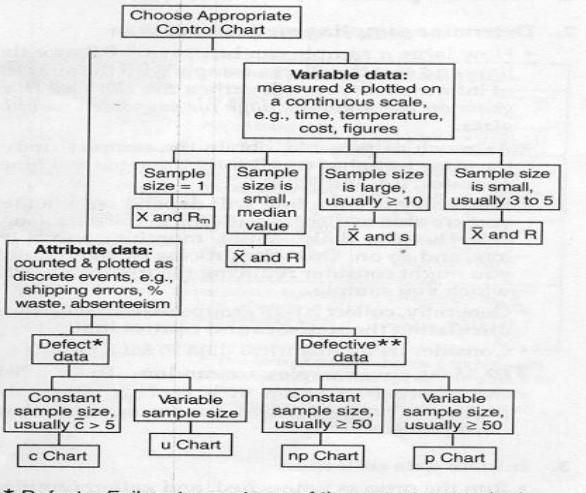
Based on the type of data and sample size you have, choose the appropriate Control Chart.



* Defect = Failure to meet one of the acceptance criteria. A defective unit might have multiple defects.

** Defective = An entire unit fails to meet acceptance criteria, regardless of the number of defects on the unit.

Memory Jogger, Page 37.

"Measured" Data

Variables Data ($\bar{X}$ and R Control Charts):

$\bar{x}$ Control Chart
$UCL = \bar{\bar{x}} + A_2\bar{R}$
$LCL = \bar{\bar{x}} - A_2\bar{R}$
$CL = \bar{\bar{x}}$

R Control Chart
$UCL = \bar{R}\,D_4$
$LCL = \bar{R}\,D_3$
$CL = \bar{R}$

Capability Study
$PCR = (USL - LSL)/(6\hat{\sigma})$; where $\hat{\sigma} = \bar{R}/d_2$

n	A_2	D_3	D_4	d_2
2	1.880	0.000	3.267	1.128
3	1.023	0.000	2.574	1.693
4	.729	0.000	2.282	2.059
5	.577	0.000	2.115	2.326
6	.483	0.000	2.004	2.534
7	.419	.076	1.924	2.704
8	.373	.136	1.864	2.847
9	.337	.184	1.816	2.970
10	.308	.223	1.777	3.078

Source: Doug Montgomery, Statistical Process Control, front cover.

See Memory Jogger, p. 42.

An automatic filling machine is used to fill 16 ounce cans of a certain product. Samples of size 5 are taken from the assembly line each hour and measured. The results of the first 25 subgroups are shown in the attached file with selected rows shown below. Does the process appear to be in statistical control?

Filling Weights								
	Sample							
subgroup	1	2	3	4	5		Average	Range
1	16.09	16.16	16.08	16.02	16.11		16.09	0.14
2	15.95	16.00	15.90	16.17	16.01		16.01	0.27
3	16.07	16.07	16.08	15.89	16.28		16.08	0.39
4	16.13	16.15	16.19	16.13	16.19		16.16	0.06
5	16.16	16.11	16.40	16.14	15.86		16.13	0.54
23	16.26	16.06	16.28	16.21	15.86		16.13	0.42
24	16.11	16.12	16.25	16.32	16.37		16.23	0.26
25	16.08	16.35	16.12	16.09	16.37		16.20	0.29
							16.11	0.33

Source: Shirland, Statistical Quality Control, problem 5.2.

"Count" Data

Attribute Data (*p*, *np*, *c*, and *u* Control Charts):

Control Chart Formulas

	p (fraction)	*np* (number of nonconforming)	*c* (count of nonconformances)	*u* (count of nonconformances/unit)
CL	$\bar{p}$	$n\bar{p}$	$\bar{c}$	$\bar{u}$
UCL	$\bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$	$n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$	$\bar{c} + 3\sqrt{\bar{c}}$	$\bar{u} + 3\sqrt{\frac{\bar{u}}{n}}$
LCL	$\bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$	$n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$	$\bar{c} - 3\sqrt{\bar{c}}$	$\bar{u} - 3\sqrt{\frac{\bar{u}}{n}}$
Notes	If n varies, use $\bar{n}$ or individual n_i	n must be a constant	n must be a constant	If n varies, use $\bar{n}$ or individual n_i

Source: Doug Montgomery, Statistical Process Control, front cover.

The commonwealth banking corporation issues a national credit card through its various locations. The bank credit card business is very competitive, so the company decided to attempt to retain its customers by improving customer service through a reduction in billing errors. The credit card division monitored its billing department process by taking daily samples of 200 customer bills for 30 days and checking their accuracy. The sample results are shown below. Develop a p control chart for the billing process.

Sample	Number of Defectives	Sample	Number of Defectives	Sample	Number of Defectives
1	7	11	9	21	13
2	12	12	6	22	9
3	9	13	3	23	10
4	6	14	2	24	12
5	5	15	8	25	15
6	8	16	10	26	14
7	10	17	12	27	16
8	11	18	14	28	12
9	14	19	16	29	15
10	10	20	15	30	14

Source: Russell and Taylor, Operations Management, p. 170.

Temperature Data

	Readings					
Day	1	2	3		**average**	**range**
1	150	160	155		155.0	10
2	140	150	155		148.3	15
3	145	150	150		148.3	5
4	150	150	155		151.7	5
5	130	155	150		145.0	25
6	140	140	145		141.7	5
7	150	150	150		150.0	0
8	155	155	160		156.7	5
9	160	160	160		160.0	0
10	150	160	165		158.3	15
					151.5	8.5

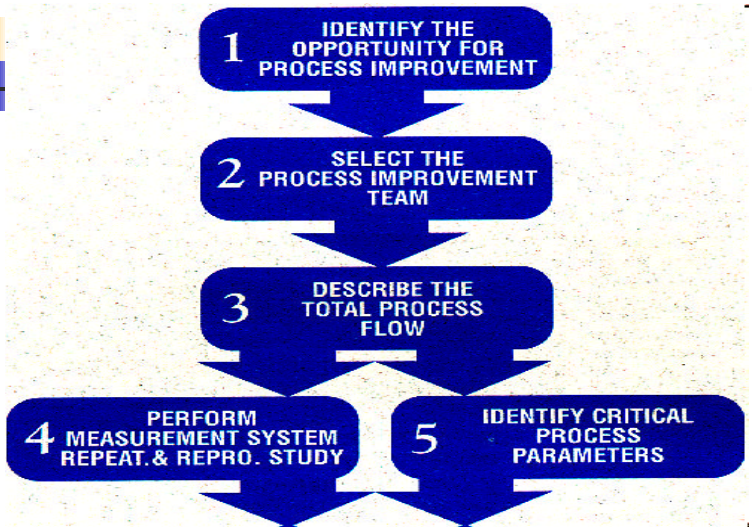
Specifications are USL = 160 degrees and LSL = 147 degrees.

Capable Process?

Source: HBS Case 686-118, Constructing and Using Process Control Charts.

Second round of Temperature Data

11	151	147	150		149.3	4
12	151	150	147		149.3	4
13	150	152	151		151.0	2
14	150	156	151		152.3	6
15	150	148	152		150.0	4
16	148	151	155		151.3	7
17	152	157	149		152.7	8
18	147	151	150		149.3	4
19	150	150	156		152.0	6
20	150	155	151		152.0	5
					150.9	5.0



source: Texas Instruments, Statistical Process Control Guidelines

source: Texas Instruments, Statistical Process Control Guidelines