MBC 638

LIVE SESSION WEEK 2

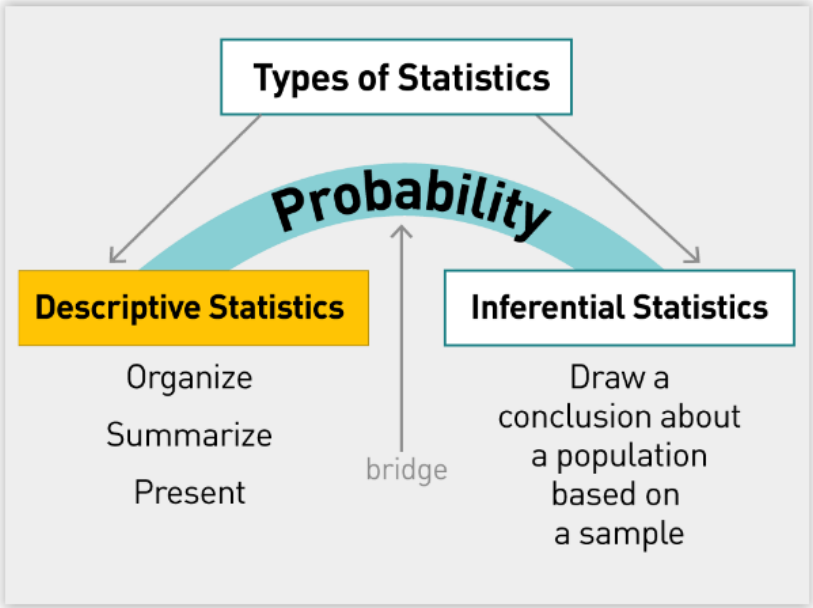
Agenda

Topic	Time	Thursday 9:00 Section	Sunday 6:30 Section
Introduction	5 min	9:00-9:05	6:30-6:35
Highlights from Week #1 Video ***QUIZ REVIEW***	25 min	9:05-9:30	6:35-7:00
Highlights from Week #2 Video	25 min	9:30-9:55	7:00-7:25
Hank Activity	20 min	9:55-10:15	7:25-7:45
Measurement Plan or Stratification	10 min	10:15-10:25	7:45-7:55
Review of Upcoming Assignments	5 min	10:25-10:30	7:55-8:00

Highlights: Video Segment 1.3 DMAIC

Statistics

Statistics provides the means to collect, organize, analyze, present and interpret numerical information in order to make more informed and effective decisions.



Highlights: Video Segment 1.3 DMAIC

DMAIC

Define – what is important, clearly articulate the business problem, goal, potential resources, business case, project scope and high-level project timeline

Measure – how are we doing, develop a data collection plan and implement, decide on what should be measured and how to measure it, establish current state baseline as the basis for improvement, the Measure phase will be compared to the performance metric at the conclusion of the project to determine objectively whether significant improvement has been made.

Analyze – what is wrong, the purpose of this step is to identify, identify and verify critical Xs, validate and select root cause for elimination

Improve – what needs to be done, identify, test and implement a solution to the problem

Control – how do we maintain the improvements, sustain the gains, create a control plan.

Highlights: Video Segment 1.3 DMAIC

The generalized equation of **Y = F(X)** describes the relationship between the inputs and the outputs, independent and dependent variables.

What inputs drive your output? If looking at your sugar intake, what meal is driving the sugar consumption up? What day of the week? What particular food item? What activities are you engaged in on a daily basis? What location? Time spent driving?

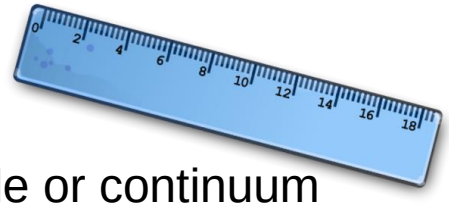
	Y	X1	X2	X3	X4	X5	X6	X7	X8
	Total Grams of Sugar per Day	Week day vs Weekend Day	Miles Driven	Out of Town	Breakfast Grams	Lunch Grams	Dinner Grams	Social Time in Mins	Mins Worked
Day 1	55	WD	20	Y	10	20	35	50	480
Day 2									
Day 3									
Day 4									

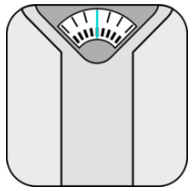
For your project – you will collect data of your current state and after you have made changes or improvements

Highlights: Video Segment 1.4 Types of Data

Discrete: the number of or proportion that fit into a category

Examples: Eye color, martial status, good/bad, boy girl, grade, objects that come in whole units(people, cars, animals, etc.)





Continuous: A number from a measurement scale or continuum

Examples: Weight, height, distance, money, time, temperature, length

Highlights: Video Segment 1.4 Data Pros/Cons

Discrete Data

Pros	Cons
Fast to collect	Prone to greater error due to subjectivity
Easy to collect	No measure of variability
Can be used to measure subjective concepts	Analysis is limited – many statistical techniques need continuous data
	Need a lot more data to use any statistical tests or tools

Continuous Data

Pros	Cons
Variability is measurable	Make take longer to collect the data
Data is objective	Data may be more difficult to collect
Less data provides more certain results	Not as easily applicable to subjective data
Get more information out of the data (instead of Small, Large, 15 inches and 27 inches)	
Statistical tests and tools can be applied	

Highlights: Video Segment 1.6: Defects and SQL

A defect is not meeting customer requirements.

- In terms of your projects, you must calculate SQL which requires you to identify a defect.
- Using my example of getting pre-launch product data to include in a bid tool – a defect could be anytime I didn't receive the pre-launch data at least 30 days prior to launch.
- For trying to save additional money per week, anytime you didn't save at least X dollars or X percent of your income per week or per day etc., would be a defect.
- For cutting sugar intake, any time you exceeded the daily recommended amount of sugar per day you could count it as a defect.

SQL – Sigma Quality Level - A sigma quality level serves as an indicator of how often defects are likely to occur in processes, parts, or products. It can be used to describe if the process is capable of meeting customer requirements. The best possible process in the world would have a Sigma Level of +∞ (infinity) and the worst possible process in the world would have a Sigma Level of –∞ (negative infinity).

Sigma Quality Levels are based on DPMO

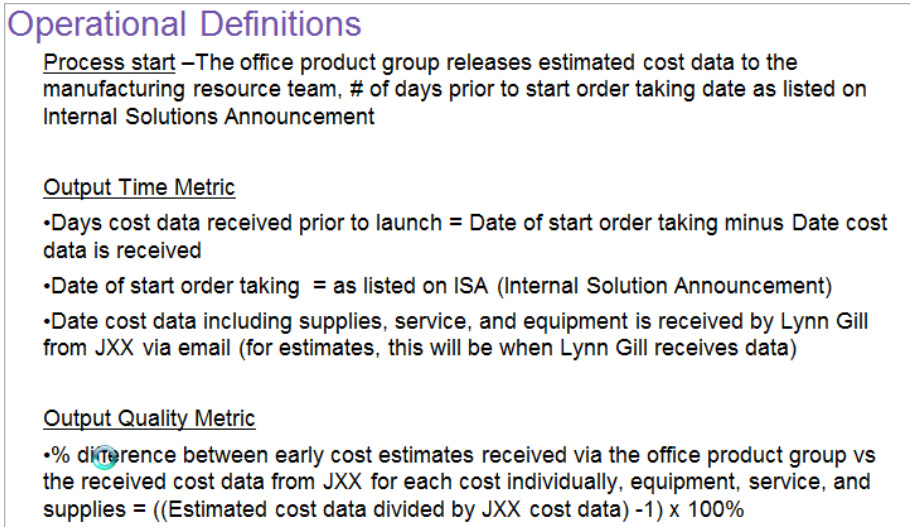
How do you calculate DPMO & SQL?

1. Defect opportunities per unit:	D = 3
2. Units produced per day:	U = 100
3. Total possible defects per day:	D × U = 300
4. Total actual defects:	A = 20
5. Defect per opportunity rate:	A ÷ DU = DPO X 100= 6.7%
6. Defects per million opportunities (DPMO):	DPO × 1,000,000 = 67,000
7. SQL value (from SQL table):	3

DPMO	S.Q.L.	Yield	DPMO	S.Q.L.	Yield	DPMO	S.Q.L.	Yield
934,000	0	6.60%	308,000	2	69.20%	6,210	4	99.40%
920,000	0.1	8.00%	274,000	2.1	72.60%	4,660	4.1	99.50%
900,000	0.2	10.00%	242,000	2.2	75.80%	3,460	4.2	99.70%
880,000	0.3	12.00%	212,000	2.3	78.80%	2,550	4.3	99.75%
860,000	0.4	14.00%	184,000	2.4	81.60%	1,860	4.4	99.81%
840,000	0.5	16.00%	158,000	2.5	84.20%	1,350	4.5	99.87%
810,000	0.6	19.00%	135,000	2.6	86.50%	960	4.6	99.90%
780,000	0.7	22.00%	115,000	2.7	88.50%	680	4.7	99.93%
750,000	0.8	25.00%	96,800	2.8	90.30%	480	4.8	99.95%
720,000	0.9	28.00%	80,800	2.9	91.90%	330	4.9	99.97%
690,000	1	31.00%	66,800	3	93.30%	230	5	99.98%
650,000	1.1	35.00%	54,800	3.1	94.50%	150	5.1	99.99%
610,000	1.2	39.00%	44,600	3.2	95.50%	100	5.2	99.99%
570,000	1.3	43.00%	35,900	3.3	96.40%	70	5.3	99.99%
540,000	1.4	46.00%	28,700	3.4	97.10%	40	5.4	99.996%
500,000	1.5	50.00%	22,700	3.5	97.70%	30	5.5	99.997%
460,000	1.6	54.00%	17,800	3.6	98.20%	20	5.6	99.998%
420,000	1.7	58.00%	13,900	3.7	98.60%	10	5.7	99.999%
382,000	1.8	61.80%	10,700	3.8	98.90%	8	5.8	99.999%
344,000	1.9	65.60%	8,190	3.9	99.20%	5	5.9	99.9995%
						3.4	6	99.9997%

Highlights: Video Segment: 1.7 Operational definitions

- Operational definitions are very important. i.e. peanut exercise – what defines a good peanut, good operational definitions for discrete data collection is critical
- An operational definition can be defined as a clear and understandable unambiguous description of what is to be observed and measured relative to a specific process or measurement, such that different people collecting, using and interpreting data will do so consistently.
- An operational definition is a concept to guide what properties will be measured and how they will be measured.



Operational Definitions

Process start –The office product group releases estimated cost data to the manufacturing resource team, # of days prior to start order taking date as listed on Internal Solutions Announcement

Output Time Metric

•Days cost data received prior to launch = Date of start order taking minus Date cost data is received

•Date of start order taking = as listed on ISA (Internal Solution Announcement)

•Date cost data including supplies, service, and equipment is received by Lynn Gill from JXX via email (for estimates, this will be when Lynn Gill receives data)

Output Quality Metric

•% difference between early cost estimates received via the office product group vs the received cost data from JXX for each cost individually, equipment, service, and supplies = ((Estimated cost data divided by JXX cost data) -1) x 100%

Chapter 3 in the textbook

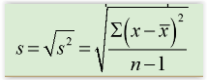
Highlights: Video Segment: 1.7:Describing Data

3 Ways to Measure the Center of the Data

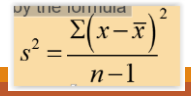
1. Mean(average): To find the mean of the values in a data set, simply add up all the numbers and divide by how many numbers you have.
2. Mode(most frequent value): The mode of a data set is the data value that occurs with the greatest frequency.
3. Median(middle point of the data): The median of a data set is the *middle data value* when the data are put into ascending order. Half of the data values lie below the median, and half lie above. If the sample size *n* is odd, then the median is the middle value. If the sample size *n* is even, then the median is the mean of the two middle data values.

3 Ways to Measure the Dispersion of the Data

1. Range: The range of a data set is the difference between the largest value and the smallest value in the data set:
2. Standard Deviation: may be interpreted as the typical difference between a data value and the sample mean for a given data set. **i.e. 10**



3. Variance: is approximately the mean of the squared deviations in the sample given by the formula, **standard deviation squared, i.e. 100**



The Mean

The **most well-known and widely used measure of center is the mean.** In everyday usage, the word *average* is often used for mean.

To find the **mean** of the values in a data set, simply add up all the numbers and divide by how many numbers you have.

The **sample mean** can be written as $\bar{x} = \Sigma x / n$. In plain English, this just means that, in order to find the mean, we

1. Add up all the data values, giving us Σx
2. Divide by how many observations are in the data set, giving us $\bar{x} = \Sigma x / n$

The Population Mean

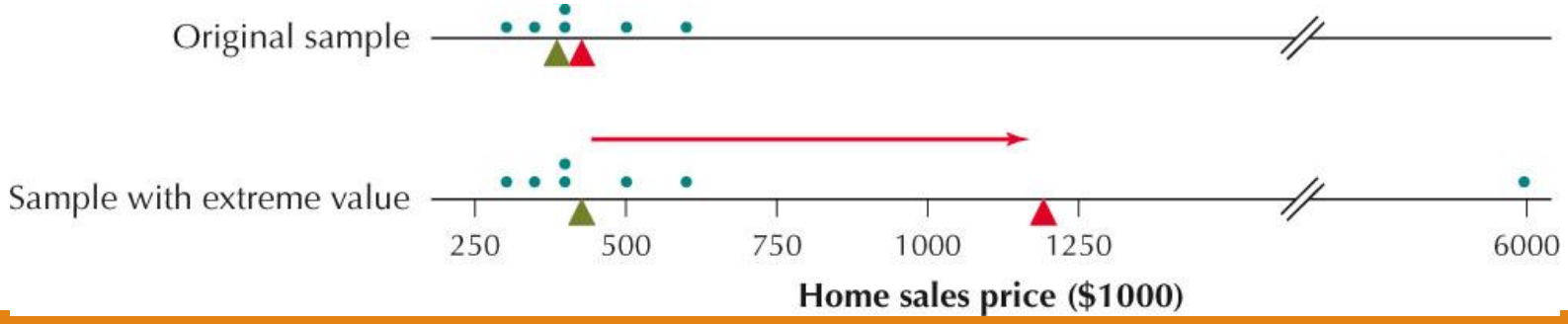
The mean value of the population is usually unknown. We denote the **population mean** with μ (mu), which is the Greek letter "m." The **population size** is denoted by N.

When all the values of the population are known, the population mean is calculated as

$$\mu = \frac{\sum x}{N}$$

We can use the sample mean as an estimate of μ. Note, however, different samples may yield different sample means.

One drawback to using the mean to measure the center of the data is that the mean is sensitive to the presence of extreme values in the data set.



The Median

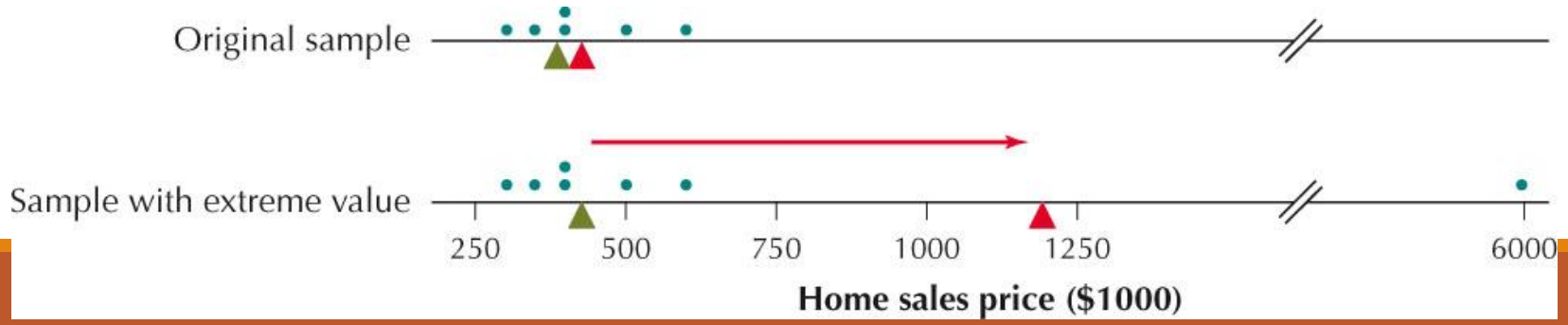
In statistics, the **median** of a data set is the *middle data value* when the data are put into ascending order.

The Median

The **median** of a data set is the *middle data value* when the data are put into ascending order. Half of the data values lie below the median, and half lie above.

- If the sample size *n* is odd, then the median is the middle value.
- If the sample size *n* is even, then the median is the mean of the two middle data values.

Unlike the mean, the median is not sensitive to extreme values.



The Mode

A third measure of center is called the **mode.** In a data set, the mode is the value that occurs the most.

The **mode** of a data set is the data value that occurs with the greatest frequency.

Rank	Person	Followers (millions)
1	Lady Gaga	6.6
2	Britney Spears	6.1
3	Ashton Kutcher	5.9
4	Justin Bieber	5.6
5	Ellen DeGeneres	5.3
6	Kim Kardashian	5.0
7	Taylor Swift	4.4
8	Oprah Winfrey	4.4
9	Katy Perry	4.2
10	John Mayer	3.7

Sample Mean

$$\bar{x} = \frac{\Sigma x}{n} = \frac{6.6 + 6.1 + \ldots + 4.2 + 3.7}{10}$$

$$= 5.11 \text{ million}$$

Median

$$median = \frac{5.0 + 5.3}{2}$$

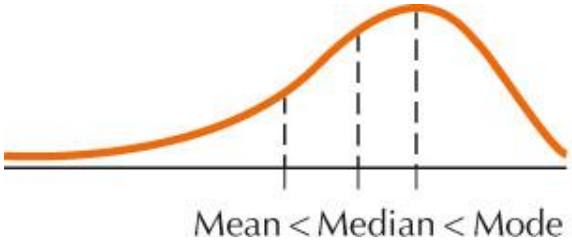
$$= 5.15 \text{ million}$$

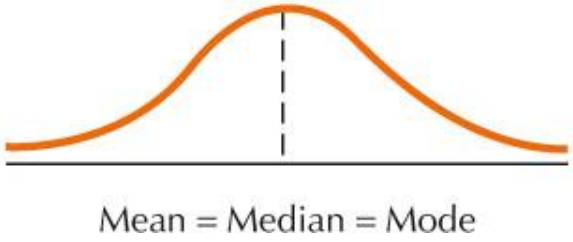
Mode

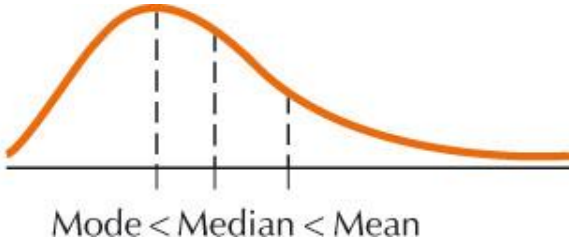
Two people have 4.4 million followers. 4.4 million is the mode.

Skewness and Measures of Center

The skewness of a distribution can often tell us something about the relative values of the mean, median, and mode.







How Skewness Affects the Mean and Median

- For a right-skewed distribution, the mean is larger than the median.
- For a left-skewed distribution, the median is larger than the mean.
- For a symmetric unimodal distribution, the mean, median, and mode are fairly close to one another.

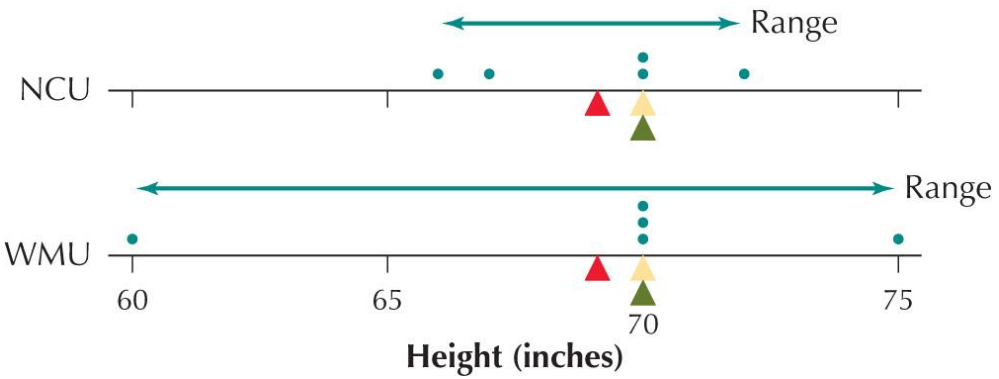
The Range

There are a variety of ways to measure how spread out a data set is. The simplest measure is the **range.**

The **range** of a data set is the difference between the largest value and the smallest value in the data set:

range = largest value – smallest value

Women's Volleyball Team Heights (in)	
Western Massachusetts Univ	Northern Connecticut Univ
60	66
70	67
70	70
70	70
75	72



$range_{WMU} = 75 – 60 = 15$ inches

$range_{NCU} = 72 – 66 = 6$ inches

What is Deviation?

The range is simple to calculate, but has its drawbacks. It is quite sensitive to extreme values and it completely ignores all of the values in the data set other than the extremes. The **standard deviation** quantifies spread with respect to the center and uses all available data values.

Deviation

A **deviation** for a given data value x is the difference between the data value and the mean of the data set. For a sample, the deviation equals $x - \bar{x}$. For a population, the deviation equals $x - \mu$.

- If the data value is larger than the mean, the deviation will be positive.
- If the data value is smaller than the mean, the deviation will be negative.
- If the data value equals the mean, the deviation will be zero.

The deviation can roughly be thought of as the distance between a data value and the mean, except that the deviation can be negative while distance is always positive.

Computational Formulas

The following *computational formulas* simplify the calculations for variance and standard deviation. They are equivalent to the definition formulas.

Standard deviation is the square root of variance. If variance is 36, the standard deviation is 6.

The variance is the standard deviation squared. If the standard deviation is 10, the variance is 100.

Computational Formulas for the Variance and Standard Deviation

Population Variance

$$\sigma^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N}$$

Population Standard Deviation

$$\sigma = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N}}$$

Sample Variance

$$s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$$

Sample Standard Deviation

$$s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

Highlights: Video Segment: 1.7:Describing Data

Example:
5,7,10,12,8,9,8,7,7,6,4,2

Descriptive Statistics from Excel Add-in

5		*Column1*	
7			
10		Mean	7.083333333
12		Standard Error	0.773209891
8		Median	7
9		Mode	7
8		Standard Deviation	2.678477632
7		Sample Variance	7.174242424
7		Kurtosis	0.405739907
6		Skewness	-0.106366273
4		Range	10
2		Minimum	2
		Maximum	12
		Sum	85
		Count	12

<u>How to Generate the Descriptive Stats in Excel</u>

1. Copy data into a column in Excel without commas
2. Click Data
3. Click Data Analysis
4. Select Descriptive Statistics
5. Select Input Range, as your column of data
6. Click Output Range, and click in the sheet where you want the output
7. Click Summary Stats
8. Click OK

<u>A Framework for thinking about sources of variation:</u>

TOME model

Task – work being done

Operator – person

Machine – technology

Environment – surroundings

Descriptive Statistics Summary

Tool	What is it?	Textbook Reference	Example	Excel Function
Measure of Center (Measure of Location)	A measure of the middle (or central portion) of the data set. 3 measures are: **Mean** = arithmetic average **Median** = middle value **Mode** = most frequent value	Discovering Stats 3e – pg.108-117	Data: 5 7 8 8 2 **Mean** = (5 + 7 + 8 + 8 + 2) /5 = 6 **Median** = 2, 5, 7, 8, 8 … middle number =7 **Mode** = occurs two times = 8	**Mean** = AVERAGE (data range) **Median** = MEDIAN (data range) **Mode** = MODE (data range)
Measure of Variability (Measure of Dispersion or Spread)	A measure of how the data is spread around the mean. 3 measures are: **Range** = difference between the largest and the smallest data point **Standard Deviation (sample)** = measure takes into account each data point and its distance from the mean **Variance** = standard deviation squared	Discovering Stats 3e – pg.126-137	Data: 5 7 8 8 2 **Range** = 2, 5, 7, 8, 8 … largest – smallest = 8-2 = 6 **Standard deviation** = use Excel = 2.5495 **Variance** = standard deviation squared = 6.5	**Range** = MAX (data range) – MIN (data range) **Standard deviation** (sample) = STDEV.S (data range) **Variance** (sample)= VAR.S (data range)

$\mu = population\ mean$

$\bar{x} = sample\ mean$

$\sigma = population$

$s = sample$

$$s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

Using Excel DataAnalysis Toolpak …..Select….. Data > Data Analysis > **Descriptive Statistics**

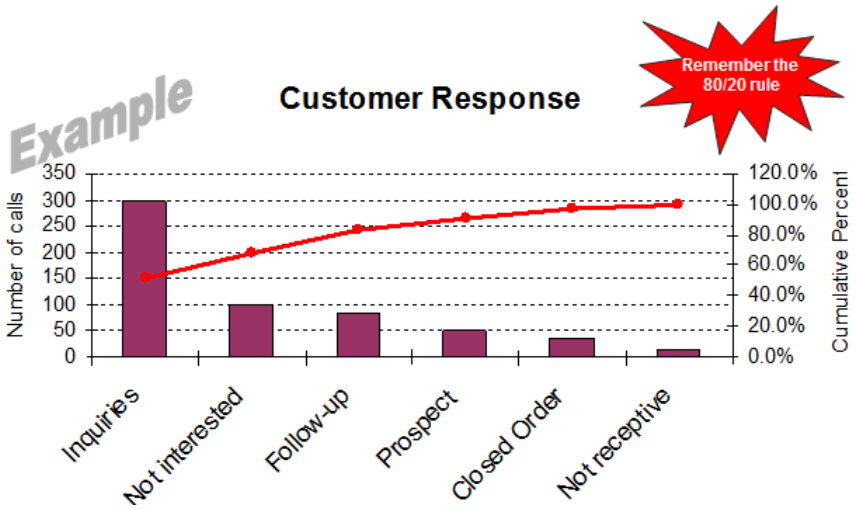
Input Range : ←-------- raw data goes here

Output Range: ←---------where you want the answer

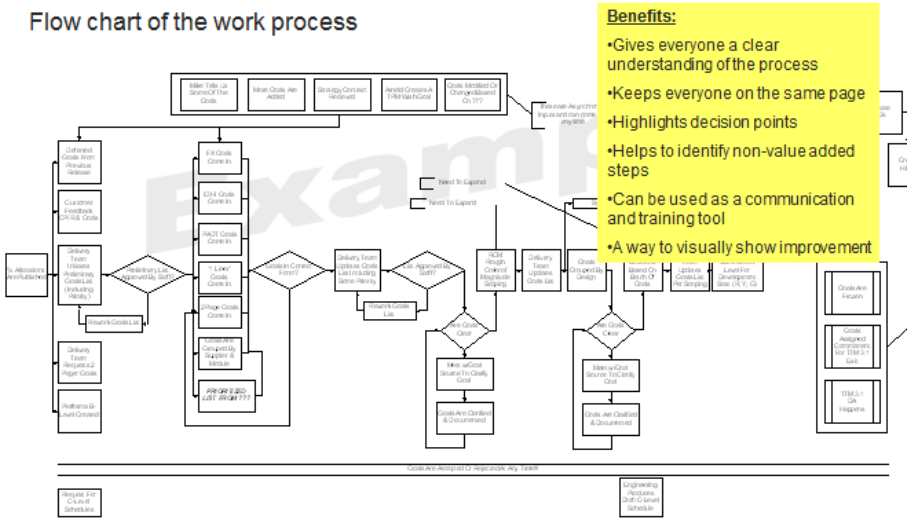
☑ Summary Statistics

Highlights: Video Segment 1.8 Soft Tools

Pareto Chart – Establishes Priorities

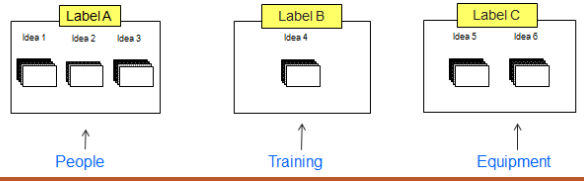


Process Map or Value Stream Map

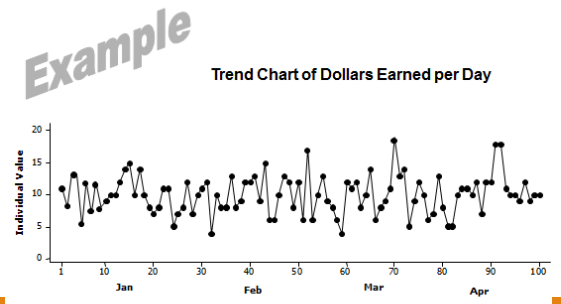


Affinity Diagram

1. Collect data/ideas from surveys, interviews, or brainstorming.
2. Write data/ideas on post-it-type notes (one idea per note).
3. Group the common ideas together (based on intuition not necessarily logic)
4. Select a common label for those ideas



Trend Chart / Time Plot



Also called Run Chart … shows trends in data over time.

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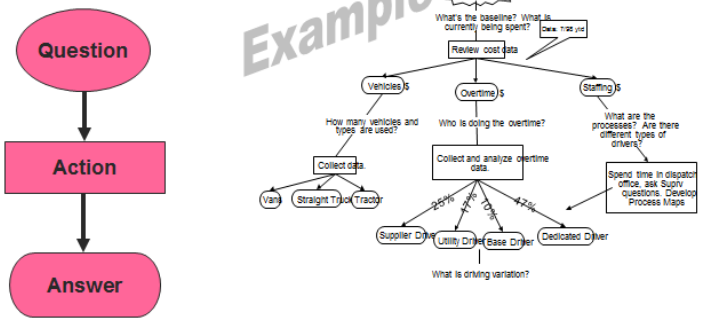
Highlights: Video Segment 1.8 Soft Tools

Thought Process Map – Critical Thinking



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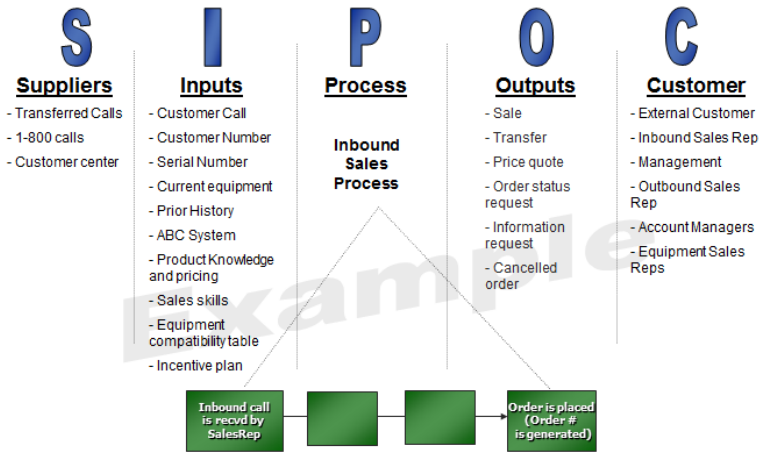
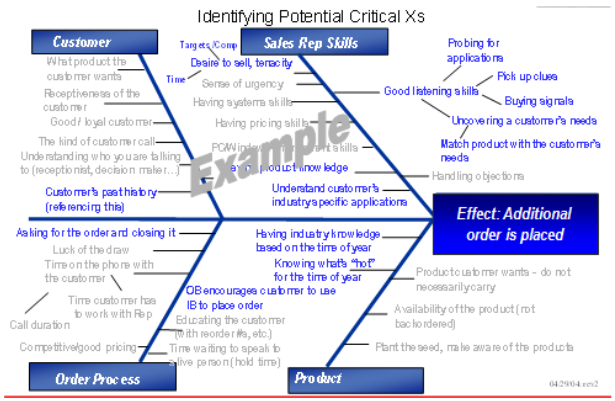
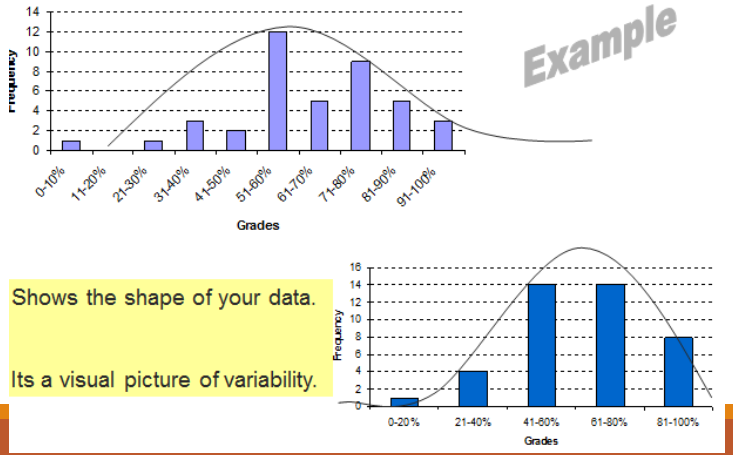


Cause & Effect Diagram (Fishbone, Ishikawa)

A way to identify all of the contributing root causes likely to be causing a problem, to document /understand the sources of process variability.



Histogram / frequency distribution



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Highlights: Video Segment 1.9/1.10 Kappa

- Kappa(K) : is an index that can be used to determine if your measurement system(tool) is working correctly for discrete data in terms of reproducibility (between people) and repeatability(the same person's ratings).
- This acts as a flag that the measurement system needs to be reevaluated if it is not producing reproducible and or repeatable results. This means your results may not be valid.

	Is it Good or Bad?	Is it Good or Bad?	Did you agree?
Peanut #	Your answer	Your fellow inspector's answers	yes/no
1	G	G	TRUE
2	B	B	TRUE
3	G	B	FALSE
4	B	B	TRUE
5	B	G	FALSE
6	G	G	TRUE
7	B	B	TRUE
8	G	G	TRUE
9	G	B	FALSE
10	B	B	TRUE
11	B	G	FALSE
12	B	B	TRUE
13	B	G	FALSE
14	G	G	TRUE
15	B	B	TRUE
16	G	G	TRUE
17	B	B	TRUE
18	B	G	FALSE
19	B	B	TRUE
20	B	B	TRUE
Totals	20	20	
Percent Good	7	9	
Percent Bad	13	11	
Percent Agreed			14
Percent Good	0.35	0.45	
Percent Bad	0.65	0.55	
Percent Agreed			0.70

Reproducible(between two different operators) example calculations for peanut exercise

Calculate Kappa:					
K = (P observed - P chance) / (1- P chance) =					
P Observed	0.70			Note:	
P Chance	(.35X.45) + (.65X.55)=	0.515		good x good + bad x bad	
	K = (.70-.515)/(1-.515)=	0.381443299			
Is your measurement system good?					

IF K> .7 then the system is good, my K value is .38, therefore it is not a good measurement system in terms of reproducibility.

Highlights: Video Segment 1.9/1.10 Kappa

- Repeatable(within operator-same operator) example calculations for peanut exercise

Inspect the peanuts again

Peanut #	Is it Good or Bad? Your 1st answer	Is it Good or Bad? Your 2nd answer	Did you agree? yes/no
1	G	G	TRUE
2	B	B	TRUE
3	G	G	TRUE
4	B	B	TRUE
5	B	B	TRUE
6	G	G	TRUE
7	B	G	FALSE
8	G	G	TRUE
9	G	B	FALSE
10	B	G	FALSE
11	B	B	TRUE
12	B	B	TRUE
13	B	G	FALSE
14	G	B	FALSE
15	B	B	TRUE
16	G	B	FALSE
17	B	B	TRUE
18	B	B	TRUE
19	B	B	TRUE
20	B	B	TRUE
Totals	20	20	
Count Good	7	7	
Count Bad	13	13	
Count Agreed			14
Percent Good	0.35	0.35	
Percent Bad	0.65	0.65	
Percent Agreed			0.70

Calculate Kappa:

K = (P observed - P chance) / (1- P chance) =

P Observe	0.70		
P Chance	(.35X.35) +	0.545	
		0.340659	

Is your measurement system good?

IF K>= .85 then the system is good, my K value is .34, therefore it is not a good measurement system in terms of repeatability.

Agenda

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Introduction	5 min	9:00-9:05	6:30-6:35
Highlights from Week #1 Video ***QUIZ REVIEW***	25 min	9:05-9:30	6:35-7:00
Highlights from Week #2 Video	25 min	9:30-9:55	7:00-7:25
Hank Activity	20 min	9:55-10:15	7:25-7:45
Measurement Plan or Stratification	10 min	10:15-10:25	7:45-7:55
Review of Upcoming Assignments	5 min	10:25-10:30	7:55-8:00

General Concepts

Process Improvement

Evaluate each step in the process:

Streamline → 1) **Customer value-add**: processes that touch the customer. Would the customer be willing to pay for it?

Minimize → 2) **Business value-add**: processes that are essential to the business (i.e., reduce financial risk; required by law; sales and marketing; invoicing).

Eliminate → 3) **Non-value-add**:

- Waiting
- Counting
- Searching
- Material handling
- Transporting or moving
- Inspecting and checking
- Reviewing
- Approving or signoffs
- Logging information
- Sorting work
- Proofreading or checking calculations
- Inventory
- Excess motion
- Defects
- Overprocessing
- Underutilized people (or misused resource)

General Concepts

Non-Value-Add: 7 primary forms of waste: TIM WOOD

Transportation
Inventory
Motion
Waiting
Over processing
Over production
Defects

Cycle Time: The time from the beginning, the first step in the process, to the last step in the process based on how you have defined the beginning and end.

Hank –Breakout

As a team come up with 3 ideas for Hank to improve his process and reduce his cycle time. Nominate 1 person to speak on behalf of your team.

Highlights: Video Segment 2.6 Hank the Handyman: Describing the Data

Data Set #1												
		Customer	Job estimate	Emergency job?	Rescheduled	Planned	Cycle time (days)	Cycle time (days)				
Sample	Job id#	Name	(hours)	(Y/N)	the job? (Y/N)	work day	job completion. to. check recvd	planned work day. to. check deposited				
1	M1	Joe	0.5	N	N	Mon	10	21				
2	M2	Betty	2	N	N	Mon	8	15				
3	M3	Mark	3	N	N	Mon	10	21				
4	M4	Cindy	1	N	**Y**	Mon	5	21				
5	M5	Tom	2	N	**Y**	Mon	12	28				
6	M6	Lucy	0.5	**Y**	N	Mon	7	15				
7	M7	Cheryl	1	**Y**	N	Mon	8	15				
8	T1	Barb	1	**Y**	N	Tue	10	19				
9	T2	Karen	0.5	**Y**	N	Tue	8	13				
10	T3	Bill	3	N	N	Tue	12	19				
11	T4	Bob	0.5	N	**Y**	Tue	10	26				
12	T5	Eric	2	N	N	Tue	11	19				
13	T6	Tim	1	N	**Y**	Tue	5	19				
14	W1	Mary	2	N	N	Wed	10	17				
15	W2	Matt	2	N	N	Wed	5	11				
16	W3	Luke	1	**Y**	N	Wed	9	17				
17	Th1	John	1	N	N	Thur	10	15				
18	Th2	Victoria	1	N	N	Thur	4	9				
19	Th3	Helen	1	N	**Y**	Thur	12	26				
20	Th4	Jessica	3	N	N	Thur	7	15				
21	Th5	Lisa	2	N	N	Thur	8	15				
22	Th6	Tina	0.5	**Y**	N	Thur	8	15				
23	F1	Lauren	2	N	N	Fri	10	14				
24	F2	Josh	1	N	N	Fri	10	14				
25	F3	Dan	1	N	N	Fri	6	13				
26	F4	Andy	0.5	N	N	Fri	8	13				
27	M8	Ted	3	N	N	Mon	10	21				
28	M9	Debbie	1	N	**Y**	Mon	8	22				
29	M10	Grant	2	**Y**	N	Mon	5	14				
30	M11	David	3	**Y**	N	Mon	9	15		example calcs for column I		
Totals			45				8.50	17.23	avg time	=AVERAGE(I4:I33)		
Average day			7.5	8	6		2.24	4.52	std dev	=STDEV.S(I4:I33)		
(this is 6 days of data)							8	19	range	=MAX(I4:I33)-MIN(I4:I33)		

Hank

Other questions

1) How are defects defined? How could you calculate SQL?

A defect for Hank's process could be anytime his cycle time is greater than 14 days.

Defect opportunities per unit or customer	D = 1
Total units/customers	U =30
If all units/customers were defective	DXU = 30 X1 = 30
How many defects actually occurred?	A = 22
Calculate the defect rate	A/DU = 22/30 = .7333 X 100 = 73%
What if you produced 1 million	73% X 1,000,000 = 730,000 (When calculating make sure to covert your percentage back to a decimal prior to multiplying, like sales tax for example)
SQL value from the table	.8-.9

DPMO	S.Q.L.	Yield	DPMO	S.Q.L.	Yield	DPMO	S.Q.L.	Yield
934,000	0	6.60%	308,000	2	69.20%	6,210	4	99.40%
920,000	0.1	8.00%	274,000	2.1	72.60%	4,660	4.1	99.50%
900,000	0.2	10.00%	242,000	2.2	75.80%	3,460	4.2	99.70%
880,000	0.3	12.00%	212,000	2.3	78.80%	2,550	4.3	99.75%
860,000	0.4	14.00%	184,000	2.4	81.60%	1,860	4.4	99.81%
840,000	0.5	16.00%	158,000	2.5	84.20%	1,350	4.5	99.87%
810,000	0.6	19.00%	135,000	2.6	86.50%	960	4.6	99.90%
780,000	0.7	22.00%	115,000	2.7	88.50%	680	4.7	99.93%
750,000	0.8	25.00%	96,800	2.8	90.30%	480	4.8	99.95%
720,000	0.9	28.00%	80,800	2.9	91.90%	330	4.9	99.97%
690,000	1	31.00%	66,800	3	93.30%	230	5	99.98%
650,000	1.1	35.00%	54,800	3.1	94.50%	150	5.1	99.99%
610,000	1.2	39.00%	44,600	3.2	95.50%	100	5.2	99.99%
570,000	1.3	43.00%	35,900	3.3	96.40%	70	5.3	99.99%
540,000	1.4	46.00%	28,700	3.4	97.10%	40	5.4	99.996%
500,000	1.5	50.00%	22,700	3.5	97.70%	30	5.5	99.997%
460,000	1.6	54.00%	17,800	3.6	98.20%	20	5.6	99.998%
420,000	1.7	58.00%	13,900	3.7	98.60%	10	5.7	99.999%
382,000	1.8	61.80%	10,700	3.8	98.90%	8	5.8	99.999%
344,000	1.9	65.60%	8,190	3.9	99.20%	5	5.9	99.9995%
						3.4	6	99.9997%

Data Stratification Tree

Questions About Process	Stratification factors X Variables	Measurements
Are orders impacted by the sales rep skill-levels (systems, product, pricing, listening, ability to follow the process)?	Skill level	•% of orders per Sales Rep by skill level type •average & range of Sales Rep skill levels
What % of the calls are order related?	Type of call	•% type of call
Does the Sales Rep have the right skills to improve selling more orders?	Training	•no. of hours of training per month
Do new orders vary by month ?	Time of year (mo.)	• total orders placed by month •% new orders are of total orders •% new order revenue of total revenue by month
Do new orders change by the receptiveness of the customer?	Customer attitude	•customer attitude rating by order type
Are orders impacted by call duration?	Call duration	•Average call duration for xyz order vs. other orders
Are orders impacted by call wait time?	Wait time	•wait time for each call
Are orders impacted by pricing issues?	Pricing Issue	•% of calls transferred to OB due to pricing issues
Are orders impacted by whether or not the Sales Rep follows the written process?	Written process	•mystery call /silent monitoring results (points per call)
Do new orders vary by the availability of the product (not on backorder)?	[illegible]	•% of orders resulting in backorders
Do the current targets impact orders?	Target settings (calls, orders, revenue)	•calls, orders, total rev, rev per mo. per Sales Rep

New Orders

(Output Y)

Example

Data Measurement Plan

Performance Measure	Data Source and Location	How Will Data Be Collected	Who Will Collect Data	When Will Data Be Collected	Target Sample Size
•% of orders per Sales Rep by skill level type •average & range of Sales Rep skill levels	•Susie	•Develop rating scale & assess performance	•Susie	5/12	N/A
•% type of call	•Manual data collection	•Use data collection form	•All	5/11-6/2	1000 calls
•no. of hours of training per month	•John's training spreadsheet	•Manual data collection	•John	5/20	12 mo
• total orders placed by month •% new orders are of total orders •% order revenue of total revenue by month	•IB performance reports	•Pull from repor	•Leanne	By 6/3	28 mo
•customer attitude rating by order type	•Manual data collectio	s da lection form	•All	5/11 - 6/2	500 orders
•Average call duration for new order vs. other	•Ma al data ecti	•Use dat collection form	•All	5/11 - 6/2	500 orders
•wait time for each call	•Ob from h team	•Aspect reports	•Leanne	tbd	tbd
•% of calls transferred to OB due to pricing issues	•Manual data collection	•Use data collection form	•All	5/11 - 6/2	1000 calls
•mystery call /silent monitoring results (points per call)	•Monthly mystery call results	•Compile Pamela's data	•Leanne	By 6/3	30
•% of orders resulting in backorders	•Manual data collection	•Use data collection form	•All	5/11 - 6/2	500 orders
•calls, orders, total rev, per Sales Rep per month	•IB performance reports	•Pull from report	•Susie	By 6/3	28 mo
• No. of inbound calls per day	•IB performance reports	•Pull from report	•Susie	By 6/3	28 mo
•order revenue per Sales Rep per month	•IB performance reports	•Pull from report	•Susie	By 6/3	28mo
• Total revenue per month	•IB performance reports	•Pull from report	•Susie	By 6/3	28 mo
• Revenue per month by product type	•SN report	•Pull from report	•Leanne	By 6/3	ytd

Data Measurement Plan

Performance Measure	Data Source and Location	How Will Data be Collected	Who Will Collect the Data	When Will the Data be Collected	Target Sample Size
No. of hardcopy paper reciepts to expense	expense management platform	Manual Data Collection	[redacted]	By 5/15/2015	12 months
Average time it takes to copy receipts	Manual Data Collection	Manual Data Collection	[redacted]	By 5/15/2015	12 months
Average time it takes to scan receipts via email (from scan to inbox)	Manual Data Collection	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of email receipts	Outlook - Mailbox	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of business trips	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
Average business trip duration (days)	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of client meetings	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of client calls	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of business trips for team meetings (internal)	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of internal meetings	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
Average amount of time it takes to file expenses	Manual Data Collection	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of taxi cab rides	expense management platform	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of client meals/entertainment	Outlook - Calendar	Manual Data Collection	[redacted]	By 5/15/2015	12 months
Average time it takes for data entry into expense management platform	Manual Data Collection	Manual Data Collection	[redacted]	By 5/15/2015	12 months
Average amount of days it takes to receive expense approval (via email)	Outlook - Mailbox	Manual Data Collection	[redacted]	By 5/15/2015	12 months
No. of emails received	Outlook - Mailbox	Manual Data Collection	[redacted]	By 5/15/2015	12 months

Example

This is a thought starter for where you want to be at the end of Measure….

Measure Tollgate

- Has the team determined what it needs to learn about process and problems? What data was collected?
- Has a Process Map been completed?
- Did the team develop clear operational definitions of the attributes being measured?
- Were the operational definitions tested?
- Has team determined what it needs to learn about transition?
- What was the team's sampling strategy (sample size, subgroup quantity, frequency, etc.)?
- Were the measurement systems validated?
- Has baseline performance and process capability been established? What is the Sigma Quality Level?
- How large is the gap between current performance and the customer requirements?

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Review of Upcoming Assignments	5 min	10:25-10:30	7:55-8:00

Review of Upcoming Assignments: 10 min

Topic	Thursday Section Due Dates	Sunday Section Due Dates
Quiz #1: Password is GoodLuck8488 You have 30 mins, which you must monitor and are responsible for not going over the time limit.	Sunday 10/14 Midnight EST	Wednesday 10/17 Midnight EST
Optional Learning for 3.12 Project Hypothesis Statements	NA	NA
Develop Measurement Plan or Data Stratification for project and begin collecting data	NA	NA
Start working on HMWK #1 in LaunchPad	Sunday, 10/21 Midnight EST	Wednesday,10/24 Midnight EST