

Process Improvement Project

MBC 638, Summer 2018

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Project: Reducing Breakfast Prep-Time



Typical Mediterranean Breakfast that I prepare almost every morning.

Define

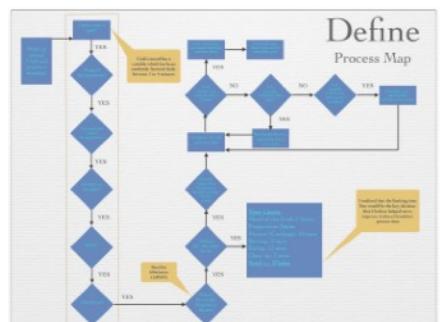
July 17 - 20

Purpose: Reduce breakfast preparation time.

Impact:

- More time to study, work, gym and hobbies
- Relative economic impact
- Living more affordable and efficient

Goal: Reducing my breakfast prep time from on average 69 minutes to 37 minutes national average(Hamrick S., 2016)



Defect: exceeding the time limit for a breakfast in a given category, as defined in the process map above

Measure

July 20 - Aug 26

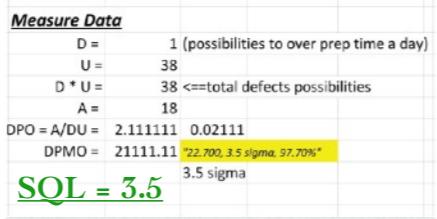
Type of Data: time in minutes, continues

Collection: recording/ collecting my own prep time by myself

Collected data sorted into categories as inputs(x's):

- Mood of the Cook
- Preparation
- Process(cooking)
- Serving
- Eating
- Clean-up

- Eating and Preparation are highly correlated:
 • Eating ($r=0.93$)
 • Preparation ($r=0.39$)
 • Serving is the least correlated ($r=0.11$)



Output (y): total daily breakfast prep time in minutes and seconds

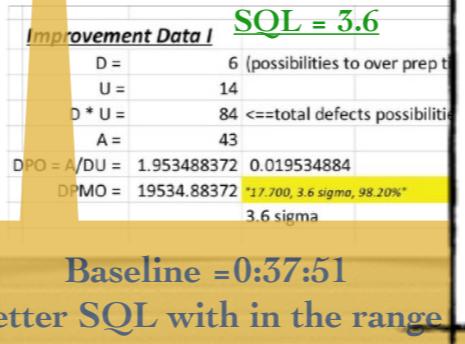
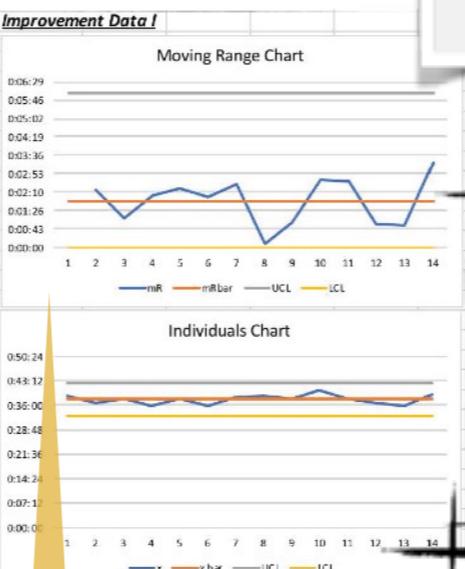
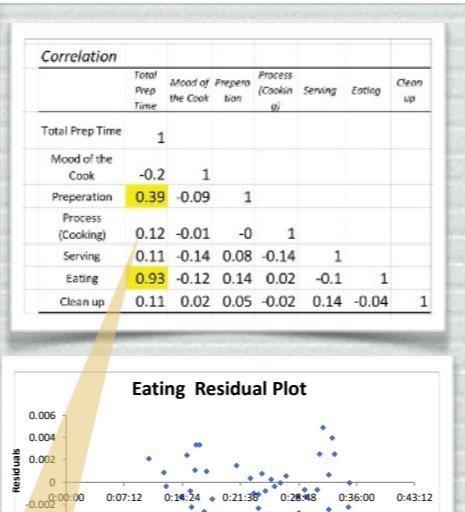
Key output:

$$y = \text{TotalBreakfastPrepTime} = f(X_{\text{cook}} + X_{\text{prep}} + X_{\text{process}} + X_{\text{serving}} + X_{\text{eating}} + X_{\text{cleanup}})$$

Baseline for output: 1:09:19 approximately 69 minutes.
 Baseline = 1:09:19 ~69 mins.
 std. deviation = 0:14:19

Analyze

Aug 27 - 31



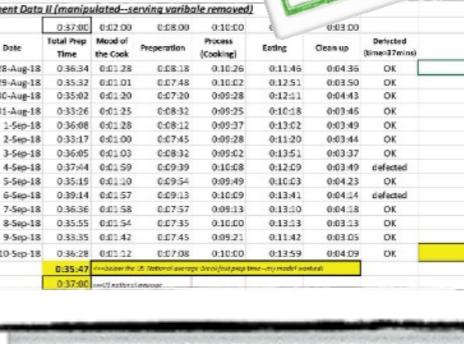
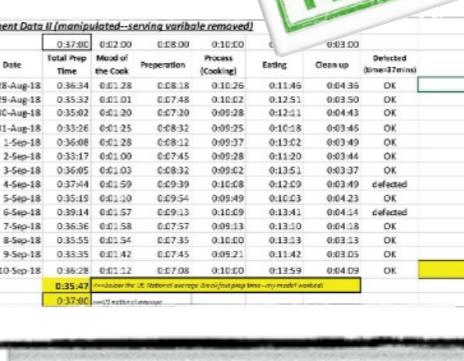
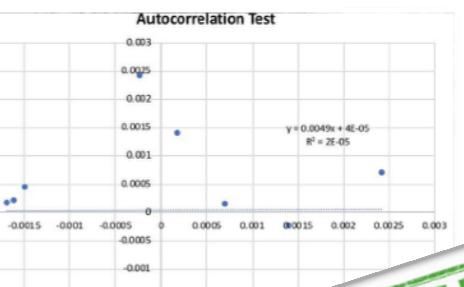
Improve

Sep 1 - 7



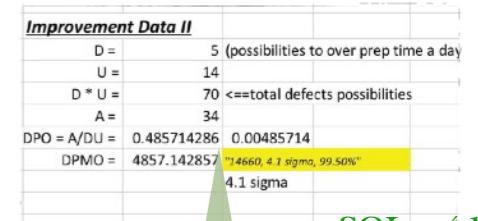
$$n = \left(\frac{z^* \hat{\sigma}}{E} \right)^2$$

Baseline = 0:35:47
Removed variation(service)
better SQL with in the range

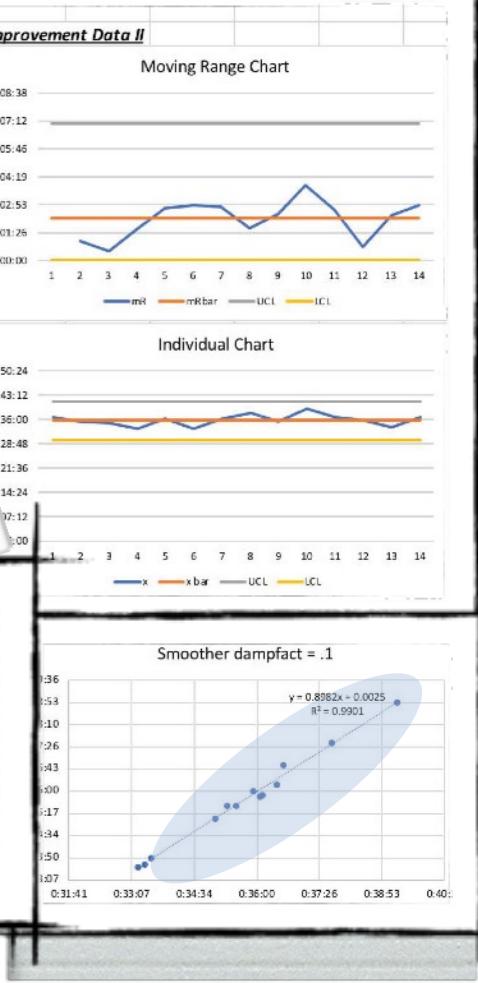


Control

Sep 8 - 15



Significant Improvement!!!
Reach the project goal!
Below the US average 37 mins! New Baseline = 0:35:47 with 4.1 Sigma



Define

Problem Statement and Impact

The purpose of this process improvement project is to decrease my breakfast prep time.

Personal Impact:

- More time to study, work, gym and hobbies
- Living more affordable and efficient
- Improve personal time efficiency

Goal:

- **To increase my free/study time - by decreasing my breakfast prep-time, 69 minutes to the national average 37 minutes.**

Team: Just me as process owner

Business Impact:

Time saving:

$$69\text{mins} - 37\text{mins} = 32\text{mins/day}$$

$$11\text{ weeks} * 7\text{ days} * 32\text{mins/day} = 2,464\text{mins} = 41.06\text{hours}$$

41.06 hours total additional study time for the Summer 18 semester

$$4\text{semester} * 42.06\text{hours} = 164.24 \text{ hours total time saving} \\ (\text{approximately 7 days or a week!})$$

Relative monetary value of the time saving:

Total full-time Graduate program's cost (one year) approximately = \$100,000

$$4 * 11\text{weeks}/\text{per semester} = 44\text{weeks}/\text{total length of the program}$$

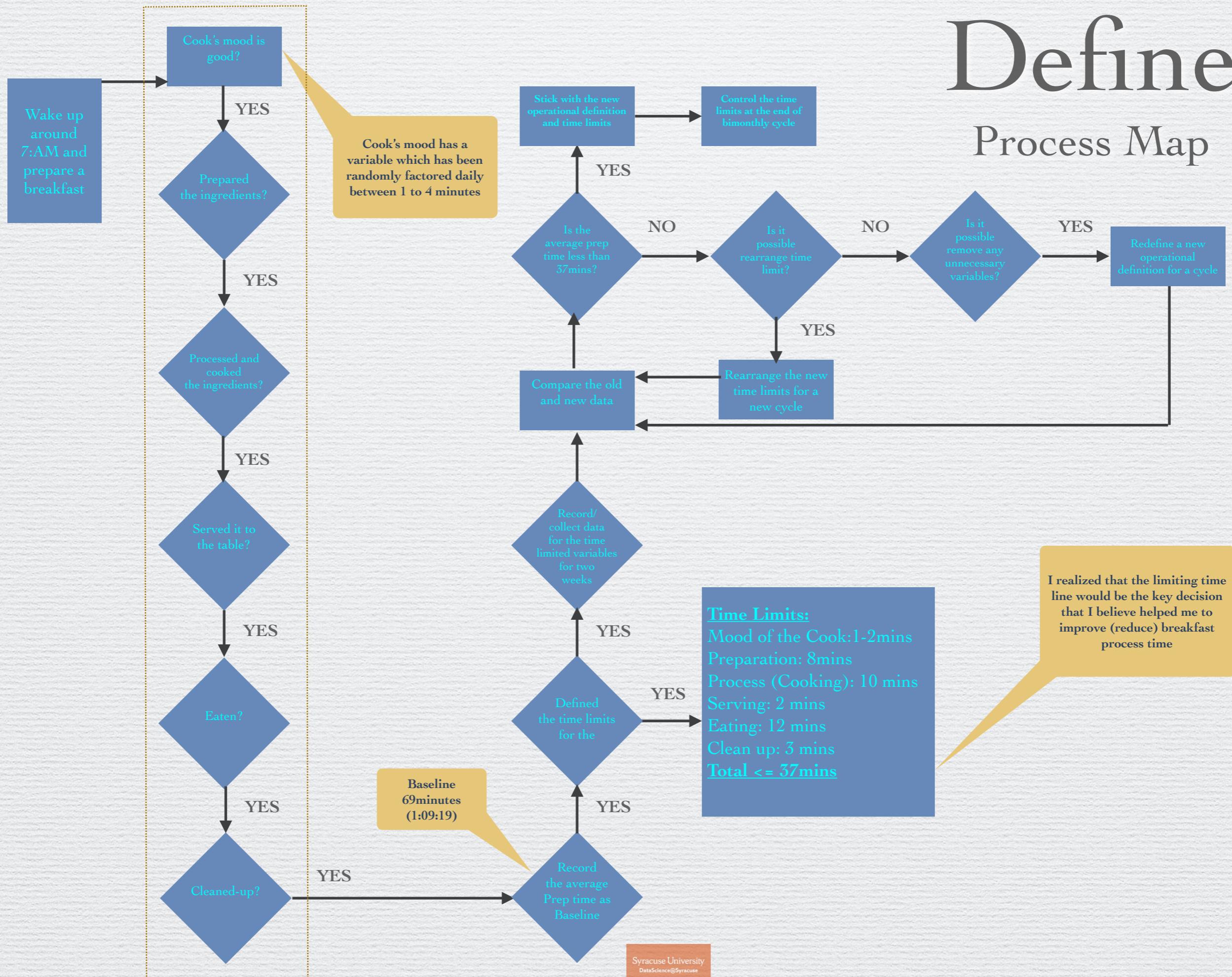
Weekly cost would be $\$100,000 / 44\text{weeks} = \$2,273/\text{week}$

$$\underline{\$2,273/\$100,000 = 2.27\% \text{ of total cost of Graduate Program at SU}}$$

As a Full-time Graduate student, just shorten my breakfast 32mins on average a day, I would **probably add 2,27% intrinsic**

Define

Process Map



Define Operational Definitions

Breakfast Prep Process Steps	Time Limits:
Mood of the Cook is a random variable, factored between 1-4 mins for every morning that adds the breakfast prep time, which I believe significantly affect the prep time.	1-2 mins
Preparation is cleaning, bringing, slicing and arranging ingredients, such as eggs, butter, honey, jam, black tea, olive, olive oil, sausage, feta cheese, Asiago, orange juice, bread and the utensil	8 mins
Process is cooking omelet and sausage, brewing black tea and organizing service plate and cups with a toasted bread	10 mins
Serving is setting a breakfast table and transferring everything on the menu	2 mins
Eating is consuming the breakfast	12 mins
Clean-up is washing breakfast related dishes	3 mins
Total Prep time <= 37 mins	

Measure

Identifying the Data

- **Type of Data and categorization:** All data in this project are in minutes and seconds. as measured by myself in six different categories (e.g. Mood of the Cook, Preparation, Process (Cooking), Serving, Eating and Clean up). The data are **continues** because time is considered to be a continues measure.
- **Data Collection:** I collected data by using iPhone chronometer's lap function for 38 days (between July 20 - August 26) with an additional 14 days (between August 28 - September 10) for the improvements. All data are owned and collected by me.
- **Defect:** exceeding the time limit for a breakfast in a given category, as defined in the process map
- **Key Output** for the project is total daily breakfast preparation time in minutes and seconds.
 - **TotalBreakfastPrepTime = f(Xcook + Xprep + Xprocess + Xserving + Xeating + Xcleanup)**

This will be the key
Output(y)= $f(x)$

Measure

Data Measurement Plan

Performance Measure	Data Source & Location	Data Collection Method	Who will collect the data?	When will data be collected? (Measure/Improvements)	Sample Size
Mood of the Cook	2122 North	random sampled by excel	AG	July 20 - August 26 August 28 - September 10	38/14
Preparation	2122 North	time lapsed by iPhone chronometer	AG	July 20 - August 26 August 28 - September 10	38/14
Process	2122 North	time lapsed by iPhone chronometer	AG	July 20 - August 26 August 28 - September 10	38/14
Serving	2122 North	time lapsed by iPhone chronometer	AG	July 20 - August 26 August 28 - September 10	38/14
Eating	2122 North	time lapsed by iPhone chronometer	AG	July 20 - August 26 August 28 - September 10	38/14
Clean-up	2122 North	time lapsed by iPhone chronometer	AG	July 20 - August 26 August 28 - September 10	38/14

Measure

Data Set and Inputs

Breakfast Prep time								
		Key Output= $Y = \text{TotalBreakfastPrepTime} = f(X_{\text{cook}} + X_{\text{prep}} + X_{\text{process}} + X_{\text{serving}} + X_{\text{eating}} + X_{\text{cleanup}})$						
Days	Date	Total Prep Time	Mood of the Cook	Preperation	Process (Cooking)	Serving	Eating	Clean up
1	20-Jul-18	1:03:00	0:02:09	0:15:49	0:16:38	0:08:06	0:15:57	0:06:30
2	21-Jul-18	1:10:34	0:03:00	0:14:20	0:15:05	0:06:29	0:28:55	0:05:45
3	22-Jul-18	0:58:49	0:02:41	0:14:25	0:13:06	0:08:56	0:17:06	0:05:16
4	23-Jul-18	1:06:58	0:03:09	0:19:00	0:13:50	0:09:47	0:16:34	0:07:47
5	24-Jul-18	1:13:52	0:03:16	0:14:44	0:16:34	0:09:53	0:27:22	0:05:19
6	25-Jul-18	1:19:21	0:03:13	0:16:59	0:16:36	0:05:38	0:32:37	0:07:31
7	26-Jul-18	1:03:54	0:03:50	0:18:16	0:16:17	0:06:51	0:14:58	0:07:32
8	27-Jul-18	1:06:32	0:02:15	0:18:40	0:15:59	0:07:50	0:16:08	0:07:55
9	28-Jul-18	1:15:47	0:02:23	0:17:00	0:14:02	0:07:23	0:31:07	0:06:15
10	29-Jul-18	1:12:06	0:03:02	0:19:16	0:14:35	0:05:09	0:26:34	0:06:32
11	30-Jul-18	1:01:25	0:03:33	0:15:07	0:15:34	0:07:16	0:18:08	0:05:20
12	31-Jul-18	1:11:32	0:02:11	0:18:53	0:15:32	0:06:11	0:25:29	0:05:27
13	1-Aug-18	1:13:34	0:01:52	0:15:02	0:14:58	0:07:04	0:29:42	0:06:48
14	2-Aug-18	1:09:01	0:03:30	0:15:47	0:15:55	0:08:13	0:22:53	0:06:13
15	3-Aug-18	1:24:40	0:02:42	0:19:45	0:16:52	0:09:05	0:31:53	0:07:05
16	4-Aug-18	1:24:34	0:01:55	0:19:38	0:15:43	0:08:53	0:33:05	0:07:15
17	5-Aug-18	0:57:47	0:01:43	0:13:38	0:16:22	0:07:49	0:14:17	0:05:41
18	6-Aug-18	1:08:44	0:01:45	0:18:12	0:13:10	0:09:10	0:21:05	0:07:07
19	7-Aug-18	1:11:03	0:01:02	0:14:32	0:16:11	0:08:27	0:25:56	0:05:57
20	8-Aug-18	1:20:49	0:02:22	0:19:46	0:16:26	0:08:07	0:31:28	0:05:02
21	9-Aug-18	0:57:14	0:03:34	0:16:00	0:13:49	0:08:38	0:12:22	0:06:25
22	10-Aug-18	0:58:58	0:03:16	0:15:45	0:13:11	0:05:19	0:18:15	0:06:28
23	11-Aug-18	1:04:21	0:02:42	0:16:11	0:16:30	0:08:32	0:17:25	0:05:43
24	12-Aug-18	0:59:44	0:03:34	0:16:23	0:15:45	0:06:11	0:15:23	0:06:02
25	13-Aug-18	0:58:50	0:01:41	0:19:49	0:16:42	0:06:57	0:10:18	0:05:04
26	14-Aug-18	1:11:04	0:02:28	0:14:31	0:14:58	0:09:37	0:24:17	0:07:41
27	15-Aug-18	1:12:29	0:03:50	0:14:09	0:16:07	0:05:57	0:28:45	0:07:31
28	16-Aug-18	1:07:25	0:01:51	0:14:12	0:16:35	0:07:06	0:23:16	0:06:16
29	17-Aug-18	1:14:38	0:03:37	0:16:14	0:15:04	0:05:18	0:32:31	0:05:31
30	18-Aug-18	0:57:40	0:03:14	0:16:14	0:15:31	0:05:14	0:15:30	0:05:11
31	19-Aug-18	1:20:51	0:03:30	0:15:55	0:14:44	0:09:06	0:35:13	0:05:53
32	20-Aug-18	1:14:17	0:01:00	0:16:32	0:16:05	0:05:56	0:29:31	0:06:13
33	21-Aug-18	1:22:45	0:01:45	0:19:30	0:14:05	0:09:58	0:33:20	0:05:52
34	22-Aug-18	1:09:16	0:02:43	0:17:42	0:13:20	0:08:25	0:24:44	0:05:05
35	23-Aug-18	0:58:54	0:01:54	0:15:35	0:13:49	0:09:48	0:12:10	0:07:32
36	24-Aug-18	1:17:26	0:01:16	0:17:41	0:13:46	0:05:16	0:34:57	0:05:46
37	25-Aug-18	1:06:02	0:02:29	0:13:28	0:16:00	0:06:17	0:23:50	0:06:27
38	26-Aug-18	1:07:53	0:01:41	0:14:19	0:15:08	0:07:08	0:23:54	0:07:24
		1:09:19						

Collected and categorized by day

Baseline for Output(y):
mean = 1:09:19

Possible Inputs (X's): I wanted to analyze how variation in each type of process affected my daily breakfast prep time.

Mood of the Cook

Preparation

Serving

Eating

Clean-up

Measure

SQL and Measurement Error

Days	Date	Total Prep Time	Mood of the Cook	Preperation	Process (Cooking)	Serving	Eating	Clean up	Defected (time > 69 mins)	
1	20-Jul-18	1:03:00	0:02:09	0:15:49	0:16:38	0:08:06	0:15:57	0:06:30	OK	
2	21-Jul-18	1:10:34	0:03:00	0:14:20	0:15:05	0:06:29	0:28:55	0:05:45	defected	
3	22-Jul-18	0:58:49	0:02:41	0:14:25	0:13:06	0:08:56	0:17:06	0:05:16	OK	
4	23-Jul-18	1:06:58	0:03:09	0:19:00	0:13:50	0:09:47	0:16:34	0:07:47	OK	
5	24-Jul-18	1:13:52	0:03:16	0:14:44	0:16:34	0:09:53	0:27:22	0:05:19	defected	
6	25-Jul-18	1:19:21	0:03:13	0:16:59	0:16:36	0:05:38	0:32:37	0:07:31	defected	
7	26-Jul-18	1:03:54	0:03:50	0:18:16	0:16:17	0:06:51	0:14:58	0:07:32	OK	
8	27-Jul-18	1:06:32	0:02:15	0:18:40	0:15:59	0:07:50	0:16:08	0:07:55	OK	
9	28-Jul-18	1:15:47	0:02:23	0:17:00	0:14:02	0:07:23	0:31:07	0:06:15	defected	
10	29-Jul-18	1:12:06	0:03:02	0:19:16	0:14:35	0:05:09	0:26:34	0:06:32	defected	
11	30-Jul-18	1:01:25	0:03:33	0:15:07	0:15:34	0:07:16	0:18:08	0:05:20	OK	
12	31-Jul-18	1:11:32	0:02:11	0:18:53	0:15:32	0:06:11	0:25:29	0:05:27	defected	
13	1-Aug-18	1:13:34	0:01:52	0:15:02	0:14:58	0:07:04	0:29:42	0:06:48	defected	
14	2-Aug-18	1:09:01	0:03:30	0:15:47	0:15:55	0:08:13	0:22:53	0:06:13	OK	
15	3-Aug-18	1:24:40	0:02:42	0:19:45	0:16:52	0:09:05	0:31:53	0:07:05	defected	
16	4-Aug-18	1:24:34	0:01:55	0:19:38	0:15:43	0:08:53	0:33:05	0:07:15	defected	
17	5-Aug-18	0:57:47	0:01:43	0:13:38	0:16:22	0:07:49	0:14:17	0:05:41	OK	
18	6-Aug-18	1:08:44	0:01:45	0:18:12	0:13:10	0:09:10	0:21:05	0:07:07	OK	
19	7-Aug-18	1:11:03	0:01:02	0:14:32	0:16:11	0:08:27	0:25:56	0:05:57	defected	
20	8-Aug-18	1:20:49	0:02:22	0:19:46	0:16:26	0:08:07	0:31:28	0:05:02	defected	
21	9-Aug-18	0:57:14	0:03:34	0:16:00	0:13:49	0:08:38	0:12:22	0:06:25	OK	
22	10-Aug-18	0:58:58	0:03:16	0:15:45	0:13:11	0:05:19	0:18:15	0:06:28	OK	
23	11-Aug-18	1:04:21	0:02:42	0:16:11	0:16:30	0:08:32	0:17:25	0:05:43	OK	
24	12-Aug-18	0:59:44	0:03:34	0:16:23	0:15:45	0:06:11	0:15:23	0:06:02	OK	
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28	16-Aug-18	1:07:25	0:01:51	0:14:12	0:16:35	0:07:06	0:23:16	0:06:16	OK	
29	17-Aug-18	1:14:38	0:03:37	0:16:14	0:15:04	0:05:18	0:32:31	0:05:31	defected	
30	18-Aug-18	0:57:40	0:03:14	0:16:14	0:15:31	0:05:14	0:15:30	0:05:11	OK	
31	19-Aug-18	1:20:51	0:03:30	0:15:55	0:14:44	0:09:06	0:35:13	0:05:53	defected	
32	20-Aug-18	1:14:17	0:01:00	0:16:32	0:16:05	0:05:56	0:29:31	0:06:13	defected	
33	21-Aug-18	1:22:45	0:01:45	0:19:30	0:14:05	0:09:58	0:33:20	0:05:52	defected	
34	22-Aug-18	1:09:16	0:02:43	0:17:42	0:13:20	0:08:25	0:24:44	0:05:05	OK	
35	23-Aug-18	0:58:54	0:01:54	0:15:35	0:13:49	0:09:48	0:12:10	0:07:32	OK	
36	24-Aug-18	1:17:26	0:01:16	0:17:41	0:13:46	0:05:16	0:34:57	0:05:46	defected	
37	25-Aug-18	1:06:02	0:02:29	0:13:28	0:16:00	0:06:17	0:23:50	0:06:27	OK	
38	26-Aug-18	1:07:53	0:01:41	0:14:19	0:15:08	0:07:08	0:23:54	0:07:24	OK	
1:09:19 <==my breakfast prep average time										

Baseline = 1:09:19 ~69 mins.
standard deviation = 0:14:19

<u>Measure Data</u>				
D =		1	(possibilities to over prep time a day)	
U =		38		
D * U =		38	<==total defects possibilities	
A =		18		
DPO = A/DU =		2.111111	0.02111	
DPMO =		21111.11	"22.700, 3.5 sigma, 97.70%"	
			3.5 sigma	<u>SQL = 3.5</u>

Sigma Quality Level (SQL): I calculated several different SQLs to see progress during my research.

- To improve SQL I will either changing model by limiting variables (time limits) or removing an inefficient variable to decrease time..
- Measurement Error:** The major potential cause of a measurement error was for me is the limited sample size of the data.
- To test measurement error, me and my friend Cherry, prepared breakfast and also categorized variables (time) and recorded time with a lap functioned iPhone stopwatch app and repeated experiment the next day to check for accuracy.
- The experiment with a Kappa of 0.79, it is reproducible (K>0.70).

Kappa=.79
reproducible.

Pobserved=	0.93
Pchance=	0.65
Kappa=	0.79

Measure

Reducing Error and Sample Size

		<i>z</i>		<i>z</i>
<i>standard dev.</i> =	0:15:52	1.645		1.96
Variables	Margin of Error (90% confidence)	sample size 90% confidence	Margin of Error (95% confidence)	sample size 95% confidence
Mood of the Cook	0:00:45	1211	0:00:30	3869
Preperation	0:01:15	436	0:01:00	967
Process (Cooking)	0:01:30	303	0:00:45	1719
Serving	0:00:30	2725	0:00:15	15474
Eating	0:01:15	436	0:01:00	967
Clean up	0:01	681	0:00:45	1719
Total prep time	0:01:15	436	0:01:00	967

$$n = \left(\frac{z^* \hat{\sigma}}{E} \right)^2$$

- It is evident that the sample size needed at 90% confidence level at least 436 samples.
 - Unfortunately, limited time constrains to collect required sample size.
- Sample size:**
 - The best way to reduce measurement error is to increase sample size significantly, which sample size calculation is evidently require to increase my sample size.
- Risk:**
 - Insufficient sample size creates the risk of the result not being statistically significant.

Needs to increase sample size significantly for better models.

Analyze

Correlation Analysis

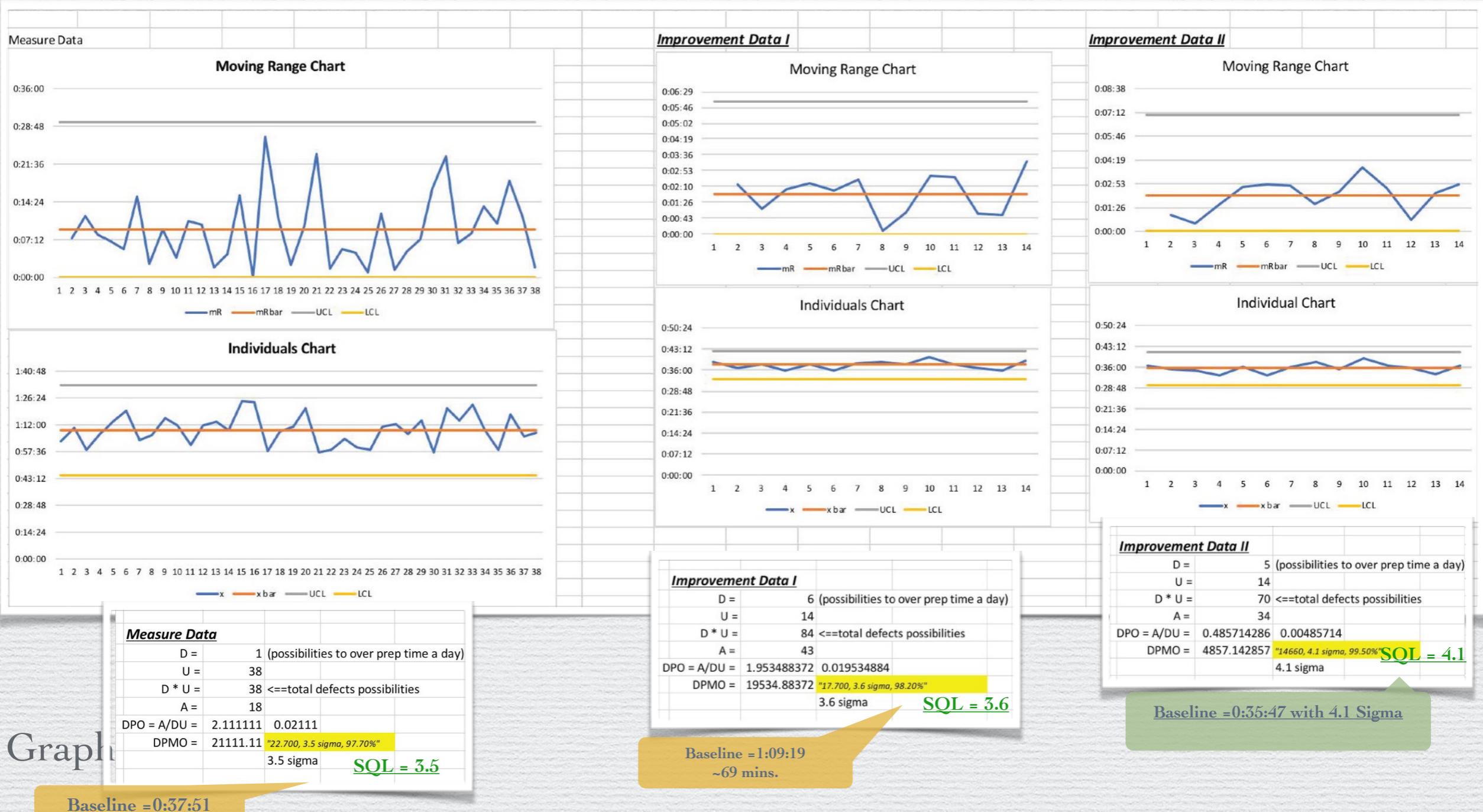
<i>Correlation</i>	<i>Total Prep Time</i>	<i>Mood of the Cook</i>	<i>Preparation</i>	<i>Process (Cooking)</i>	<i>Serving</i>	<i>Eating</i>	<i>Clean up</i>
<i>Total Prep Time</i>	1						
<i>Mood of the Cook</i>	-0.2	1					
<i>Preparation</i>	0.39	-0.09	1				
<i>Process (Cooking)</i>	0.12	-0.01	-0	1			
<i>Serving</i>	0.11	-0.14	0.08	-0.14	1		
<i>Eating</i>	0.93	-0.12	0.14	0.02	-0.1	1	
<i>Clean up</i>	0.11	0.02	0.05	-0.02	0.14	-0.04	1

Serving could be one of the less correlated variables. It could be removable for a better model if the operational function redefines.

- Used a multiple linear regression model
 - Some issues with regression
 - All coefficients = 1
 - because sum(xs)=y
- A correlation analysis helps me to see which variations are closely associated with the output measure:
 - Eating ($r = .93$)
 - Preparation ($r = .39$)
- Modeling trends do not generate random residuals.
 - High possibility of Autocorrelation
 - Relationship between neighboring points
 - Lack of randomness

Analyze

Process Control Charts



- Graph

Improve

New SQL, and New Model

Improvement Data I									
Days	Date	Total Prep Time	Mood of the Cook	Preperation	Process (Cooking)	Serving	Eating	Clean up	Defected (time>37mins)
1	28-Aug-18	0:38:59	0:01:28	0:08:18	0:10:26	0:02:25	0:11:46	0:04:36	defected
2	29-Aug-18	0:36:43	0:01:01	0:07:48	0:10:02	0:01:11	0:12:51	0:03:50	OK
3	30-Aug-18	0:37:51	0:01:20	0:07:20	0:09:28	0:02:49	0:12:11	0:04:43	defected
4	31-Aug-18	0:35:48	0:01:25	0:08:32	0:09:25	0:02:22	0:10:18	0:03:46	OK
5	1-Sep-18	0:38:09	0:01:28	0:08:12	0:09:37	0:02:01	0:13:02	0:03:49	defected
6	2-Sep-18	0:36:08	0:01:00	0:07:45	0:09:28	0:02:51	0:11:20	0:03:44	OK
7	3-Sep-18	0:38:39	0:01:03	0:08:32	0:09:02	0:02:34	0:13:51	0:03:37	defected
8	4-Sep-18	0:38:50	0:01:59	0:09:39	0:10:08	0:01:06	0:12:09	0:03:49	defected
9	5-Sep-18	0:37:50	0:01:10	0:09:54	0:09:49	0:02:31	0:10:03	0:04:23	defected
10	6-Sep-18	0:40:30	0:01:57	0:09:13	0:10:09	0:01:16	0:13:41	0:04:14	defected
11	7-Sep-18	0:37:55	0:01:58	0:07:57	0:09:13	0:01:19	0:13:10	0:04:18	defected
12	8-Sep-18	0:36:58	0:01:54	0:07:35	0:10:00	0:01:03	0:13:13	0:03:13	OK
13	9-Sep-18	0:36:06	0:01:42	0:07:45	0:09:21	0:02:31	0:11:42	0:03:05	OK
14	10-Sep-18	0:39:26	0:01:12	0:07:08	0:10:00	0:02:58	0:13:59	0:04:09	defected
0:37:51 <--improvements average									
0:37:00 <--US national average									

Improvement Data II (manipulated--serving varibale removed)

Days	Date	Total Prep Time	Mood of the Cook	Preperation	Process (Cooking)	Eating	Clean up	Defected (time>37mins)
1	28-Aug-18	0:36:34	0:01:28	0:08:18	0:10:26	0:11:46	0:04:36	OK
2	29-Aug-18	0:35:32	0:01:01	0:07:48	0:10:02	0:12:51	0:03:50	OK
3	30-Aug-18	0:35:02	0:01:20	0:07:20	0:09:28	0:12:11	0:04:43	OK
4	31-Aug-18	0:33:26	0:01:25	0:08:32	0:09:25	0:10:18	0:03:46	OK
5	1-Sep-18	0:36:08	0:01:28	0:08:12	0:09:37	0:13:02	0:03:49	OK
6	2-Sep-18	0:33:17	0:01:00	0:07:45	0:09:28	0:11:20	0:03:44	OK
7	3-Sep-18	0:36:05	0:01:03	0:08:32	0:09:02	0:13:51	0:03:37	OK
8	4-Sep-18	0:37:44	0:01:59	0:09:39	0:10:08	0:12:09	0:03:49	defected
9	5-Sep-18	0:35:19	0:01:10	0:09:54	0:09:49	0:10:03	0:04:23	OK
10	6-Sep-18	0:39:14	0:01:57	0:09:13	0:10:09	0:13:41	0:04:14	defected
11	7-Sep-18	0:36:36	0:01:58	0:07:57	0:09:13	0:13:10	0:04:18	OK
12	8-Sep-18	0:35:55	0:01:54	0:07:35	0:10:00	0:13:13	0:03:13	OK
13	9-Sep-18	0:33:35	0:01:42	0:07:45	0:09:21	0:11:42	0:03:05	OK
14	10-Sep-18	0:36:28	0:01:12	0:07:08	0:10:00	0:13:59	0:04:09	OK
0:35:47 <--below the US National average Breakfast prep time--my model worked!								
0:37:00 <--US national average								

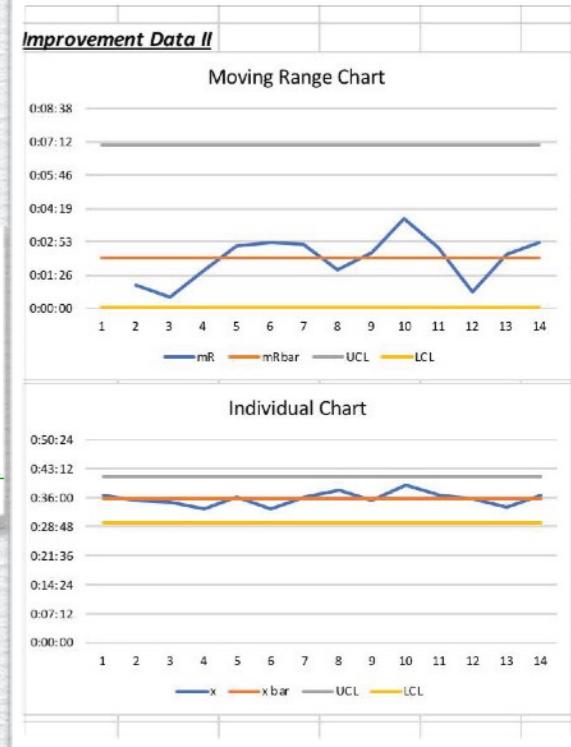
Significant time improvement with a low defect rate on the new model.

Improvement Data II	
D =	5 (possibilities to over prep time a day)
U =	14
D * U =	70 <=total defects possibilities
A =	34
DPO = A/DU =	0.485714286 0.00485714
DPMO =	4857.142857 "14660, 4.1 sigma, 99.50%"
	SQL = 4.1

Improvement Data I	
D =	6 (possibilities to over prep time a day)
U =	14
D * U =	84 <=total defects possibilities
A =	43
DPO = A/DU =	1.953488372 0.019534884
DPMO =	19534.88372 "17.700, 3.6 sigma, 98.20%"
	SQL = 3.6

Measure Data	
D =	1 (possibilities to over prep time a day)
U =	38
D * U =	38 <=total defects possibilities
A =	18
DPO = A/DU =	2.111111 0.02111
DPMO =	21111.11 "22.700, 3.5 sigma, 97.70%"
	SQL = 3.5

Baseline = 1:09:19
~69 mins.



Sigma Quality Level (SQL): I calculated several different SQLs to see progress during my research.

- The new SQL improved from 3.5 to 4.1 by removing service variable at the final improvement model.

Improve

Implement a solution

- The control Charts shows that reduced sample and removed variation(service) helped me to improve my breakfast prep time to below the US average of 37 mins.
 - To be able to use the regression model I have to see whether data violates the assumption of independent residuals rule.
 - I'll check autocorrelation in residuals first,
 - If there is, I will apply exponential smoothing time series analysis to predict forthcoming breakfast prep time.



Improve Autocorrelation Analysis

Improvement Data II (manipulated-serving variable removed)						
Days	Date	Total Prep Time	0:37:00	x	x input	y output
			lagged output	lagged residuals	Residuals	
1	28-Aug-18	0:36:34				-0.0004906
2	29-Aug-18	0:35:32	0:36:34			
3	30-Aug-18	0:35:02	0:35:32	-0.000490565	-0.0016158	
4	31-Aug-18	0:33:26	0:35:02	-0.001615789	0.000214	
5	1-Sep-18	0:36:08	0:33:26	0.000214049	-0.0016889	
6	2-Sep-18	0:33:17	0:36:08	-0.001688907	0.0001751	
7	3-Sep-18	0:36:05	0:33:17	0.000175093	0.0014	
8	4-Sep-18	0:37:44	0:36:05	0.00139996	-0.0002317	
9	5-Sep-18	0:35:19	0:37:44	-0.000231708	0.00242	
10	6-Sep-18	0:39:14	0:35:19	0.002419986	0.0007018	
11	7-Sep-18	0:36:36	0:39:14	0.000701836	0.000153	
12	8-Sep-18	0:35:55	0:36:36	0.000152969	-0.0014867	
13	9-Sep-18	0:33:35	0:35:55	-0.001486689	0.0004498	
14	10-Sep-18	0:36:28	0:33:35	0.000449764		
		0:36:28				

SUMMARY OUTPUT

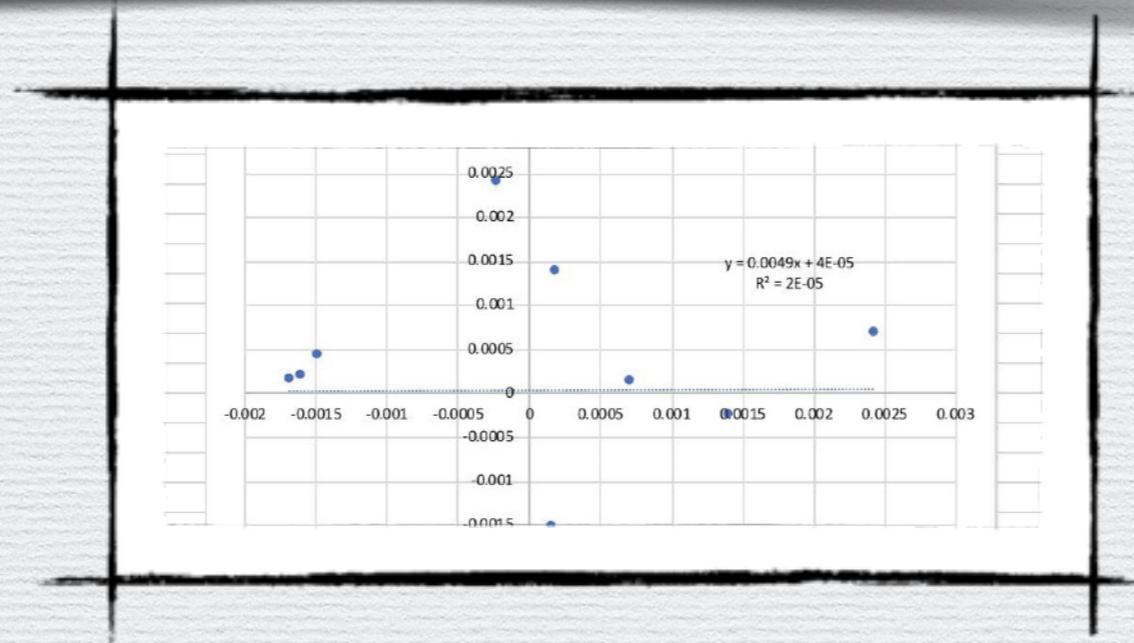
Regression Statistics							
Multiple R	0.0403094	R Square	0.0016248	Adjusted R S	-0.0982127	Standard Err	0.0012876
Observation:	12						

ANOVA

	df	SS	MS	F	Significance F
Regression	1	2.69817E-08	2.698E-08	0.0162749	0.9010158
Residual	10	1.65787E-05	1.658E-06		
Total	11	1.66057E-05			

Coefficients

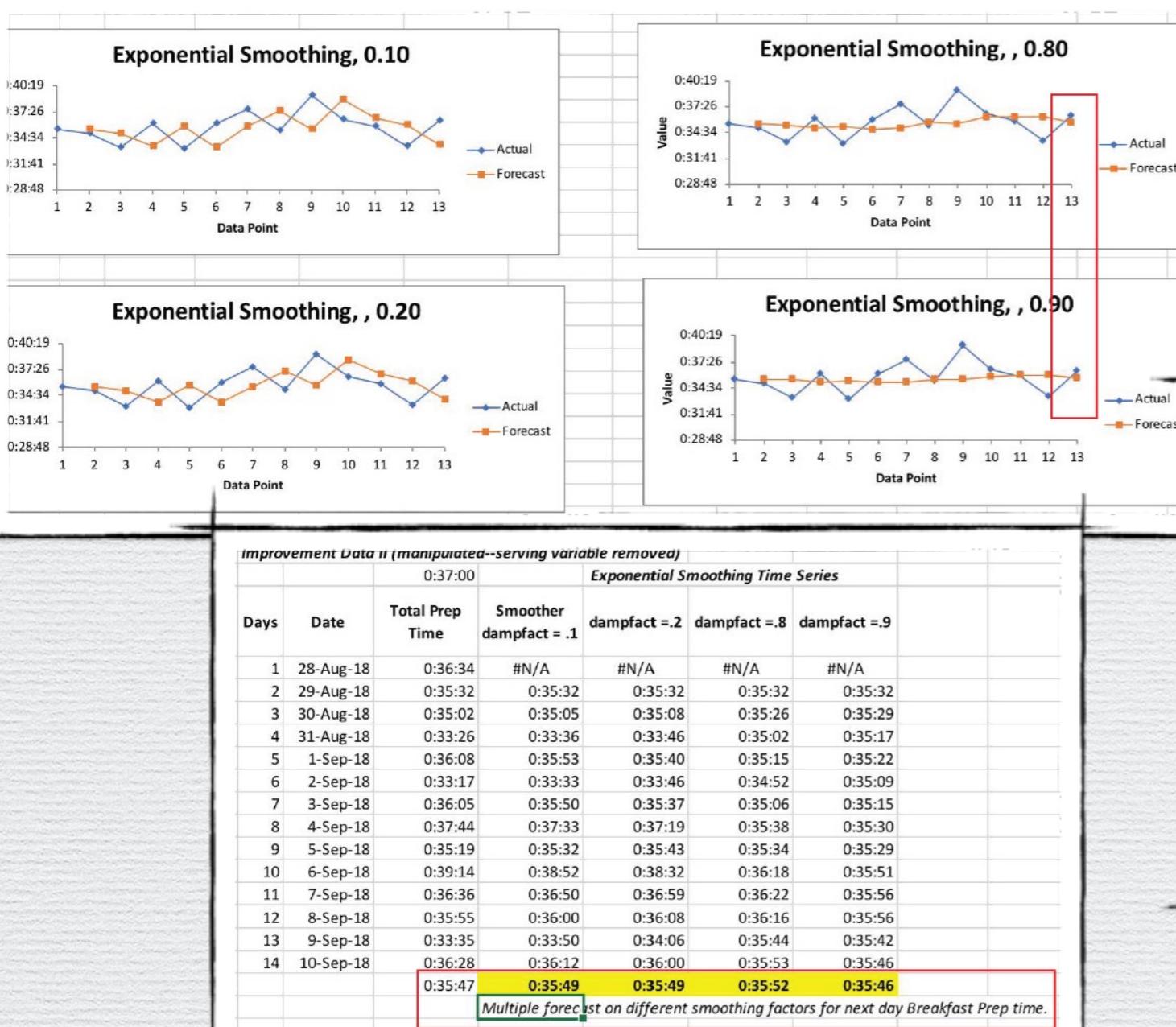
Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%		
Intercept	0.0258222	0.007898059	3.2694415	0.0084383	0.0082243	0.0434202	0.0082243	0.04342021	
	0.0253935	-0.0406458	0.318608448	-0.127573	0.9010158	-0.7505497	0.669258	-0.7505497	0.66925801



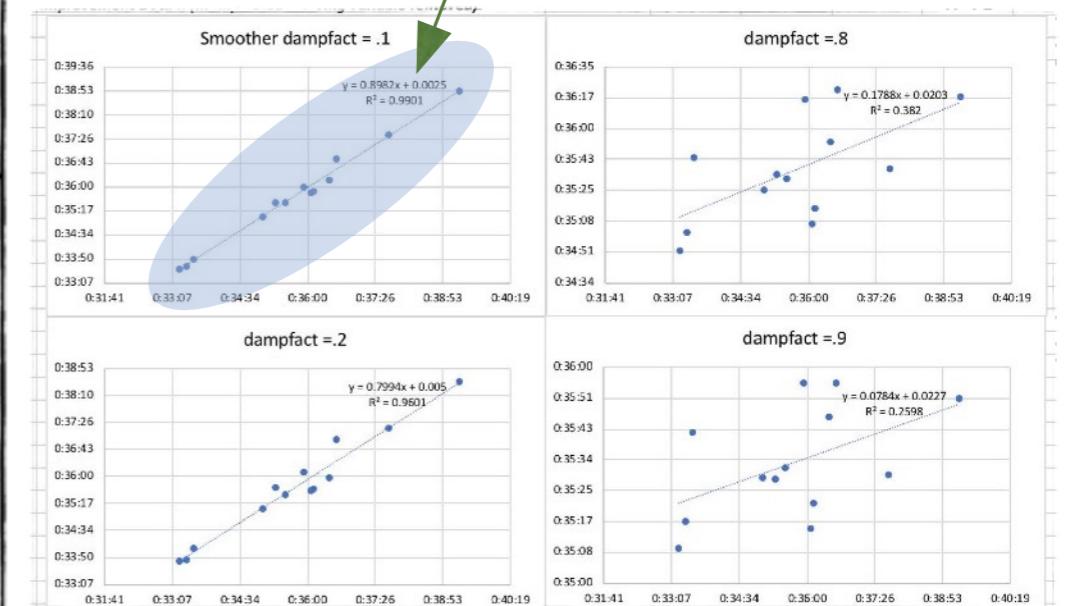
- Lagged residual applied and noticed there is no auto correlation present on this new model.
- Very small R square.
- Data is eligible to forecast the future (next morning) breakfast prep time value.
- The data is also eligible to regression.

Control

Forecast the Next Day Prep-time: Exponential Smoothing Time Series



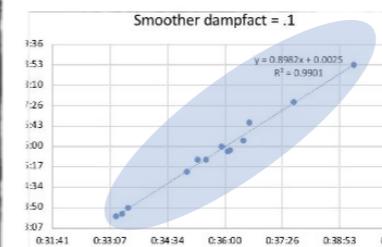
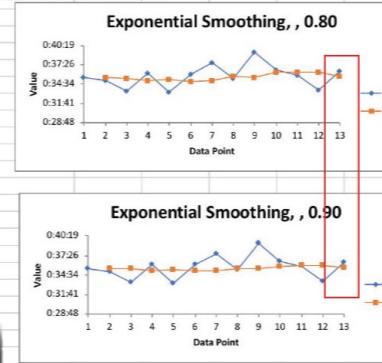
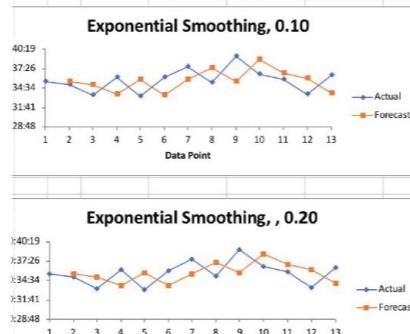
- Exponential smoothing time series assigns exponentially decreasing weights as the observation get older.
- Current observations are given fairly more weight in forecasting than the historic/past observations.
- I run regression to determine the strength of the 4 differently factored exponential smoothing analysis.
- Evidently, the 0.10 factored one has a better over-all strength than the others.



Conclusion

Improvement Data II (manipulated--serving variable removed)									
Days	Date	Total Prep Time	Mood of the Cook	Preparation (Cooking)	Eating	Clean up (time:37mins)	Defected		
1	28-Aug-18	0:36:34	0:01:28	0:08:18	0:10:26	0:11:46	0:04:36	OK	
2	29-Aug-18	0:35:32	0:01:01	0:07:48	0:10:02	0:12:51	0:03:50	OK	
3	30-Aug-18	0:35:02	0:01:20	0:07:20	0:09:28	0:12:11	0:04:43	OK	
4	31-Aug-18	0:33:26	0:01:25	0:08:32	0:09:25	0:10:18	0:03:46	OK	
5	1-Sep-18	0:36:08	0:01:28	0:08:12	0:09:37	0:13:02	0:03:49	OK	
6	2-Sep-18	0:33:17	0:01:00	0:07:45	0:09:28	0:11:20	0:03:44	OK	
7	3-Sep-18	0:36:05	0:01:03	0:08:32	0:09:02	0:13:51	0:03:37	OK	
8	4-Sep-18	0:37:44	0:01:59	0:09:39	0:10:08	0:12:09	0:03:49	defected	
9	5-Sep-18	0:35:19	0:01:10	0:09:54	0:09:49	0:10:03	0:04:23	OK	
10	6-Sep-18	0:39:14	0:01:57	0:09:13	0:10:09	0:13:41	0:04:14	defected	
11	7-Sep-18	0:36:36	0:01:58	0:07:57	0:09:13	0:13:10	0:04:18	OK	
12	8-Sep-18	0:35:55	0:01:54	0:07:35	0:10:00	0:13:13	0:03:13	OK	
13	9-Sep-18	0:33:33	0:01:42	0:07:45	0:09:21	0:11:42	0:03:05	OK	
14	10-Sep-18	0:36:28	0:01:12	0:07:08	0:10:00	0:13:59	0:04:09	OK	

Improvement Data II (manipulated--serving variable removed)									
Days	Date	Total Prep Time	Smoother dampfact = .1	dampfact = .2	dampfact = .8	dampfact = .9			
1	28-Aug-18	0:36:34	#N/A	#N/A	#N/A	#N/A			
2	29-Aug-18	0:35:32	0:35:32	0:35:32	0:35:32	0:35:32			
3	30-Aug-18	0:35:02	0:35:05	0:35:08	0:35:26	0:35:29			
4	31-Aug-18	0:33:26	0:33:36	0:33:46	0:35:02	0:35:17			
5	1-Sep-18	0:36:08	0:35:53	0:35:40	0:35:15	0:35:22			
6	2-Sep-18	0:33:17	0:33:33	0:33:46	0:34:52	0:35:09			
7	3-Sep-18	0:36:05	0:35:50	0:35:37	0:35:06	0:35:15			
8	4-Sep-18	0:37:44	0:37:33	0:37:19	0:35:38	0:35:30			
9	5-Sep-18	0:35:19	0:35:32	0:35:43	0:35:34	0:35:29			
10	6-Sep-18	0:39:14	0:38:52	0:38:32	0:36:18	0:35:51			
11	7-Sep-18	0:36:36	0:36:50	0:36:59	0:36:22	0:35:56			
12	8-Sep-18	0:35:55	0:36:00	0:36:08	0:36:16	0:35:56			
13	9-Sep-18	0:33:35	0:33:50	0:34:06	0:35:44	0:35:42			
14	10-Sep-18	0:36:28	0:36:12	0:36:00	0:35:53	0:35:46			



Improvement Data II

D =	5 (possibilities to over prep time a day)
U =	14
D * U =	70 <==total defects possibilities
A =	34
DPO = A/DU =	0.485714286 0.00485714
DPMO =	4857.142857 "14660, 4.1 sigma, 99.50%"
	4.1 sigma

SQL = 4.1

Improvement Data II

