

A Fun Method to Teach The Seven Tools of Quality

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Introduction - Purpose

- This Program will illustrate a simple and fun way to train others on the basic Quality Tools.
- As groups, we will briefly go through each of the Seven Tools of Quality (what they are, why they are used, the steps to construct them and how they are interpreted).
- We will also learn a little about the history and other facts about M&M's[®].

Introduction cont.

- Quality Tools are “tools that help organizations understand their processes to improve them.”
- These methods are utilized by quality professionals to aid in the analysis, documentation, and organization of quality systems.
- Each tool helps in seeing sources of variation.
- They are listed under the Body of Knowledge (BoK) in almost all of the ASQ Certifications.

Introduction cont.

- The Seven Basic Quality Tools are:
 - **flowcharts**
 - **check sheets**
 - **Pareto charts**
 - **histograms**
 - **cause and effect diagrams**
 - **scatter diagrams**
 - **control charts**

Introduction cont.

- A brief history of M&M's®:
 - Invented by Forrest Mars Sr. who was inspired during a trip to Spain by seeing chocolate pellets encased in a hard sugary coating to prevent melting.
 - M&M's® Chocolate Candies were first sold in 1941 and was a favorite of American GIs in WWII.
 - In 1954, Peanut M&M's® and their famous slogan, "The milk chocolate melts in your mouth, not in your hand" were introduced.
 - In the early 80's, they were chosen by the first space shuttle astronauts to be included as part of their food supply.

Introduction cont.

- Color history of M&M's®:
 - Originally Brown
 - Added Red, Green and Yellow in 1960.
 - Orange was added in 1976 (red was removed).
 - Early 80's, holiday line seasonal color blends added.
 - In 1987, Red was brought back.
 - America voted Blue to be added in 1995.
 - Recently the world voted Purple to be the new color.
- For more on M&M's® history and other info visit:
www.mms.com

FLOWCHARTS

- Flowcharts are a visual diagram of a process broken down by activities.
- Document processes as they flow from start to finish and they show how each step is related.
- At a high level, help users understand complex processes without confusing details.
- At a detail level, they help users analyze their processes for optimization and improvements.

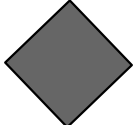
FLOWCHARTS - Construction

- Select a start and stop point (define boundaries).
- List major steps/tasks and decision points (list, in order, the steps or tasks and possible decisions).
- Use standardized graphical symbols to document the process, e.g.

 = start/stop

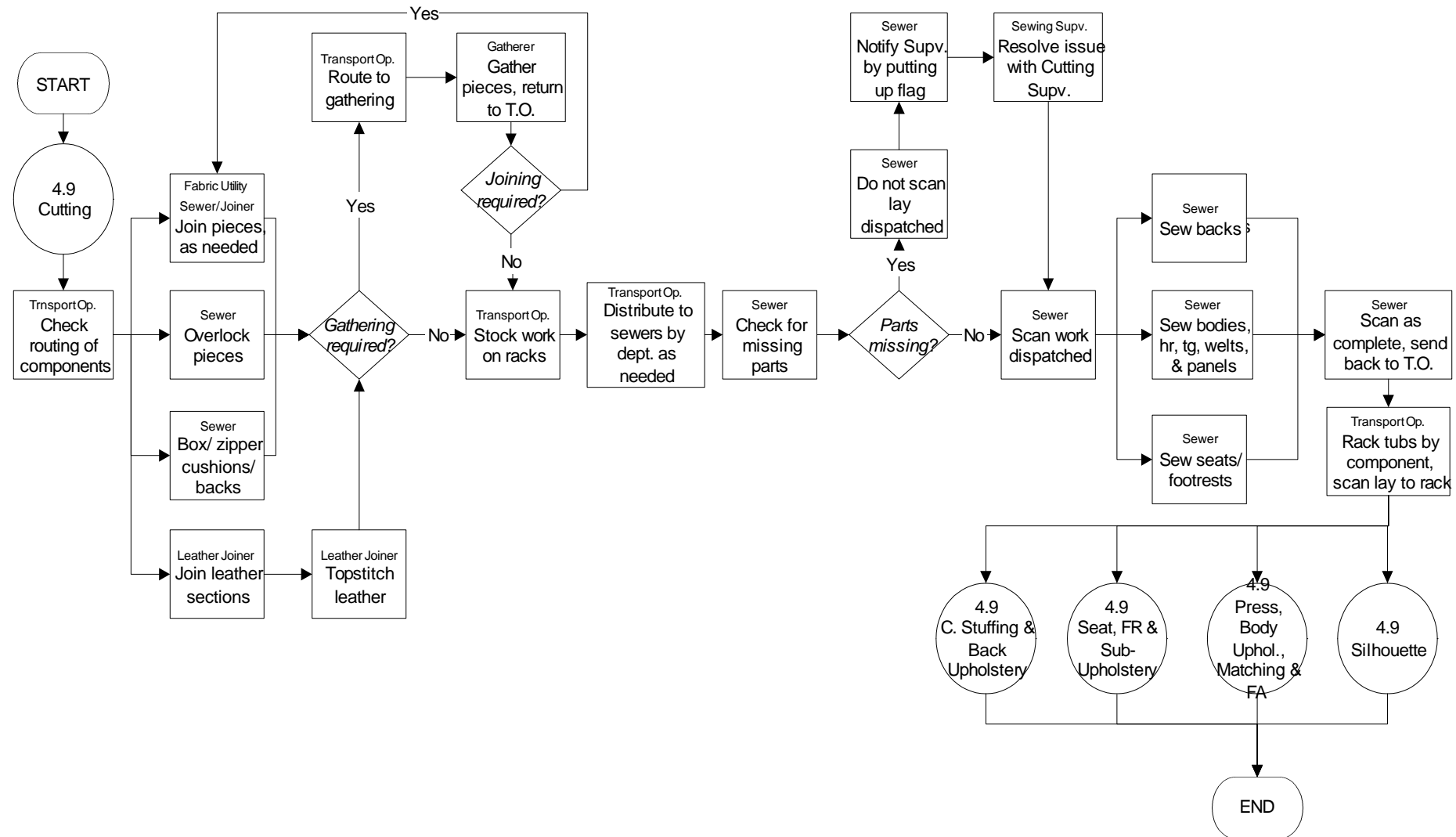
 = dir. of flow

 = step/task

 = decision

4. Review the results (compare to real process and verify it is complete and accurate).

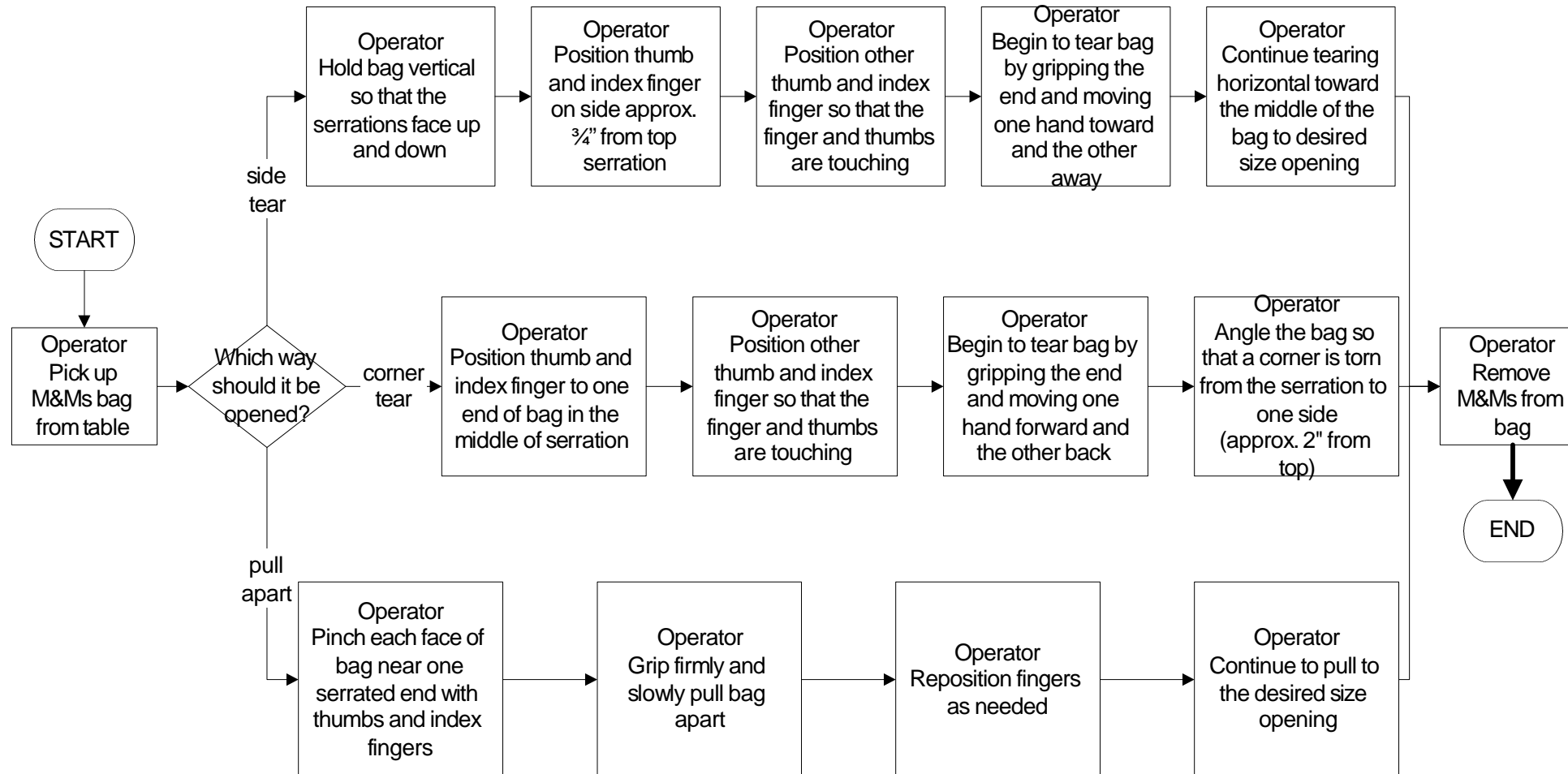
FLOWCHARTS



FLOWCHARTS

- Group Assignment #1: Construct a Flowchart on “Opening a bag of M&M’s[®]”
 - Use worksheet for Start and End points.
 - Use Post-Its for tasks/steps and decisions.
 - Transfer complete flowchart to one group worksheet and be ready to present.
- **GET READY, SET,**
- **GO!!!**

FLOWCHARTS



CHECK SHEETS

- Check sheets are forms used to summarize a tally count of event occurrences.
- Count the number of occurrences, such as defects, for an event (e.g. inspection, audit etc.)
- For primary data collection for other Q. Tools such as Pareto charts and histograms.

CHECK SHEETS - Construction

- Design the check sheet for a given application (include relevant information for later reference).
- Record the data in space provided (place an “X” or other mark for each occurrence).
- Use the data for analysis or input to additional graphical tools (such as for Pareto charts and histograms).

CHECK SHEETS

- Group Assignment #2: Complete the Check Sheet for M&M's[®] data.
 - Note your bag number, remove the M&M's[®] and tally each color.
 - Record the rest of your team's bag #s and totals.
 - Transfer the tallies for your group to one group worksheet and be ready to present.
- **GET READY, SET,**
- **GO!!!**
- After you collect all of the data on the check sheet, you may eat some, if you'd like.

PARETO CHARTS

- Pareto charts prioritize data from highest occurrence to lowest.
- They identify the “vital few” categories that account for the largest relative frequencies and separate the “trivial many.”
- Depict the “80/20 rule” (orig. postulated by Vilfredo Pareto) which is 20% of the factors account for 80% of potential problems.

PARETO CHARTS - Construction

- Rank order the columns or categories of data (start with the highest occurrences column on the left and proceed to the right, down to the lowest occurrence).
- Prepare the graphic (arrange the categories to match the frequencies).
- Calculate and place on the graphic a relative frequency line above the data columns or categories (calculate the % of each category and graph the cumulative percentage).

PARETO CHARTS

- Group Assignment #3: Construct a Pareto chart based on Group M&M's[®] data.
 - Arrange the colors in decreasing order of frequency on the worksheet.
 - Fill in the total numbers for each color in the next column.
 - Graph the results worksheet and be ready to present.

● **GET READY, SET,**

● **GO!!!**

HISTOGRAMS

- Histograms are a graphic representation of the frequency of occurrence sorted into categories of a defined range.
- Helpful for displaying the distribution of data columns relative to another.
- Useful to see if data follows a normal (bell-shaped) distribution or another type of distribution.

HISTOGRAMS - Construction

- Determine the amount of data to be collected.
- Determine the number of columns or categories to be used (See right).
- Collect and record data (use a check sheet).
- Prepare the graphic (title, labels, scales, categories).
- Graph the data (plot as bar graph).

# Data points	# Columns
<50	5-7
50-100	6-10
100-250	7-12
>250	10-20

HISTOGRAMS

- Group Assignment #4: Construct a histogram based on all M&M's[®] data.
 - Count the number of bags for each “# per bag” category.
 - Graph the results on the worksheet.
- Is the distribution of M&M's[®] normal?
- Why is there such a variation in the number of per M&M's[®] bag?

CAUSE AND EFFECT DIAGRAM

- Cause and effect diagrams (or fishbone or Ishikawa diagrams) graphically document the causes of a single effect.
- Useful for determining root cause(s) of a problem.
- Considers the six types of causes: Man/People, Methods, Machines/Equipment, Materials, Measurement and Environment.

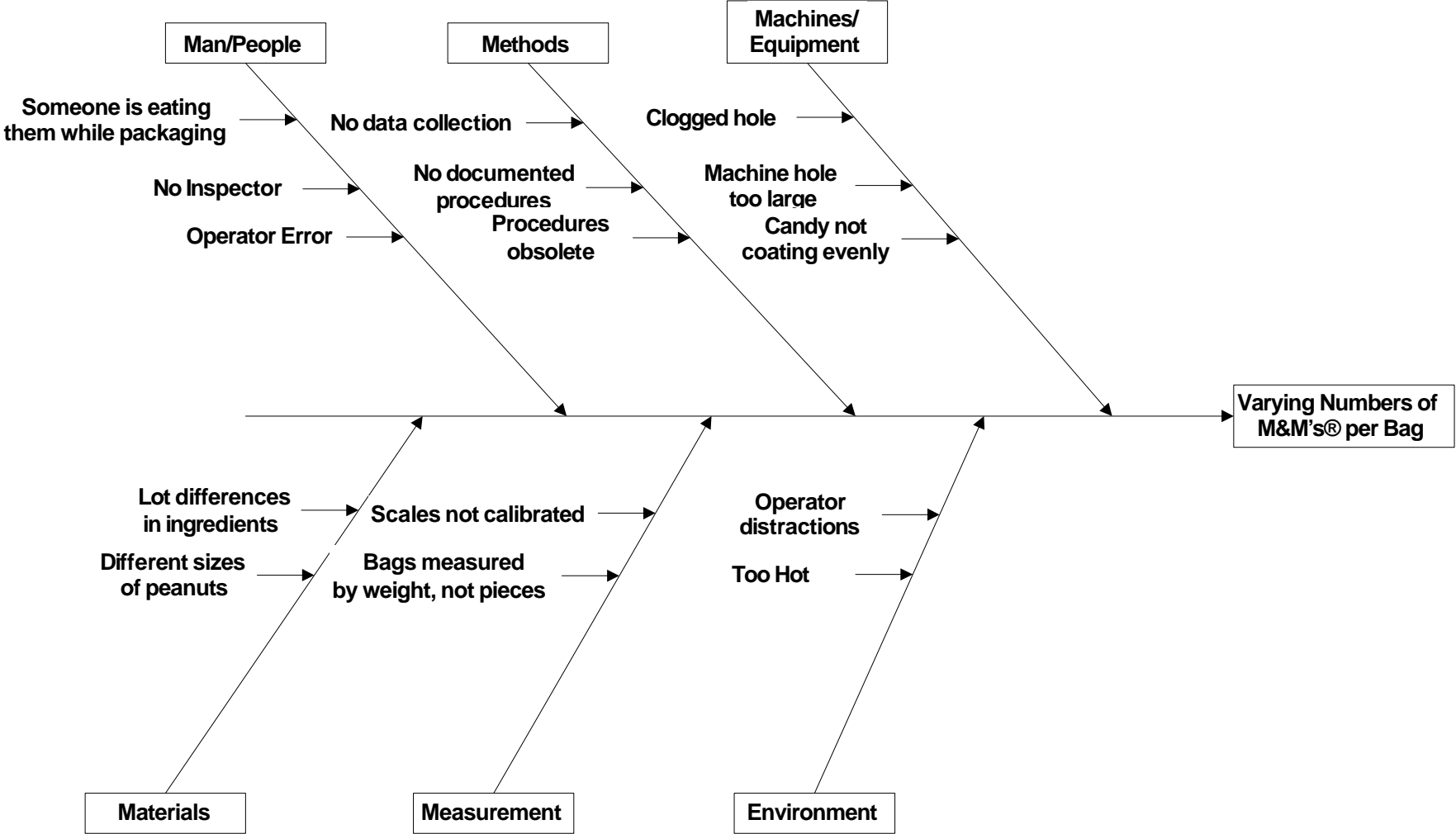
CAUSE AND EFFECT DIAGRAM - Construction

- Select a single problem or opportunity (place the effect in the right hand box).
- Identify the major causes of the problem or opportunity (5 M&E).
- Identify the minor causes associated with each major cause (branch out on bones).
- Identify additional cause structure (add more detail as needed).

CAUSE AND EFFECT DIAGRAM

- Group Assignment #5: Construct a C & E diagram on “Varying Numbers of M&M’s[®] per Bag”
 - As a group, fill in as many “bones” for causes under each category.
 - Be ready to present.
 - **GET READY, SET,**
 - **GO!!!**

CAUSE AND EFFECT DIAGRAM



SCATTER DIAGRAMS

- Scatter diagrams are used to determine if there is any correlation between two variables.
- Useful in the quantitative analysis of data to see how a variable behaves relative to another variable.
- Supplies the data to confirm a hypothesis that two variables are related.

SCATTER DIAGRAMS - Construction

- Select two variables of interest (they should have the potential for a cause and effect relationship).
- Set a scale for the axes (around the maximum data points of each variable).
- Collect and chart the data.
- Evaluate the results (calculate the correlation coefficient).

SCATTER DIAGRAMS - Construction

- Group Assignment #6: Construct a Scatter Diagram to see if Total M&M's[®] correlates with Total Green.
 - Enter the results for the Bag Total and Green total for 25 bags.
 - Graph the results on the worksheet.
- What type of relationship exists between total M&M's[®] and total green?

CONTROL CHARTS

- Control charts are a very powerful quality tool to recognize sources of variation over time.
- Useful to monitor and help improve process performance over time by studying variation and its source.
- Distinguish special from common causes of variation.
- Serves as a guide to make adjustment decisions.

CONTROL CHARTS – p chart

Construction

- Determine the purpose of the chart.
- Select the quality characteristics to be charted.
- Decide on a subgroup size.
- Construct or obtain the appropriate data collection sheets and control chart forms.
- Record the data
- Calculate p (percent) for each sample.

CONTROL CHARTS – p chart

Construction cont.

- Calculate $p\text{-bar}$.
- Calculate UCL and LCL.
- Plot $p\text{-bar}$, UCL and LCL.
- Plot the p values.
- Initiate corrective action when plotted values fall outside either of the 3 sigma limits.
- Periodically review and revise the p standard value, as necessary.

CONTROL CHARTS – p chart

Construction cont.

- Group Assignment #7: Construct a p-chart Attribute Control Chart of Percent Green M&M's[®].
 - Enter the results for the Bag Total and Green total for 20 bags on the Excel Spreadsheet.
 - Graph the results.
- Any points out of control?

Summary/Conclusion

- **Flowcharts** illustrate processes,
- **Checksheets** count data,
- **Paretos** place data in order,
- **Histograms** help determine distribution type,
- **Cause and Effect Diagrams** organize root cause(s),
- **Scatter Diagrams** help determine (co)relationships,
- **Control Charts** show random and assignable cause variability.
- Using M&M's[®] as data, we have demonstrated what each of the Seven Tools of Quality are, why they are used, the steps to construct them and how they are interpreted.

References

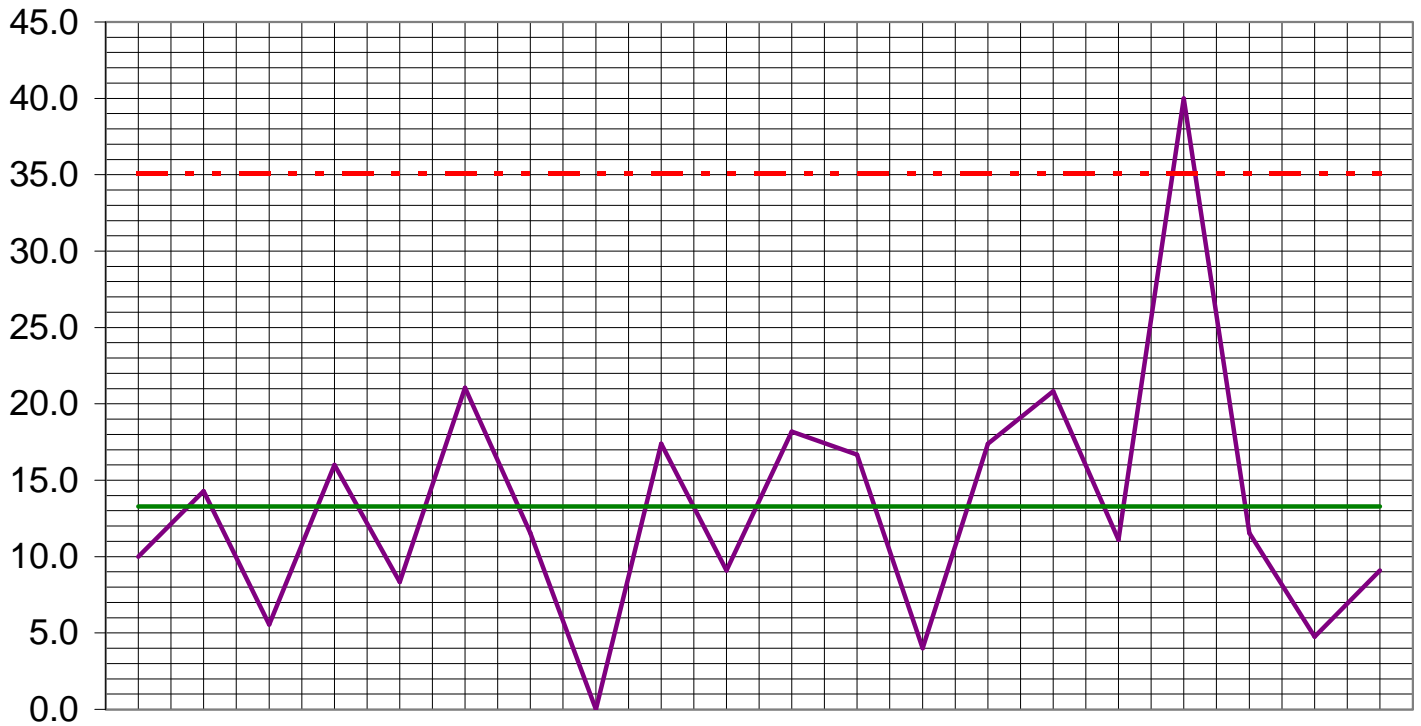
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Questions??

- Ideas, Comments, Method Improvements?
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**A FUN METHOD TO TEACH THE SEVEN TOOLS OF QUALITY:
ATTRIBUTES CONTROL CHART**

PART#:	DESCRIPTION:	CHARACTERISTIC:	DATE:
N/A	Peanut M&M's	% Green M&M's	March 19, 2003
SOURCE:		OPERATOR:	INSPECTOR:
ASQ Meeting Program		Various	
UCL:	35.05	LCL:	0
			AVERAGE:
			13.27



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Sample (n)	20	21	18	25	24	19	26	20	23	22	22	18	25	23	24	18	20	26	21	22	
Number (np, c)	2	3	1	4	2	4	3	0	4	2	4	3	1	4	5	2	8	3	1	2	
Fraction (p _u)	10.0	14.3	5.6	16.0	8.3	21.1	11.5	0.0	17.4	9.1	18.2	16.7	4.0	17.4	20.8	11.1	40.0	11.5	4.8	9.1	
Date/Time																					
Notes																					

A FUN METHOD TO TEACH THE SEVEN TOOLS OF QUALITY:

Check Sheet for M&M's® Data

Inspector: _____

Date: _____

INDIVIDUAL BAG

BAG #	304GT13	TOTAL	%
Brown	5	5	23%
Yellow	3	3	14%
Red	3	3	14%
Orange	5	5	23%
Blue	4	4	18%
Green	2	2	9%
TOTAL IN BAG		22	100%

TEAM RESULTS

TEAM BAG #	1	2	3	4	5	6	TOTAL	%
Brown (30%)	2	7	6	6	5	6	32	24%
Yellow (20%)	5	4	4	2	4	3	22	17%
Red (20%)	6	5	3	3	6	5	28	21%
Orange (10%)	3	2	5	4	2	4	20	15%
Blue (10%)	1	4	4	4	1	2	16	12%
Green (10%)	2	3	2	3	2	1	13	10%
BAG TOTALS	19	25	24	22	20	21	131	100%