Salutations' Effect on Tipping Percentage

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Statement of task:

The purpose of this investigation is to determine whether there is a relationship between average tip percentage and presence of a salutation on the bill. The data will be collected from the Texas Roadhouse in Winchester, VA and will be from individual servers' nightly checkouts. Seeing as I am going to be a server in a few months, I want to know if it is worth my time to write salutations on every one of my checks.

In order to randomize my data, but still have it be accurate, I created a standard by which I will have all servers meet. The servers will have to have been employed for a year or more and have a manager's recommendation. They will be tracked for a period of four weeks and I will record the final data at checkouts. I will collect at least 40 pieces of data for each server, totaling in over 120 pieces of data at the end of the four week period. They will be instructed on which days whether to write a salutation or not. The individual data pieces will consist of whether they had a salutation, the total bill, amount tipped, and the percentage of the tip. All information is available on checks and turned in at checkouts.

With the data collected there is going to be a range of mathematical processes used to present it. Starting with finding percentages of tips, most of the other comparative data will be based on it, because it can easily be compared. Then, I will use the averages of the data for different severs to plug into a comparative bar graph, for visual representation of data and easier interpretation. Then I will find the Standard Deviation of the averages to see how far apart the data is and see if there are any outliers which affect my results. Lastly, the X^2 Test of Independence will determine, statistically, if two independent occurrences are dependent. My null hypothesis is that tip percentages are independent of salutations. The X^2 Test of Independence will be done by hand and on calculator to assure accurate results.

Notation

I hypothesize that there will be a dependency in higher tips based on the presence of a salutation and what the difference is. I hope to share my findings with other servers and when I am old enough to serve I hope to apply this data to my everyday working life. The outcomes of this data could improve upon many people's income and therefore can have positive, lasting ramifications.

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Data Collection:

Maddie

YES	Check total	Tip	NO	Check total	Tip
11/29/13	$ 130.30	$ 20.00	12/14/13	$ 84.09	$ 16.00
	$ 102.12	$ 10.00		$ 55.56	$ 10.44
	$ 37.76	$ 5.24		$ 23.57	$ 5.00
	$ 42.15	$ 8.00		$ 54.07	$ 10.00
				$ 70.17	$ 9.00
12/01/13	$ 100.26	$ 25.00		$ 32.50	$ 6.00
	$ 12.32	$ 5.00		$ 46.96	$ 10.00
	$ 15.28	$ 5.00		$ 68.64	$ 6.00
	$ 27.17	$ 5.00			
	$ 27.18	$ 5.00	12/15/13	$ 74.11	$ 10.00
	$ 37.22	$ 6.00		$ 29.26	$ 4.00
	$ 45.09	$ 10.91		$ 33.39	$ 6.00
				$ 45.41	$ -
	$ 29.15	$ 10.00		$ 50.09	$ 10.00
12/03/13	$ 50.07	$ 10.00			
	$ 40.81	$ 7.00	12/16/13	$ 45.65	$ 10.00
	$ 33.85	$ 8.15		$ 61.78	$ 8.22
				$ 68.61	$ 12.00
	$ 130.03	$ 20.00		$ 54.18	$ 20.00
	$ 22.16	$ 6.00		$ 36.02	$ 5.00
12/05/13	$ 30.02	$ 6.00			
	$ 16.61	$ 3.61	12/19/13	$ 45.73	$ 7.00
	$ 15.56	$ 2.50		$ 31.74	$ 6.00
	$ 16.39	$ 3.61		$ 29.20	$ 5.00
	$ 11.47	$ 4.00		$ 29.21	$ 5.00
	$ 27.62	$ 6.00		$ 62.96	$ 10.00
	$ 20.76	$ 5.00			
	$ 32.30	$ 4.00			
	$ 38.85	$ 7.00			

Amiee

YES	CheckTotal	Tip	NO	Check Total	Tip
11/29/13	$ 45.33	$ 20.00	12/5/13	$ 39.56	$ 7.00
	$ 87.42	$ 5.48		$ 121.13	$ 20.00
	$ 3.27	$ 5.00		$ 94.25	$ 20.00
	$ 10.32	$ 8.00		$ 43.68	$ 9.00
	$ 90.84	$ 10.00		$ 42.32	$ 8.00
	$ 71.60	$ 14.00			
	$ 52.61	$ 10.39	12/7/13	$ 39.41	$ 6.00
	$ 38.86	$ 7.00		$ 89.38	$ 8.00
	$ 55.47	$ 10.00		$ 50.88	$ 4.12
				$ 44.86	$ 10.00
12/1/13	$ 56.16	$ 10.00		$ 134.91	$ 30.00
	$ 64.45	$ 13.00		$ 35.25	$ 5.75
	$ 70.05	$ 20.00			
	$ 48.68	$ 10.00	12/16/13	$ 38.75	$ 7.74
	$ 78.99	$ 16.00		$ 43.68	$ 15.00
	$ 69.50	$ 10.50		$ 84.66	$ 15.00
	$ 77.41	$ 12.00		$ 61.73	$ 10.00
	$ 56.86	$ 9.14		$ 30.56	$ 6.00
	$ 56.16	$ 10.00		$ 10.96	$ 2.00
				$ 19.75	$ 10.00
12/2/13	$ 26.17	$ 5.20		$ 84.65	$ 10.00
	$ 43.76	$ 10.00		$ 10.37	$ 2.00
	$ 86.33	$ 30.00		$ 12.88	$ 3.00
	$ 15.06	$ 5.00			
	$ 27.63	$ 6.00			

Brittany

YES	Check Total	Tip	NO	Check Total	Tip
11/29/14	$ 17.47	$ 3.00	12/5/13	$ 19.97	$ 5.00
	$ 43.30	$ 7.00		$ 18.33	$ 5.00
	$ 11.07	$ 10.00		$ 13.42	$ 4.00
	$ 80.14	$ 15.00		$ 26.31	$ 7.00
	$ 26.49	$ 3.51		$ 90.95	$ 20.00
	$ 50.80	$ 7.20		$ 48.77	$ 7.00
	$ 27.31	$ 6.00			
	$ 26.48	$ 4.00	12/7/13	$ 73.92	$ 8.00
	$ 32.77	$ 7.00		$ 38.89	$ 4.00
	$ 26.11	$ 10.00		$ 35.42	$ 8.00
	$ 46.74	$ 8.00		$ 51.71	$ 11.00
				$ 63.69	$ 8.00
12/1/13	$ 63.74	$ 8.00		$ 31.21	$ 6.00
	$ 125.72	$ 20.00		$ 56.27	$ 10.00
	$ 66.93	$ 20.00		$ 58.73	$ 10.00
	$ 42.33	$ 8.00		$ 27.39	$ 5.00
	$ 33.38	$ 6.00		$ 56.40	$ 10.00
	$ 28.45	$ 5.00		$ 18.85	$ 4.00
	$ 21.84	$ 7.00		$ 18.02	$ 6.98
	$ 71.17	$ 11.00		$ 26.53	$ -
	$ 50.41	$ 14.59		$ 30.09	$ 5.00
				$ 56.41	$ 11.00
12/2/13	$ 48.67	$ 8.33			
	$ 34.68	$ 5.32		$ 34.98	$ 3.00
	$ 69.44	$ 20.00		$ 34.68	$ 7.60
	$ 51.13	$ 5.00		$ 17.63	$ 5.00

B3

The data previously listed shows the dates on which certain checks were obtained with the tip, if there was one. These values were collected at Texas Roadhouse in Winchester, VA between November 29 and December 19 in 2013, a four week period. All three severs had been employed for over a year, were recommended by managers, and they all also averaged 30-40 hours a week.

Calculations:

The first calculation I did was the percentage of each tip on each check. From those percentages I calculated a sum and then divided by the number of checks collected. This gave me an individual mean average. I kept five decimal places for improved accuracy.

Amiee YES	Check Toal		Tip		Tip Percentage	NO	Check Total		Tip		Tip Percentage
11/29/13	$	130.30	$	20.00	15.34919	12/14/13	$	84.09	$	16.00	19.02723
	$	102.12	$	10.00	9.79240		$	55.56	$	10.44	18.79050
	$	37.76	$	5.24	13.87712		$	23.57	$	5.00	21.21341
	$	42.15	$	8.00	18.97983		$	54.07	$	10.00	18.49454
							$	70.17	$	9.00	12.82599
12/1/13	$	100.26	$	25.00	24.93517		$	32.50	$	6.00	18.46154
	$	12.32	$	5.00	40.58442		$	46.96	$	10.00	21.29472
	$	15.28	$	5.00	32.72251		$	68.64	$	6.00	8.74126
	$	27.17	$	5.00	18.40265						
	$	27.18	$	5.00	18.39588	12/15/13	$	74.11	$	10.00	13.49346
	$	37.22	$	6.00	16.12037		$	29.26	$	4.00	13.67054
	$	45.09	$	10.91	24.19605		$	33.39	$	6.00	17.96945
							$	45.41	$	–	0.00000
	$	29.15	$	10.00	34.30532		$	50.09	$	10.00	19.96406
12/3/13	$	50.07	$	10.00	19.97204						
	$	40.81	$	7.00	17.15266	12/16/13	$	45.65	$	10.00	21.90581
	$	33.85	$	8.15	24.07681		$	61.78	$	8.22	13.30528
							$	68.61	$	12.00	17.49016
	$	130.03	$	20.00	15.38107		$	54.18	$	20.00	36.91399
	$	22.16	$	6.00	27.07581		$	36.02	$	5.00	13.88118
12/5/13	$	30.02	$	6.00	19.98668						
	$	16.61	$	3.61	21.73390	12/19/13	$	45.73	$	7.00	15.30724
	$	15.56	$	2.50	16.06684		$	31.74	$	6.00	18.90359
	$	16.39	$	3.61	22.02563		$	29.20	$	5.00	17.12329
	$	11.47	$	4.00	34.87358		$	29.21	$	5.00	17.11743
	$	27.62	$	6.00	21.72339		$	62.96	$	10.00	15.88310
	$	20.76	$	5.00	24.08478						
	$	32.30	$	4.00	12.38390		Sum Total				391.77776
	$	38.85	$	7.00	18.01802			Number			24
	$	19.66	$	5.00	25.43235		Mean Tip % Average				16.32407
		Sum Total			587.64835						
		Number			27						
	Mean Tip % Average				21.76475365						

First simple process

Maddie

YES	Check Total	Tip	Tip Percentage
11/29/2013	$ 45.33	$ 20.00	44.12089
	$ 87.42	$ 5.48	6.26859
	$ 3.27	$ 5.00	152.90520
	$ 10.32	$ 8.00	77.51938
	$ 90.84	$ 10.00	11.00837
	$ 71.60	$ 14.00	19.55307
	$ 52.61	$ 10.39	19.74910
	$ 38.86	$ 7.00	18.01338
	$ 55.47	$ 10.00	18.02776
12/1/2013	$ 56.16	$ 10.00	17.80627
	$ 64.45	$ 13.00	20.17067
	$ 70.05	$ 20.00	28.55103
	$ 48.68	$ 10.00	20.54232
	$ 78.99	$ 16.00	20.25573
	$ 69.50	$ 10.50	15.10791
	$ 77.41	$ 12.00	15.50187
	$ 56.86	$ 9.14	16.07457
	$ 56.16	$ 10.00	17.80627
12/2/2013	$ 26.17	$ 5.20	19.87008
	$ 43.76	$ 10.00	22.85192
	$ 86.33	$ 30.00	34.75038
	$ 15.06	$ 5.00	33.20053
	$ 27.63	$ 6.00	21.71553
		Sum Total	671.3708198
		Number	23
	Mean Tip % Average		29.19004

NO	Check Total	Tip	Tip Percentage
12/5/2013	$ 39.56	$ 7.00	17.69464
	$ 121.13	$ 20.00	16.51119
	$ 94.25	$ 20.00	21.22016
	$ 43.68	$ 9.00	20.60440
	$ 42.32	$ 8.00	18.90359
12/7/2013	$ 39.41	$ 6.00	15.22456
	$ 89.38	$ 8.00	8.95055
	$ 50.88	$ 4.12	8.09748
	$ 44.86	$ 10.00	22.29157
	$ 134.91	$ 30.00	22.23705
	$ 35.25	$ 5.75	16.31206
12/16/2013	$ 38.75	$ 7.74	19.97419
	$ 43.68	$ 15.00	34.34066
	$ 84.66	$ 15.00	17.71793
	$ 61.73	$ 10.00	16.19958
	$ 30.56	$ 6.00	19.63351
	$ 10.96	$ 2.00	18.24818
	$ 19.75	$ 10.00	50.63291
	$ 84.65	$ 10.00	11.81335
	$ 10.37	$ 2.00	19.28640
	$ 12.88	$ 3.00	23.29193
		Sum Total	419.18588
		Number	21
	Mean Tip % Average		19.96123

Brittany

YES	Check Total	Tip	Tip Percentage
11/29/14	$ 17.47	$ 3.00	17.17230
	$ 43.30	$ 7.00	16.16628
	$ 11.07	$ 10.00	90.33424
	$ 80.14	$ 15.00	18.71724
	$ 26.49	$ 3.51	13.25028
	$ 50.80	$ 7.20	14.17323
	$ 27.31	$ 6.00	21.96997
	$ 26.48	$ 4.00	15.10574
	$ 32.77	$ 7.00	21.36100
	$ 26.11	$ 10.00	38.29950
	$ 46.74	$ 8.00	17.11596
12/1/13	$ 63.74	$ 8.00	12.55099
	$ 125.72	$ 20.00	15.90837
	$ 66.93	$ 20.00	29.88197
	$ 42.33	$ 8.00	18.89913
	$ 33.38	$ 6.00	17.97484
	$ 28.45	$ 5.00	17.57469
	$ 21.84	$ 7.00	32.05128
	$ 71.17	$ 11.00	15.45595
	$ 50.41	$ 14.59	28.94267
12/2/13	$ 48.67	$ 8.33	17.11527
	$ 34.68	$ 5.32	15.34025
	$ 69.44	$ 20.00	28.80184
	$ 51.13	$ 5.00	9.77899
	$ 62.83	$ 9.17	14.59494

NO	Check Total	Tip	Tip Percentage
12/5/13	$ 19.97	$ 5.00	25.03756
	$ 18.33	$ 5.00	27.27769
	$ 13.42	$ 4.00	29.80626
	$ 26.31	$ 7.00	26.60585
	$ 90.95	$ 20.00	21.99010
	$ 48.77	$ 7.00	14.35309
12/7/13	$ 73.92	$ 8.00	10.82251
	$ 38.89	$ 4.00	10.28542
	$ 35.42	$ 8.00	22.58611
	$ 51.71	$ 11.00	21.27248
	$ 63.69	$ 8.00	12.56084
	$ 31.21	$ 6.00	19.22461
	$ 56.27	$ 10.00	17.77146
	$ 58.73	$ 10.00	17.02707
	$ 27.39	$ 5.00	18.25484
	$ 56.40	$ 10.00	17.73050
	$ 18.85	$ 4.00	21.22016
	$ 18.02	$ 6.98	38.73474
	$ 26.53	$ -	0.00000
	$ 30.09	$ 5.00	16.61682
	$ 56.41	$ 11.00	19.50009
12/9/13	$ 34.98	$ 3.00	8.57633
	$ 34.68	$ 7.60	21.91465
	$ 17.63	$ 5.00	28.36075
	$ 40.51	$ 7.00	17.27968

I graphed the averages of each server's tip percentages for a visual comparison of the differences.

Averages of Percentages By Server

Second simple process
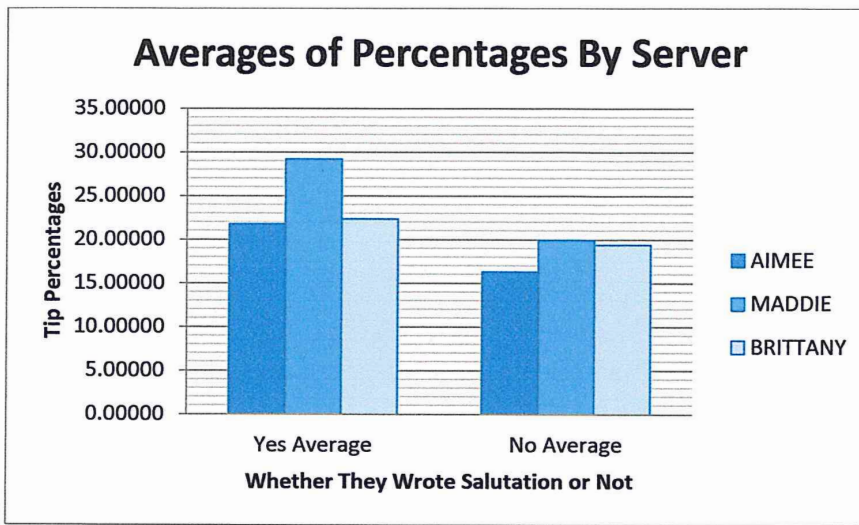
The "Yes Average" had more of a spread between them, but all of them were higher than the "No Average". On average, writing Salutations on the checks during this four-week span, with these three servers, proved to have an improvement in the overall tipping percentage. The numerical differences are listed below:

Server	Yes Average	No Average	Difference
AIMEE	21.76475	16.32407	5.44068
MADDIE	29.19004	19.96123	9.22880
BRITTANY	22.34148	19.39238	2.94909
Average	24.43209	18.55923	5.87286

Next I used the formula for standard deviation to with intent to eliminate data points that didn't fit within two standard deviations of the data and then reevaluate the averages. This also was a good comparison across the data to see how large the data spread was. The formula I used for standard deviation was:

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

In each of these spread sheets, there are five columns. The first two are the bill and it's respective tip. The next is the percentage that the tip is, with a total and average at the bottom. Then there is the difference between the percentage and the average. Then the last column is the absolute value of the difference squared. The sum of the squared values is then divided by the total number of values, which was then squared rooted, resulting in the standard deviation.

YES			Aimee			NO					
11/29/13						12/14/13					
Check Total	Tip		Tip %	$(x-\bar{x})$	$(x-\bar{x})^2$	Check Total	Tip		Tip %	$(x-\bar{x})$	$(x-\bar{x})^2$
$ 130.30	$	20.00	15.34919	–6.41556	41.15940	$ 84.09	$	16.00	19.02723	2.70316	7.30707
$ 102.12	$	10.00	9.79240	–11.97235	143.33723	$ 55.56	$	10.44	18.79050	2.46642	6.08325
$ 37.76	$	5.24	13.87712	–7.88764	62.21479	$ 23.57	$	5.00	21.21341	4.88933	23.90558
$ 42.15	$	8.00	18.97983	–2.78492	7.75578	$ 54.07	$	10.00	18.49454	2.17047	4.71094
12/1/13						$ 70.17	$	9.00	12.82599	–3.49808	12.23656
$ 100.26	$	25.00	24.93517	3.17041	10.05153	$ 32.50	$	6.00	18.46154	2.13747	4.56876
$ 12.32	$	5.00	40.58442	18.81966	354.17968	$ 46.96	$	10.00	21.29472	4.97065	24.70732
$ 15.28	$	5.00	32.72251	10.95776	120.07249	$ 68.64	$	6.00	8.74126	–7.58281	57.49908
$ 27.17	$	5.00	18.40265	–3.36210	11.30374	12/15/13					
$ 27.18	$	5.00	18.39588	–3.36887	11.34931	$ 74.11	$	10.00	13.49346	–2.83062	8.01240
$ 37.22	$	6.00	16.12037	–5.64439	31.85912	$ 29.26	$	4.00	13.67054	–2.65353	7.04124
$ 45.09	$	10.91	24.19605	2.43130	5.91121	$ 33.39	$	6.00	17.96945	1.64538	2.70727
12/3/13						$ 45.41	$	-	0.00000	–16.32407	266.47537
$ 29.15	$	10.00	34.30532	12.54056	157.26574	$ 50.09	$	10.00	19.96406	3.63999	13.24954
$ 50.07	$	10.00	19.97204	–1.79271	3.21383	12/16/13					
$ 40.81	$	7.00	17.15266	–4.61209	21.27142	$ 45.65	$	10.00	21.90581	5.58173	31.15573
$ 33.85	$	8.15	24.07681	2.31206	5.34560	$= 61.78	$	8.22	13.30528	–3.01880	9.11313
12/5/13						$ 68.61	$	12.00	17.49016	1.16609	1.35976
$ 130.03	$	20.00	15.38107	–6.38369	40.75147	$ 54.18	$	20.00	36.91399	20.58992	423.94469
$ 22.16	$	6.00	27.07581	5.31106	28.20734	$ 36.02	$	5.00	13.88118	–2.44290	5.96774
$ 30.02	$	6.00	19.98668	–1.77808	3.16156	12/19/13					
$ 16.61	$	3.61	21.73390	–0.03086	0.00095	$ 45.73	$	7.00	15.30724	–1.01684	1.03395
$ 15.56	$	2.50	16.06684	–5.69792	32.46624	$ 31.74	$	6.00	18.90359	2.57952	6.65392
$ 16.39	$	3.61	22.02563	0.26087	0.06805	$ 29.20	$	5.00	17.12329	0.79921	0.63874
$ 11.47	$	4.00	34.87358	13.10883	171.84141	$ 29.21	$	5.00	17.11743	0.79335	0.62941
$ 27.62	$	6.00	21.72339	–0.04136	0.00171	$ 62.96	$	10.00	15.88310	–0.44097	0.19446
$ 20.76	$	5.00	24.08478	2.32002	5.38251						
$ 32.30	$	4.00	12.38390	–9.38085	88.00040	Sum Total			391.77776	Sum	910.04542
$ 38.85	$	7.00	18.01802	–3.74674	14.03803		Number			24 Number	24
$ 19.66	$	5.00	25.43235	3.66760	13.45126	Mean Tip % Average			16.32407	Average	37.91856
										Deviation	6.15780
Sum Total			587.64835	Sum	1383.66181						
	Number		27	Number	27						
Mean Tip % Average			21.76475	Average	51.24673						
				Deviation	7.15868						

Third simple process

YES		Maddie			NO				
11/29/13									
Check Total	Tip	Tip %	(x-x̄)	(x-x̄)²	Check Total	Tip	Tip %	(x-x̄)	(x-x̄)²
$ 45.33	$ 20.00	44.12089	14.93086	222.93045	$ 39.56	$ 7.00	17.69464	-2.26659	5.137
$ 87.42	$ 5.48	6.26859	-22.92145	525.39274	$ 121.13	$ 20.00	16.51119	-3.45005	11.902
$ 3.27	$ 5.00	152.90520	123.71516	15305.44159	$ 94.25	$ 20.00	21.22016	1.25893	1.584
$ 10.32	$ 8.00	77.51938	48.32934	2335.72551	$ 43.68	$ 9.00	20.60440	0.64316	0.413
$ 90.84	$ 10.00	11.00837	-18.18167	330.57310	$ 42.32	$ 8.00	18.90359	-1.05764	1.118
$ 71.60	$ 14.00	19.55307	-9.63696	92.87106	12/7/13				
$ 52.61	$ 10.39	19.74910	-9.44094	89.13132	$ 39.41	$ 6.00	15.22456	-4.73667	22.436
$ 38.86	$ 7.00	18.01338	-11.17665	124.91760	$ 89.38	$ 8.00	8.95055	-11.01068	121.235
$ 55.47	$ 10.00	18.02776	-11.16227	124.59634	$ 50.88	$ 4.12	8.09748	-11.86375	140.748
12/1/13			-29.19004		$ 44.86	$ 10.00	22.29157	2.33034	5.430
$ 56.16	$ 10.00	17.80627	-11.38377	129.59017	$ 134.91	$ 30.00	22.23705	2.27581	5.179
$ 64.45	$ 13.00	20.17067	-9.01936	81.34887	$ 35.25	$ 5.75	16.31206	-3.64918	13.316
$ 70.05	$ 20.00	28.55103	-0.63900	0.40832	12/16/13			-19.96123	
$ 48.68	$ 10.00	20.54232	-8.64772	74.78303	$ 38.75	$ 7.74	19.97419	0.01296	0.000
$ 78.99	$ 16.00	20.25573	-8.93431	79.82184	$ 43.68	$ 15.00	34.34066	14.37943	206.767
$ 69.50	$ 10.50	15.10791	-14.08212	198.30616	$ 84.66	$ 15.00	17.71793	-2.24330	5.032
$ 77.41	$ 12.00	15.50187	-13.68816	187.36579	$ 61.73	$ 10.00	16.19958	-3.76165	14.150
$ 56.86	$ 9.14	16.07457	-13.11547	172.01546	$ 30.56	$ 6.00	19.63351	-0.32772	0.107
$ 56.16	$ 10.00	17.80627	-11.38377	129.59017	$ 10.96	$ 2.00	18.24818	-1.71306	2.934
12/2/13			-29.19004		$ 19.75	$ 10.00	50.63291	30.67168	940.751
$ 26.17	$ 5.20	19.87008	-9.31996	86.86157	$ 84.65	$ 10.00	11.81335	-8.14788	66.388
$ 43.76	$ 10.00	22.85192	-6.33812	40.17172	$ 10.37	$ 2.00	19.28640	-0.67483	0.455
$ 86.33	$ 30.00	34.75038	5.56034	30.91739	$ 12.88	$ 3.00	23.29193	3.33069	11.093
$ 15.06	$ 5.00	33.20053	4.01050	16.08407	Sum Total		419.18588 Sum		1576.184
$ 27.63	$ 6.00	21.71553	-7.47451	55.86829		Number		21 Number	
					Mean Tip % Average		19.9612324 Average		75.056
Sum Total		671.37082 Sum		20434.71256			Standard Deviation		8.663
	Number	23 Number		23					
Mean Tip % Average		29.19004 Average		888.46576					
		Standard Deviation		29.80714					

11/29/14							12/5/13				
Check Total	Tip		Tip %	(x-x̄)	(x-x̄)²		Check Total	Tip		Tip %	(x-x̄)	(x-x̄)²

Combined table:

11/29/14 Check Total	Tip	Tip %	(x-x̄)	(x-x̄)²		12/5/13 Check Total	Tip	Tip %	(x-x̄)	(x-x̄)²
$ 17.47	$ 3.00	17.17230	-7.82770	61.27296		$ 19.97	$ 5.00	25.03756	0.03756	0.00141
$ 43.30	$ 7.00	16.16628	-8.83372	78.03458		$ 18.33	$ 5.00	27.27769	2.27769	5.18786
$ 11.07	$ 10.00	90.33424	65.33424	4268.56248		$ 13.42	$ 4.00	29.80626	4.80626	23.10013
$ 80.14	$ 15.00	18.71724	-6.28276	39.47301		$ 26.31	$ 7.00	26.60585	1.60585	2.57876
$ 26.49	$ 3.51	13.25028	-11.74972	138.05585		$ 90.95	$ 20.00	21.99010	-3.00990	9.05947
$ 50.80	$ 7.20	14.17323	-10.82677	117.21898		$ 48.77	$ 7.00	14.35309	-10.64691	113.35678
$ 27.31	$ 6.00	21.96997	-3.03003	9.18106	12/7/13					
$ 26.48	$ 4.00	15.10574	-9.89426	97.89638		$ 73.92	$ 8.00	10.82251	-14.17749	201.00120
$ 32.77	$ 7.00	21.36100	-3.63900	13.24231		$ 38.89	$ 4.00	10.28542	-14.71458	216.51885
$ 26.11	$ 10.00	38.29950	13.29950	176.87676		$ 35.42	$ 8.00	22.58611	-2.41389	5.82687
$ 46.74	$ 8.00	17.11596	-7.88404	62.15808		$ 51.71	$ 11.00	21.27248	-3.72752	13.89440
12/1/13						$ 63.69	$ 8.00	12.56084	-12.43916	154.73266
$ 63.74	$ 8.00	12.55099	-12.44901	154.97789		$ 31.21	$ 6.00	19.22461	-5.77539	33.35516
$ 125.72	$ 20.00	15.90837	-9.09163	82.65778		$ 56.27	$ 10.00	17.77146	-7.22854	52.25180
$ 66.93	$ 20.00	29.88197	4.88197	23.83359		$ 58.73	$ 10.00	17.02707	-7.97293	63.56756
$ 42.33	$ 8.00	18.89913	-6.10087	37.22066		$ 27.39	$ 5.00	18.25484	-6.74516	45.49722
$ 33.38	$ 6.00	17.97484	-7.02516	49.35294		$ 56.40	$ 10.00	17.73050	-7.26950	52.84568
$ 28.45	$ 5.00	17.57469	-7.42531	55.13519		$ 18.85	$ 4.00	21.22016	-3.77984	14.28720
$ 21.84	$ 7.00	32.05128	7.05128	49.72058		$ 18.02	$ 6.98	38.73474	13.73474	188.64306
$ 71.17	$ 11.00	15.45595	-9.54405	91.08888		$ 26.53	$ -	0.00000	-25.00000	625.00000
$ 50.41	$ 14.59	28.94267	3.94267	15.54465		$ 30.09	$ 5.00	16.61682	-8.38318	70.27777
12/2/13						$ 56.41	$ 11.00	19.50009	-5.49991	30.24903
$ 48.67	$ 8.33	17.11527	-7.88473	62.16903	12/9/13					
$ 34.68	$ 5.32	15.34025	-9.65975	93.31070		$ 34.98	$ 3.00	8.57633	-16.42367	269.73696
$ 69.44	$ 20.00	28.80184	3.80184	14.45401		$ 34.68	$ 7.60	21.91465	-3.08535	9.51940
$ 51.13	$ 5.00	9.77899	-15.22101	231.67900		$ 17.63	$ 5.00	28.36075	3.36075	11.29463
$ 62.83	$ 9.17	14.59494	-10.40506	108.26530		$ 40.51	$ 7.00	17.27968	-7.72032	59.60328

Sum Total		558.53692	Sum	6131.38265		Sum Total		484.80960	Sum	2271.38713
	Number	25	Number	25			Number	25	Number	25
Mean Tip % Average		22.34148	Average	245.25531		Mean Tip % Average		19.39238	Average	90.85549
		Standard Deviation		15.66063				Standard Deviation		9.53181

Below is a chart that has the averages and standard deviations for each data set. Then the Z score was calculated

using the formula:

$$z = \frac{x - \bar{x}}{s}$$

Where x is an individual data value, $\bar{x}$ is the mean of x, and s is the standard deviation of x.

Solving for Z=-2 and Z=+2, I was able to calculate the highest and lowest numbers within 2 standard deviations

of the average, then if the numbers were above or below the Z score numbers, then they wouldn't turn green.

	Aimee			Maddie			Brittany	
Avg	21.76475	16.32407		29.19004	19.96123		22.34148	19.39238
Stdv	7.15868	6.15780		29.80714	8.66351		15.43333	7.70780
Z=-2	7.44739	4.00846		-30.42425	2.63421		-8.52518	3.97679
Z=+2	36.08212	28.63968		88.80432	37.28825		53.20813	34.80798
	9.79240	0.00000		6.26859	8.09748		9.77899	0.00000
	12.38390	8.74126		11.00837	8.95055		12.55099	8.57633
	13.87712	12.82599		15.10791	11.81335		13.25028	10.28542
	15.34919	13.30528		15.50187	15.22456		14.17323	10.82251
	15.38107	13.49346		16.07457	16.19958		14.59494	12.56084
	16.06684	13.67054		17.80627	16.31206		15.10574	14.35309
	16.12037	13.88118		17.80627	16.51119		15.34025	16.61682
	17.15266	15.30724		18.01338	17.69464		15.45595	17.02707
	18.01802	15.88310		18.02776	17.71793		15.90837	17.27968
	18.39588	17.11743		19.55307	18.24818		16.16628	17.73050
	18.40265	17.12329		19.74910	18.90359		17.11527	17.77146
	18.97983	17.49016		19.87008	19.28640		17.11596	18.25484
	19.97204	17.96945		20.17067	19.63351		17.17230	19.22461
	19.98668	18.46154		20.25573	19.97419		17.57469	19.50009
	21.72339	18.49454		20.54232	20.60440		17.97484	21.22016
	21.73390	18.79050		21.71553	21.22016		18.71724	21.27248
	22.02563	18.90359		22.85192	22.23705		18.89913	21.91465
	24.07681	19.02723		28.55103	22.29157		21.36100	21.99010
	24.08478	19.96406		33.20053	23.29193		21.96997	22.58611
	24.19605	21.21341		34.75038	34.34066		28.80184	25.03756
	24.93517	21.29472		44.12089	50.63291		28.94267	26.60585
	25.43235	21.90581		77.51938			29.88197	27.27769
	27.07581	36.91399					32.05128	28.36075
	32.72251						38.29950	29.80626
	34.30532						90.33424	38.73474
	34.87358							
	40.58442							

The points that aren't green should be rejected to prove for more accurate data in the averages.

Next I used the x^2 Test of Independence, to determine if there is statistical significance between writing

salutations and higher tipping percentages.

First thing I did was create an Observed frequency chart based on percentages grouped by a range of 5%.

Observed Values		
Percentages	*yes*	**no**
0>5	0	2
5>10	3	6
10>15	8	9
15>20	30	28
20>25	16	12
25>30	7	6
30>35	7	1
35>40	1	2
40>45	2	0
45>50	0	1
50+	3	0

However, according to x^2 Test of Independence, all frequencies must equal at least 5. So I regrouped my data.

Observed Values		
Percentages	*yes*	**no**
0>15	11	17
15>20	30	28
20>25	16	12
25>30	7	6
30>35	7	1
35-50+	6	3

I then utilized the x^2 Test of Independence

$$x^2_{Calc} = \sum \frac{(fo - fe)^2}{fe}$$

Observed Values				Expected Values			X² Test of Independence						
Percentages	yes	no			yes	no		Yfo	Yfe	y(fo-fe)²/fe	Nfo	Nfe	N(fo-fe)²/fe	X² Calc
0>15	11	17	28	0>15	14.97222	13.02778	0>5	0	14.97222	14.97222	2	13.02778	9.33481
15>20	30	28	58	15>20	31.01389	26.98611	15>20	30	31.01389	0.03315	28	26.98611	0.03809
20>25	16	12	28	20>25	14.97222	13.02778	20>25	16	14.97222	0.07055	12	13.02778	0.08108
25>30	7	6	13	25>30	5.95139	6.04861	25>30	7	6.95139	0.00034	6	6.04861	0.00039
30>35	7	1	8	30>35	4.27778	3.72222	30>35	7	4.27778	1.73232	1	3.72222	1.99088
35-50+	6	3	9	35>40	4.81250	4.18750	35>40	1	4.81250	3.02029	2	4.18750	1.14272
	77	67	144							19.82888			12.58798	32.41686

The final x^2 calculation is 32.41686 which I then calculated the degrees freedom, and with the assistance of a

x^2 Critical chart and received the values below.

A1 *Notation*

Degrees Freedom	X² Critical Value Versus X² Calculated Value	
(2-1)(11-1)=1X10=**10**	Calculated Value	32.417
	Critical Value(@.5%)	25.188 reject H₀

The Null hypothesis is: H_o = Tipping Percentages are independent of the presence of salutations.

Interpretation:

Overall there appeared to be a difference in tipping percentages at the time, with these servers, and at this restaurant. Likewise, statistically, writing salutations on checks is dependent of getting a higher tip percentage, to .5% significance. So it did support my theory that there is an increase in tip percentage when salutations are present on the check.

Validity:

The validity was strongly questioned throughout this project, because it is impossible to get consistent tippers over time. I combatted it as much as could, with multiple servers, days and a large amount of data collected. However, I found that there were points that were above and below two standard deviation s. If I had removed them from my data, then it might have made my project more accurate, but I completed all of frequency data before standard deviation.

E0

Conclusion:

As a result of my investigation, I decided that I will be writing thank you on my checks. In my project, the difference between the averages was 5.87286%, and ended up being statistically significant to .5%, which is very significant. Based on these findings I can prove that there is a positive effect when writing on checks. Maddie experienced much higher tips when writing salutations as opposed to Amiee and Brittany, which I thought was interesting because she does not typically write on her checks. However, neither does Brittany and Amiee was the only one who usually writes on the checks and yet she landed in the middle. Throughout the collection of data I spoke with various servers and guests. They had suggested that while not every guest may have noted the extra effort, the ones that did may have offset the averages.