Notes:

Measurement System Analysis Using Attribute Data

Key Learning Points

1. Describe what is entailed in an attribute MSA study.

2. Explain how to analyze measurement systems using attribute data to determine their adequacy for a given application.

3. Explain how to evaluate the output of the measurement system

Attribute Measurement System Study

- Discrete qualitative data

- Go/no-go basis; or limited data categories

- Compares parts to specific criteria for accept/not accept or to be placed in category

- Must screen for effectiveness to discern good parts from bad

- At least two appraisers and two trials each

- If available, have Quality Master rate parts first

Attribute MSA Example

	Master	Appraiser A		Appraiser B	
		1	2	1	2
1	G	G	G	G	G
2	G	G	G	G	G
3	G	NG	G	G	G
4	NG	NG	NG	NG	NG
5	G	G	G	G	G
6	G	G	G	NG	G
7	NG	NG	NG	G	NG
8	NG	NG	NG	G	G
9	G	G	G	G	G
10	G	G	G	G	G
11	G	G	G	G	G
12	G	G	G	G	G
13	G	G	NG	G	G
14	G	G	G	G	G
15	NG	G	G	G	G
16	G	G	G	G	G
17	G	G	G	G	G
18	G	G	G	G	G
19	G	G	G	G	G
20	NG	G	G	G	G

G = Good
NG = Not Good

Attribute MSA Method

1. Select 20 parts from the process that include both good and bad samples (or include the entire range of categories).

2. Two appraisers independently measure each part twice (in random order).

3. Use a spreadsheet to record the data and analyze data.

4. All Appraisers vs. Standard is the final summary evaluation. How good is good enough?

Example Attribute MSA Study

Completing An Attribute MSA Study

This example compares an item or part to a master specification. There are two appraisers which assess the items or parts in two trials. The items or parts can be considered good or not good.

Step 1: Select 20 Items or Parts From the Process

A project team selected 20 items from their process. They made sure to include both good and bad samples.

Step 2: Have Two Appraisers Measure The Items

The team selected two people to appraise the 20 items independently. The appraisers each measured each item twice in random order.

During the appraisal, they compared each item against standard specifications, and made a determination if the item was "Good" (G), or "No Good" (NG).
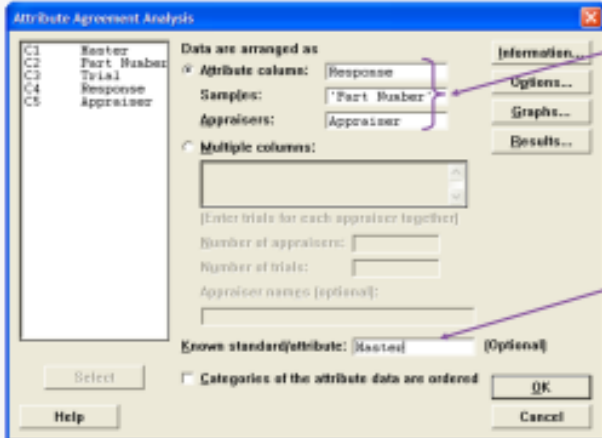
Step 3: Use a Spreadsheet to Record and Analyze the Data

The team recorded the responses created by the appraisers in a Minitab spreadsheet.

Row	Master	Part Number	Trial	Response	Appraiser
1	G	1	1	G	1
2	G	2	1	G	1
3	G	3	1	NG	1
4	NG	4	1	NG	1
5	G	5	1	G	1
6	G	6	1	G	1
7	NG	7	1	NG	1
8	NG	8	1	NG	1
9	G	9	1	G	1
10	G	10	1	G	1
11	G	11	1	G	1
~	~	~	~	~	~
76	G	16	2	G	2
77	G	17	2	G	2
78	G	18	2	G	2
79	G	19	2	G	2
80	NG	20	2	G	2

Step 4: Compare All Appraisers Against the Standard

The team next used Minitab to compare the appraisers responses against the standard.

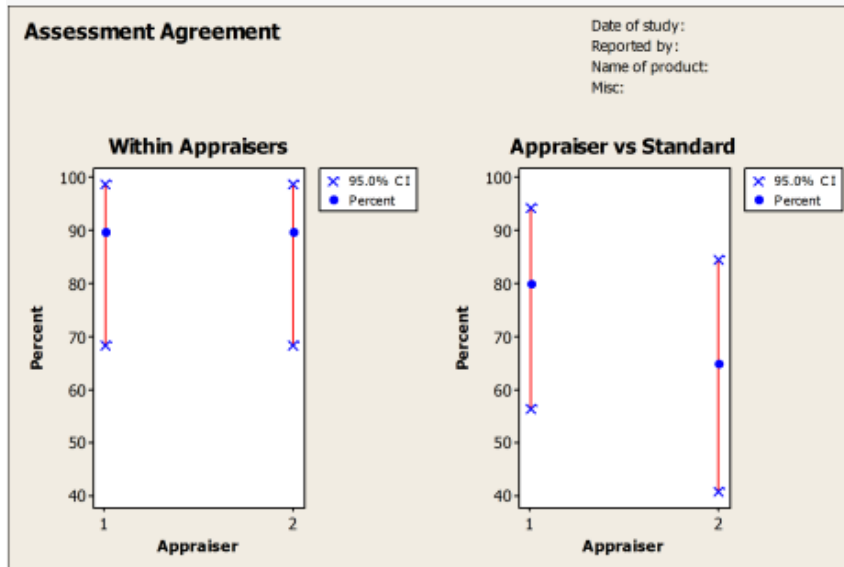**Minitab: Stat > Quality Tools > Attribute Agreement Analysis**

- Insert columns of data.

- If you have the correct evaluation for each part, enter it here. **Note:** You will have to duplicate these data for each appraiser trial.

Attribute MSA Assessment Agreement

- Agreement Within Appraisers: This shows the Confidence Interval (CI) around the percent of time that the appraiser agrees with themselves.

- Agreement Appraiser vs. Standard: This shows the Confidence Interval (CI) around the percent of time that all trials for each appraiser agrees with the standard.

Attribute MSA Session Window

Within Appraisers

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	20	18	90.00	(68.30, 98.77)
2	20	18	90.00	(68.30, 98.77)

Matched: Appraiser agrees with him/herself across trials.

Each Appraiser vs Standard

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	20	16	80.00	(56.34, 94.27)
2	20	13	65.00	(40.78, 84.61)

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

- Within Appraiser: This shows the number matched across trials and the confidence interval around the percent matched.

- Appraiser vs. Standard: This shows the number matched vs. the standard across all trials and the confidence interval around the percent agreement with the standard.

Between Appraisers

Assessment Agreement

```
# Inspected  # Matched  Percent     95% CI
       20          14    70.00  (45.72, 88.11)
```

Matched: All appraisers' assessments agree with each other.

All Appraisers vs Standard

Assessment Agreement

```
# Inspected  # Matched  Percent     95% CI
       20          12    60.00  (36.05, 80.88)
```

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

- Between Appraisers: This shows the number of times that appraisers agree with each other across all trials.

- All Appraisers vs. Standard: This shows the number of times that appraisers agree with the standard across all trials.

Practical Conclusions

- The appraisers were fairly consistent agreeing with themselves 90% of the time. Note that the confidence intervals are very wide, which is typical of attribute data with small sample sets.

- What might be done to improve consistency?

- The appraisers did not agree with each other (only 70%) which is not good. What could cause the poor agreement?

- The appraisers also did not agree with the standard (80% and 65% respectively) and this is unacceptable. First check would be to ensure that the standard is correct, but then what else might you do?

- Overall, the appraisers agreed with the standard 60% of the time (Total Agreement). The measurement system is not valid.

When Should Attribute MSA Be Used?

Attribute MSA should be used when attribute or discreet data is being measured.

- Subjective testing of pass/fail characteristics

- Categorizing defect types, reason codes, or severity levels

- Identifying acceptable documentation

- Identifying acceptable computer records

Pitfalls to Avoid

- Be careful with sample selection. Aim for twenty or more samples, with around 30% defective samples.

- If there are multiple defect categories, you will need more data to understand the appraisers' abilities with each one.

- Be sure all appraisers are trained and experienced. If the measurement system is known to be solid, the MSA can be used to evaluate appraisers.

- Pick your master appraiser carefully. They will be setting the standard for the company.

- Evaluate disagreements after the test. Sometimes the appraiser is not right! Use the disagreements to better define borderline quality.