

GR&R Study (Average & Range) Report For Gage ID: Demo_01

Gage ID	Demo_01	Parts	10	Part No./Name	-	Tolerance	2	Study Date	19/02/2016
Gage Type	Micrometer	Appraiser(s)	3	Characteristic	-	Pro. Std. Dev. (1 Sigma)	-	Target Pp / Ppk	-
Resolution	0.001	Trials	3	Study By	-	Confidence	95 %	Coverage	99.73% (6 * Sigma)
Lower Specification	-	Upper Specification	-	GR&R Method	Average & Range				

Average & Range Data

GR&R - Range & Average Report	
Measurement Systems Analysis	% Total Variation (TV)
Repeatability - Equipment Variation (EV)	
$EV = R\bar{D}bar * K1$ $= 0.040811 * 0.590818$ $= 0.024112$	$\% EV = 100[EV/TV]$ $= 100[0.024112 / 0.268058]$ $= 9.00$
Reproducibility - Appraiser Variation (AV)	
$AV = \sqrt{[(X\bar{B}ar Diff * K2)^2 + (EV^2 / nr)]}$ $= \sqrt{[(0.026856 * 0.523136)^2 + (0.024112^2 / 30)]}$ $= 0.013342$	$\% AV = 100[AV/TV]$ $= 100[0.013342/0.268058]$ $= 4.98$
Repeatability & Reproducibility (RR)	
$RR = \sqrt{[EV^2 + AV^2]}$ $= \sqrt{[0.024112^2 + 0.013342^2]}$ $= 0.027557$	$\% RR = 100[RR/TV]$ $= 100[0.027557/0.268058]$ $= 10.28$
Part Variation (PV)	
$PV = R_p * K3$ $= 0.847654 * 0.314559$ $= 0.266638$	$\% PV = 100[PV/TV]$ $= 100[0.266638/0.268058]$ $= 99.47$
Total Variation (TV)	
$TV = \sqrt{[R\&R^2 + PV^2]}$ $= \sqrt{[0.027557^2 + 0.266638^2]}$ $= 0.268058$	$nDC = 1.41 (PV/RR)$ $= 1.41 (0.266638/0.027557)$ $= 13.740 \sim 13$

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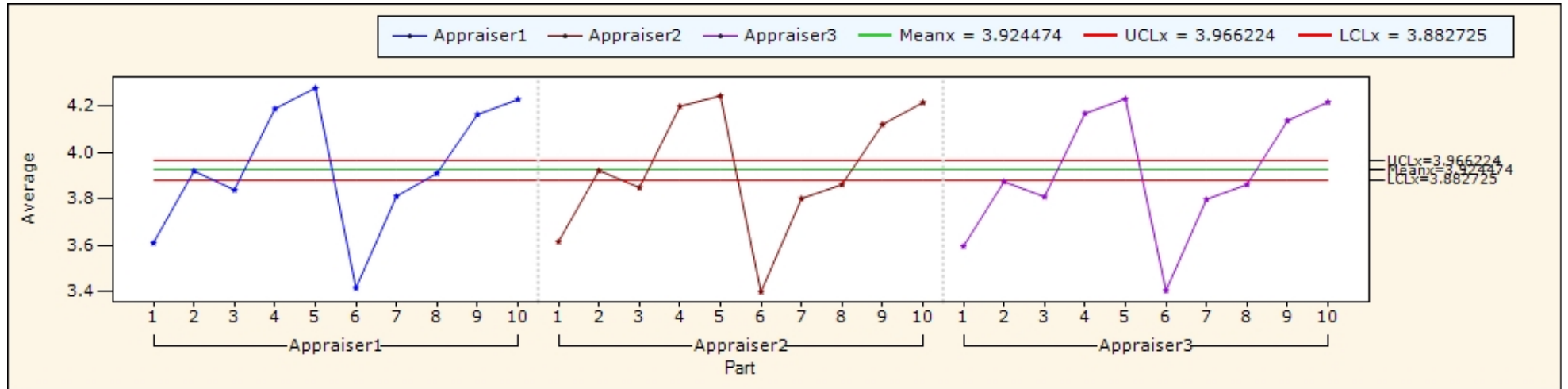
Statistic	St.Dev	6.* St.Dev	% Study	% Contrib	% Tol	% Proc	Pp/Ppk
Based On Study Variation							
EV	0.024112	0.144671	9.00	0.81	7.23	-	-
AV	0.013342	0.080052	4.98	0.25	4.00	-	-
RR	0.027557	0.165342	10.28	1.06	8.27	-	-
PV	0.266638	1.599826	99.47	98.94	79.99	-	-
TV	0.268058	1.608347	100.00	100.00	80.42	-	-
nDC	13.643[~13]		S/N Ratio	9.68			

nDC Calculation			
	Based On Process Tolerance	Based On Process Variation	Based On Target Pp/Ppk
TV	0.333333	-	-
PV	0.332192	-	-
nDC	16.997147[~16]		-
S/N Ratio	12.054714	-	-

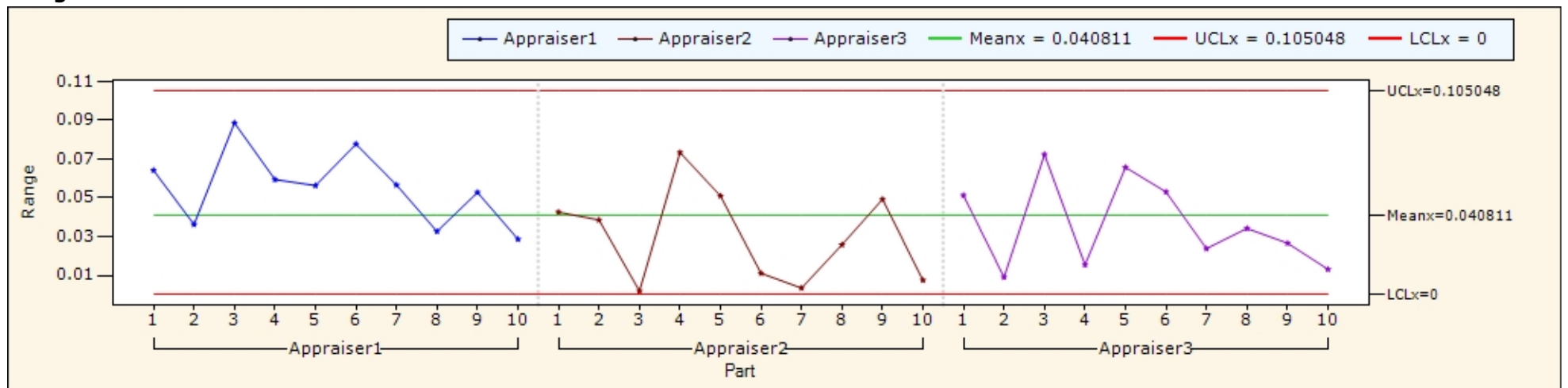
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XBar Chart



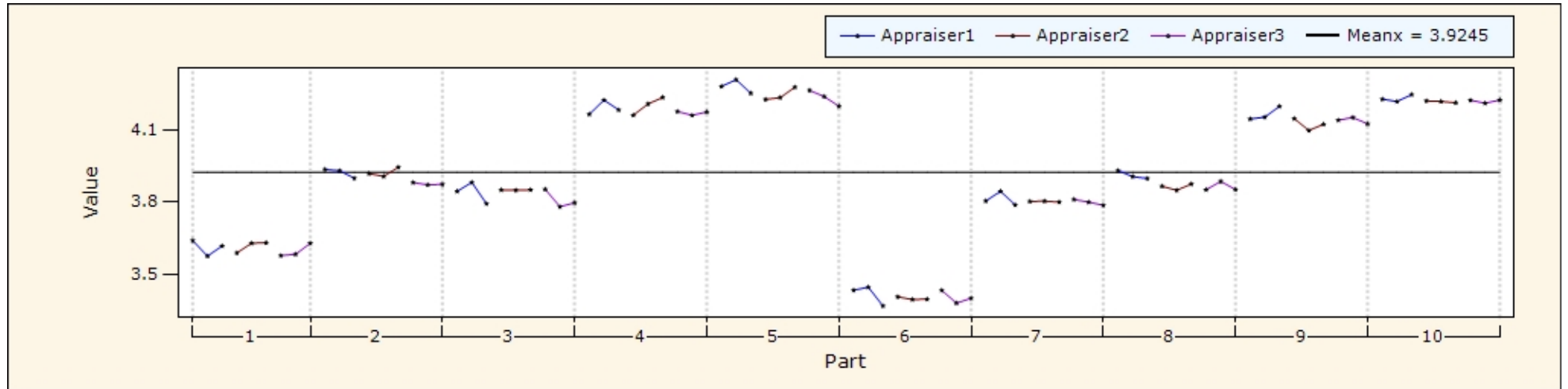
Range Chart



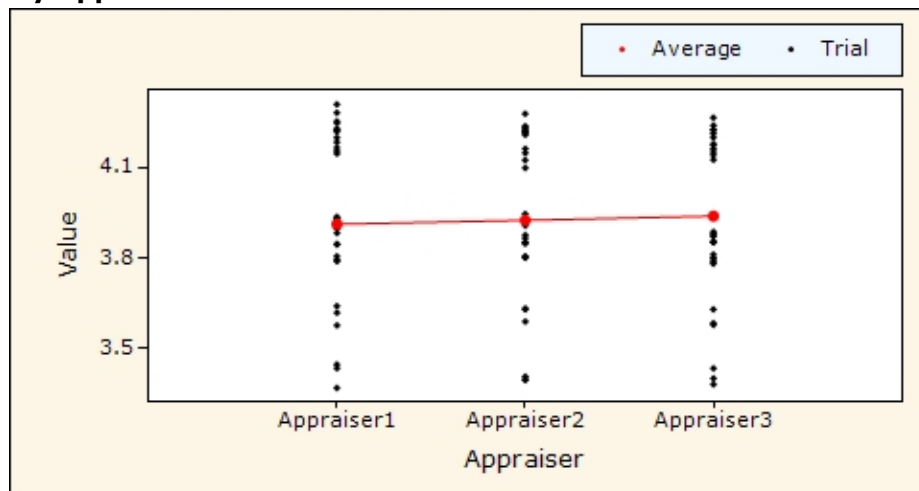
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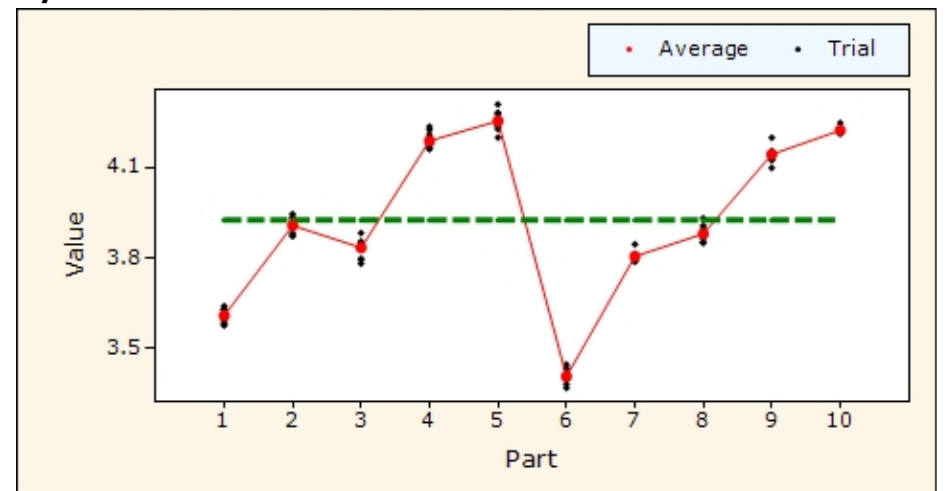
Scatter Chart



By Appraiser Chart



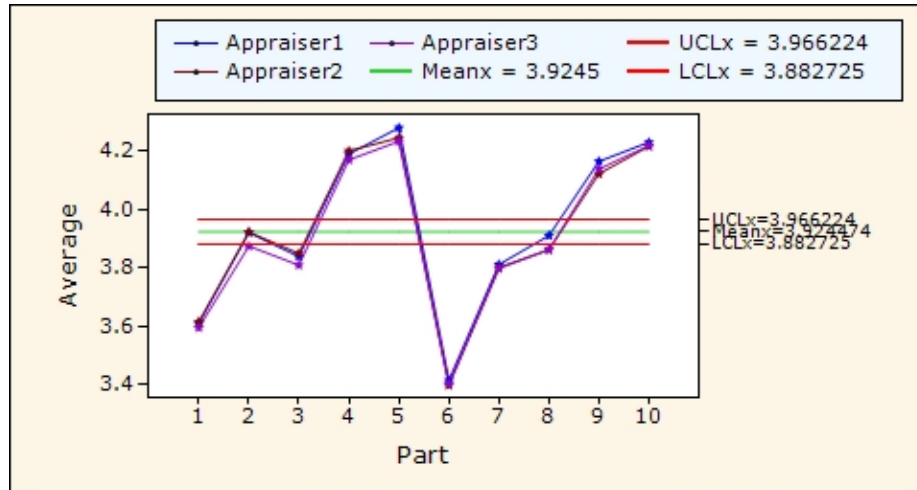
By Part Chart



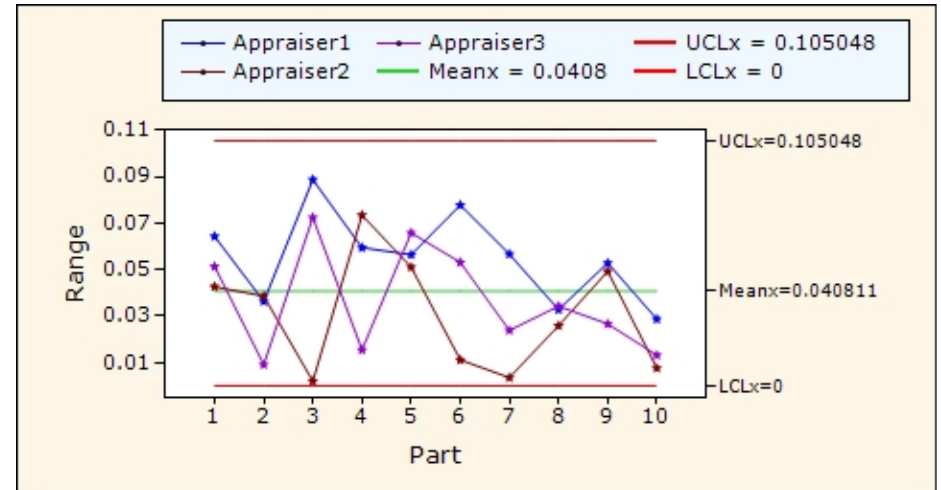
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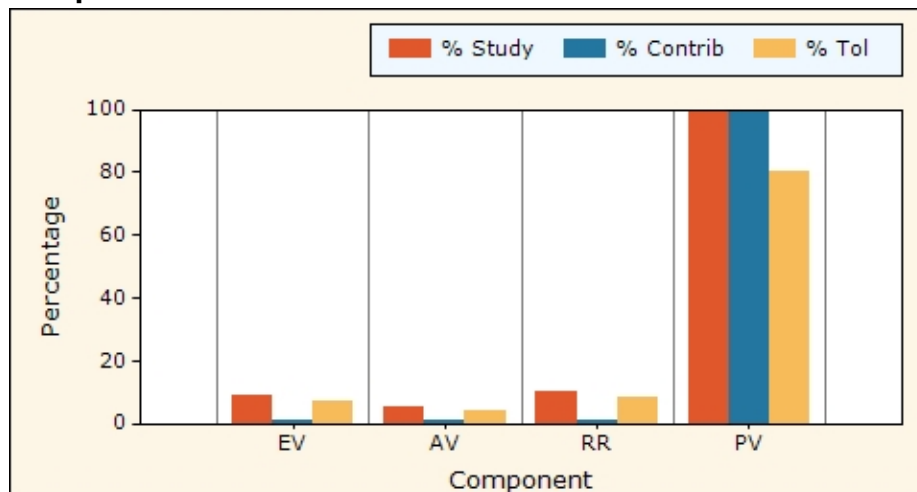
Xbar Stacked Chart



Range Stacked Chart



Components of Variation



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Average & Range Data

Appraisers	Trials	Part										Average	
		1	2	3	4	5	6	7	8	9	10		
Appraiser1	Trial 1	3.63957	3.93548	3.84455	4.1651	4.28118	3.43333	3.80442	3.93066	4.14554	4.22784		3.940767
	Trial 2	3.57531	3.93015	3.88189	4.22454	4.30886	3.44552	3.84481	3.90602	4.15316	4.21844		3.948870
	Trial 3	3.61748	3.89916	3.79324	4.18314	4.25248	3.36779	3.78816	3.89789	4.19837	4.24714		3.924485
	Average	3.610787	3.921597	3.839893	4.190927	4.280840	3.415547	3.812463	3.911523	4.165690	4.231140	Xa-Bar	3.938041
	Range	0.06426	0.03632	0.08865	0.05944	0.05638	0.07773	0.05665	0.03277	0.05283	0.0287	Ra-Bar	0.055373
Appraiser2	Trial 1	3.58826	3.91847	3.85039	4.16154	4.22682	3.40564	3.80264	3.86563	4.14732	4.22073		3.918744
	Trial 2	3.62865	3.90653	3.84887	4.20828	4.23444	3.39446	3.80366	3.84912	4.09804	4.2187		3.919075
	Trial 3	3.63094	3.94514	3.8509	4.23495	4.27788	3.39599	3.8001	3.87503	4.1237	4.21311		3.934774
	Average	3.615950	3.923380	3.850053	4.201590	4.246380	3.398697	3.802133	3.863260	4.123020	4.217513	Xb-Bar	3.924198
	Range	0.04268	0.03861	0.00203	0.07341	0.05106	0.01118	0.00356	0.02591	0.04928	0.00762	Rb-Bar	0.030534
Appraiser3	Trial 1	3.57734	3.88087	3.85293	4.17678	4.26467	3.43282	3.81052	3.85141	4.14072	4.22352		3.921158
	Trial 2	3.58268	3.87173	3.78054	4.16129	4.23876	3.37973	3.79959	3.8857	4.15189	4.21133		3.906324
	Trial 3	3.62865	3.87351	3.7968	4.1745	4.19888	3.3998	3.78664	3.85217	4.12522	4.22454		3.906071
	Average	3.596223	3.875370	3.810090	4.170857	4.234103	3.404117	3.798917	3.863093	4.139277	4.219797	Xc-Bar	3.911184
	Range	0.05131	0.00914	0.07239	0.01549	0.06579	0.05309	0.02388	0.03429	0.02667	0.01321	Rc-Bar	0.036526
												XD-Bar	3.924474
Part Average		3.607653	3.906782	3.833346	4.187791	4.253774	3.406120	3.804504	3.879292	4.142662	4.222817	Rp	0.847654

[[Ra-Bar = 0.055373] + [Rb-Bar = 0.030534] + [Rc-Bar = 0.036526] / [# of Operators = 3]]= RD-Bar =0.040811

[Max XBar =3.911184] - [Min XBar =3.911184] =XBar Diff = 0.026856

[RD-Bar = 0.040811] X [D4 = 2.574]=UCLr = 0.105048