FLORIDA POLYTECHNIC UNIVERSITY

Six Sigma: Week 2

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Fall 2020

Agenda: Week 2

- Textbook status update (LS & LSSM texts)
- Download Minitab

Navigate to:
- *Florida Poly Pulse home page*
- *Finance and Administration*
- *Technology Services*
- *Software Downloads*
- *Minitab*

- Texas Instruments TI Nspire calculator
  - Will be used to enhance some of the Six Sigma/statistical tools
  - Students ***do not*** need to purchase this calculator; will be demonstrated in class
- Finish introduction to defining Six Sigma visually
  - Using Smuckers Uncrustables as example
    - https://www.smuckersuncrustables.com/products/peanut-butter-and-grape-jelly-club-size
- DMAIC principles – Quentin Brook Video (our textbook author)
  - Review of project components for each phase
  - https://video.search.yahoo.com/search/video?fr=mcafee&p=what+is+Six+Sigma+DMAIC+video#id=2&vid=622981aec8a82e4e62dde0e9dd2fb0a5&action=click
- DMAIC from LS Text Chapters 1-2
  - Review and class discussion
    - What is your impression/interpretation of the different phases?

Agenda: Week 2

- (9) class groups have been randomly created (3 students per team)
  - Some assignments will be group-based
- Continue review of DMAIC phases (LS text Chapters 1-2)
  - Review of project components for each phase and class discussion
- Preview of Minitab software (LSSM text)
  - Begin with graphical tools
- Article 1 Discussion Review
  - A few students to provide a brief summary of their assignment in class for discussion

Six Sigma Defined Visually (cont'd)

Defining Six Sigma visually - Smuckers Uncrustables

https://www.smuckersuncrustables.com/products/peanut-butter-and-grape-jelly-club-size

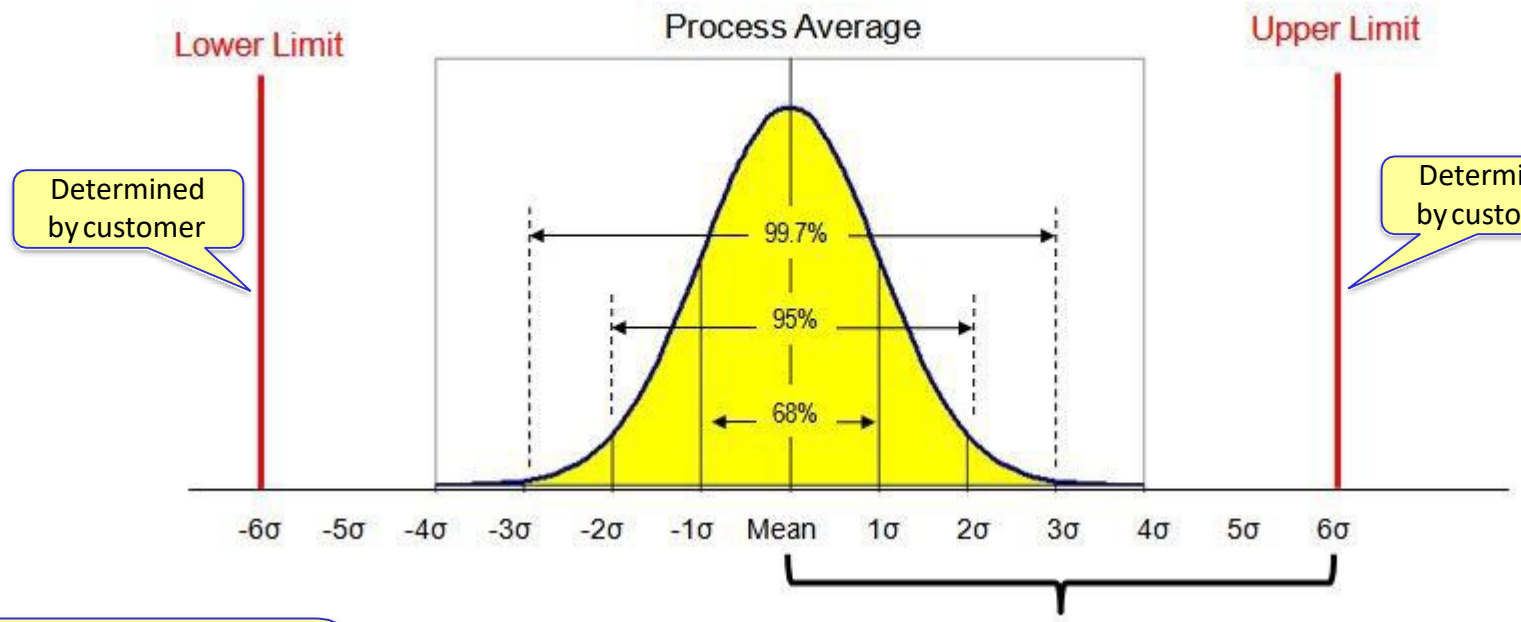
Identifying & controlling sources of variation in ingredients & baking processes for each sandwich during production are key process variables.

y=f(x) Example:

- *Y=net sandwich weight*
- *Xs: How much….*
  - *jelly?*
  - *peanut butter?*
  - *bread?*
  - *Sandwich dimensions*

How much variation is allowed? Determined by customer specifications.

Six Sigma Defined Visually (cont'd)



Initially deployed at Motorola in 1986. Adopted at GE at a global scale in 1990s; inspiring many other companies to follow.

Example: In a 2 Sigma process, 95% of the measured values taken in a process will be within two standard deviations from the process average.

Within in a standard normal distribution:
- 68% of the data points will fall within ± one standard deviation from the mean
- 95% will fall within ± two standard deviations
- 99.73% of the data points will fall within ± three standard deviations from the mean

σ = Standard Deviation

DMAIC vs. DMADV

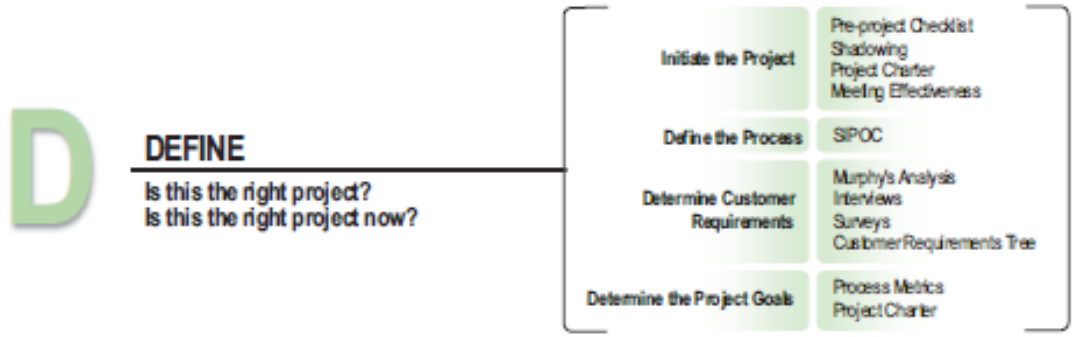
- Review of DMAIC

MAN 3520
Course Focus

  - Define, Measure, Analyze, Improve, Control
    - Improve existing process (i.e. producing fewer defective parts)
- Review of DMADV
  - Define, Measure, Analyze, Design, Verify)
    - Part of Design for Six Sigma
    - Develop new process (i.e. new product to achieve time to market objective)

Six Sigma projects are characterized by predefined phases – depending on the type of product or process.

DMAIC - Define



- Project scope is clear
- Customer/market value is understood
- Business value is understood
- Process performance measures are agreed upon and baselined
- Business support for project in place (project leader and team)
- Champions & process owners in place to remove barriers

During Define, primary objectives are to understand whether this is the right project and the best project to do right now.

Gaining Understanding of a Process Example: Filing an Income Tax Return

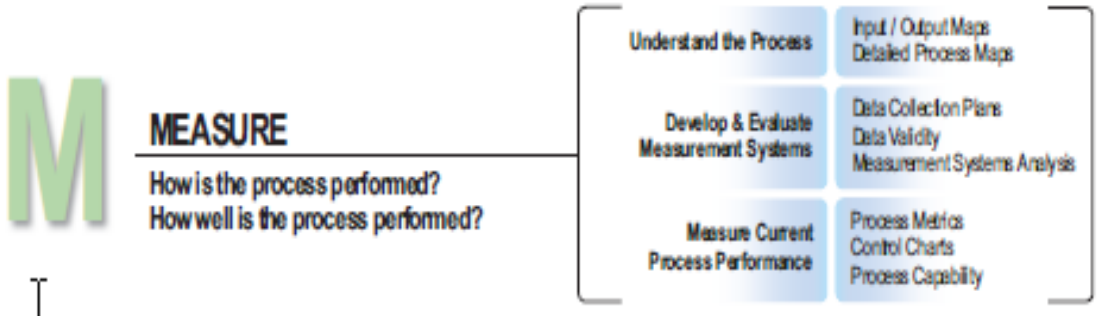
What elements can impact a process?

DMAIC – Define - SIPOC

The Process of Filing Your Tax Return				
S	**I**	**P**	**O**	**C**
Suppliers	**Inputs**	**Process**	**Output**	**Customers**
Government	Forms	Collect Tax Return Information	Completed Tax Return	Government Tax Agency
Employer	Wage Statements	Hire Accountant	Copy for Accountant	Accountant
Charities	Donation Receipts	Review Information with Accountant	Copy for Yourself	
Church	Donation Receipts	File Return	Payment to Accountant	
Investment Firms	Interest Statements	Pay Accountant		

SIPOC is used for understanding the scope and purpose of the process. SIPOC drives important early discussion with the project team about true purpose of process and what it should deliver.

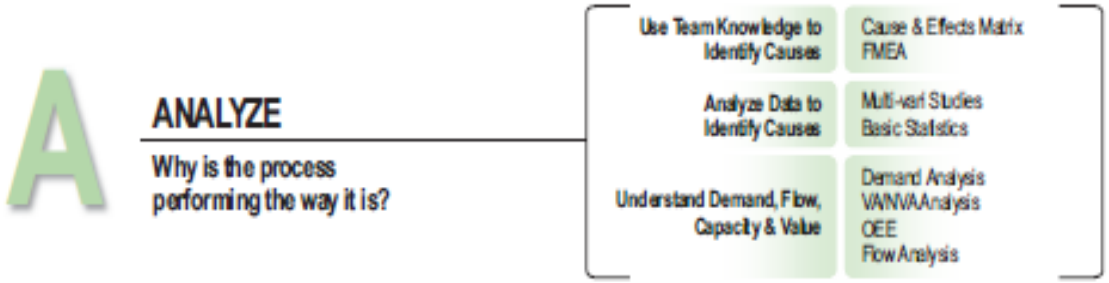
DMAIC - Measure



- Team works to understand current state of process through use of mapping tools
- Focus is on reliability of primary performance metrics
- Once baseline is confirmed, if team finds any quick hits, they can be addressed right away

During Measure, team gets a much deeper understanding of current process; how it has performed in the past and current performance.

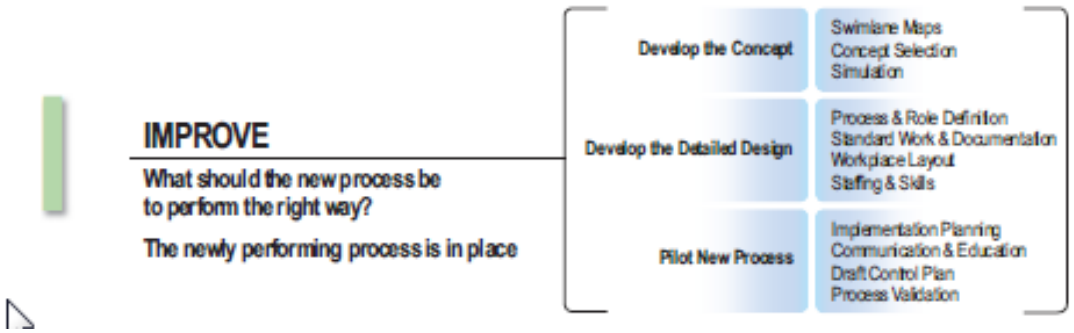
DMAIC - Analyze



- Team uses data-drive tools (statistical and/or flow-related to understand key variation sources

The path through the complexities of Measure and Analyze phases is problem specific. Tools applied depend on the type of problem to be solved.

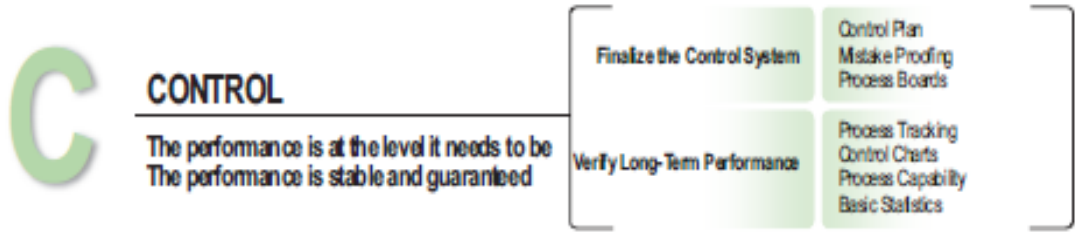
DMAIC - Improve



- Purpose of Improve is to develop and implement the solution
- Solution is designed based on data and the understanding gained to this point in project
- Ensure that process will achieve its performance goals
- Process is clearly defined and laid out

Once a concept is identified, the team produces a detailed design of the improved process and pilots the design to ensure success.

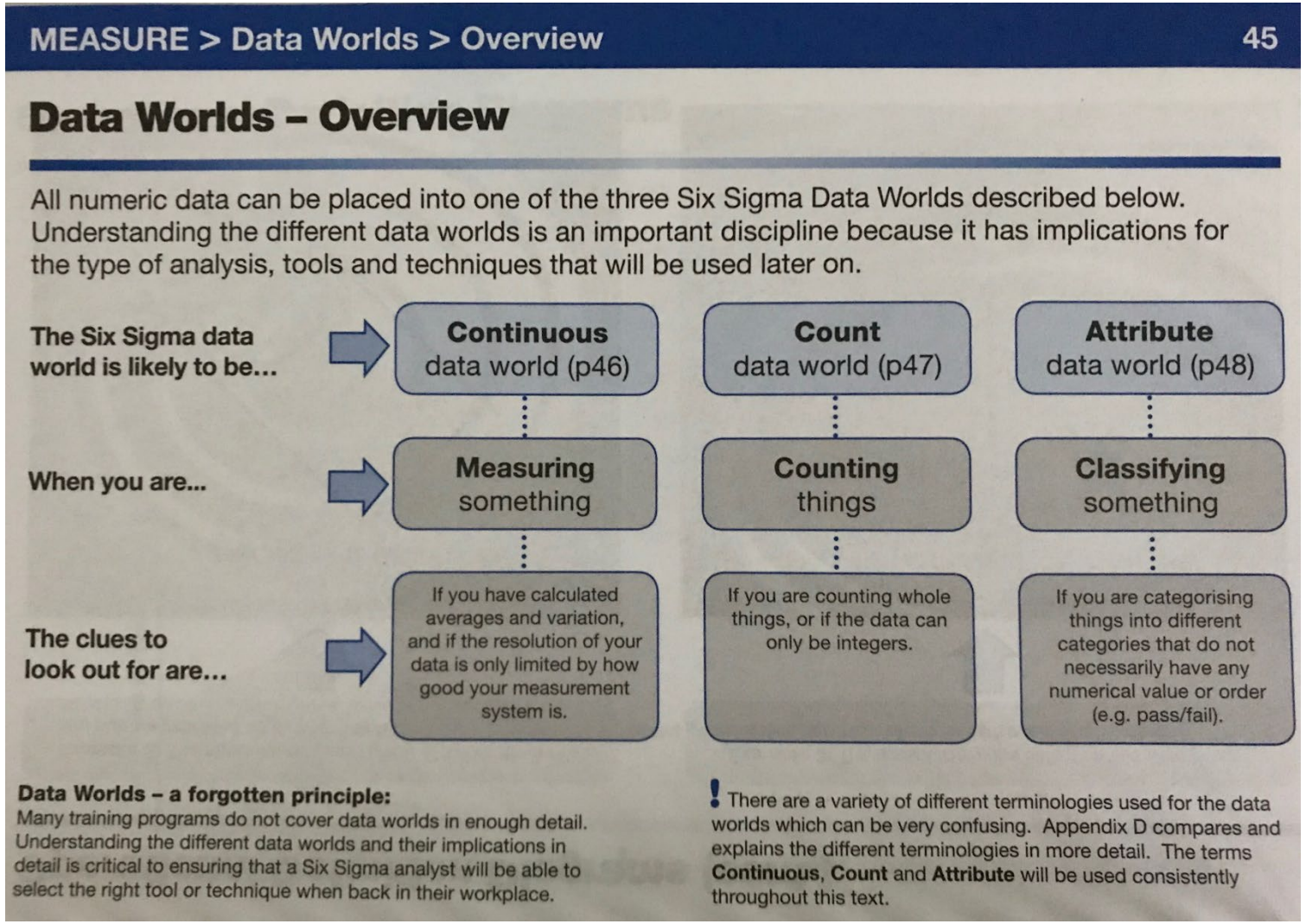
DMAIC - Control



- Process control mechanisms are in place
- Process is executed consistently
- Process performance meets project goals and is sustainable
- Process staff is set at appropriate competency level

The primary deliverable of any project is the Control Plan, which represents all of the elements that must come together to ensure the process is sustainable.

Measure: Types of Data (Data Worlds)



MEASURE > Data Worlds > Overview 45

Data Worlds – Overview

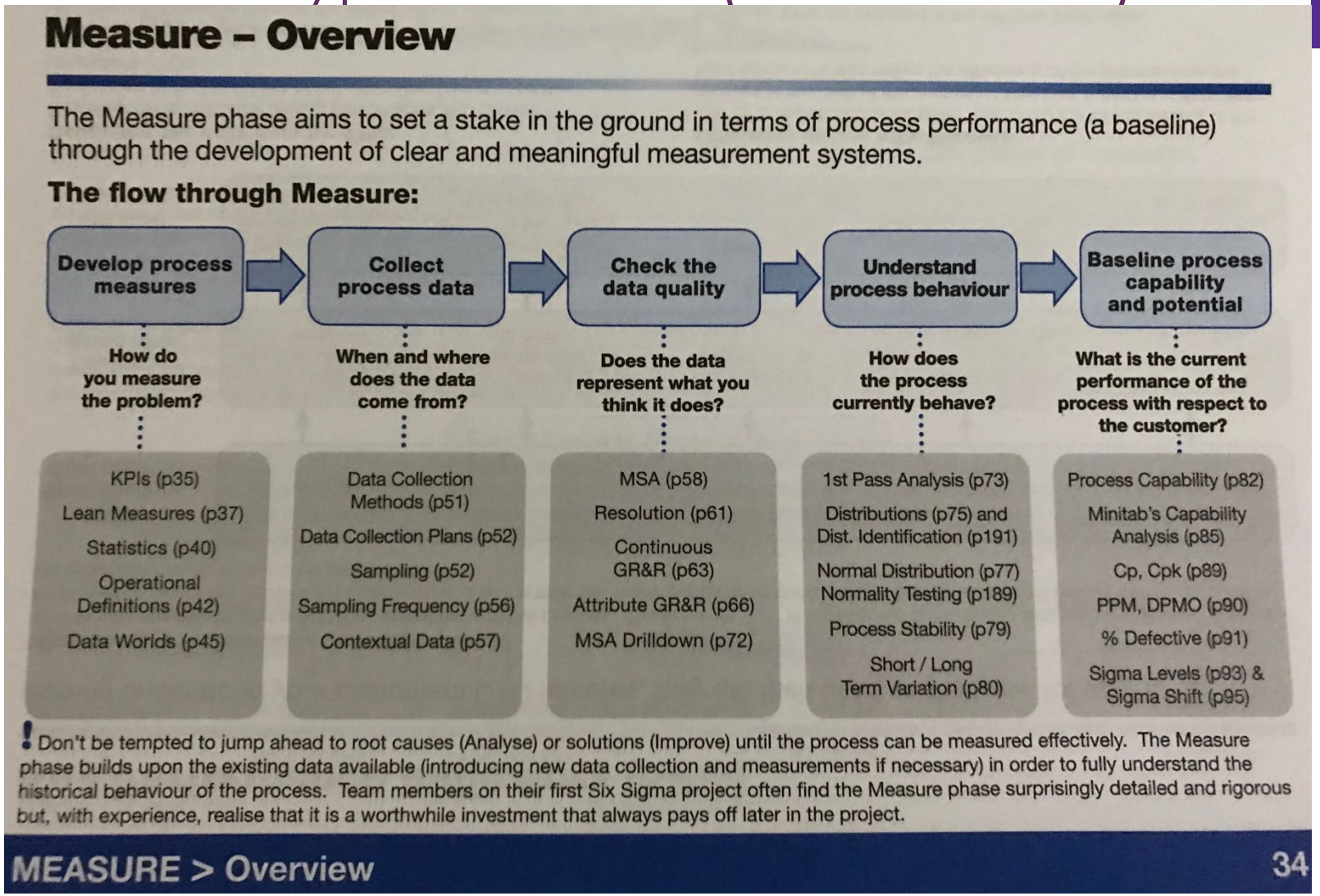
All numeric data can be placed into one of the three Six Sigma Data Worlds described below. Understanding the different data worlds is an important discipline because it has implications for the type of analysis, tools and techniques that will be used later on.

The Six Sigma data world is likely to be...	**Continuous** data world (p46)	**Count** data world (p47)	**Attribute** data world (p48)
When you are...	**Measuring** something	**Counting** things	**Classifying** something
The clues to look out for are...	If you have calculated averages and variation, and if the resolution of your data is only limited by how good your measurement system is.	If you are counting whole things, or if the data can only be integers.	If you are categorising things into different categories that do not necessarily have any numerical value or order (e.g. pass/fail).

Data Worlds – a forgotten principle:
Many training programs do not cover data worlds in enough detail. Understanding the different data worlds and their implications in detail is critical to ensuring that a Six Sigma analyst will be able to select the right tool or technique when back in their workplace.

! There are a variety of different terminologies used for the data worlds which can be very confusing. Appendix D compares and explains the different terminologies in more detail. The terms **Continuous**, **Count** and **Attribute** will be used consistently throughout this text.

Measure: Types of Data (Data Worlds)



Measure – Overview

The Measure phase aims to set a stake in the ground in terms of process performance (a baseline) through the development of clear and meaningful measurement systems.

The flow through Measure:

Develop process measures	Collect process data	Check the data quality	Understand process behaviour	Baseline process capability and potential
How do you measure the problem?	When and where does the data come from?	Does the data represent what you think it does?	How does the process currently behave?	What is the current performance of the process with respect to the customer?
KPIs (p35)	Data Collection Methods (p51)	MSA (p58)	1st Pass Analysis (p73)	Process Capability (p82)
Lean Measures (p37)	Data Collection Plans (p52)	Resolution (p61)	Distributions (p75) and Dist. Identification (p191)	Minitab's Capability Analysis (p85)
Statistics (p40)	Sampling (p52)	Continuous GR&R (p63)	Normal Distribution (p77) Normality Testing (p189)	Cp, Cpk (p89)
Operational Definitions (p42)	Sampling Frequency (p56)	Attribute GR&R (p66)	Process Stability (p79)	PPM, DPMO (p90)
Data Worlds (p45)	Contextual Data (p57)	MSA Drilldown (p72)	Short / Long Term Variation (p80)	% Defective (p91)
				Sigma Levels (p93) & Sigma Shift (p95)

! Don't be tempted to jump ahead to root causes (Analyse) or solutions (Improve) until the process can be measured effectively. The Measure phase builds upon the existing data available (introducing new data collection and measurements if necessary) in order to fully understand the historical behaviour of the process. Team members on their first Six Sigma project often find the Measure phase surprisingly detailed and rigorous but, with experience, realise that it is a worthwhile investment that always pays off later in the project.

MEASURE > Overview 34

Summarizing Process Data

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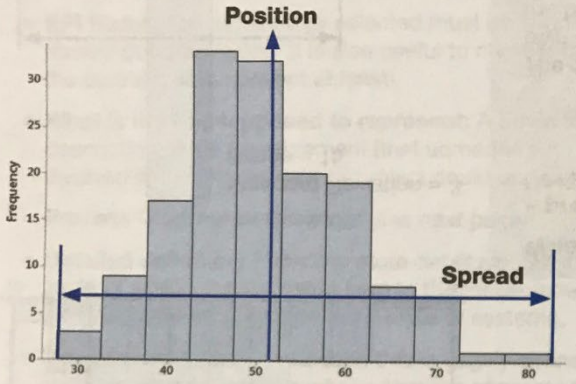
Statistics for Summarising Process Position

It is more than likely that your chosen KPIs involve an 'average' of some kind. Despite the common use of the arithmetic average, it is worth remembering that there are alternatives!



The two key features of a histogram are its central **Position** and its **Spread**:

The **Spread** of the histogram (how wide it is) is important because it gives an indication of the amount of variation in the process. This is explained further on the next page.

The **Position** of the histogram refers to where the process is centred. There are two common statistics that can be used to reflect Position:

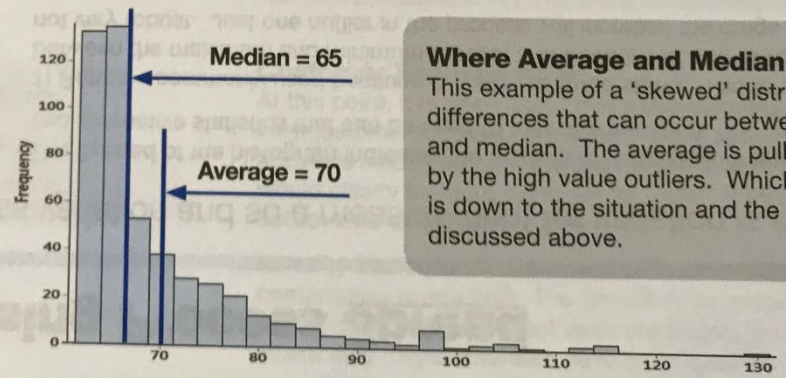
1) The Average – commonly used because it is easy to understand and calculate. The average works well where the process is reasonably symmetrical and there are not any 'outliers' (unexpectedly small or large data points) which can significantly affect the calculation of the average.

2) The Median – less widely used, but a useful statistic due to its 'robustness'. The median is defined as the middle value of the data (the 50th percentile) and its calculation is not significantly affected by any outliers in the data.

Alternative terminology for the average:

- **Mean –** sometimes used instead of average.
- $\bar{X}$ **–** (pronounced 'X Bar') – used to represent the average of a sample.
- **μ –** (pronounced 'mu') – used to represent the average of the total population.

NB: In theory, X Bar and Mu are for use in the different situations described above. In reality, they're often used interchangeably (although this isn't very good statistical practice).



Where Average and Median are different:
This example of a 'skewed' distribution shows the differences that can occur between the average and median. The average is pulled to the right by the high value outliers. Which statistic to use is down to the situation and the pros and cons discussed above.

MEASURE > Statistics for Process Position 40

Summarizing Process Data

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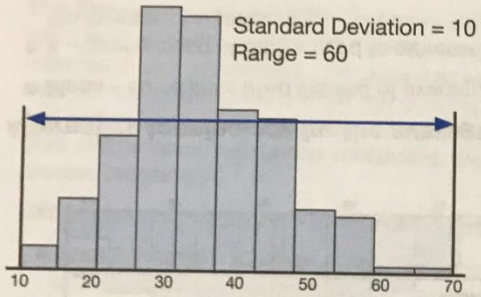
support its use both in a training environment and

MEASURE > Statistics for Process Spread 41

Statistics for Summarising Process Spread

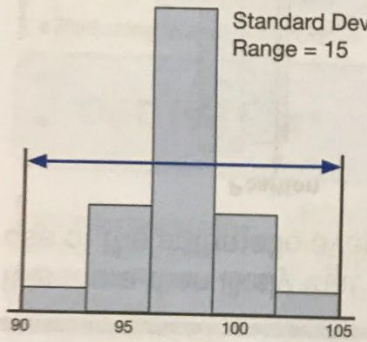
Six Sigma focuses on reducing process variation and so a measurement for variation is essential.



The **Spread** of the histogram indicates the amount of variation in the process. There are two alternative statistics that can be used to measure variation:

1) Range – commonly used because it is easy to understand. The range is the difference between the maximum and minimum results, and because of this 'simple' approach it is not very robust. Just one outlier in the process will increase the range dramatically.

2) Standard Deviation – is a more robust measure of variation, but it is perceived as difficult to understand because it is not easy to picture what it is. See below for an explanation.



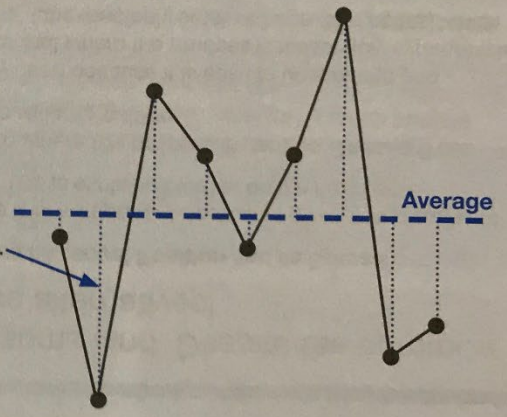
What is Standard Deviation?

A **practical** definition of Standard Deviation is:

"The average distance of the data points from their own average".

The distance of the data points from their own average is shown graphically here by the blue dotted lines on the Time Series plot.

The symbol used for standard deviation is the Greek symbol '**σ**' - pronounced Sigma!



Distributions.mpj This data file contains a selection of the different distributions shown over the last two pages.

Measure: Six Sigma Tools

- Key Performance Indicators (KPIs) – pages 34-35
- Summarizing Process Data (Position and Spread) – pages 40-41
- Types of Data (Data Worlds) – page 45
- Minitab® Graphical tools to cover (LSSM text)
  - Summary of graphical tools (page 118)
  - Histograms (page 123)
  - Graphical Summary (page 126)
  - Pareto Analysis (page 136)
  - Time Series Plots (page 130)
  - Dot Plots (page 125)
  - Scatter Plots (page 145)
  - Box Plots (page 140)
  - Fitted Line Plots (page 198)

Demonstration of Six Sigma analysis tools in Minitab during course

Problem Solvers Guide