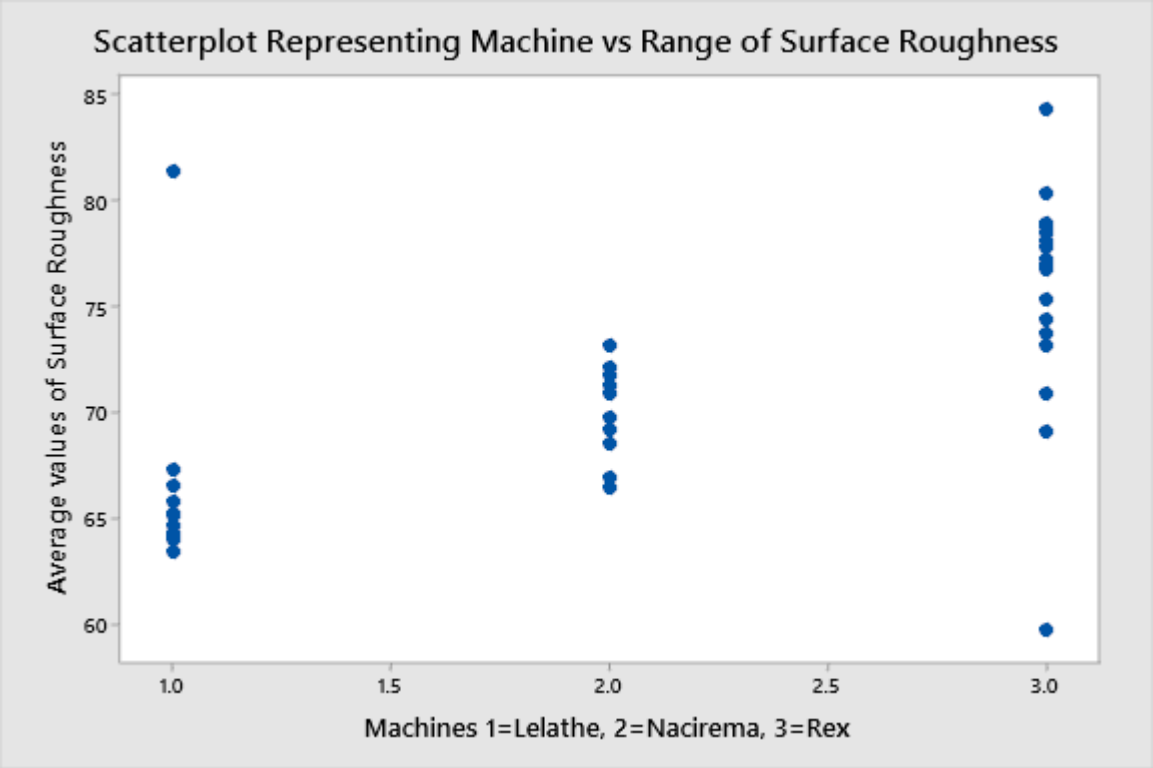


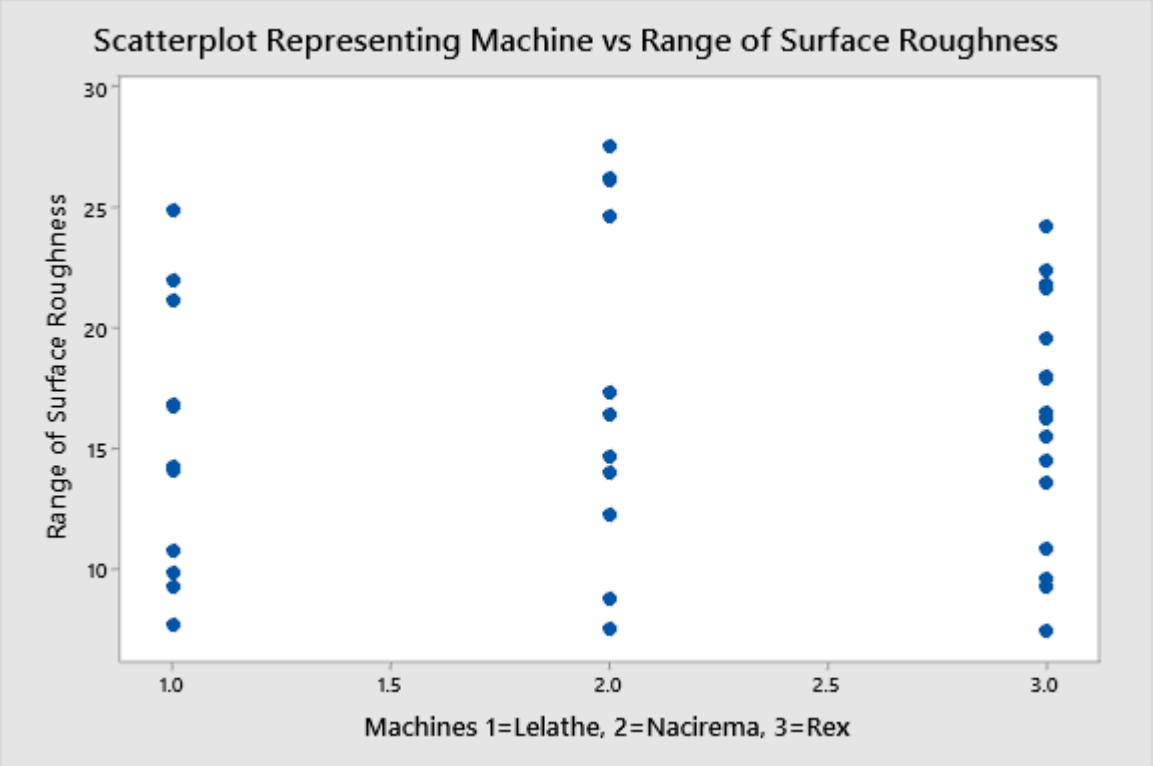
Test Results for $\bar{X}$ Chart for Third Run

TEST 1. One point more than 3.00 standard deviations from centre line. Test Failed at points: 82, 85, 118.

TEST 5. 2 out of 3 points more than 2 standard deviations from centre line (on one side of CL). Test Failed at points: 85, 99, 100, 112.

TEST 6. 4 out of 5 points more than 1 standard deviation from centre line (on one side of CL). Test Failed at points: 100.

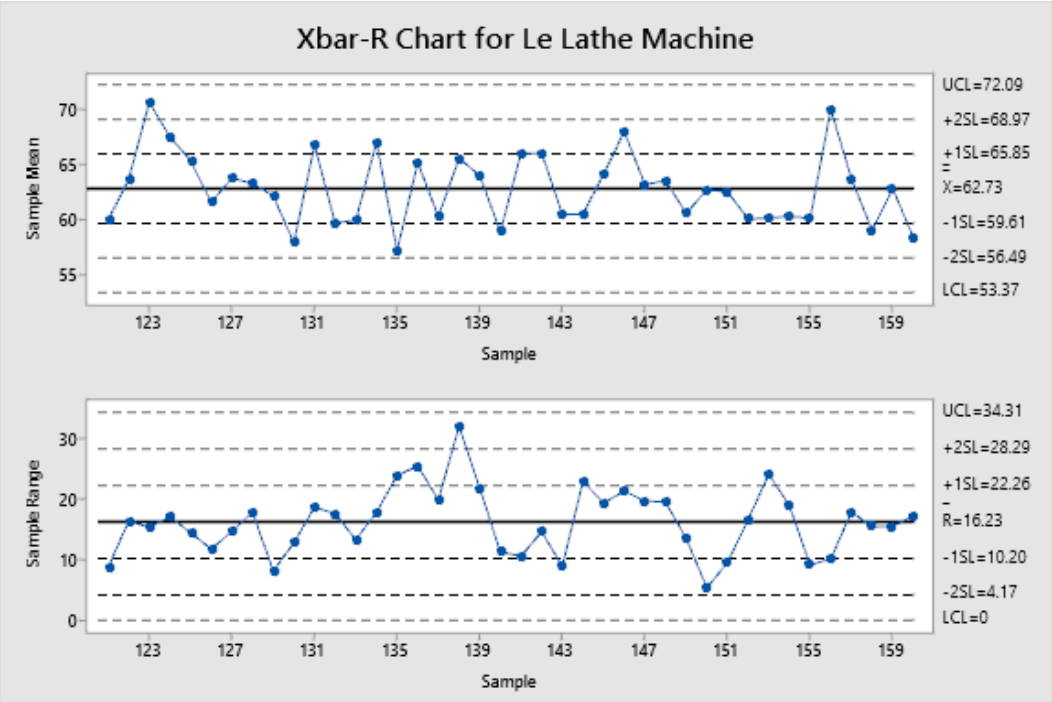


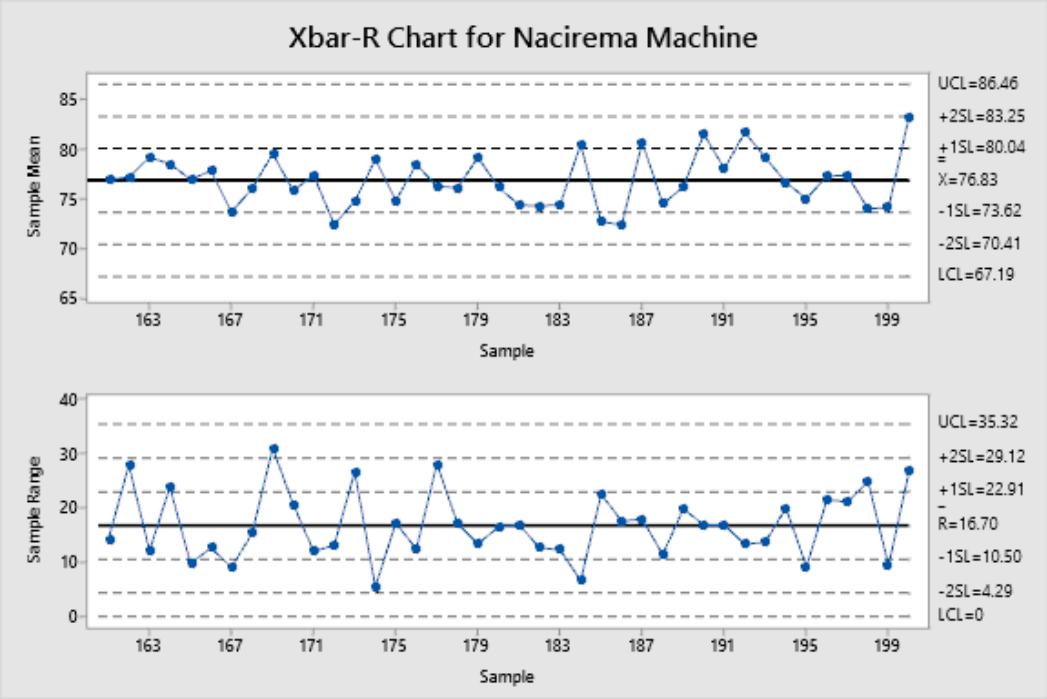


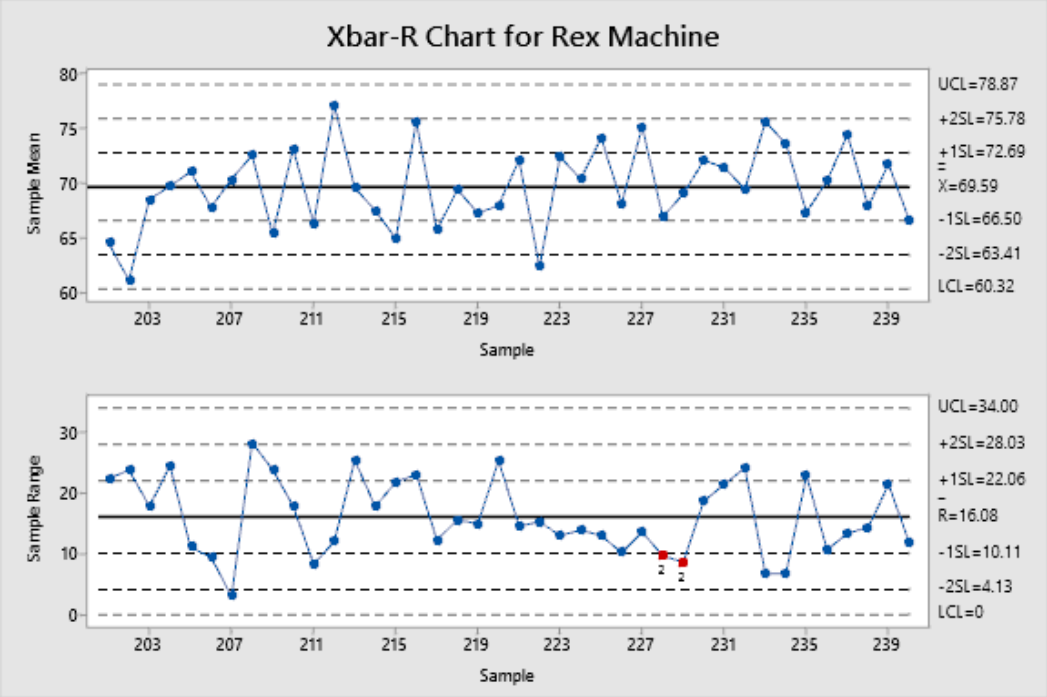
From the rule violations in the $\bar{X}$ and R control chart we checked the sample points in the data sheet to check for potential special cause. From the data sheet we could easily see that the violations were all at the Rex machine. Plotting and analysing the scatter plot we came to conclusion that machine would be the potential third special cause in the process which influence the surface roughness.

Trial – 4

In the 4th run of the TURNSIM, we have identified the three special causes which influence the process. We entered the three special causes: tool condition, operator and machine in the TURNSIM. We chose to keep the sample size same as forty. When we entered machine as a special cause the TURNSIM asked us weather we want data to be in group of different machine or a mix of data from all machine. To avoid the error of mixing we chose the data to be different. The new data generated was of forty sample size of data for each machine. We then plotted the $\bar{X}$ and R control chart for check weather the potential special causes selected are accurate. From the $\bar{X}$ and R control chart below we can see that there are no rule violation for the Le-Lathe and Nacirema machine and thus the special causes identified are correct as the process is under statistical control. We could see that for Rex machine there is rule violation in the R chart thus there are still special causes in the Rex machine process which are needed to be identified.







Test Results for R Chart for Rex Machine

TEST 2. 8 points in a row on same side of centre line. Test Failed at points: 228, 229.

Conclusion

The special causes identified in this workshop are the tool condition, operator and machine. The tool condition is changed to sharp and regular operator is used for the samples. For machine we have collected different data for each machine to avoid error of mixing. Le- Lathe and Nacirema machine show statistical control and process capability study is performed for them. The Rex machine is not under statistical control and we have seen that from the start that Rex machine is the source of special cause. The Rex machine shows violation at sample number 228 and 229. Thus, we can say that further identification of special causes is required for the Rex machine.

From the above we can conclude that to avoid special causes to come in the process, sharp tool should be used and regular operator should be employed instead of substitute operator to bring the surface roughness value of the outside diameter surface on bronze bushing close to nominal value.

The process capability study is performed for the Nacirema and Le-Lathe machine. The values of C_p and C_{pk} are less than 1 and percent of surface roughness are also less than 99.73%. Thus, we can say that the process of manufacturing of bronze bushing is not capable.

To increase the process capability of the Nacirema and Le-Lathe machine the surface roughness value should be brought as close to the nominal value of 70 microinches. It could be done by finding the common causes affecting the process and eliminating them. This would bring fundamental change to the process capability. For the Rex machine further statistical study is required to search and eliminate the special causes to bring process under statistical control.

Process Capability

1. Process capability study for process running on Le-lathe machine:

1. $C_p = \frac{(USL-LSL)}{6*\sigma}$

As from the control charts,

$\bar{R}$ = 16.23, μ = 62.73

For n = 5, d, d_2 = 2.326

σ = $\bar{R}$ /d_2 = 16.23/2.326 = 6.98

$C_p = \frac{(USL-LSL)}{6*\sigma}$

$C_p = \frac{(85-55)}{6*6.98}$

C_p =0.72

2. For calculating C_{pk},

Z_{USL} = (USL-μ) /σ

Z_{USL} = (85-62.73)/6.98 = 3.19

Z_{LSL} = (LSL-μ) /σ

Z_{LSL} = (55-65.45)/7.46 = -1.107

Z_{min} = min [$Z_{USL,}$ - Z_{LSL}]

Z_{min} = -(-1.107) =1.107

$C_{pk} = \frac{Z_{min}}{3}$ = 0.37

Capability Index

C_p = 0.72

C_{pk} = 0.37

3. Products having surface roughness within specifications:

Area within specifications is 0.9992 – 0.1341 = 0.8651

% of products within specifications is 86.51

2. Process capability study for process running on Nacirema machine:

1. $C_p = \frac{(USL-LSL)}{6*\sigma}$

As from the control charts,

$\bar{R}$ = 16.7, μ=76.83

For n=5, d, d_2= 2.326

σ = $\bar{R}$ /d_2 = 16.7/2.326 = 7.18

C_p = (USL-LSL)/ 6*σ

$C_p = \frac{(85-55)}{6*7.18}$

C_p = 0.696

2. For calculating Cpk,

Z_{USL} = (USL-μ) /σ

Z_{USL} = (85-76.83)/7.18 = 1.13

Z_{LSL} = (LSL-μ) /σ

Z_{LSL} = (55-76.83)/ 7.18 = -3.04

Z_{min} = min [$Z_{USL,}$ - Z_{LSL}]

Z_{min} = 1.13

$C_{pk} = \frac{Z_{min}}{3}$ = 0.376

Capability Index

C_p 0.696

C_{pk} = 0.376

3. Products having surface roughness within specifications:

Area within specifications is 0.8707 – 0.001183 = 0.8695

% of products within specifications is 86.95

3. Process running on Rex machine:

After observing R chart plotted for Rex machine it is inferred that process is not under statistical control as two points in that plot (Point 228 and 229) violates Shewhart's chart test rules for R chart. Hence, we are not evaluating process capability for this machine.

Appendix:

Trial 1:

Name	Group No-7																
Date	11-23-2019																
Instructor	Dr. Radheshyam Tewari																
TA	Mr. Salil Sule																
Trial	1																
Subgroups	40																
Special Cause																	
	Candidate Special Causes of Variation and Their Levels										Sample Roughness (microinches)						
Test No.	Cutting Speed	Feed Rate (ipr)	Set up Person	Operator	Tool Type	Tool Condition	Depth-to-Shoulder	Machine	Measuring Device	Rake Angle (deg.)	1	2	3	4	5	X bar	R
1	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	86.416	79.902	67.286	72.552	68.234	74.878	19.13
2	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	66.997	63.85	63.677	80.739	73.167	69.686	17.062
3	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	68.774	81.587	59.692	73.499	59.229	68.5562	22.358
4	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	57.596	67.237	63.116	62.234	58.608	61.7582	9.641
5	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	79.209	67.185	75.043	83.31	60.387	73.0268	22.923
6	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Le-Lathe	Talymeas 5	5	62.61	62.596	67.769	55.682	56.604	61.0522	12.087
7	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	77.092	74.598	66.538	71.994	83.454	74.7352	16.916
8	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	72.716	70.731	74.265	67.069	70.196	70.9954	7.196
9	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	68.429	70.128	64.569	60.354	63.058	65.3076	9.774
10	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Dull	0.0997	Rex	Surfchek 3	10	55.225	60.937	72.156	74.841	77.044	68.0406	21.819
11	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	52.458	66.3	62.912	65.059	78.649	65.0756	26.191
12	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Dull	0.1	Rex	Surfchek 3	10	58.715	79.903	85.204	49.665	60.418	66.781	35.539
13	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	68.539	63.623	81.3	72.307	80.264	73.2066	17.677
14	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	69.234	82.154	68.609	84.033	87.741	78.3542	19.132
15	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	60.255	66.292	63.61	70.582	72.938	66.7354	12.683
16	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	63.277	55.719	76.8	72.642	55.626	64.8128	21.174
17	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	77.311	65.591	56.491	64.316	72.957	67.3332	20.82
18	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	69.252	69.887	61.765	70.12	67.217	67.6482	8.355
19	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	69.748	57.052	64.249	64.508	63.707	63.8528	12.696
20	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	58.772	63.728	66.804	79.275	62.463	66.2084	20.503
21	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	61.742	63.019	72.507	68.24	58.314	64.7644	14.193
22	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	65.904	83.546	72.232	73.087	59.434	70.8406	24.112
23	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	82.599	66.789	62.559	79.597	66.875	71.6838	20.04
24	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	71.256	60.81	64.022	68.911	84.218	69.8434	23.408
25	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	67.26	76.173	62.907	72.762	63.025	68.4254	13.266
26	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	57.582	64.564	58.332	66.641	60.982	61.6202	9.059
27	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	71.617	70.29	74.522	59.56	70.689	69.3356	14.962
28	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	83.411	63.468	75.859	74.077	88.087	76.9804	24.619
29	1050	0.0089	Mr. Ricard	Substitute	Nork-V	Dull	0.1003	Rex	Surfchek 3	10	71.686	76.384	49.665	58.616	98.792	71.0286	49.127
30	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	78.7	79.121	77.94	82.947	73.262	78.394	9.685
31	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Dull	0.0997	Rex	Surfchek 3	10	74.683	25.86	68.583	68.066	80.375	63.5134	54.515
32	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Dull	0.0997	Rex	Surfchek 3	10	82.946	72.817	51.214	74.286	59.199	68.0924	31.732
33	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	53.299	71.045	59.013	52.652	72.051	61.612	19.399
34	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	63.681	56.766	56.041	72.299	72.391	64.2356	16.35
35	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	70.176	74.758	66.174	73.084	65.731	69.9846	9.027
36	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Dull	0.0997	Rex	Surfchek 3	10	66.909	75.395	56.583	53.964	43.578	59.2858	31.817
37	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	70.395	82.292	72.634	77.365	82.878	77.1128	12.483
38	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Dull	0.1	Rex	Surfchek 3	10	45.539	70.41	71.082	115.395	41.167	68.7186	74.228
39	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	70.028	62.937	46.322	60.478	73.709	62.6948	27.387
40	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Le-Lathe	Talymeas 5	5	61.233	64.044	60.32	73.316	70.309	65.8444	12.996

Trial 2:

Date	11/27/2019																
Trial	2																
Subgroups	40																
Special Ca	Tool Condition																
Test No.	Candidate Special Causes of Variation and Their Levels										Sample Roughness (microinches)						
	Cutting Speed	Feed Rate (ipr)	Set up Person	Operator	Tool Type	Tool Condition	Depth-to-Shoulder	Machine	Measuring Device	Rake Angle (deg.)	1	2	3	4	5	X bar	R
41	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	79.522	73.528	60.531	79.069	74.182	73.3664	18.991
42	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	64.043	57.357	57.172	73.788	60.884	62.6488	16.616
43	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	82.219	95.048	63.622	89.457	62.471	78.5634	32.577
44	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	59.741	80.303	78.802	77.052	72.903	73.7602	20.562
45	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	89.477	67.423	71.086	89.658	98.867	83.3022	31.444
46	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	75.598	77.761	89.604	66.422	64.031	74.6832	25.573
47	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	82.078	77.487	68.653	74.192	60.437	72.5694	21.641
48	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	82.917	77.503	66.867	80.659	61.399	73.869	21.518
49	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	63.621	65.316	60.048	56.786	58.394	60.833	8.53
50	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	73.707	73.181	84.578	87.818	90.759	82.0086	17.578
51	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	72.313	77.622	67.804	82.278	75.415	75.0864	14.474
52	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	66.277	77.142	80.557	64.141	68.23	71.2694	16.416
53	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	63.557	97.931	91.465	72.043	88.739	82.747	34.374
54	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	74.592	58.328	73.837	62.504	66.395	67.1312	16.264
55	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	71.539	79.23	75.078	86.065	83.603	79.103	14.526
56	1100	0.008	Mr. Samuel	Substitute	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	63.761	57.102	47.735	74.616	57.028	60.0484	26.881
57	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	78.801	66.493	59.702	68.928	78.752	70.5352	19.099
58	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	75.473	76.739	61.322	77.206	78.692	73.8864	17.37
59	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	81.55	67.12	73.76	74.139	79.62	75.2378	14.43
60	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	66.251	70.419	73.331	86.594	69.715	73.262	20.343
61	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	67.014	62.397	63.347	60.382	69.483	64.5246	9.101
62	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	61.96	54.148	68.315	69.323	55.392	61.8276	15.175
63	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	79.033	86.579	83.818	76.647	81.787	81.5728	9.932
64	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	69.831	54.576	67.584	71.894	62.664	65.3098	17.318
65	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	59.326	70.474	77.931	67.665	78.067	70.6926	18.741
66	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	70.768	57.743	71.646	60.341	79.539	68.0074	21.796
67	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	68.939	67.372	73.355	57.432	63.269	66.0734	15.923
68	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	70.963	74.424	63.895	60.674	72.839	68.559	13.75
69	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	76.404	82.72	70.141	73.443	68.879	74.3174	13.841
70	1050	0.0089	Mr. Ricard	Substitute	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	79.872	80.263	79.099	82.694	78.908	80.1672	3.786
71	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	76.421	83.015	73.437	73.159	78.738	76.954	9.856
72	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	82.529	74.519	64.627	75.391	67.694	72.952	17.902
73	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	80.185	73.81	61.112	61.766	81.015	71.5776	19.903
74	1100	0.008	Mr. Samuel	Substitute	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	65.685	59.582	59.439	48.122	48.667	56.299	17.563
75	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	76.584	59.572	71.934	85.532	71.548	73.034	25.96
76	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Le-Lathe	Talymeas 5	5	53.529	60.324	53.741	63.553	61.436	58.5166	10.024
77	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	77.589	62.591	79.954	85.878	63.257	73.8538	23.287
78	1050	0.0089	Mr. Ricard	Substitute	Nork-V	Sharp	0.1003	Rex	Surfchek 3	10	68.999	80.854	81.56	55.009	57.643	68.813	26.551
79	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	73.773	64.931	55.741	61.46	79.106	67.0022	23.365
80	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	66.941	70.381	66.066	58.71	56.207	63.661	14.174

Trial 3:

Date	11/27/2019																
Trial	3																
Subgroups	40																
Special Ca	Operator,Tool Condition,																
Test No.	Candidate Special Causes of Variation and Their Levels										Sample Roughness (microinches)						
	Cutting Speed	Feed Rate (ipr)	Set up Person	Operator	Tool Type	Tool Condition	Depth-to-Shoulder	Machine	Measuring Device	Rake Angle (deg.)	1	2	3	4	5	X bar	R
81	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	77.601	73.68	81.066	77.409	74.267	76.8046	7.386
82	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	72.886	95.294	92.402	80.607	80.728	84.3834	22.408
83	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	59.264	63.841	69.082	62.399	68.606	64.6384	9.818
84	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	74.914	65.423	56.652	84.221	77.607	71.7634	27.569
85	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	67.251	55.66	64.657	47.698	63.195	59.6922	19.553
86	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	71.841	57.708	66.802	74.426	75.044	69.1642	17.336
87	1050	0.0089	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Rex	Surfchek 3	10	74.302	72.41	83.889	69.37	76.568	75.3078	14.519
88	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	80.707	78.508	74.89	64.192	70.578	73.775	16.515
89	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	63.411	65.103	59.799	67.376	70.516	65.241	10.717
90	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	77.669	77.215	62.993	64.808	65.973	69.7316	14.676
91	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	55.96	62.547	59.813	77.082	66.152	64.3108	21.122
92	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	74.083	86.936	62.722	72.248	75.91	74.3798	24.214
93	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	72.233	67.852	67.953	79.316	67.079	70.8866	12.237
94	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	66.629	82.135	66.201	55.979	61.085	66.4058	26.156
95	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	67.75	71.596	69.52	76.547	75.119	72.1064	8.797
96	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	57.378	66.596	63.869	62.546	66.548	63.3874	9.218
97	1050	0.0089	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Rex	Surfchek 3	10	75.291	83.958	78.409	73.085	81.738	78.4962	10.873
98	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	77.603	78.261	71.341	78.508	80.594	77.2614	9.253
99	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	65.757	79.284	83.377	83.712	82.753	78.9766	17.955
100	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	78.571	81.267	85.514	75.936	80.636	80.3848	9.578
101	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	64.021	65.268	72.729	68.366	58.458	65.7684	14.271
102	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	79.368	71.844	65.398	66.345	73.59	71.309	13.97
103	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	64.685	70.044	68.489	62.375	67.025	66.5236	7.669
104	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	67.291	58.215	61.65	74.942	63.679	65.1554	16.727
105	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	80.522	70.213	76.855	64.248	76.927	73.753	16.274
106	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	85.83	71.76	87.47	73.995	65.847	76.9804	21.623
107	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	77.375	75.386	51.125	66.932	72.045	68.5726	26.25
108	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	65.021	81.543	71.079	68.464	79.812	73.1838	16.522
109	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	77.331	79.609	65.496	70.663	61.619	70.9436	17.99
110	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	65.062	65.657	63.556	68.242	83.12	69.1274	19.564
111	1050	0.0089	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Rex	Surfchek 3	10	75.048	81.029	71.9	78.483	87.406	78.7732	15.506
112	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	65.945	85.615	74.152	87.788	76.799	78.0598	21.843
113	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	72.081	68.166	75.69	71.886	68.742	71.313	7.524
114	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	69.128	82.735	82.552	77.408	77.454	77.8554	13.607
115	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	70.295	52.959	65.739	77.837	69.474	67.2608	24.878
116	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	65.604	70.489	55.671	53.548	75.527	64.1678	21.979
117	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	71.343	54.617	73.675	79.265	55.713	66.9226	24.648
118	1050	0.0089	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Le-Lathe	Surfchek 3	10	78.476	88.71	91.021	74.165	74.669	81.4082	16.856
119	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	66.919	82.609	70.532	66.167	79.749	73.1952	16.442
120	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Le-Lathe	Talymeas 5	5	67.235	70.796	66.346	59.058	56.684	64.0238	14.112

Trial 4:

Date	11/27/2019																
Trial	4																
Subgroups	120																
Special Ca	Operator,Tool Condition,Machine,																
Test No.	Candidate Special Causes of Variation and Their Levels										Sample Roughness (microinches)						
	Cutting Speed	Feed Rate (ipr)	Set up Person	Operator	Tool Type	Tool Condition	Depth-to-Shoulder	Machine	Measuring Device	Rake Angle (deg.)	1	2	3	4	5	X bar	R
121	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Le-Lathe	Surfchek 3	10	60.928	55.42	64.094	60.721	58.221	59.8768	8.674
122	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Le-Lathe	Talymeas 5	5	63.71	56.816	56.616	72.973	67.658	63.5546	16.357
123	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	63.397	67.818	78.745	66.247	76.341	70.5096	15.348
124	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Le-Lathe	Surfchek 3	10	66.587	56.504	73.551	71.703	68.654	67.3998	17.047
125	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	73.711	61.402	69.308	59.244	62.662	65.2654	14.467
126	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	61.986	63.09	68.346	56.598	57.408	61.4856	11.748
127	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	62.583	60.719	72.429	57.787	64.844	63.6724	14.642
128	1100	0.008	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Le-Lathe	Surfchek 3	10	58.054	54.547	72.42	63.9	67.037	63.1916	17.873
129	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Le-Lathe	Surfchek 3	10	64.383	66.101	60.912	57.976	60.99	62.0724	8.125
130	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Le-Lathe	Surfchek 3	10	51.913	50.555	61.058	62.369	63.319	57.8428	12.764
131	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	66.831	75.481	70.058	64.016	56.818	66.6408	18.663
132	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	66.798	49.184	55.232	61.718	65.255	59.6374	17.614
133	1100	0.008	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Le-Lathe	Surfchek 3	10	60.242	52.487	65.775	55.895	64.938	59.8674	13.288
134	1100	0.008	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Le-Lathe	Surfchek 3	10	56.193	69.307	74.03	66.754	68.328	66.9224	17.837
135	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	69.845	48.691	67.872	53.256	45.948	57.1224	23.897
136	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Le-Lathe	Talymeas 5	5	74.118	62.197	52.714	78.191	58.183	65.0806	25.477
137	1100	0.008	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Le-Lathe	Surfchek 3	10	72.112	60.111	52.599	52.228	64.028	60.2156	19.884
138	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Le-Lathe	Talymeas 5	5	50.816	53.451	67.512	72.669	82.846	65.4588	32.03
139	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	48.2	66.154	69.751	70.018	65.521	63.9288	21.818
140	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Le-Lathe	Surfchek 3	10	57.867	60.751	63.299	52.023	60.193	58.8266	11.276
141	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	63.361	64.604	65.553	62.722	73.309	65.9098	10.587
142	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	74.497	66.275	59.899	60.81	68.07	65.9102	14.598
143	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	58.867	63.978	62.802	55.066	61.489	60.4404	8.912
144	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Le-Lathe	Surfchek 3	10	68.218	59.278	62.483	66.808	45.286	60.4146	22.932
145	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	52.111	64.141	71.329	61.311	71.453	64.069	19.342
146	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Le-Lathe	Surfchek 3	10	70.695	57.674	71.563	60.288	79.04	67.852	21.366
147	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	57.592	55.233	60.911	66.822	74.939	63.0994	19.706
148	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	74.275	57.399	66.287	64.49	54.785	63.4472	19.49
149	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Le-Lathe	Talymeas 5	5	65.222	67.488	55.878	59.902	53.982	60.4944	13.506
150	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Le-Lathe	Surfchek 3	10	62.335	63.631	63.066	64.757	59.381	62.634	5.376
151	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	62.221	68.028	58.893	58.549	64.489	62.436	9.479
152	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	58.095	51.682	65.453	56.445	68.327	60.0004	16.645
153	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Le-Lathe	Surfchek 3	10	56.756	74.336	60.83	58.158	50.215	60.059	24.121
154	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	60.398	51.284	50.623	69.461	69.523	60.2578	18.9
155	1100	0.008	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Le-Lathe	Talymeas 5	5	60.036	64.479	56.124	64.143	55.373	60.031	9.106
156	1100	0.008	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Le-Lathe	Surfchek 3	10	68.283	76.428	69.793	68.649	66.308	69.8922	10.12
157	1100	0.008	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Le-Lathe	Surfchek 3	10	69.881	59	74.014	56.139	59.149	63.6366	17.875
158	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	59.691	65.704	66.045	50.562	52.841	58.9686	15.483
159	1100	0.008	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Le-Lathe	Talymeas 5	5	65.193	58.156	69.126	53.652	67.587	62.7428	15.474
160	1100	0.008	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Le-Lathe	Surfchek 3	10	53.263	58.564	48.947	66.223	64.571	58.3136	17.276
161	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Nacirema	Talymeas 5	5	81.133	71.126	71.734	75.169	85.299	76.8922	14.173
162	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	90.959	72.031	85.451	63.137	74.278	77.1712	27.822
163	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Nacirema	Surfchek 3	10	70.862	82.97	80.682	80.919	80.223	79.1312	12.108
164	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Nacirema	Surfchek 3	10	74.406	71.818	74.479	95.577	76.223	78.5006	23.759
165	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	74.543	75.794	76.732	73.888	83.629	76.9172	9.741
166	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	84.475	77.436	75.973	71.882	79.145	77.7822	12.593
167	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Nacirema	Surfchek 3	10	69.585	75.063	78.615	72.619	72.487	73.6738	9.03
168	1000	0.0086	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Nacirema	Surfchek 3	10	79.169	70.058	78.283	83.867	68.58	75.9914	15.287
169	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Nacirema	Talymeas 5	5	96.906	80.237	82.051	72.416	65.97	79.516	30.936
170	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	81.511	68.341	66.141	76.306	86.77	75.8138	20.629
171	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	74.216	72.817	76.861	77.964	84.768	77.3252	11.951
172	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Nacirema	Talymeas 5	5	70.372	74.087	77.448	75.68	64.341	72.3856	13.107
173	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	77.512	89.446	73.159	70.897	62.842	74.7712	26.604
174	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	79.427	79.64	79.01	81.001	75.546	78.9248	5.455
175	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	73.259	86.389	69.615	69.213	75.576	74.8104	17.176
176	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	75.568	72.631	77.934	85.023	80.908	78.4128	12.392
177	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Nacirema	Talymeas 5	5	90.32	62.271	74.589	89.057	64.935	76.2344	28.049
178	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Nacirema	Talymeas 5	5	74.195	81.931	65.147	82.271	76.912	76.0912	17.124
179	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	73.87	73.425	84.86	76.715	86.776	79.1292	13.351
180	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Nacirema	Surfchek 3	10	77.038	64.932	77.11	81.386	80.164	76.126	16.454
181	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	82.738	71.711	80.787	70.725	65.844	74.361	16.894
182	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Nacirema	Talymeas 5	5	67.63	74.996	80.233	68.433	79.983	74.255	12.603
183	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Nacirema	Surfchek 3	10	70.771	68.027	79.54	80.28	73.41	74.4056	12.253
184	1000	0.0086	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Nacirema	Surfchek 3	10	80.13	84.175	79.189	77.596	81.027	80.4234	6.579
185	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Nacirema	Talymeas 5	5	72.122	75.089	84.747	62.284	69.15	72.6784	22.463
186	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	65.956	83.49	69.25	71.014	72.158	72.3736	17.534
187	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Nacirema	Surfchek 3	10	79.484	81.401	78.451	72.944	90.8	80.616	17.856
188	1000	0.0086	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Nacirema	Surfchek 3	10	70.973	81.527	70.135	75.44	74.252	74.4654	11.392
189	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Nacirema	Surfchek 3	10	84.111	73.593	73.641	84.639	64.857	76.1682	19.782
190	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	90.231	73.432	88.065	74.604	81.065	81.4794	16.799
191	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Nacirema	Surfchek 3	10	78.489	83.41	80.452	66.619	81.105	78.015	16.791
192	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Nacirema	Talymeas 5	5	76.017	79.833	82.446	80.648	89.267	81.6422	13.25
193	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	85.398	77.859	78.373	82.257	71.701	79.1176	13.697
194	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Nacirema	Talymeas 5	5	81.836	82.787	76.68	78.891	62.835	76.6058	19.952
195	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	81.405	74.023	72.263	73.972	73.378	75.0082	9.142
196	1000	0.0086	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Nacirema	Talymeas 5	5	88.132	66.581	70.784	76.808	84.028	77.2666	21.551
197	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	64.109	83.25	85.101	82.026	72.044	77.306	20.992
198	1000	0.0086	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Nacirema	Surfchek 3	10	64.155	71.726	69.8	88.93	75.28	73.9782	24.775
199	1000	0.0086	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Nacirema	Talymeas 5	5	68.987	74.68	74.893	73.708	78.334	74.1204	9.347
200	1000	0.0086	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Nacirema	Surfchek 3	10	85.773	76.363	87.55	69.91	96.68	83.2552	26.77
201	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	64.514	66.583	56.199	78.568	56.663	64.5054	22.369
202	1050	0.0089	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Rex	Surfchek 3	10	50.314	74.125	57.026	61.133	62.924	61.1044	23.811
203	1050	0.0089	Mr. Ricard	Regular	Cutgo-T	Sharp	0.1002	Rex	Surfchek 3	10	67.338	79.38	70.024	64	61.518	68.452	17.862
204	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	63.128	84.033	75.89	59.51	65.623	69.6368	24.523
205	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	75.979	71.018	66.225	76.361	65.236	70.9638	11.125
206	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Rex	Talymeas 5	5	72.513	65.996	72.117	63.062	65.047	67.747	9.451
207	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Rex	Talymeas 5	5	71.262	70.39	68.312	71.239	70.224	70.2854	2.95
208	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Rex	Talymeas 5	5	68.83	79.225	55.575	74.768	83.891	72.4578	28.316
209	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	67.945	75.819	76.544	52.678	53.551	65.3074	23.866
210	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Rex	Talymeas 5	5	70.661	76.941	64.106	71.539	82.003	73.05	17.897
211	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Rex	Talymeas 5	5	70.348	62.071	66.372	66.585	65.936	66.2624	8.277
212	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	82.584	76.654	82.959	70.904	72.031	77.0264	12.055
213	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	83.321	57.92	60.851	80.62	64.807	69.5038	25.401
214	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	68.96	62.286	75.568	72.606	57.776	67.4392	17.792
215	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	74.493	52.636	55.401	68.619	73.289	64.8876	21.857
216	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	64.929	71.145	87.95	83.257	70.203	75.4968	23.021
217	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Rex	Talymeas 5	5	67.595	60.805	63.412	73.104	63.522	65.6876	12.299
218	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	62.788	70.069	69.058	78.382	66.43	69.3454	15.594
219	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Rex	Talymeas 5	5	70.015	68.695	72.704	57.727	66.807	67.1896	14.977
220	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1003	Rex	Surfchek 3	10	66.571	69.89	54.033	79.433	69.6	67.9054	25.4
221	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Rex	Talymeas 5	5	81.687	67.105	69.011	72.932	69.286	72.0042	14.582
222	1050	0.0089	Mr. Ricard	Regular	Nork-V	Sharp	0.1003	Rex	Surfchek 3	10	58.798	59.426	57.169	63.902	72.469	62.3528	15.3
223	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	74.091	66.409	70.945	70.685	79.43	72.312	13.021
224	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	77.029	73.316	63.119	70.308	67.763	70.307	13.91
225	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	70.589	71.393	83.611	71.506	73.142	74.0482	13.022
226	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.0997	Rex	Surfchek 3	10	73.404	67.407	73.211	63.196	63.268	68.0972	10.208
227	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Rex	Talymeas 5	5	73.056	83.461	70.236	78.636	69.861	75.05	13.6
228	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0997	Rex	Talymeas 5	5	63.463	73.141	63.572	68.144	65.878	66.8396	9.678
229	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0998	Rex	Talymeas 5	5	63.666	72.152	66.468	70.244	72.274	68.9608	8.608
230	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	72.74	84.282	65.576	68.419	68.919	71.9872	18.706
231	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	81.571	77.275	68.529	69.171	60.118	71.3328	21.453
232	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	69.355	72.129	68.524	56.323	80.505	69.3672	24.182
233	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	75.579	78.346	71.683	74.201	77.71	75.5038	6.663
234	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	71.291	71.029	77.825	73.144	74.221	73.502	6.796
235	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	79.957	69.659	59.777	57.029	69.94	67.2724	22.928
236	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1001	Rex	Talymeas 5	5	74.371	70.848	63.691	69.133	72.69	70.1466	10.68
237	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	67.755	80.977	81.135	69.43	72.357	74.3308	13.38
238	1050	0.0089	Mr. Ricard	Regular	Roved Cube	Sharp	0.1	Rex	Surfchek 3	10	66.116	73.029	65.671	74.321	59.967	67.8208	14.354
239	1050	0.0089	Mr. Samuel	Regular	Nork-V	Sharp	0.0999	Rex	Talymeas 5	5	81.476	78.974	75.467	62.281	60.051	71.6498	21.425
240	1050	0.0089	Mr. Samuel	Regular	Cutgo-T	Sharp	0.1	Rex	Talymeas 5	5	60.026	66.005	68.182	66.78	71.944	66.5874	11.918