

STAT 495, Fall 2008

Homework Assignment #4

1. A study was done on the toe alignment on the independent rear suspension system of a particular make and model of automobile. The independent rear suspension is made by an outside vendor. The vendor sets the rear toe alignment in a process that simulates how the suspension will operate in the vehicle. At the assembly plant the rear suspension is united with the underbody. Once the vehicle is assembled, alignment machines measure the total alignment. The actual toe alignment of the independent rear suspension for the finished vehicle is determined from this measurement. The nominal value is 0.36 with a tolerance of ± 0.12 . On the next page are the data on 50 subgroups of 5 independent rear suspensions. The data are also available in a JMP file and a flat text file on WebCT and the course website: www.public.iastate.edu/~wrstephe/stat495/html

- a) Using all 50 subgroups the average subgroup mean is $\bar{\bar{X}} = 0.33868$ and the average subgroup range is $\bar{\bar{R}} = 0.2502$. Use these values to compute (by hand) the centerlines and control limits for \bar{X} and R charts.
- b) Actually construct the \bar{X} and R charts. You may use JMP or Minitab or another computer program to do this.
- c) Looking at the R chart, are there any subgroups that plot outside the control limits? If so, what subgroups plot outside? Are there unusual individual values within these subgroups? Explain briefly.
- d) Exclude any subgroups that plot outside the control limits on the R chart and reconstruct the \bar{X} and R charts. Again, you can use a computer program to do this.
- e) How have the limits on both charts changed compared to those constructed in b)?
- f) Looking at the new R chart, are there any subgroups that plot outside the control limits? What does this indicate about the process?
- g) Looking at the new \bar{X} chart, are there any subgroups that plot outside the control limits? If so, what subgroups plot outside? Are there unusual individual values within these subgroups? Explain briefly.
- h) Exclude any subgroups that plot outside the control limits on either \bar{X} or R charts and reconstruct the \bar{X} and R charts. Again, you can use a computer program to do this.
- i) How have the limits on both charts changed compared to those constructed in b)?
- j) Looking at the newest \bar{X} chart, are there any subgroups that plot outside the control limits? What does this indicate about the process?
- k) Based on the charts in h) give an estimate of the process standard deviation.
- l) Working with the full set of 50 subgroups, un-exclude those subgroups you excluded for parts d) and h), use a computer program to construct \bar{X} and s charts. How do the limits on the \bar{X} chart compare to those for the \bar{X} chart in b)?
- m) Exclude any subgroups that plot outside the control limits on either the \bar{X} or s chart and reconstruct the \bar{X} and s charts. Based on these charts come up with an estimate of the process standard deviation. How does this estimate compare to the estimate in k)?

Subgroup	X_1	X_2	X_3	X_4	X_5	R	\bar{X}
1	0.26	0.33	0.16	0.21	0.23	0.17	0.238
2	0.29	0.36	0.34	0.24	0.22	0.14	0.290
3	0.36	0.34	0.08	0.22	-0.07	0.43	0.186
4	0.17	0.15	0.33	0.30	0.16	0.18	0.222
5	0.43	0.36	0.12	0.46	0.40	0.34	0.354
6	0.25	0.18	0.24	0.42	0.11	0.31	0.240
7	0.32	0.39	0.32	0.09	0.40	0.31	0.304
8	0.45	0.17	0.33	0.24	0.21	0.28	0.280
9	0.25	0.24	0.28	0.22	0.23	0.06	0.244
10	0.30	0.28	0.28	0.14	0.33	0.19	0.266
11	0.30	0.20	0.29	0.20	0.27	0.10	0.252
12	0.24	0.18	0.31	0.29	0.21	0.13	0.246
13	0.17	0.25	0.40	0.22	0.26	0.23	0.260
14	0.32	0.44	0.33	0.34	0.20	0.24	0.326
15	0.54	0.30	0.43	0.45	0.41	0.24	0.426
16	0.26	0.22	0.38	0.41	0.28	0.19	0.310
17	0.42	0.19	0.22	0.32	0.20	0.23	0.270
18	0.29	0.28	0.38	0.30	0.40	0.12	0.330
19	0.36	0.24	0.37	0.16	0.30	0.21	0.286
20	0.39	0.35	0.31	0.52	0.27	0.25	0.368
21	0.21	0.33	0.29	0.35	0.36	0.15	0.308
22	0.37	0.37	0.39	0.27	0.22	0.17	0.324
23	0.46	0.31	0.30	0.31	0.16	0.30	0.308
24	0.20	0.40	0.36	0.51	0.10	0.41	0.314
25	0.35	0.30	0.46	0.50	0.50	0.20	0.422
26	0.34	0.45	-0.04	0.30	0.42	0.49	0.294
27	0.43	0.77	0.38	0.29	0.33	0.48	0.440
28	0.31	0.29	0.38	0.47	0.58	0.29	0.406
29	0.28	0.40	0.16	0.32	0.41	0.25	0.314
30	0.95	0.23	0.19	0.47	0.23	0.76	0.414
31	0.47	0.46	0.32	0.35	0.62	0.30	0.444
32	0.44	0.26	0.47	0.52	0.32	0.26	0.402
33	0.40	0.33	0.50	0.38	0.35	0.17	0.392
34	0.41	0.43	0.53	0.49	0.33	0.20	0.438
35	0.44	0.46	0.30	0.48	0.35	0.18	0.406
36	0.33	0.42	0.28	0.42	0.38	0.14	0.366
37	0.28	0.24	0.37	0.35	0.16	0.21	0.280
38	0.47	0.36	0.22	0.38	0.27	0.25	0.340
39	0.27	0.47	0.39	0.32	0.26	0.21	0.342
40	0.32	0.42	0.40	0.30	0.29	0.13	0.346
41	0.25	0.19	0.43	0.41	0.58	0.39	0.372
42	0.28	0.32	0.25	0.30	0.32	0.07	0.294
43	0.65	0.36	0.24	0.37	0.58	0.41	0.440
44	0.38	0.50	0.34	0.47	0.48	0.16	0.434
45	0.44	0.29	0.59	0.20	0.39	0.39	0.382
46	0.26	0.49	0.37	0.59	0.48	0.33	0.438
47	0.50	0.42	0.43	0.46	0.55	0.13	0.472
48	0.47	0.24	0.29	0.36	0.24	0.23	0.320
49	0.45	0.22	0.38	0.36	0.52	0.30	0.386
50	0.33	0.35	0.41	0.37	0.53	0.20	0.398
						0.2502	0.33868