SPC Attribute Control Charts
p-chart, np-chart, c-chart

Laboratory Quality Systems
Dr. Susie Dai & Dr. Tim Herrman

Why Use An Attribute Control Chart

- Whenever you need to monitor a non-measurable characteristic in your product:
  - The p-chart helps monitor and control percentage of defects
  - The np-chart helps monitor and control the number of defects
  - The c-chart counts the number of defects in a part

Developing a p-chart

Step 1. Take the sample
Step 2. Complete information on the p-chart form
Step 3. Record data
Step 4. Calculate p, percent defective
Step 5. Calculate the average percent defects
Step 6. Determine scales for the graph and plot data
Step 7. Calculate the control limits
Step 8. Create the p-chart
Step 9. Interpret the p-chart

Step 2. Complete p-chart form

Investigator 3 – Work Error List

Date	Switched seal/ sample #s	Sample receipt form mistakes/ Label mistakes	Alfrims data mistakes	No label(s) submitted (electronic)	Missing Sample	No sample receipt form/ or labels rec'd	No pesticide stickers (orange)	No BSE sticker (pink)	Samples Rec'd in office late	Comments
10/20/ 2008				x						Incorrect class code added to samples
10/20/ 2008				x						Added wrong unit code for zinc & copper
11/18/ 2008			x							2008103117 & 103118 not finalized
1/21/ 2009			x							2009103176 crude protein assignment should be 7.0% he had 9.0%
1/20/ 2009			x							2009103176 added manganese as 180 ppm should be 130 ppm
1/30/ 2009			x							20091031192 added calcium max as 13.0 should b 13.2

Step 3 & 4. Record data & calculate % defective

Date	No. Insp	No. Def	Switched seal/ sample #s	Sample receipt form mistakes/ Label mistakes	Alfrims data mistakes	No label(s) submitted (electronic)	Missing Sample	No sample receipt form/ or labels rec'd	No pesticide stickers (orange)	No BSE sticker (pink)	Samples Rec'd in office late	Percent
Oct	721	27	1	2	7	12	1	3	0	0	0	3.7
Nov	393	19	0	1	12	6	0	0	0	0	0	4.8
Dec	283	3	0	0	2	1	0	0	0	0	0	1.1
Jan	576	33	2	2	12	5	0	6	0	0	6	5.7
Feb	551	30	4	0	19	0	0	7	0	0	0	5.4
March	629	20	0	1	14	0	0	2	0	0	3	3.2
April	444	10	0	2	8	0	0	0	0	0	0	2.3

Step 5. Calculate the average percent defective for the process

Number defective: 27 + 19 + 3 + 33 + 30 + 20 + 10 = 142

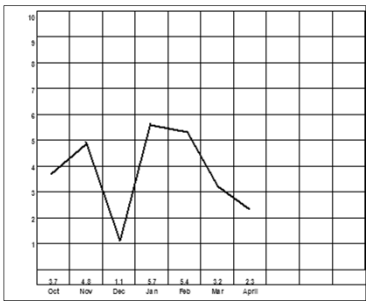
Total number of inspection samples = 3597

142/3597 * 100 = 3.95%

$\overline{p}$ = average percent defect = 3.95

n = average sample size = 3597/7 = 514

Step 6. Determine the scales for the graph and plot data

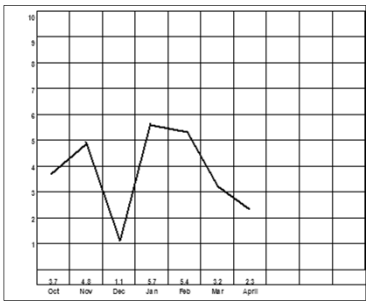


Step 7. Calculate the control limits for percent defects

$UCLp = \bar{p} \text{ plus } 3\sqrt{\bar{p} \times (100\% - \bar{p}) / n}$

$UCLp = 3.95 + 3\sqrt{(3.95 \times (100-3.95))/514} = 6.52$

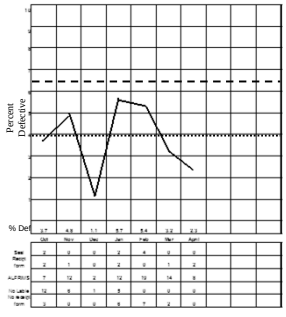
Step 7. Graph the control limits for percent defects



Step 8. Create the p-chart (Fill in the kinds of defects)

Switched seal/ sample #s	Sample receipt form mistakes/ Label mistakes	Alfrims data mistakes	No label(s) submitted (electronic)	Missing Sample	No sample receipt form/ or labels rec'd	No pesticide stickers (orange)	No BSE sticker (pink)	Samples Rec'd in office late
2	2	7	12	1	3	0	0	0
0	1	12	6	0	0	0	0	0
0	0	2	1	0	0	0	0	0
2	2	12	5	0	6	0	0	6
4	0	19	0	0	7	0	0	0
0	1	14	0	0	2	0	0	3
0	2	8	0	0	0	0	0	0

Step 9. Interpreting the p-chart – Graph the percent defective



Possibilities

- All points below the UCLp
- One or more points above the UCLp
- If all points are within the control limits, the process is in statistical control

Resources

- **Amsden, Butler, and Amsden, 1998, SPC Simplified Practical Steps to Quality, Chapter 4.**