Lecture #32

Prasad S. Shirodkar

Nov. 9, 2005

Quality Engineering (MEEM 4650 / 5650)
Dept. of Mechanical Engineering - Engineering Mechanics
Michigan Technological University

Workshop #2

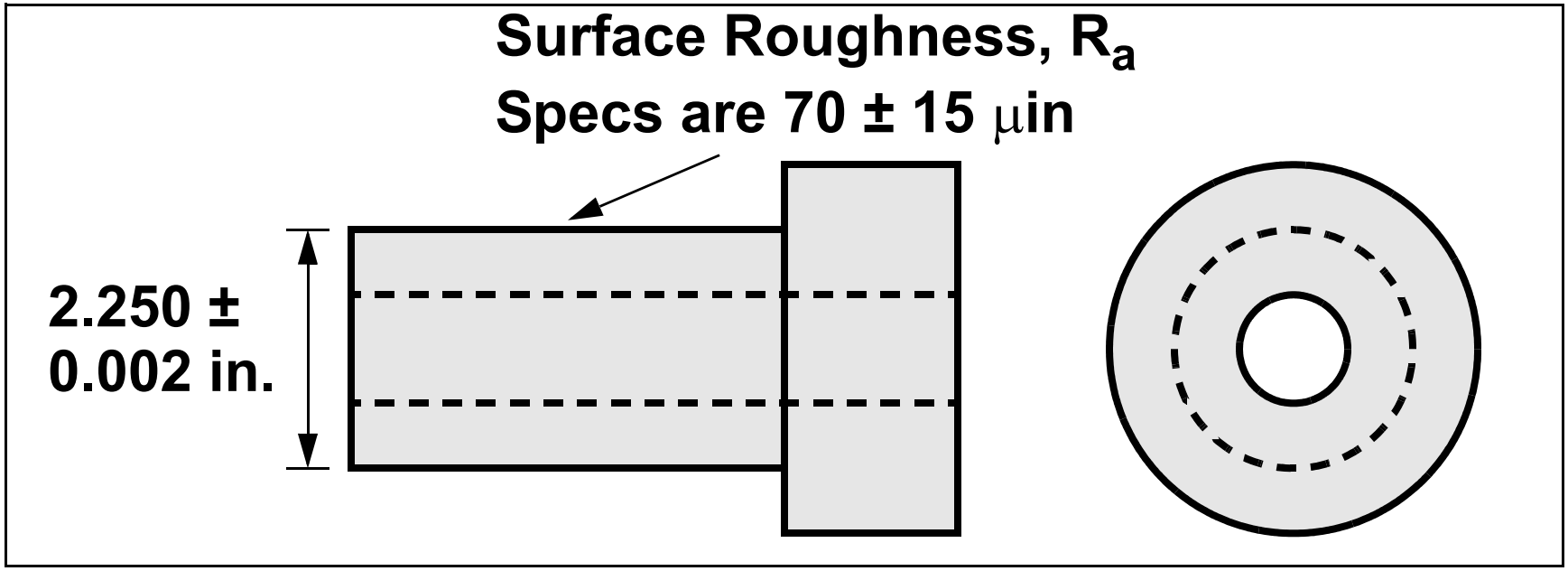
TURNSIM: Creates 2 types of data

- **Product Data (surface roughness)**
  - **k samples, n = 5**
  - **Study with XRCHRT**
- **Process condition data**
  - **Levels for 10 candidate special cause variables**
  - **Look for correlations**

XRCHRT: Assess product data

PROCAP: Assess process capability
  - **System must be in CONTROL!!**

Background



- Recently, many of the bronze bushings have been outside surface roughness specs.
- Ad hoc changes have been ineffective.

Background

- Process of interest: Single point turning

- Number of machines: 3 operating in parallel
  - All machines are needed to meet production.

- 10 variables identified as candidate special causes
  - In fact, only 3 of them are bona fide.

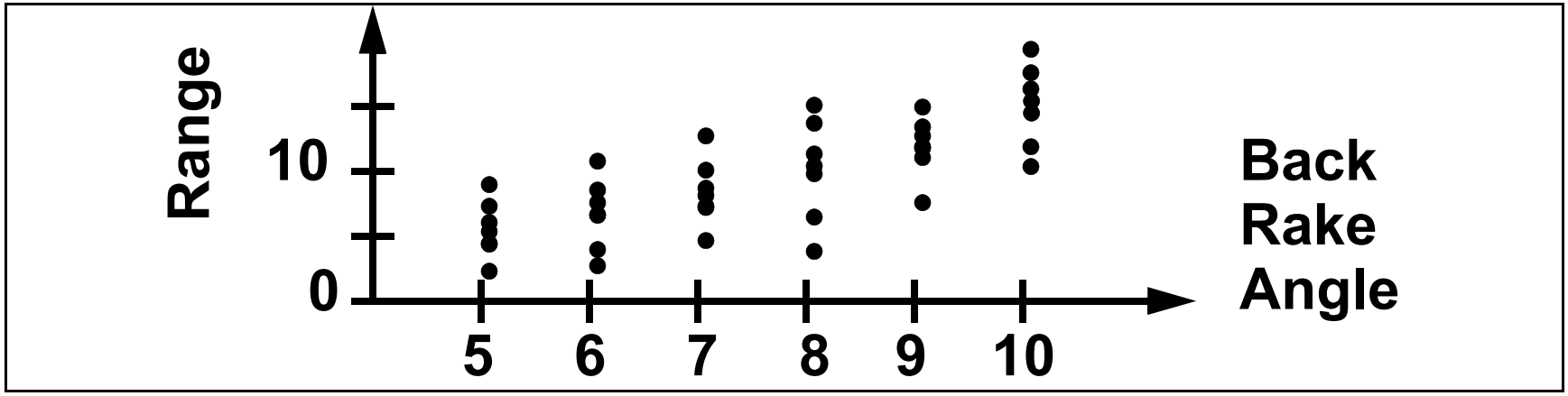
Your Task: Identify and remove the special causes. Once the process is in control, assess its capability.

Cause	Nature of Variation
Cutting Speed	From 1000 to 1100 fpm
Feed Rate	From 0.008 to 0.0089 ipr
Operator	Regular or Substitute
Setup person	Samuel or Ricard
Tool type	Nork-V, Cutgo-T, or Roved Cube
Tool condition	Sharp or Dull
Depth-to-shoulder measurement	0.0997 - 0.1003
Lathes used	Nacirema, Rex, and Lelathe
Surface measuring device	Talymeas 5 or Surfchek 3
Tool back rake angle	5° or 10°

The Approach

- Collect data from the process (TURNSIM)
  - 2 types of data
  - Chart the Surface Roughness data (XRCHRT)

- Statistical signals on the charts - need to correlate these with behavior of candidate special causes.



More on Approach

- If we think we have found a special cause - take corrective action.
- Continue to collect data (TURNSIM) - verify that previous action was correct; have additional data that may be examined for special causes.
- Once all 3 special causes have been found, can conduct process capability study (PROCAP).
- Process capability completed. Now what??

Using TURNSIM

- Asked for filename for surface roughness data:
  e.g., bob.dat
- Asked for filename for process conditions - variable levels for 10 candidate special causes:
  e.g., bob.con
- # of special causes identified? 0 (first time thru)
- # of subgroups to be collected?
- Samples created and stored in the user specified files

Data generated with program: TURNSIM
Outside diameter turning of a bronze bushing
Surface roughness in micro-inches
Sutherland

5			50	
74.67	62.19	68.32	66.76	82.38
73.14	54.09	66.69	61.56	48.18
63.70	73.28	64.83	58.27	60.57
58.59	65.92	61.99	57.00	46.68
59.37	69.68	72.03	60.79	52.33
77.76	82.11	84.14	59.02	70.04
64.88	49.85	56.02	64.18	43.91
74.03	44.88	68.21	66.97	83.99
45.07	39.67	77.20	57.87	67.29
53.42	72.35	51.02	71.72	62.09
80.34	62.86	91.03	66.16	88.56
65.10	72.16	83.98	65.43	77.40
58.49	62.94	61.51	56.08	78.11
82.54	76.23	81.01	90.87	71.75
74.82	79.19	76.04	72.98	81.72
84.17	69.55	59.76	59.79	62.61
85.96	67.33	81.09	79.65	71.55
66.74	71.49	71.67	62.88	71.23
72.18	78.73	79.26	73.22	72.43
74.07	69.69	62.83	65.16	69.85

TEST	SPEED (SFPM)	FEED (IPR)	SETUP MAN	OPERTR	TOOL TYPE	TOOL COND.	D TO S (IN)	MACHIN	MEAS. DEVICE	RAKE ANGLE
1	1000	.0086	RICARD	REGULR	CUTGOT	SHARP	0.1003	NACIRM	SRFCHK	10 DEG
2	1100	.0080	SAMUEL	REGULR	NORK-V	SHARP	0.1003	LELATH	TALYMS	5 DEG.
3	1100	.0080	SAMUEL	REGULR	NORK-V	SHARP	0.1003	LELATH	TALYMS	5 DEG.
4	1100	.0080	SAMUEL	REGULR	CUTGOT	DULL	0.1001	LELATH	SRFCHK	10 DEG
5	1050	.0089	RICARD	REGULR	ROVED	DULL	0.1001	REX	SRFCHK	10 DEG
6	1050	.0089	RICARD	REGULR	CUTGOT	SHARP	0.1003	REX	TALYMS	10 DEG
7	1000	.0086	SAMUEL	SUBST.	NORK-V	DULL	0.0999	NACIRM	SRFCHK	5 DEG.
8	1000	.0086	SAMUEL	SUBST.	CUTGOT	SHARP	0.0998	NACIRM	SRFCHK	10 DEG
9	1100	.0080	RICARD	SUBST.	CUTGOT	SHARP	0.1001	LELATH	SRFCHK	10 DEG
10	1100	.0080	RICARD	SUBST.	ROVED	SHARP	0.1003	LELATH	SRFCHK	10 DEG
11	1050	.0089	SAMUEL	SUBST.	ROVED	SHARP	0.1000	REX	SRFCHK	10 DEG
12	1000	.0086	SAMUEL	REGULR	ROVED	SHARP	0.1000	NACIRM	TALYMS	10 DEG
13	1100	.0080	RICARD	REGULR	NORK-V	SHARP	0.1003	LELATH	SRFCHK	5 DEG.
14	1050	.0089	SAMUEL	REGULR	CUTGOT	SHARP	0.0997	REX	TALYMS	5 DEG.
15	1050	.0089	SAMUEL	REGULR	ROVED	SHARP	0.0997	REX	SRFCHK	5 DEG.
16	1050	.0089	SAMUEL	REGULR	NORK-V	DULL	0.1003	REX	TALYMS	5 DEG.
17	1050	.0089	RICARD	REGULR	CUTGOT	SHARP	0.1000	REX	TALYMS	10 DEG
18	1000	.0086	RICARD	REGULR	ROVED	SHARP	0.0997	NACIRM	SRFCHK	10 DEG
19	1000	.0086	SAMUEL	REGULR	ROVED	SHARP	0.1003	NACIRM	TALYMS	5 DEG.
20	1000	.0086	SAMUEL	REGULR	NORK-V	SHARP	0.1000	NACIRM	TALYMS	10 DEG
21	1050	.0089	RICARD	REGULR	NORK-V	SHARP	0.1000	REX	TALYMS	10 DEG
22	1050	.0089	SAMUEL	SUBST.	NORK-V	SHARP	0.1000	REX	TALYMS	5 DEG.

Using XRCHRT

- **Should be pros at this.**

- **User asked for data file name:**
  e.g, bob.dat

- **Name for output file:**

Using PROCAP

- Run PROCAP after all the three special causes are identified to generate:
  - Histogram of individual measurements
  - Normal Probability Plot of the individuals.
  - Calculation of process capability(%, C_p, & C_{pk})
- Asks for input file name:
- User asked for name, date
- Data dump, invalidate samples, skip plot
- Output file name:

Assignment

1. Run TURNSIM to generate data
2. Run XRCHRT to construct the charts
3. Correlate the statistical signals / patterns on control charts with the levels for the 10 candidate special causes

4. If you identified a special cause move to step 1 and repeat 1-3 till you have identified all three, and then...

5. Run PROCAP to assess the capability of process

6. Prepare a report that details your findings

X BAR
48.000
58.667
69.333
80.000
RANGE
.000
20.000
40.000
60.000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37

The Report

- 1-page Executive Summary.
  - Summarizes contents & conclusions of the report.

- Body of the report.
  - Introduction
  - Procedures -- spell out the logic that you used to make your decisions
  - Conclusions

- Appendix

DUE: Nov 28, 2005