MSA – Gage R&R Study Example

APPRAISER/ TRIAL #		PART 1	2	3	4	5	6	7	8	9	10	AVERAGE
1. A	1	0.29	-0.56	1.34	0.47	-0.80	0.02	0.59	-0.31	2.26	-1.36	0.194
2.	2	0.41	-0.68	1.17	0.50	-0.92	-0.11	0.75	-0.20	1.99	-1.25	0.166
3.	3	0.64	-0.58	1.27	0.64	-0.84	-0.21	0.66	-0.17	2.01	-1.31	0.211
4.	AVE	0.447	-0.607	1.260	0.537	-0.853	-0.100	0.667	-0.227	2.087	-1.307	X_a= 0.190
5.	R	0.35	0.12	0.17	0.17	0.12	0.23	0.16	0.14	0.27	0.11	r_a= 0.184
6. B	1	0.08	-0.47	1.19	0.01	-0.56	-0.20	0.47	-0.63	1.80	-1.68	0.001
7.	2	0.25	-1.22	0.94	1.03	-1.20	0.22	0.55	0.08	2.12	-1.62	0.115
8.	3	0.07	-0.68	1.34	0.20	-1.28	0.06	0.83	-0.34	2.19	-1.50	0.089
9.	AVE	0.133	-0.790	1.157	0.413	-1.013	0.027	0.617	-0.297	2.037	-1.600	X_b= 0.068
10.	R	0.18	0.75	0.40	1.02	0.72	0.42	0.36	0.71	0.39	0.18	r_b= 0.513
11. C	1	0.04	-1.38	0.88	0.14	-1.46	-0.29	0.02	-0.46	1.77	-1.49	-0.223
12.	2	-0.11	-1.13	1.09	0.20	-1.07	-0.67	0.01	-0.56	1.45	-1.77	-0.256
13.	3	-0.15	-0.96	0.67	0.11	-1.45	-0.49	0.21	-0.49	1.87	-2.16	-0.284
14.	AVE	-0.073	-1.157	0.880	0.150	-1.327	-0.483	0.080	-0.503	1.697	-1.807	X_c= -0.254
15.	R	0.19	0.42	0.42	0.09	0.39	0.38	0.20	0.10	0.42	0.67	r_c= 0.328
16. PART AVE (Xp)		0.169	-0.851	1.099	0.367	-1.064	-0.186	0.454	-0.342	1.940	-1.571	X= 0.001 R_p= 3.511
17.	$(r_a + r_b + r_c) / (\#\ OF\ APPRAISERS)$ =											R= 0.342
18.	(Max X - Min X) =											X_{DIFF}= 0.445
19.	$R \times D_4^* =$ APPRAISER B OUT OF CONTROL											UCL_R= 0.882
20.	$R \times D_3^* =$											LCL_R= 0.000

Measurement Unit Analysis

Repeatability - Equipment Variation (EV)

EV = $R \times K_1$

= 0.342 x 0.5908

= 0.202

Trials	K1
2	0.8862
3	0.5908

Reproducibility - Appraiser Variation (AV)

AV = $\{(X_{DIFF} \times K_2)^2 - (EV^2/nr)\}^{1/2}$

= {(0.445 x 0.5231)^2 - (0.202 ^2/(10 x 3))}^1/2

= 0.230

Appraisers	2	3
K_2	0.7071	0.5231

Repeatability & Reproducibility (GRR)

GRR = $\{(EV^2 + AV^2)\}^{1/2}$

= {(0.202^2 + 0.230^2)}^1/2

= 0.306

Parts	K_3
2	0.7071
3	0.5231
4	0.4467
5	0.4030
6	0.3742
7	0.3524
8	0.3375
9	0.3249
10	0.3146

Part Variation (PV)

PV = $R_P \times K_3$

= 3.511 x 0.3146

= 1.105

Total Variation (TV)

TV = $\{(GRR^2 + PV^2)\}^{1/2}$

= {(0.306^2 + 1.105^2)}^1/2

= 1.146

% Total Variation (TV)

% EV = 100 (EV/TV)

= 100(0.202/1.146)

= 17.61

% AV = 100 (AV/TV)

= 100(0.230/1.146)

= 20.04

n = number of parts

r = number of trials

% GRR = 100 (GRR/TV)

= 100(0.306/1.146)

= 26.68

Gage system may be acceptable

% PV = 100 (PV/TV)

= 100(1.105/0.000)

= 96.38

ndc = 1.41(PV/GRR)

= 1.41(1.105/0.306)

= 5.093692 ~ 5

The percent error is questionable and may be used under high level of scrutiny at 26.68%

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