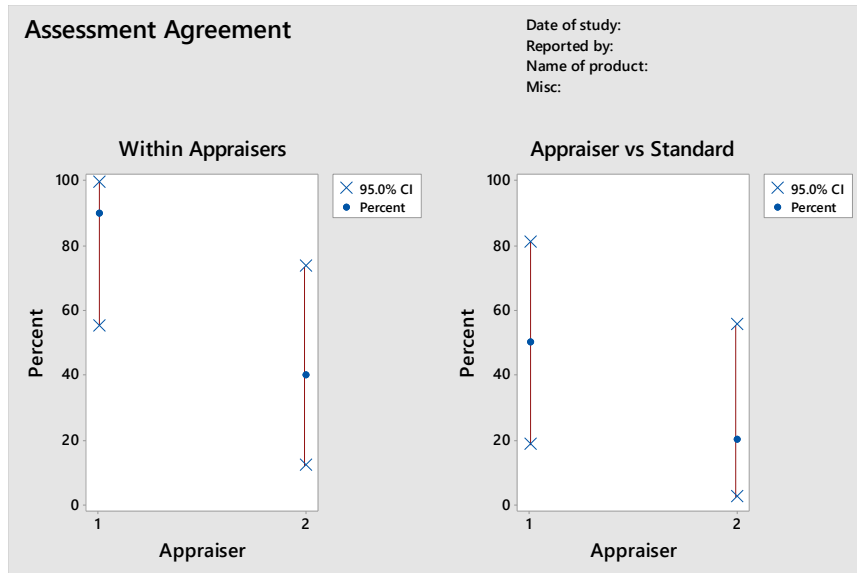


Measurement System Analysis

Discrete GRR

1. An attribute gage repeatability and reproducibility study is to be performed to validate the Go-No Go Gage. (File: MSA Data_Practicefile.xls; **Data Set : MSA 1 - Attribute GRR**)



Attribute Agreement Analysis for Assessments

Within Appraisers

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	10	9	90.00	(55.50, 99.75)
2	10	4	40.00	(12.16, 73.76)

Matched: Appraiser agrees with him/herself across trials.

Fleiss' Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	N	0.733333	0.316228	2.31900	0.0102
	Y	0.733333	0.316228	2.31900	0.0102
2	N	-0.428571	0.316228	-1.35526	0.9123
	Y	-0.428571	0.316228	-1.35526	0.9123

Each Appraiser vs Standard

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	10	5	50.00	(18.71, 81.29)
2	10	2	20.00	(2.52, 55.61)

Matched: Appraiser's assessment across trials agrees with the known standard.

Assessment Disagreement

Appraiser	# Y / N	Percent	# N / Y	Percent	# Mixed	Percent
1	3	60.00	1	20.00	1	10.00
2	0	0.00	2	40.00	6	60.00

Y / N: Assessments across trials = Y / standard = N.

N / Y: Assessments across trials = N / standard = Y.

Mixed: Assessments across trials are not identical.

Fleiss' Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	N	0.0338828	0.223607	0.151528	0.4398
	Y	0.0338828	0.223607	0.151528	0.4398
2	N	-0.0722611	0.223607	-0.323161	0.6267
	Y	-0.0722611	0.223607	-0.323161	0.6267

Between Appraisers

Assessment Agreement

# Inspected	# Matched	Percent	95% CI
10	1	10.00	(0.25, 44.50)

Matched: All appraisers' assessments agree with each other.

Fleiss' Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
N	-0.0359231	0.129099	-0.278259	0.6096
Y	-0.0359231	0.129099	-0.278259	0.6096

All Appraisers vs Standard

Assessment Agreement

# Inspected	# Matched	Percent	95% CI
10	1	10.00	(0.25, 44.50)

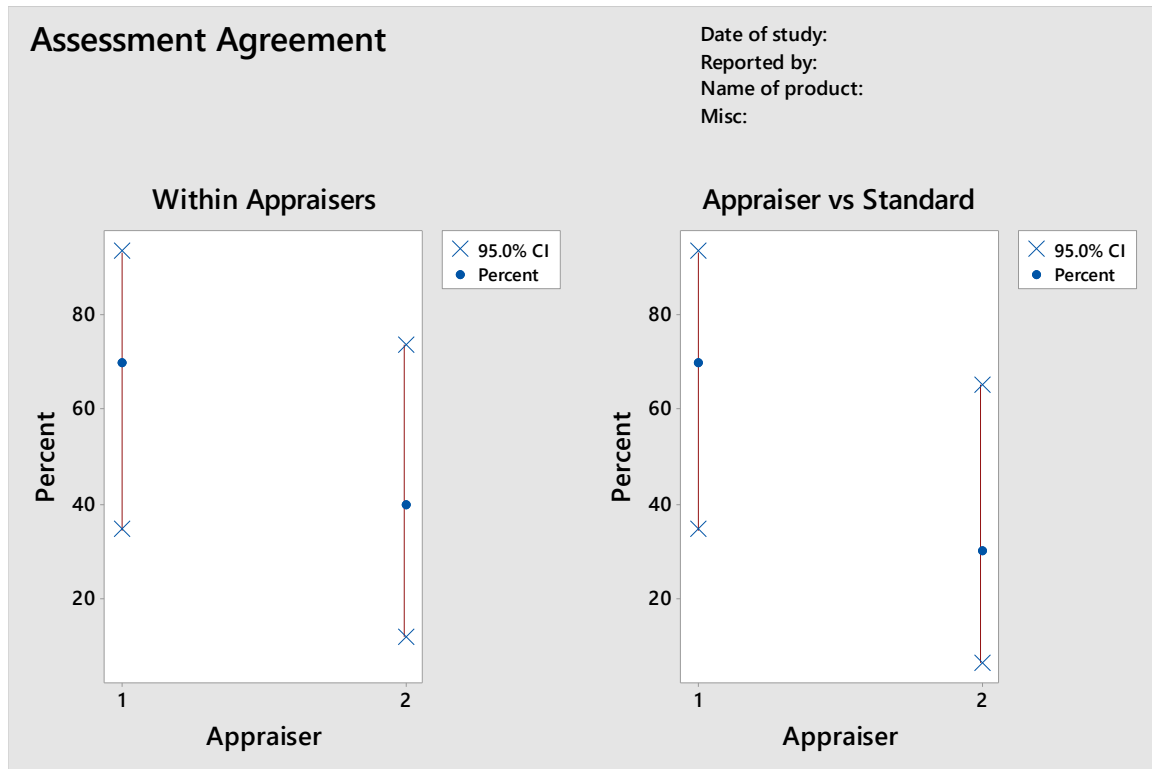
Matched: All appraisers' assessments agree with the known standard.

Fleiss' Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
N	-0.0191891	0.158114	-0.121363	0.5483
Y	-0.0191891	0.158114	-0.121363	0.5483

Attribute Agreement Analysis

2. The riding comfort of different models of cars are assessed by 2 appraisers in ordinal scale. Perform GRR study to evaluate if their assessment is within acceptable gage variation. (File: MSA Data_Practicefile.xls; Data Set : MSA 2 - Attribute GRR with Kappa)



Attribute Agreement Analysis for Assessments_1

Within Appraisers

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	10	7	70.00	(34.75, 93.33)
2	10	4	40.00	(12.16, 73.76)

* Matched: Appraiser agrees with him/herself across trials.

Fleiss' Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	High	0.523810	0.316228	1.65643	0.0488
	Low	0.523810	0.316228	1.65643	0.0488
	Medium	0.583333	0.316228	1.84466	0.0325
	Overall	0.545455	0.224529	2.42933	0.0076
2	High	0.166667	0.316228	0.52705	0.2991
	Low	-0.098901	0.316228	-0.31275	0.6228
	Medium	0.200000	0.316228	0.63246	0.2635
	Overall	0.083969	0.225946	0.37163	0.3551

Cohen's Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	High	0.545455	0.281672	1.93649	0.0264
	Low	0.545455	0.281672	1.93649	0.0264
	Medium	0.583333	0.316228	1.84466	0.0325
	Overall	0.558824	0.207139	2.69782	0.0035
2	High	0.200000	0.289828	0.69007	0.2451
	Low	-0.086957	0.308665	-0.28172	0.6109
	Medium	0.285714	0.221313	1.29099	0.0984
	Overall	0.130435	0.195572	0.66694	0.2524

Each Appraiser vs Standard

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	10	7	70.00	(34.75, 93.33)
2	10	3	30.00	(6.67, 65.25)

* Matched: Appraiser's assessment across trials agrees with the known standard.

Fleiss' Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	High	0.756777	0.223607	3.38441	0.0004
	Low	0.536996	0.223607	2.40152	0.0082
	Medium	0.791667	0.223607	3.54044	0.0002
	Overall	0.694656	0.159768	4.34790	0.0000
2	High	0.107143	0.223607	0.47916	0.3159
	Low	0.432234	0.223607	1.93301	0.0266
	Medium	0.391667	0.223607	1.75159	0.0399
	Overall	0.315290	0.159268	1.97962	0.0239

Cohen's Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	High	0.759725	0.216996	3.50110	0.0002
	Low	0.542334	0.216996	2.49928	0.0062
	Medium	0.791667	0.223607	3.54044	0.0002
	Overall	0.696970	0.156582	4.45115	0.0000
2	High	0.123810	0.214476	0.57726	0.2819
	Low	0.435818	0.220949	1.97248	0.0243
	Medium	0.434524	0.192989	2.25154	0.0122
	Overall	0.334651	0.148880	2.24778	0.0123

Between Appraisers

Assessment Agreement

# Inspected	# Matched	Percent	95% CI
10	2	20.00	(2.52, 55.61)

* Matched: All appraisers' assessments agree with each other.

Fleiss' Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
High	0.120879	0.129099	0.93633	0.1746
Low	0.202279	0.129099	1.56685	0.0586
Medium	0.430199	0.129099	3.33231	0.0004
Overall	0.249531	0.091314	2.73266	0.0031

Cohen's Kappa Statistics

You must have two appraisers and single trial per appraiser to compute kappa.

All Appraisers vs Standard

Assessment Agreement

# Inspected	# Matched	Percent	95% CI
10	2	20.00	(2.52, 55.61)

* Matched: All appraisers' assessments agree with the known standard.

Fleiss' Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
High	0.431960	0.158114	2.73195	0.0031
Low	0.484615	0.158114	3.06498	0.0011
Medium	0.591667	0.158114	3.74203	0.0001
Overall	0.504973	0.112796	4.47686	0.0000

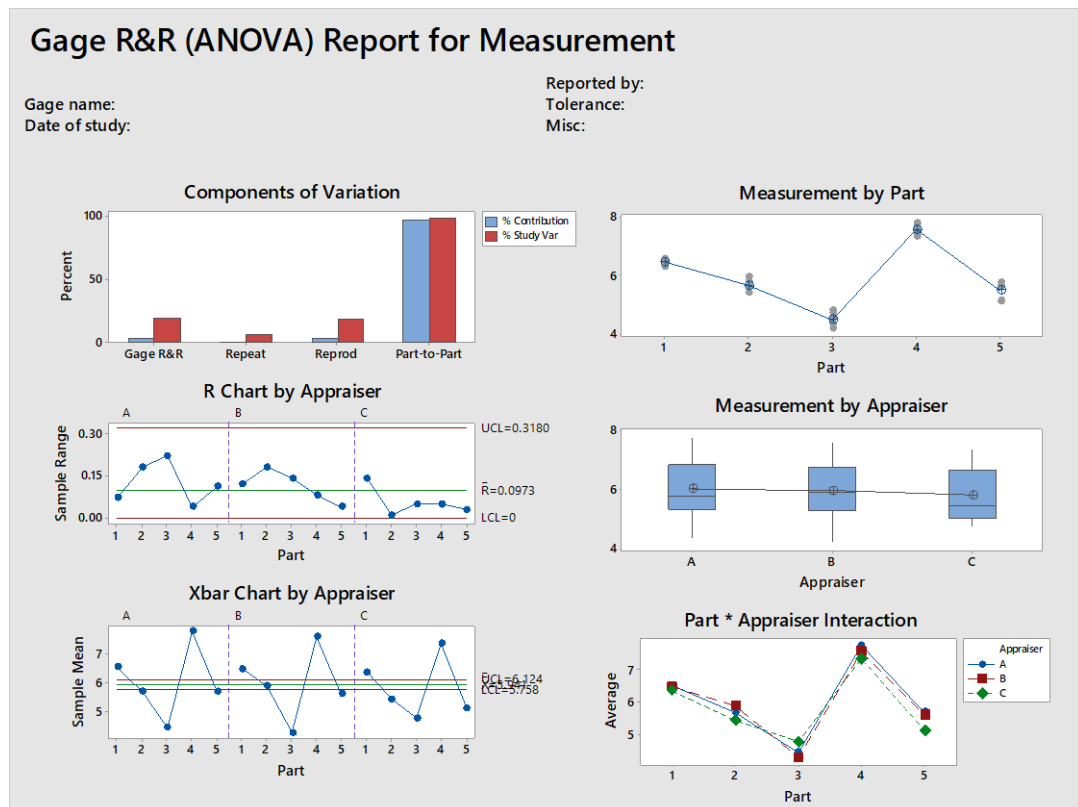
Cohen's Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
High	0.441767	0.152551	2.89587	0.0019
Low	0.489076	0.154843	3.15852	0.0008
Medium	0.613095	0.147686	4.15134	0.0000
Overall	0.515810	0.108032	4.77463	0.0000

Attribute Agreement Analysis

Variable GRR

- Perform Variable GRR to validate the measurement process of Weight of Parts (File: MSA Data_Practicefile.xls; Data Set : MSA 3 - Gage R&R ANOVA)



Gage R&R Study - ANOVA Method

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part	4	31.9020	7.97550	80.7312	0.000
Appraiser	2	0.2513	0.12565	1.2719	0.331
Part * Appraiser	8	0.7903	0.09879	14.8632	0.000
Repeatability	15	0.0997	0.00665		
Total	29	33.0433			

α to remove interaction term = 0.05

Gage R&R

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.05541	4.05
Repeatability	0.00665	0.49
Reproducibility	0.04876	3.56
Appraiser	0.00269	0.20
Appraiser*Part	0.04607	3.37
Part-To-Part	1.31279	95.95
Total Variation	1.36819	100.00

Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)
Total Gage R&R	0.23538	1.41230	20.12
Repeatability	0.08153	0.48916	6.97
Reproducibility	0.22081	1.32488	18.88
Appraiser	0.05183	0.31097	4.43
Appraiser*Part	0.21464	1.28786	18.35
Part-To-Part	1.14577	6.87461	97.95
Total Variation	1.16970	7.01818	100.00

Number of Distinct Categories = 6

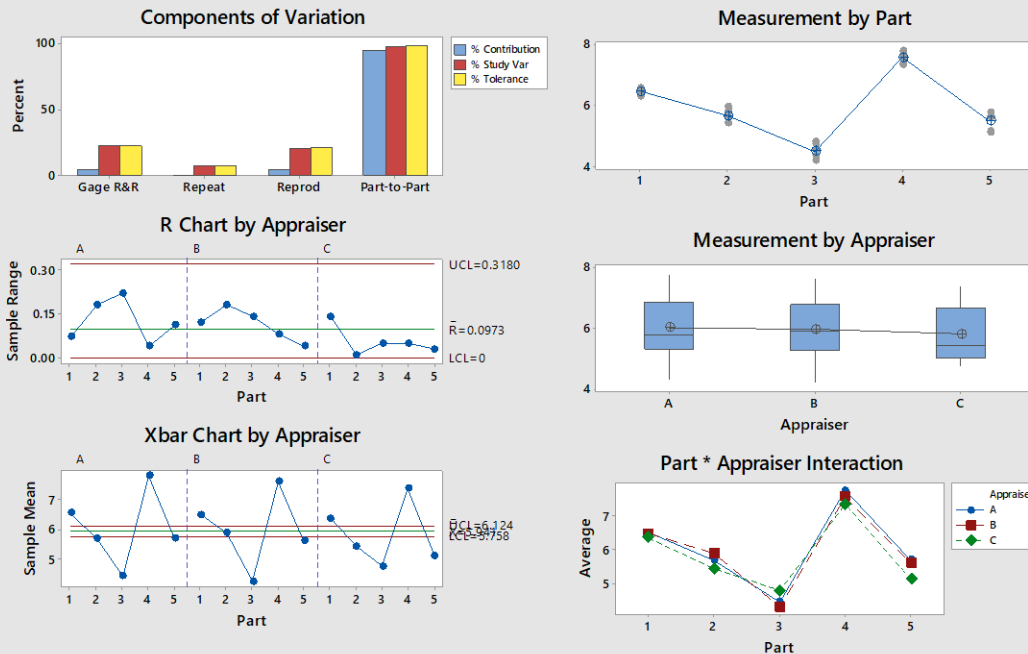
Gage R&R for Measurement

4. Perform Variable GRR to validate the measurement process of dimension of component (File: MSA Data_Practicefile.xls; **Data Set : MSA 4 - Gage R&R ANOVA**)

Gage R&R (ANOVA) Report for Measurement

Gage name:
Date of study:

Reported by:
Tolerance:
Misc:



Gage R&R Study - ANOVA Method

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part	4	31.9020	7.97550	80.7312	0.000
Appraiser	2	0.2513	0.12565	1.2719	0.331
Part * Appraiser	8	0.7903	0.09879	14.8632	0.000
Repeatability	15	0.0997	0.00665		
Total	29	33.0433			

α to remove interaction term = 0.05

Gage R&R

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.05541	5.03
Repeatability	0.00665	0.60
Reproducibility	0.04876	4.42
Appraiser	0.00269	0.24
Appraiser*Part	0.04607	4.18
Part-To-Part	1.04709	94.97
Total Variation	1.10250	100.00

Process tolerance = 6.25

Historical standard deviation = 1.05

Total Variance = historical standard deviation squared = 1.1025

Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)	%Tolerance (SV/Toler)
Total Gage R&R	0.23538	1.41230	22.42	22.60
Repeatability	0.08153	0.48916	7.76	7.83
Reproducibility	0.22081	1.32488	21.03	21.20
Appraiser	0.05183	0.31097	4.94	4.98
Appraiser*Part	0.21464	1.28786	20.44	20.61
Part-To-Part	1.02328	6.13966	97.45	98.23
Total Variation	1.05000	6.30000	100.00	100.80

Historical standard deviation is used to calculate some values for StdDev, Study Var, and %Tolerance.