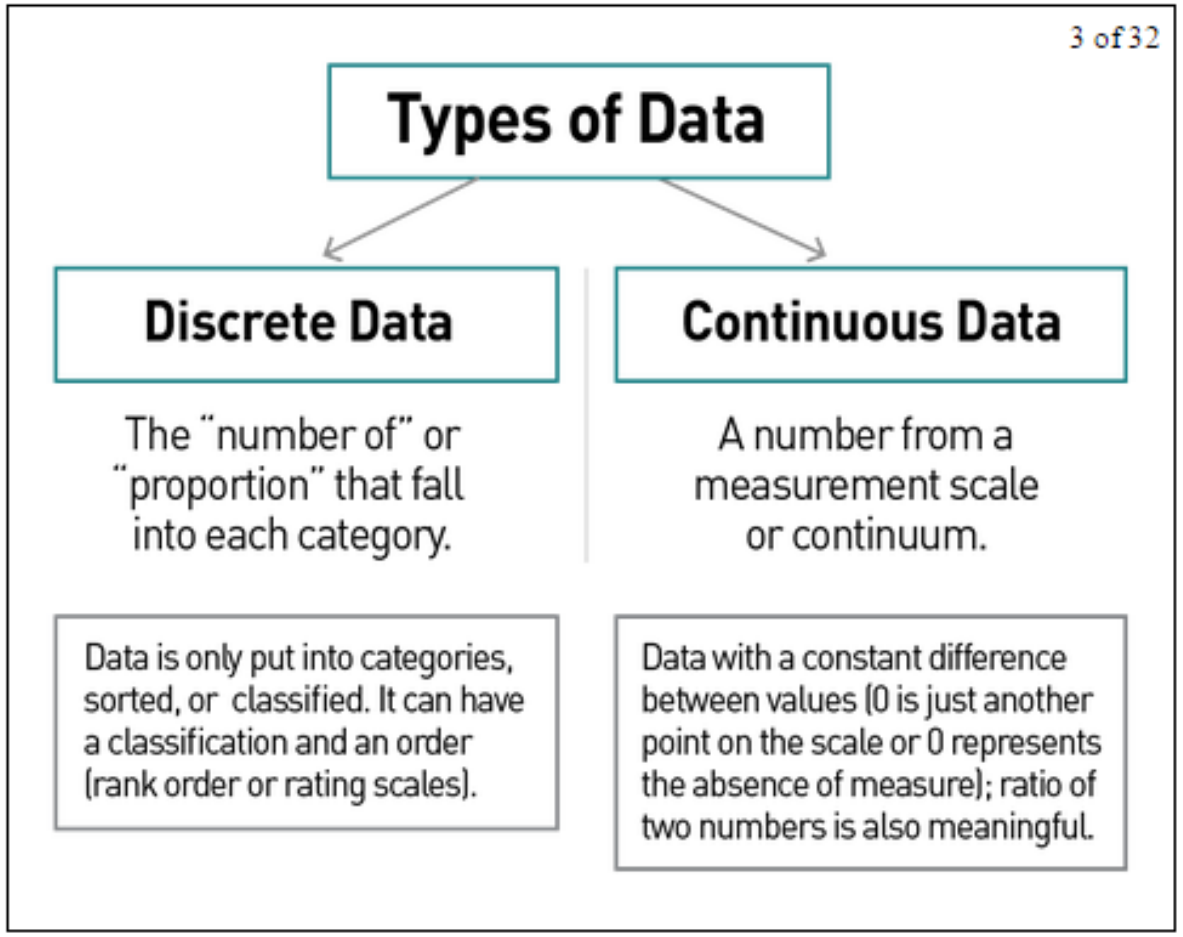
Live Session 2

1. Welcome and agenda review
2. Continuous vs Discrete data
3. Project Feedback and Next Steps
   a. DMAIC overview, y=f(x)
   b. Data Stratification Tree/Data Measurement Plan
   c. SQL (Sigma Quality Level)
   d. Soft Tools
4. Topic Review
   a. Descriptive Statistics
   b. Hank the Handyman (process mapping)
      - variance, standard deviation
5. Assignments for next 2 weeks
6. Wrap up, feedback

Discrete/Continuous Data



What is the benefit of using one versus the other?

DMAIC

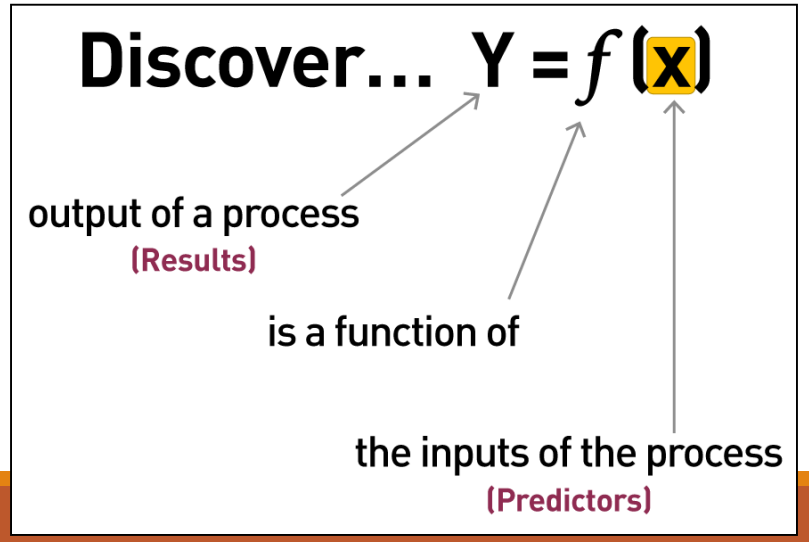
Define: Identify the problem and the team's scope.

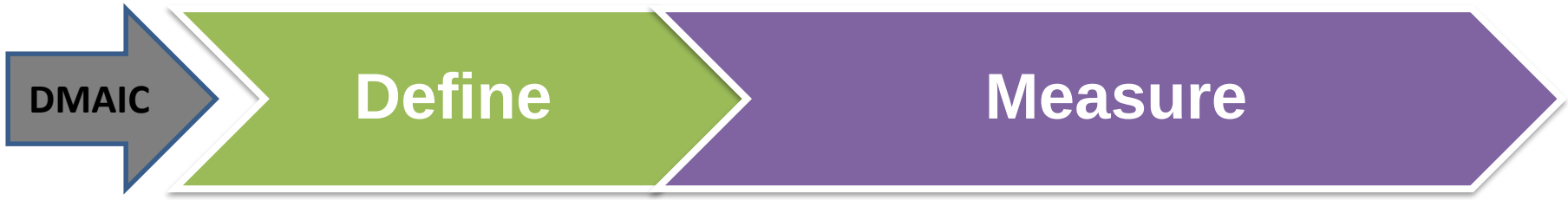
Measure: Develop data collection plan and implement it.

Analyze: Determine root causes; identify and verify critical variables.

Improve: Develop/select/pilot and then implement a solution.

Control: Put a control plan in place; ensure the problem stays fixed.





Description:

Clearly identify the business problem / performance gap (output measure), customer, scope, goals and resources.

Key Concepts:

y = f(x)
Types of data
Descriptive statistics and soft tools

Project:

Complete Problem Definition Worksheet

Tools:

Process map
SIPOC
Descriptive statistics
Thought process map
Affinity diagram
Sigma Quality Level (SQL)

Description:

Validate your measurement system and collect baseline data.

Key Concepts:

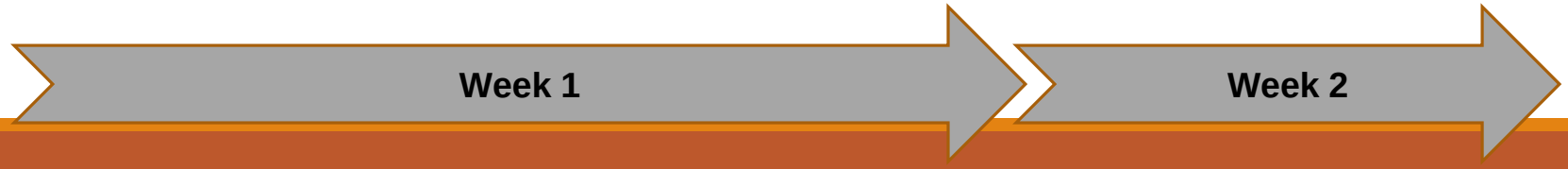
Mapping a process/value-stream, forms of waste, measurement error, reproducibility, repeatability

Project:

Identify potential inputs, develop operational definitions, develop data measurement/collection plan, validate measurement system, collect baseline data, calculate SQL.

Tools:

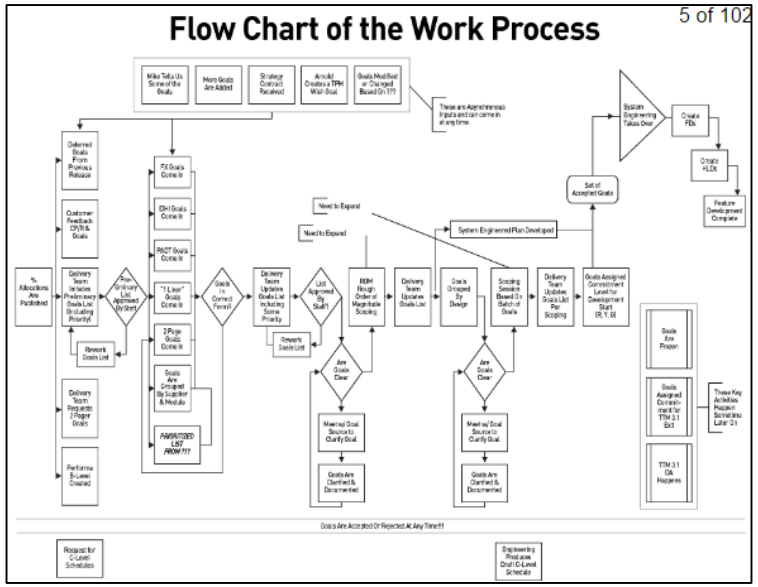
Operational definitions
Kappa
Process map (detailed)
Data measurement plan
Data stratification tree
Histogram
Trend/ line chart
Pareto chart
Fishbone (cause/effect) diagram



Project Next Steps - Measure Phase

- **Incorporate Feedback on Problem Definition Worksheet**
- **Process Map** ***(required for final project)***
- **Data Measurement Plan or Data Stratification Tree** ***(required for final project)***
- **SQL baseline** ***(required for final project)***
- **Soft Tools**

Process Map



Goal is to remove waste (non-value-added steps):
This will improve efficiency and productivity

8 TYPES OF WASTE IN DIFFERENT SECTORS

Wastes: DOWNTIME	Manufacturing	Supply Mngt.	Service
Defects	rework, scrap, poor quality	missing/ wrong supplies	errors, misinformation
Overproduction	unclear/ excess production	excessive warehousing	information overload
Waiting	waiting, delays, idle time	order/ delivery delays	delays, meeting overrun
Non-utilized Skills	unused resources/ skills	under-utilizing capabilities	wrong resource allocation
Transportation	transport of goods	small quantity deliveries	travel/ search activities
Inventory	work in progress, parts	overstocked supplies	excessive multitasking
Motion	poor production layout	difficult govt. approvals	unnecessary action
Excess Processing	overshooting requirements	excessive documentation	duplication/ excess work

Benefits of a Process Map:
Keeps everyone on same page
Highlights decision points
Helps identify non-value-add steps
Gives everyone clear understanding of process
Can be used as communication and training tool
Gives a way to show improvement visually

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 [illegible] orders
Are orders impacted by call wait time?	Wait time	•wait [illegible]
Are orders impacted by pricing issues?	Pricing Issue	[illegible] 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)?	No.of backorders	•% 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 collecti	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 n from n 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

SQL: Sigma Quality Level
Coursework Section 1.6

Identifying 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 = 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%

What is a defect in your project?

SQL: Sigma Quality Level
Coursework Section 1.6

A call center takes 1500 calls in a month. Customer wait times shouldn't be longer than 15 seconds. In addition, there should be no hang ups by customers before they get addressed. This month, the call center had 200 calls that had a wait longer than 15 seconds and 50 hang ups. What is the SQL for this month?

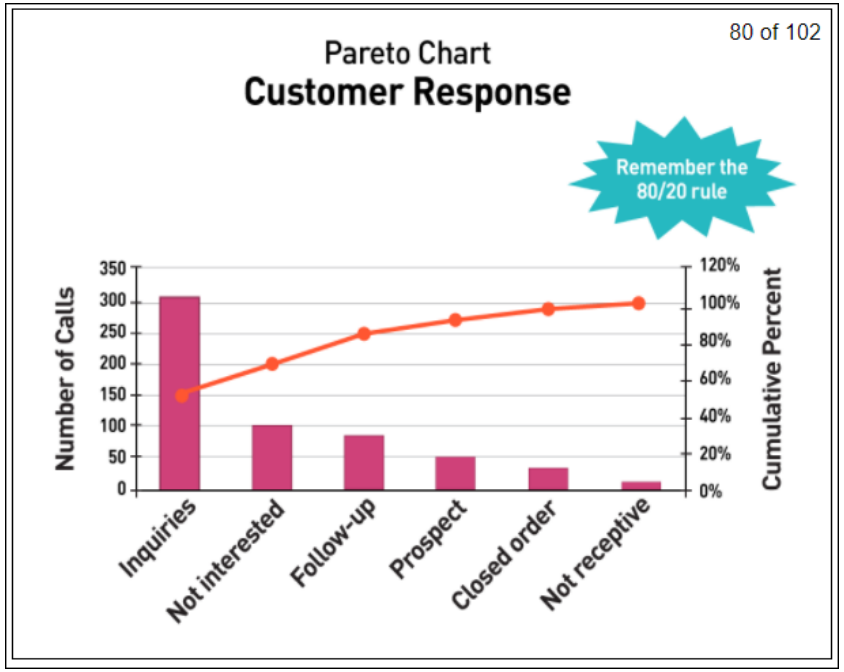
Identifying SQL

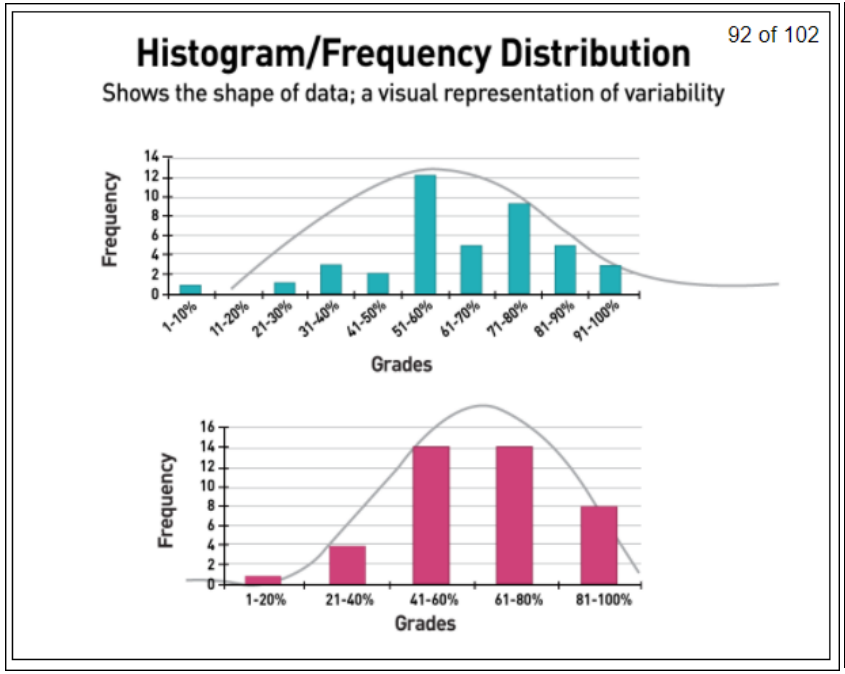
1. Defect opportunities per unit: D =
2. Units produced per timeframe: U =
3. Total possible defects per timeframe: D × U =
4. Total actual defects in timeframe: A =
5. Defect-per-opportunity rate: A ÷ DU = DPO =
6. Defects per million opportunities (DPMO): DPO × 1,000,000 =
7. SQL value (from SQL table) =

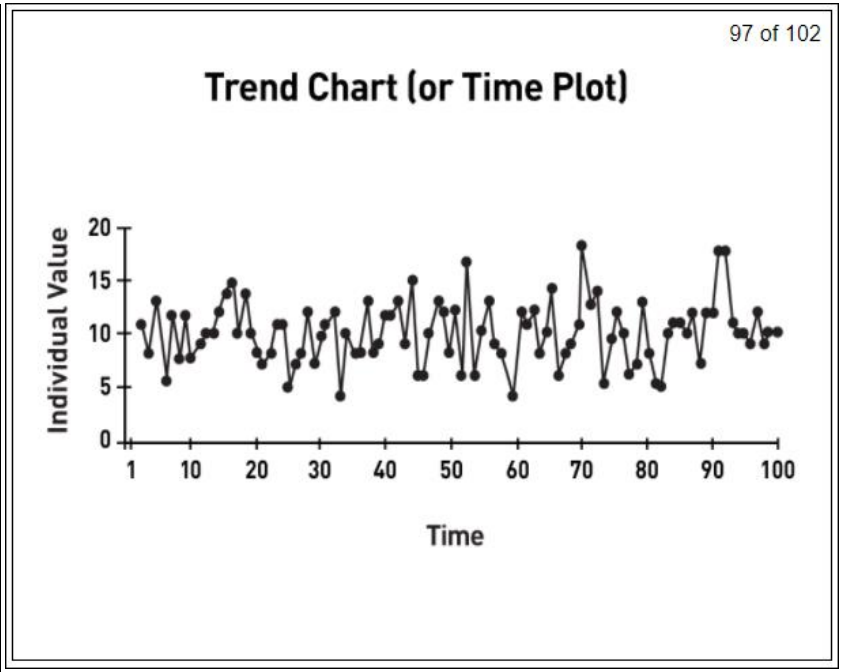
Breakouts

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%

Soft Tools







The tools we have discussed in this unit don't require many calculations but are just as powerful and effective as some of the statistical/analytical tools we'll learn about later.

Descriptive Statistics

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

Hank the Handyman

Variance and Standard Deviation

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

where

$s = the\ standard\ deviation$

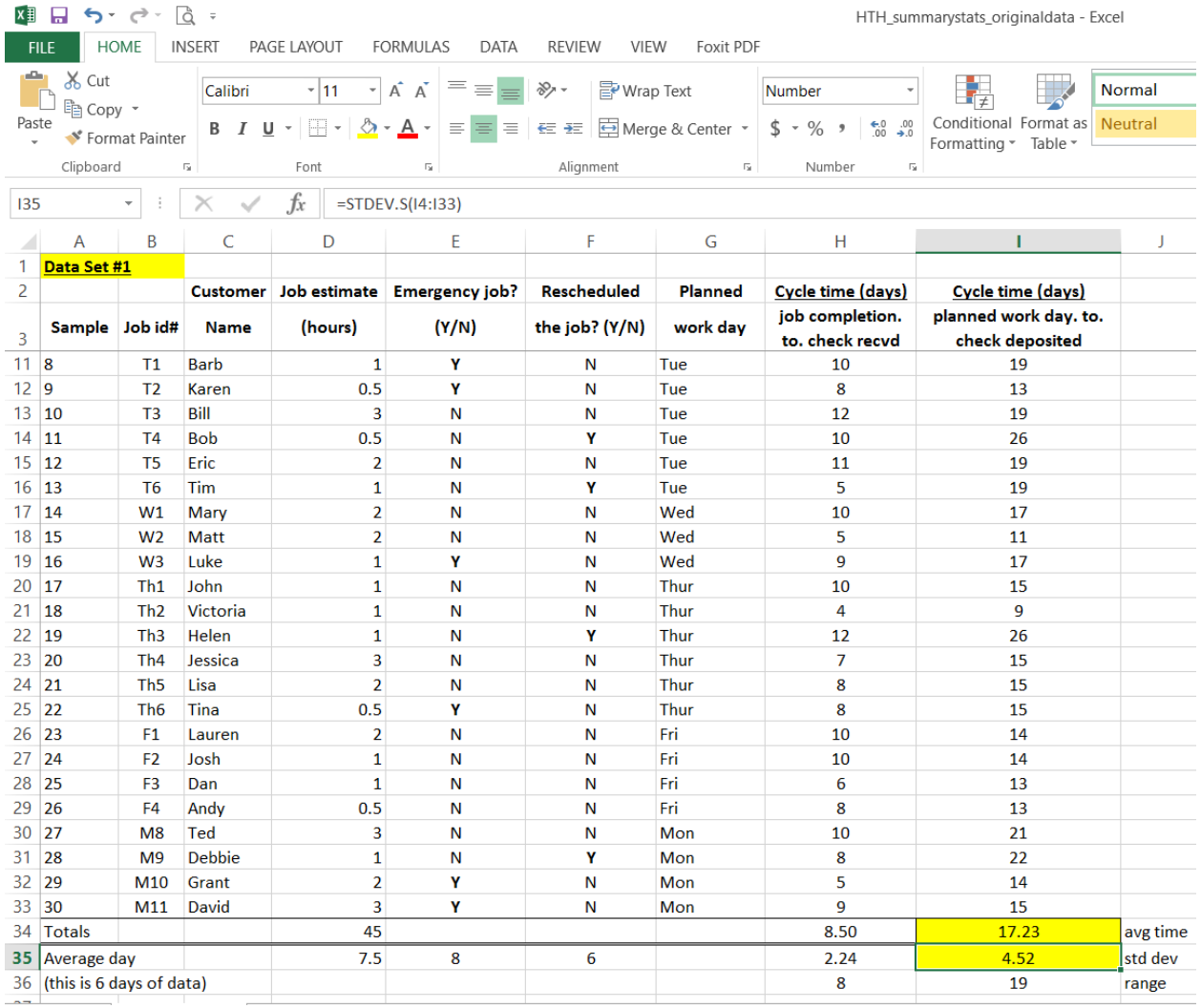
$x = each\ value\ in\ the\ sample$

$\overline{x} = the\ mean\ of\ the\ values$

$N = the\ number\ of\ values\ (the\ sample\ size)$

Formulas in Excel:

Mean	=AVERAGE(data range of cells in a column)
Median	=MEDIAN(data range)
Mode	=MODE.SNGL(data range)
Range	= MAX (data range) - MIN(data range)
Standard deviation	=STDEV.S(data range)
Variance	=VAR.S(data range)



	A	B	C	D	E	F	G	H	I	J
1	Data Set #1									
2			Customer	Job estimate	Emergency job?	Rescheduled	Planned	Cycle time (days)	Cycle time (days)	
3	Sample	Job id#	Name	(hours)	(Y/N)	the job? (Y/N)	work day	job completion. to. check recvd	planned work day. to. check deposited	
11	8	T1	Barb	1	Y	N	Tue	10	19	
12	9	T2	Karen	0.5	Y	N	Tue	8	13	
13	10	T3	Bill	3	N	N	Tue	12	19	
14	11	T4	Bob	0.5	N	Y	Tue	10	26	
15	12	T5	Eric	2	N	N	Tue	11	19	
16	13	T6	Tim	1	N	Y	Tue	5	19	
17	14	W1	Mary	2	N	N	Wed	10	17	
18	15	W2	Matt	2	N	N	Wed	5	11	
19	16	W3	Luke	1	Y	N	Wed	9	17	
20	17	Th1	John	1	N	N	Thur	10	15	
21	18	Th2	Victoria	1	N	N	Thur	4	9	
22	19	Th3	Helen	1	N	Y	Thur	12	26	
23	20	Th4	Jessica	3	N	N	Thur	7	15	
24	21	Th5	Lisa	2	N	N	Thur	8	15	
25	22	Th6	Tina	0.5	Y	N	Thur	8	15	
26	23	F1	Lauren	2	N	N	Fri	10	14	
27	24	F2	Josh	1	N	N	Fri	10	14	
28	25	F3	Dan	1	N	N	Fri	6	13	
29	26	F4	Andy	0.5	N	N	Fri	8	13	
30	27	M8	Ted	3	N	N	Mon	10	21	
31	28	M9	Debbie	1	N	Y	Mon	8	22	
32	29	M10	Grant	2	Y	N	Mon	5	14	
33	30	M11	David	3	Y	N	Mon	9	15	
34	Totals			45				8.50	17.23	avg time
35	Average day			7.5	8	6		2.24	4.52	std dev
36	(this is 6 days of data)							8	19	range

What's the difference between Variance and Standard Deviation?

Next two weeks

1.Project Next Steps - Measure Phase

Process Map
Data Stratification Tree OR Data Measurement Plan
Baseline SQL

2. Coursework BLT's:

2.5 Hank the Handyman: Mapping the Process
2.6 Hank the Handyman: Describing the Data
2.7 Hank the Handyman: Improving the Process
3.11 Alpha vs. Beta
3.12 Project Hypothesis Statements

3. Assignments:

Quiz #1

Due 3 days after live session 2
Complete by midnight eastern

Upcoming assignment:

Homework #1: *(worth 5 points)*
Due 3 days after live session 3

LaunchPad Assignments

- Complete **LearningCurve** for Chapter **3**.
- Complete **StatTutor** (3 topics): Chapter **6**
  - Normal Distributions
  - The Standard Normal Distribution
  - Using the Standard Normal Table