Educational Outreach for Restaurant Sanitation and Food Safety

Is education effective and where to target educational efforts in Wake County

Megan Wright July 24, 2008

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EXECUTIVE SUMMARY

A critical part of public health is food sanitation. Restaurant inspections in North Carolina follow a grade card format with the following scores: A (90-102), B (80-89), C (70-79) and below 70 failing. Environmental Health Specialists inspect approximately 2,300 restaurants and food stands within Wake County to ensure sanitation standards are met.

Education is presumed to change behavior and thus mitigate violations. As a proactive approach to maintaining sanitation standards, Cooperative Extension plans to identify types of restaurants that would benefit from targeted education. Do "mom and pop" establishment score lower than corporate chains? Does a limited menu allow fast food restaurants to score higher than full service? Do ethnic restaurants score lower as a result of English comprehension problems? Do rural parts of the county score lower than urban areas? Is the current model of education, ServSafe effective? These answers will allow Cooperative Extension to create an effective way to provide supplemental education to the ServSafe course.

Contrary to our expectations, we found ServSafe participants actually perform generally worse on inspections. More specifically, we found independently owned restaurants serving ethnic cuisine also scored lower than other independently owned restaurants, suggesting a potential language barrier in understanding of regulations. Based on these results, I recommend the Cooperative Extension agency focus its outreach efforts on:

 Owners or operators with English as their second language
Maximizing the website to disseminate information and include positive publicity for establishments that consistently do well as an incentive
Offering training in the field to bring education to owners and operators who may not attend due to distance

The Environmental Services Division also can also as a resource for individuals regarding the new inspection rubric.

PURPOSE

This report compares restaurant sanitation scores across a multitude of subcategories in order to determine areas Cooperative Extension should focus their education. Cooperative Extension's primary mission is outreach and education. Capitalizing on this strength, there may be an opportunity for Cooperative Extension to assume the burden of on-site education and thereby free Environmental Health Specialists (EHS) to perform more routine inspections. The current backlog of inspections demands the inspectors to maximize their time by being more efficient. Decreasing on-site education will decrease the length of an inspection and help boost their productivity.

RESEARCH QUESTIONS

The primary questions are:

- 1. Do ServSafe participants have a higher raw sanitation score than nonparticipants?
- 2. Do corporate or franchise owned restaurants have a higher raw score than independently owned restaurants?
- 3. Does a particular area of the county exhibit lower scores than others? If so, why?
- 4. For independently owned restaurants, do language barriers prevent comprehension of regulations (measured by type of cuisine) affect the score?
- 5. Does size of a restaurant (measured by seating capacity) affect the score?
- 6. Do fast food restaurants (with a more limited or specific menu) score significantly better than full service restaurants?

BACKGROUND

For the purposes of this report the sanitation score received represents the measure of an establishment's sanitation. In July 2008 North Carolina's Department of Environment and Natural Resources (NC DENR) is implementing a new grading form. This form has new points assigned to violations and there is a greater emphasis on critical violations. Critical violations relate to the Center for Disease Control's 5 categories of risk factors, which contribute to food-borne illness if left uncontrolled. The CDC Risk factors are:

- 1. Approved Sources
- 2. Personal Hygiene
- 3. Cooking Temperatures
- 4. Holding Temperatures
- 5. Contamination

The current form assigns a maximum value of 35 points to critical violations and the new form increases that weight to a maximum of 58 points. Scores are expected to become a more accurate depiction of the sanitation of a restaurant under the new form because critical violations that were once lumped together as one violation are now broken out into multiple violations with more points attached.

Another proposed change for July 2009 will be to require ServSafe certification as part of the inspection rather than adding two additional bonus points to the base score, as is currently done. The new required course will be shorter than the current 18-hour classroom based training. The online version will not be accepted, but may be something NC DENR adopts to allow for flexibility. A citizen survey conducted by the Food Sanitation Section in January of 2008 showed mixed feelings about receiving points for educational credit. Citizens thought the padded scores did not give them a clear picture of what the restaurant's sanitation really was. However, changing the bonus points into required points starting next year will help establish clear expectations of the restaurant owners and allow for a level-grading field.

METHODOLOGY

Inspection data for restaurant and food stands in Wake County for 1999-2007 were provided through the County's Digital Health Department (DHD) software. Only sanitation inspections with open status codes were included in the analysis. This was done in order to look at the areas where education is currently needed and would be used if offered. Permits, visits and status changes were not included because grades are not recorded on these trips. Re-inspections were also not included. Although re-inspections result in a score they are requested by the restaurant owner, and must be completed within 15 days of the request. Because the restaurateur has a general knowledge of the re-inspection timeframe, there may be bias in re-inspection scores. As a result, these data were not included.

Inspection scores are available electronically from 1999 to 2008. Once exported into Excel, the data became a static set, unable to receive new uploaded data. Approximately 21,000 inspections were included in the analysis. In addition to the filtering of the inspections, any scores that were unreasonable (thought to be a typo) were excluded as well.

The data were exported from Microsoft Access to Microsoft Excel and then sorted in a variety of ways based on the research questions:

- Restaurant type (corporate or independent, full service or fast food, etc.)
- Territory (geographic location in the county)
- Risk categories (1=low risk 4=high risk)
- Within non-corporate restaurants ethnic cuisine vs. non-ethnic cuisine

Risk categories are based on the number of potentially hazardous foods an establishment prepares. These categories are outlined below.

Risk Type 1 – Prepare only non-potentially hazardous foods

Risk Type 2 – Cook and cool no more than 2 potentially hazardous foods Raw potentially hazardous ingredients received in a ready to cook form

- **Risk Type 3** Cook and cool no more than 3 potentially hazardous foods Unlimited amount of Raw potentially hazardous preparation
- Risk Type 4 Establishments serving highly susceptible populations and/or Establishments using specialized processes Unlimited number of cook and cool of potentially hazardous foods Unlimited amount of Raw potentially hazardous preparation

A raw score was calculated by subtracting the 2 additional bonus points awarded for completing the ServSafe educational course. Using a raw score gives a more accurate representation of the actual earned score and overall sanitation of the restaurant. It also allows for easier comparison of ServSafe participants and non-participants. Also, having sanitation education was assumed to help a restaurant's overall sanitation, which would have resulted in a higher raw score than their counterparts without the education course. Correcting for the two points shows whether the ServSafe course actually has an impact on the overall sanitation.

First the descriptive statistics were performed to get a general understanding of the data set. Then a t-test using unequal variances was performed to determine statistical significance of differences between scores. Finally the results were analyzed to gather conclusions about where and how best to direct educational efforts within the county. Next steps for analysis are included, depending on their feasibility and relevance.

FINDINGS AND ANALYSIS

Descriptive Statistics

The complete descriptive statistics are included in Appendix A. All scores reported are the calculated raw scores.

- Overall, the mean score for restaurants and food stands was a **93.28** with a median score of **94**. Scores ranged from **68.5** to **100**.
- Surprisingly, ServSafe participants had a mean of 92.04 while those that did not have ServSafe certification had a higher raw score mean by nearly 2 points (93.99). Factoring in the bonus points for ServSafe the restaurants would be essentially equal in scores, but the level of sanitation is best described by the raw score.
- The descriptive statistics confirmed the usage of risk categories as an appropriate tool. Risk 1 restaurants scored quite highly at **95.73** compared to Risk 4 restaurants with a score of **92.57**.
- Corporate and non-corporate restaurants and food stands scored very closely with a **93.32** and a **93.21** respectively.

	ServSafe	No ServSafe
Corporate	92.15	94.24
Non-Corporate	91.67	93.67

 Territory breakdowns showed consistent grading throughout the county, with only minor fluctuation from the mean.

Discussion of Descriptive Statistics

The most perplexing finding was the ServSafe participants' scores vs. the non-ServSafe participants' scores. At first glance it seemed counterintuitive the educational course would result in lower raw scores. Education in theory should improve awareness and help to change behavior related to violations, thereby raising scores. When explored further, the difference was originally thought to be a result of record keeping discrepancies. When the Sanitation Program started using the current Digital Health Department software they would record scores on hard copy paper forms and later transfer them into the computer system. Final scores were input into the DHD program and ServSafe bonus points were not distinguished. In an attempt to correct for the hidden bonus points, the statistics were run again for a more recent time period (2004-2008) and the results were similar to the larger dataset (mean of **92.69** for ServSafe and **94.42** for non-ServSafe).

Other possibilities for the lower ServSafe scores may be a result of a "built in cushion" mentality. Restaurant owners or managers may not enforce behavior changes in their staff because of the timesavings they receive for cutting corners. As a result they tradeoff the potential points lost in an inspection for the bonus points of the ServSafe course. A final possibility is rater bias, if an inspector knows a restaurant will receive the two bonus points, they may be more apt to take off full points where they otherwise would take half or take half points instead of making a general comment.

Another possibility could be the types of restaurants self-selecting for the ServSafe course are doing so because they need the help. Those taking ServSafe potentially could be low scorers to begin with and want the extra boost of the bonus points. Or it may be linked to their risk. The bulk of inspections for ServSafe participants were from higher risk categories. These restaurants prepare potentially hazardous foods and therefore are more likely to miss critical violations regarding those. Ensuring they know the rules and getting the bonus points are possible incentives for these higher risked restaurants.

	ServSafe	No ServSafe
Risk 1	.64%	99.36%
Risk 2	34.15%	65.85%
Risk 3	42.9%	57.1%
Risk 4	34.2%	65.8%

T-tests and Statistical Significance

All t-tests performed can be found in Appendix B with a brief description of what t-tests and their results mean. Each research question was applied to a t-test and the results are as follows. In this dataset, the bulk of inspections are within the range of 90-100,

meaning slight variations in scores actually are statistically significant. This was kept in mind when interpreting results because a small difference in reality may not be enough justification for additional educational resources to that specific type of restaurant.

	ServSafe	Non ServSafe
Mean	92.04083	93.99144
Observations	7867	13579

1. Do ServSafe participants have a higher raw score than non-participants?

No, ServSafe restaurants do not have a higher score. In fact, on average, they have lower scores. The difference is statistically significant, or in other words, too large to be attributed to chance and potential reasons for the score reversal were highlighted above. At first glance the educational course seems ineffective, but further discussion explores other explanations.

2. Do corporate or franchise owned restaurants have a higher raw score than independently owned restaurants?

	Corporate	Non Corporate
Mean	93.3132	93.20825
Observations	13824	7622

As expected, corporate and franchise restaurants score higher than non-corporate. This difference does not seem significant at first glance since corporate and franchise restaurants' mean score was a mere .11 higher than the non-corporate but the difference is statistically significant. However, I am less confident the difference is great enough to target education exclusively to non-corporate establishments. A more logical justification for extra educational efforts at non-corporate restaurants is that corporate and franchise establishments often have standard operating procedures and their own food safety courses. Therefore, targeting education at resource poor noncorporate establishments would be a more effective use of the staff resources.

Another example of corporate restaurant's access to resources is the fact that their staff is more likely to complete ServSafe (6,110 corporate establishments versus 1,757 non-corporate establishments) illustrating the commitment corporate establishments have made to food safety and/or the desire to achieve 2 bonus points.

3. Does a particular area of the county exhibit lower scores than others? Do rural or urban areas have any pattern of scoring? If no rural-urban pattern exists does rater bias have any impact on scores?

The territories that showed statistically significant p-values were territories 1, 3, 4, 8, 9, 10, 11. However, no rural-urban pattern of scores emerged from the data. Also, the differences in means, although statistically significant were all relatively close with a range of only 1.32 points. There is not a large enough difference in my

opinion to determine any types of rater bias or grade inflation since the means are very consistent across territories. Also, it is difficult to make conclusions regarding rater bias because over the time period, the inspectors assigned to specific territories have changed.

4. Does type of cuisine for independently owned restaurants affect the score? (Independently owned Asian, Mexican and Indian restaurants were examined because they were the most prevalent ethnic cuisines in the county).



* Scale begins at 91 in order to show detail

	Ethnic	Non Ethnic
Mean	92.081661	93.55567
Observations	2143	4900

	Asian	Non Ethnic
Mean	91.80406	93.55567
Observations	1378	4900

	Mexican	Non Ethnic
Mean	92.654472	93.55567
Observations	615	4900

	Indian	Non Ethnic
Mean	92.25667	93.55567
Observations	150	4900

The p-values are all statistically significant meaning ethnic restaurants have a statistically significant lower score than other non-corporate restaurants. These statistics are aligned with the anecdotal evidence I have heard of cultural differences associated with food preparation and overall sanitation. Also, language barriers may account for the lack of understanding of the state's regulations.

5. Does size of a restaurant affect (measured by seating capacity) a score?

	Small	Large
Mean	93.46147924	92.88451725
Observations	14548	6898

Small restaurants were defined by a seating capacity of 50 or less, and large restaurants were defined by a seating capacity greater than 50. Assumptions based on size could favor either large or small establishments. For example, larger restaurants may score lower than smaller restaurants because they have more to keep clean and a

high volume of food to prepare and handle. Conversely, smaller restaurants may be more likely to be independently owned and have their own way of doing things, which are not within the set standards. Small restaurants' mean score was higher and confirmed a statistically significant difference in sanitation from larger restaurants.

	Fast Food	Full Service
Mean	93.13782	90.59827
Observations	5928	1213

6. Do fast food restaurants (with a more limited or specific menu) score statistically significantly better than full service restaurants?

Fast food restaurants score higher than full service, as expected. Only corporate fast food and full service restaurants were compared to see if a limited menu contributed to a higher score. Another factor for consideration is the fast food restaurants include lower risked establishments and could contribute to higher scores.

General Discussion

The "two point safety net" phase out next year into mandatory managerial training courses is an important move for the State. Integrating an educational requirement for food service establishments will provide a more level approach to the current grade card system. Setting a clear basis for expectations regarding food safety and sanitation is critical for public health. Required education will provide managers and owners the information necessary to keep their establishments in compliance and their customers healthy. Currently ServSafe does not provide an equal foundation, because restaurants opt in to take the course. The incentive of two bonus points may be the only reason some people take the course; others may truly need help on food safety. The oversight the county currently provides does not allow much time for on site training and the movement to a required educational course will hopefully help to eliminate some of the need for on site training. Having sat in on the ServSafe course, I personally think it is a valuable tool for restaurant operators. The presentation of material is relevant and done by actual health inspectors allowing them to cue people in to what they look for and what violations they see most often. Transferring the information learned from the course is the largest challenge but the current format is very engaging and practical.

RECOMMENDATIONS FOR EDUCATION

Ideas for the Cooperative Extension's Educational Efforts

1. *Work to overcome language barriers*– The ServSafe books in Spanish and Chinese are a start, but there is a real need to work with ethnic restaurant owners to help them understand the regulations. Pictographs may be useful for disseminating some information.

Other supplemental information would be useful not just for English as a second language owners and operators. For repeat violators certain reminders could help

change behaviors and eliminate some risks. Many informational items already exist, as I found out from the ServSafe course. Initially hand out during inspections and eventually transition to a posted pdf on the website. It could be something as simple as the "ABC's of food safety" or a type of pneumonic device.

- 2. *Hands-on Education* Any way to make the ServSafe course more interactive may be worth exploring. The course is extremely informative but in a classroom setting with a lecturer presenting there inevitably may be some attention problems. The hand washing activity was interactive and from my observations really engaged people, making them realize their habits are probably not as healthy as they should be.
- 3. Leverage existing resources NC-DENR has useful information that can be formatted in a less technical manner to be more appropriate for public distribution. They do have some materials (tools, exercises and templates) that are appropriate as are and minor changes to some others could speed up the start of the educational efforts. Specifically, a formal Risk Control Plan may be a useful way to monitor and educate consistently poor performing restaurants. One way to use the tool would be to require the bottom 5% of establishments to have one (approximately 91 restaurants and 26 food stands). This would allow for the repeated violations to be targeted and an action plan written with the owner or manager for the establishment. The action plan would be no question over the expectations and requirements.
- 4. Maximizing the website Links on the website for restaurant owners or management to already existing resources could provide further guidance for them. Links for consumers cooking at home are numerous through the FDA, the Partnership for Food Safety Education. Putting the information in an easily accessible place close to the online grades may spark people's interest even if they were going to the page just for the grade.
- 5. Offer training opportunities besides ServSafe in the field Targeting specific areas of the county by holding workshops or one on one voluntary training with an individual owner. If an owner has the option of having someone come to their restaurant for a non-inspection training session they can learn the safety and techniques necessary for their specific kitchen. The downside to this approach is the time it requires. However, if the inspectors could schedule a weekday morning to hold a 2 hour workshop in their territory every other month it could build rapport with the restaurant owners and help them to see what is needed to keep their restaurant clean and customers safe. Meeting in a restaurant that scores well often would be a chance to show how things should be done or conversely meeting in a low scoring one could give opportunities to show by correcting behavior.

6. *Food Facility Award of Excellence* – Some type of recognition or award. This could be as simple as the top 10 restaurant scores of the week, or the top restaurants, which have maintained above a 95 for the past 3 inspections. Placed on the web where the inspections are electronically accessed would be helpful for everyone who does care to check them out to hear of new, clean places to try. Another option would be to have a top 10 list by area, for people to pick places close to where they live that score well. It would provide incentive for restaurant owners to work towards achieving their name on the list and give the restaurants that consistently score well good publicity.

CONCLUSION AND NEXT STEPS

The statistics from this analysis uncovered some interesting issues. The most pressing issue for the Cooperative Extension is how to make the information learned during ServSafe translate into a change in behavior in the kitchen. Transferring knowledge to employees is a crucial aspect and one that the county relies on the course participants to do. If the education is not producing the desired effect, perhaps the model of delivery or additional efforts should be explored. The course from my observations has been extremely informative, but if there is a way to have the participants go into a kitchen and actually put these food safety techniques into practice it may prove to be valuable.

I propose the following steps to provide the Cooperative Extension with a more comprehensive understanding of educational needs and opportunities.

- 1. Analysis of the most common critical violations. Using the same types of criteria for comparison: type of restaurant, geographic location, and size. Knowing only the scores does not give enough detail to see what areas need the most focus.
 - *Purpose:* As the new form rolls out in July, several issues could arise. Breaking down the critical violations will allow for more specific deductions and more weight is placed on critical deductions. On the current form a maximum of 35 points can be deducted for critical violations, those same critical violations now max out at 58 points on the new form. While a heavier emphasis on specific critical violations is important, it is likely this will result in lower scores. Lower scores for establishments who are used to scoring well will likely result in more requests for re-inspections and thus increase the workload for the inspectors.
- 2. Create supplemental educational information for those who have participated in ServSafe but continue to receive repeat violations.
 - *Purpose:* This will be important as the new form comes online because reminding ServSafe participants of the regulations. Since the new form has more weight on the critical violations, the scores will suffer if they do not change behavior and reminders can be useful.

- 3. In a separate yet related area, efficiency of inspections is a pressing issue currently. Using a work distribution analysis as well as plotting job travel to create a more efficient use of inspectors will help increase the number of inspections performed and help the county to remain in compliance with the state requirements.
 - *Purpose*: If education can mitigate repeat violations, the inspectors will have fewer re-inspections to perform. Also, the time spent on inspections may decrease as establishments maintain compliance. With fuel costs rising and time constraints matched with the backlog of inspections needed the more efficient the inspectors can be in the field, the quicker the county will get within the rate of inspections the state requires.

Appendix A: Descriptive Statistics

All Inspections

Mean	93.2759
Standard Error	0.026028
Median	94
Mode	95
Standard Deviation	3.811631
Sample Variance	14.52853
Kurtosis	3.308678
Skewness	-1.25542
Range	31.5
Minimum	68.5
Maximum	100
Sum	2000395
Count	21446

Serv Safe

Mean	92.04083
Standard Error	0.039419
Median	92.5
Mode	93
Standard Deviation	3.496321
Sample Variance	12.22426
Kurtosis	4.122579
Skewness	-1.35968
Range	31.5
Minimum	68.5
Maximum	100
Sum	724085.2
Count	7867

ALL Corporate

No Serv Safe

Mean	93.99144
Standard Error	0.032642
Median	94.5
Mode	95
Standard Deviation	3.803769
Sample Variance	14.46866
Kurtosis	3.876121
Skewness	-1.45799
Range	30
Minimum	70
Maximum	100
Sum	1276310
Count	13579

ALL Non Corporate

Mean	93.20825
Standard Error	0.045631
Median	94
Mode	95
Standard Deviation	3.983749
Sample Variance	15.87026
Kurtosis	3.381867
Skewness	-1.3438
Range	31.5
Minimum	68.5
Maximum	100
Sum	710433.3
Count	7622

Corporate with Serv Safe

92.14848
0.043873
92.5
93
3.429396
11.76076
4.026898
-1.31792
31.5
68.5
100
563027.2
6110

Corporate without Serv Safe

94.23574
0.041781
95
95
3.669592
13.46591
3.939712
-1.43931
30
70
100
726934.5
7714

Restaurant Types

Fast Food, Cafes and Delis

Mean	93.13782
Standard Error	0.048387
Median	93.5
Mode	93
Standard Deviation	3.725511
Sample Variance	13.87943
Kurtosis	3.34295
Skewness	-1.19813
Range	33.5
Minimum	68.5
Maximum	102
Sum	552121
Count	5928

Non Corporate with Serv Safe

Mean	91.66648
Standard Error	0.088184
Median	92.5
Mode	93
Standard Deviation	3.696375
Sample Variance	13.66319
Kurtosis	4.207229
Skewness	-1.4512
Range	30.5
Minimum	68.5
Maximum	99
Sum	161058
Count	1757

Non Corporate without Serv Safe

Mean	93.67013
Standard Error	0.051587
Median	94.5
Mode	95
Standard Deviation	3.950732
Sample Variance	15.60829
Kurtosis	3.725753
Skewness	-1.46272
Range	30
Minimum	70
Maximum	100
Sum	549375.3
Count	5865

Non Corporate

Mean	93.10723
Standard Error	0.047869
Median	93.5
Mode	95
Standard Deviation	4.017564
Sample Variance	16.14082
Kurtosis	3.340508
Skewness	-1.34108
Range	32.5
Minimum	68.5
Maximum	101
Sum	655847.3
Count	7044

Corporate/Franchised Full Service	
Mean	90.59827
Standard Error	0.113936
Median	91
Mode	91.5
Standard Deviation	3.968172
Sample Variance	15.74639
Kurtosis	4.045988
Skewness	-1.37588
Range	31.5
Minimum	68.5
Maximum	100
Sum	109895.7
Count	1213

Corporate Foodstands (Grocery Stores)

Mean	94.80042
Standard Error	0.052647
Median	95
Mode	95
Standard Deviation	2.940205
Sample Variance	8.644807
Kurtosis	2.380122
Skewness	-0.90839
Range	30.5
Minimum	71
Maximum	101.5
Sum	295682.5
Count	3119

Corporate Cafeterias/Snack Bars

93.6291
0.078839
94
94
3.175159
10.08163
2.04111
-0.92782
26.5
75.5
102
151866.4
1622

Gas Stations

Mean	92.65094
Standard Error	0.115074
Median	93
Mode	90
Standard Deviation	4.104125
Sample Variance	16.84384
Kurtosis	2.151702
Skewness	-1.09576
Range	30
Minimum	70
Maximum	100
Sum	117852
Count	1272

Corporate Foodstands (Grocery Stores)

Mean	94.2377
Standard Error	0.33948
Median	94.5
Mode	97
Standard Deviation	2.651425
Sample Variance	7.030055
Kurtosis	1.147897
Skewness	-0.80727
Range	13.5
Minimum	85.5
Maximum	99
Sum	5748.5
Count	61

Non Corporate Cafeterias/Snack Bars

Mean	94.19639
Standard Error	0.155751
Median	95
Mode	95
Standard Deviation	3.380194
Sample Variance	11.42571
Kurtosis	3.300319
Skewness	-1.19957
Range	24
Minimum	76
Maximum	100
Sum	44366.5
Count	471

Note: These territories are no longer the same. Now there are 14 territories in anticipation of the addition of 3 new EHS positions.

Territory 1: Eastern Wa	ake including	
Wendell, Zebulon and	parts of Garner	
Mean	02 06226	
Standard Error	92.90330	
Standard Error	0.093429	
Median	93.5	
Mode	94	
Standard Deviation	3.71724	
Sample Variance	13.81787	
Kurtosis	2.792869	
Skewness	-1.26065	
Range	27	
Minimum	73	
Maximum	100	
Sum	147161	
Count	1583	
Territory 3: South Wak	e including Garner	
Moon		
Standard Error	94.1001	
Stanuaru Error Madian	0.000430	
Meda	94.5	
NOUE Standard Deviation	90	
Standard Deviation	3.431128	
Sample variance	11.77264	
Kurtosis	2.341296	
Skewness	-0.94233	
Range	29.5	
Minimum	70.5	
Maximum	100	
Sum	148299	
Count	. 1575	
Inspector: Vacant	'	
Mean	93 20616	
Standard Error	0 085994	
Median	94	
Mode	95	
Standard Deviation	4 15716	
Sample Variance	17 28108	
Sample vanance	2 677615	
Skownooc	1 46965	
Dongo	-1.40000	
Minimum	29	
Movimum	1 1	
Count	Z1/0ZZ.Ŏ	
COULIE	2337	

Territory 2: South West Wake including				
Fuquay				
Inspector: Laura Lerch				
Mean	93.26168			
Standard Error	0.08178			
Median	94			
Mode	95			
Standard Deviation	3.858406			
Sample Variance	14.8873			
Kurtosis	3.364404			
Skewness	-1.36599			
Range	29.5			
Minimum	70.5			
Maximum	100			
Sum	207600.5			
Count	2226			
Territory 4: Apex				
Inspector: David Adcock				
Mean	94.01164			
Standard Error	0.080641			
Median	94.5			
Mode	95.5			
Standard Deviation	3.442171			
Sample Variance	11.84854			
Kurtosis	3.166283			
Skewness	-1.13541			
Range	29			
Minimum	71			
Maximum	100			
Sum	171289.2			
Count	1822			
Territory 6: Cary and Hills	borough Street			
Inspector: Angela Myers	~~~~~			
Mean	93.2885			
Standard Error	0.090242			
Median	94			
Mode	95			
Standard Deviation	4.061875			
Sample Variance	16.49883			
Kurtosis	3.133222			
Skewness	-1.2889			
Range	29.5			
Minimum	70.5			
Maximum	100			
Sum	189002.5			
Count	2026			

Territory 7: Morrisville, RDU Airport, Brier Creek

Inspector: James Smith	
Mean	93.25939
Standard Error	0.096231
Median	94
Mode	95
Standard Deviation	4.034831
Sample Variance	16.27986
Kurtosis	3.862341
Skewness	-1.45971
Range	29
Minimum	71
Maximum	100
Sum	163950
Count	1758

Territory 9: Raleigh: North Hills, Six Forks, Falls of the Neuse Inspector: Brian Johnson

Mean	93.03766
Standard Error	0.080248
Median	93.5
Mode	95
Standard Deviation	3.508962
Sample Variance	12.31281
Kurtosis	2.732081
Skewness	-1.12457
Range	29.5
Minimum	70.5
Maximum	100
Sum	177888
Count 1912	
Territory 11: North Wal	ke Roseville, Part
of Wake Forest	
Moon	
Nearl Standard Error	92.64016
Standard Error	0.102783
Median	93.5
Mode	90
Standard Deviation	4.157301
Sample Variance	17.28315
Kurtosis	3.683868
Skewness	-1.37369
Range	31.5
Minimum	68.5
Maximum	100
Sum	151886.5
Count	1636

Territory 8: Raleigh: Glenwood Avenue, Creedmoor Rd

Inspector: Ashley Whittington			
Mean	93.10674		
Standard Error	0.065481		
Median	93.5		
Mode	94		
Standard Deviation	3.365746		
Sample Variance	11.32825		
Kurtosis	2.389546		
Skewness	-0.87624		
Range	31.5		
Minimum	68.5		
Maximum	100		
Sum	245988		
Count	2642		

Territory 10: Raleigh: Capital Boulevard and Wake Forest Inspector: Chris Askew

Mean	93.05728
Standard Error	0.088937
Median	93
Mode	93
Standard Deviation	3.906149
Sample Variance	15.258
Kurtosis	2.550634
Skewness	-1.02844
Range	31.5
Minimum	68.5
Maximum	100
Sum	179507.5
Count	1929

Appendix B: T-tests

T-tests are a valuable tool for hypothesis testing with samples. The research questions formulated for this statistical analysis can be re-written into null hypotheses and accepted or rejected. Our null hypotheses assume the differing characteristics of our food establishments do not affect their scores and therefore should be equal to their compared score. The alternate hypothesis for all of our research questions is the differences do affect the scores. Once the t-test is run a p-value results giving a probability the difference is attributable to chance. If the probability is very small less than 10%, 5% or 1% then the test is statistically significant. A probability of 10% is clearly different than one of 1% so a confidence level corresponds to the significance. A p-value of .10 means you are 90% confident the results are not occurring due to random chance while a p-value of less than .01 means you are 99% confident the results are not occurring due to random chance. A final important note: the statistical significance of tests does not imply causation; the analysis reflects the observations made in the field and an attempt to make logical conclusions from the results.

	ServSafe	No ServSafe
Mean	92.04083	93.99144
Variance	12.22426	14.46866
Observations	7867	13579
Hypothesized Mean Difference	0	
df	17567	
t Stat	-38.1129	
P(T<=t) one-tail	9.4E-306***	
t Critical one-tail	1.644939	
P(T<=t) two-tail	1.9E-305	
t Critical two-tail	1.960098	

Serv Safe v. No Serv Safe

Risk 1 vs. Risk 4

	Risk 1	Risk 2
Mean	95.73397	92.57105
Variance	14.48845	15.49577
Observations	156	5607
Hypothesized Mean Difference	0	
df	164	
t Stat	10.22757	
P(T<=t) one-tail	1.33E-19***	
t Critical one-tail	1.654198	
P(T<=t) two-tail	2.66E-19	
t Critical two-tail	1.974536	

¹ *** p < .01, ** p < .05, * p < .10

Corporate Raw Scores vs. Non Corporate Raw Scores

	Corporate	Non Corp
Mean	93.3132	93.20825
Variance	13.78593	15.87026
Observations	13824	7622
Hypothesized Mean Difference	0	
df	14798	
t Stat	1.891235	
P(T<=t) one-tail	0.029306**	
t Critical one-tail	1.644958	
P(T<=t) two-tail	0.058612	
t Critical two-tail	1.960125	

Corporate with Serv Safe vs. Non Corporate with Serv Safe

	Corp with SS	Non Corp with SS
Mean	92.14848	91.66648
Variance	11.76076	13.66319
Observations	6110	1757
Hypothesized Mean Difference	0	
df	2686	
t Stat	4.893659	
P(T<=t) one-tail	5.24E-07***	
t Critical one-tail	1.645421	
P(T<=t) two-tail	1.05E-06	
t Critical two-tail	1.960848	

Corporate with Serv Safe vs. Corporate without Serv Safe

	Corp with SS	Corp without SS
Mean	92.14848	94.23574
Variance	11.76076	13.46591
Observations	6110	7714
Hypothesized Mean Difference	0	
df	13451	
t Stat	-34.4521	
P(T<=t) one-tail	1.2E-249***	
t Critical one-tail	1.644967	
P(T<=t) two-tail	2.4E-249	
t Critical two-tail	1.960138	

Non Corporate with Safe Serv vs. Non Corporate without Serv Safe

		Non Corp without
	Non Corp with SS	SS
Mean	91.66648	93.67013
Variance	13.66319	15.60829
Observations	1757	5865

Hypothesized Mean Difference	0	
df	3056	
t Stat	-19.6119	
P(T<=t) one-tail	4.62E-81***	
t Critical one-tail	1.645353	
P(T<=t) two-tail	9.25E-81	
t Critical two-tail	1.960739	

Corporate without Serv Safe vs. Non Corporate without Serv Safe

	Corp NO SS	Non Corp NO SS
Mean	94.23574	93.67013
Variance	13.46591	15.60829
Observations	7714	5865
Hypothesized Mean Difference	0	
df	12116	
t Stat	8.520244	
P(T<=t) one-tail	8.9E-18***	
t Critical one-tail	1.64498	
P(T<=t) two-tail	1.78E-17	
t Critical two-tail	1.960161	
Fast Food vs. Full Service (all corporate)		

	Fast Food	Full Service
Mean	93.13782	90.59827
Variance	13.87943	15.74639
Observations	5928	1213
Hypothesized Mean Difference	0	
df	1677	
t Stat	20.51585	
P(T<=t) one-tail	6.18E-84	
t Critical one-tail	1.645762	
P(T<=t) two-tail	1.24E-83	
t Critical two-tail	1.96138	

Ethnic Non Corporate vs. Non-Ethnic Non Corporate

	Ethnic	Non Ethnic
Mean	92.08166	93.55567
Variance	19.51993	14.01154
Observations	2143	4900
Hypothesized Mean Difference	0	
df	3545	
t Stat	-13.4736	
P(T<=t) one-tail	1.08E-40***	
t Critical one-tail	1.645285	
P(T<=t) two-tail	2.16E-40	
t Critical two-tail	1.960634	

Asian Non Corporate vs. Non-Ethnic Non Corporate

	Asian	Non Ethnic
Mean	91.80406	93.55567
Variance	20.11808	14.01154
Observations	1378	4900
Hypothesized Mean Difference	0	
df	1948	
t Stat	-13.2564	
P(T<=t) one-tail	9.09E-39***	
t Critical one-tail	1.645635	
P(T<=t) two-tail	1.81E-38	
t Critical two-tail	1.961184	

Mexican Non Corporate vs. Non-Ethnic Non Corporate

	Mexican	Non Ethnic
Mean	92.65447	93.55567
Variance	17.72772	14.01154
Observations	615	4900
Hypothesized Mean Difference	0	
df	741	
t Stat	-5.06284	
P(T<=t) one-tail	2.60E-07***	
t Critical one-tail	1.646913	
P(T<=t) two-tail	5.21E-07	
t Critical two-tail	1.963171	

Indian Non Corporate vs. Non-Ethnic Non Corporate

	Indian	Non Ethnic
Mean	92.25666	93.55567
Variance	19.27763982	14.01154
Observations	150	4900
Hypothesized Mean Difference	0	
df	156	
t Stat	-3.58386	
P(T<=t) one-tail	0.000226***	
t Critical one-tail	1.654680	
P(T<=t) two-tail	0.000452	
t Critical two-tail	1.975286	

ServSafe in Risk 2 Establishments

	No SS Risk 2	SS Risk 2
Mean	94.44121656	92.70153
Variance	13.13083158	10.71638
Observations	5869	3134
Hypothesized Mean Difference	0	
df	6979	

t Stat	23.13068694
P(T<=t) one-tail	2.0417E-114
t Critical one-tail	1.645071279
P(T<=t) two-tail	4.0835E-114
t Critical two-tail	1.960302143

ServSafe in Risk 3 Establishments

	No SS Risk 3	SS Risk 3
Mean	94.14967658	91.53868
Variance	13.10356162	13.17891
Observations	3865	2857
Hypothesized Mean Difference	0	
df	6144	
t Stat	29.186093	
P(T<=t) one-tail	8.704E-176	
t Critical one-tail	1.645103112	
P(T<=t) two-tail	1.7408E-175	
t Critical two-tail	1.960352165	

ServSafe in Risk 4 Establishments

	No SS Risk 4	SS Risk 4
Mean	93.03680217	91.70192
Variance	16.64557936	12.08032
Observations	3690	1875
Hypothesized Mean Difference	0	
df	4337	
t Stat	12.75439557	
P(T<=t) one-tail	6.64691E-37	
t Critical one-tail	1.64520543	
P(T<=t) two-tail	1.32938E-36	
t Critical two-tail	1.960511327	

Territory 1 vs. All

	Territory 1	All raw score
Mean	92.96336	93.2759
Variance	13.81787	14.52853
Observations	1583	21446
Hypothesized Mean Difference	0	
df	1836	
t Stat	-3.22253	
P(T<=t) one-tail	0.000646***	
t Critical one-tail	1.645685	
P(T<=t) two-tail	0.001293	
t Critical two-tail	1.961257	

Territory 2 vs. All

	Territory 2	All raw score
Mean	93.26168	93.2759
Variance	14.8873	14.52853
Observations	2226	21446
Hypothesized Mean Difference	0	
df	2696	
t Stat	-0.16572	
P(T<=t) one-tail	0.434196	
t Critical one-tail	1.645419	
P(T<=t) two-tail	0.868392	
t Critical two-tail	1.960843	

Territory 3 vs. All

	Territory 3	All raw score
Mean	94.1581	93.2759
Variance	11.77264	14.52853
Observations	1575	21446
Hypothesized Mean Difference	0	
df	1871	
t Stat	9.770748	
P(T<=t) one-tail	2.5E-22***	
t Critical one-tail	1.645667	
P(T<=t) two-tail	5E-22	
t Critical two-tail	1.961234	

Territory 4 vs. All

	Territory 4	All raw score
Mean	94.01164	93.2759
Variance	11.84854	14.52853
Observations	1822	21446
Hypothesized Mean Difference	0	
df	2218	
t Stat	8.682473	
P(T<=t) one-tail	3.68E-18***	
t Critical one-tail	1.64554	
P(T<=t) two-tail	7.37E-18	
t Critical two-tail	1.961034	

Territory 5 vs. All

	Territory 5	All raw score
Mean	93.20616	93.2759
Variance	17.28198	14.52853
Observations	2337	21446
Hypothesized Mean Difference	0	
df	2781	

t Stat	-0.77622
P(T<=t) one-tail	0.218843
t Critical one-tail	1.645401
P(T<=t) two-tail	0.437686
t Critical two-tail	1.960816

Territory 6 vs. All

	Territory 6	All raw score
Mean	93.2885	93.2759
Variance	16.49883	14.52853
Observations	2026	21446
Hypothesized Mean Difference	0	
df	2374	
t Stat	0.134127	
P(T<=t) one-tail	0.446657	
t Critical one-tail	1.645496	
P(T<=t) two-tail	0.893313	
t Critical two-tail	1.960962	

Territory 7 vs. All

	Territory 7	All raw score
Mean	93.25939	93.2759
Variance	16.27986	14.52853
Observations	1758	21446
Hypothesized Mean Difference	0	
df	2023	
t Stat	-0.16568	
P(T<=t) one-tail	0.434212	
t Critical one-tail	1.645608	
P(T<=t) two-tail	0.868424	
t Critical two-tail	1.961139	

Territory 8 vs. All

	Territory 8	All raw score
Mean	93.10674	93.2759
Variance	11.32825	14.52853
Observations	2642	21446
Hypothesized Mean Difference	0	
df	3531	
t Stat	-2.40072	
P(T<=t) one-tail	0.008207***	
t Critical one-tail	1.645285	
P(T<=t) two-tail	0.016414	
t Critical two-tail	1.960634	

Territory 9 vs. All

	Territory 9	All raw score
Mean	93.03766	93.2759
Variance	12.31281	14.52853
Observations	1912	21446
Hypothesized Mean Difference	0	
df	2332	
t Stat	-2.82403	
P(T<=t) one-tail	0.002391***	
t Critical one-tail	1.645508	
P(T<=t) two-tail	0.004783	
t Critical two-tail	1.96098	

Territory 10 vs. All

	Territory 10	All raw score
Mean	93.05728	93.2759
Variance	15.258	14.52853
Observations	1929	21446
Hypothesized Mean Difference	0	
df	2271	
t Stat	-2.35918	
P(T<=t) one-tail	0.0092***	
t Critical one-tail	1.645526	
P(T<=t) two-tail	0.0184	
t Critical two-tail	1.961007	

Territory 11 vs. All

t-Test: Two-Sample Assuming Unequal Variances

	Territory 11	All raw score
Mean	92.84016	93.2759
Variance	17.28315	14.52853
Observations	1636	21446
Hypothesized Mean Difference	0	
df	1851	
t Stat	-4.10974	
P(T<=t) one-tail	2.07E-05***	
t Critical one-tail	1.645676	
P(T<=t) two-tail	4.13E-05	
t Critical two-tail	1.961248	