

NYC Travel Guide – Visitor Information Volume 1A: Restaurant sanitation

By: PJ Hardas and Hyera Moon



When it comes to exploring restaurants, travelers will notice on the windows of restaurants in New York City the giant ‘A’, ‘B’ or ‘C’ letters. Their initial guess may be that these letters are related to the sanitary conditions and food safety of the restaurants. Correct! However, it is very important to fully understand how these grades work and what they truly mean. This volume in the NYC travel guide will cover sanitary inspections for restaurants based on a dataset that is publically available and provided by the Department of Health and Mental Hygiene (DOHMH). An additional zip code boundaries dataset from NYC Open Data source has also been used for the restaurants grades map by zip code areas. All details of the datasets are disclosed in Appendix A.



Background 101

The NYC Department of Health and Mental Hygiene (DOH) inspects about 24,000 restaurants every year to monitor compliance with City and State food safety regulations. Since July 2010, the DOH has required restaurants to post letter grades showing sanitary inspection results. Restaurants with a score between 0 and 13 points receive an ‘A’, those with 14 to 27 points a ‘B’ and those with 28 and more a ‘C’.

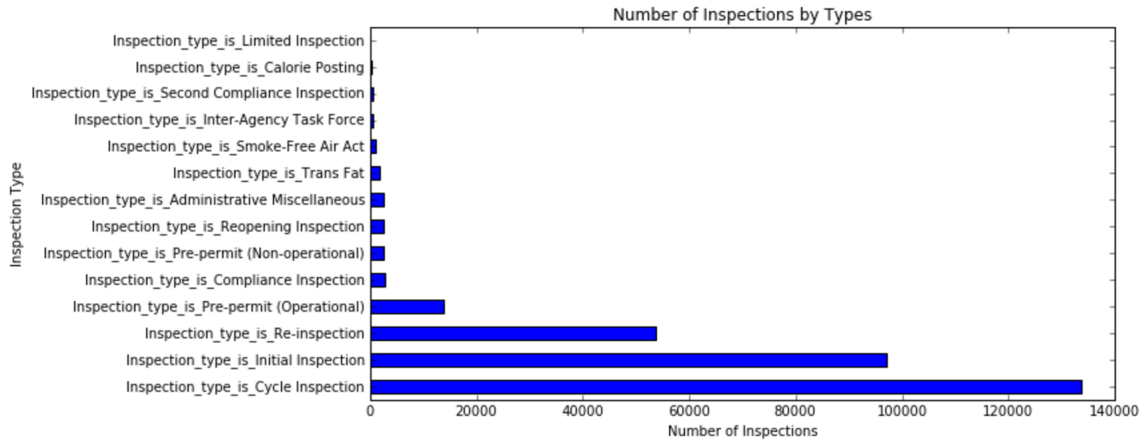
The DOH inspectors conduct unannounced visits to each restaurant at least once a year, and check for food safety factors such as food handling, food temperature, personal hygiene, facility and equipment maintenance, and vermin control. More information regarding scoring/grading and inspections in general can be found in Appendix B.



A to Z of Inspections

Just as there are numerous tests a doctor performs during a medical check-up, there are various kinds of inspections with corresponding checklists to determine the condition of a restaurant as well as its food. Given that restaurants have inspection cycles that consist of a series of related inspections by the DOHMH for general evaluations, it is no surprise that cycle inspections are the most common inspection type, followed by initial inspections and re-inspections.

**“Cycle inspections
are the most
common
inspection type”**

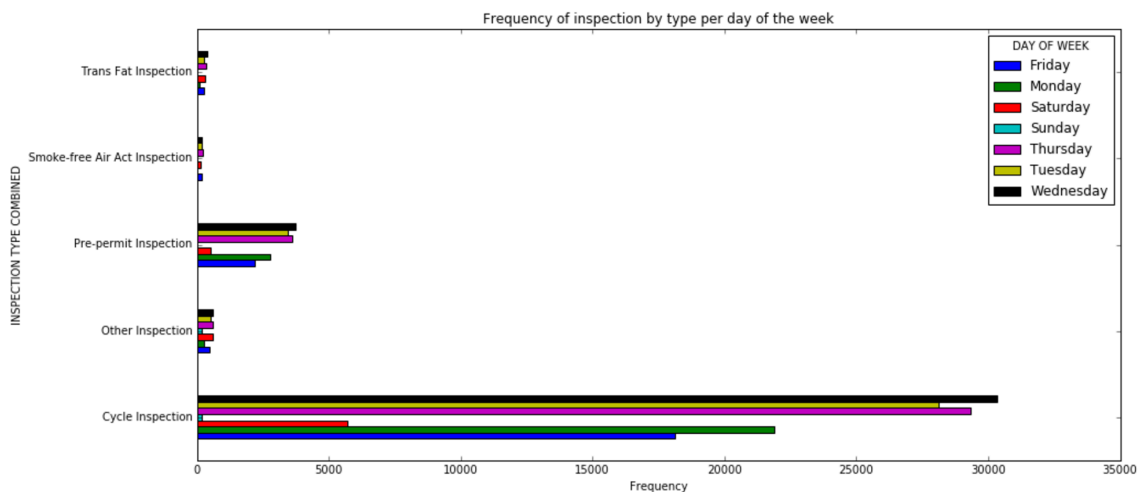


Since inspections can be split up into various main types and subtypes, further categorization of the main types revealed that Cycle inspections are indeed the most frequent inspections overall. They are also the most common on each day of the week, and for all seasons.

“Wednesdays and Thursdays are the most common days for most types of inspections”

Any tourists interested in witnessing live inspections should know that Wednesdays and Thursdays are the most common days for most types of inspections, whereas weekends are generally less eventful. Sunday inspections are either nonexistent in the dataset or extremely rare for Trans fat and Smoke-free Air Act inspections. Cycle inspections and Pre-permit

inspections are also very rare on Sundays and infrequent on Saturdays. So, restaurant owners should consider themselves lucky (or unlucky!) in the event of a weekend inspection.



Inspection data from February 2010 to April 2016

If the purpose of all of the inspections above is to evaluate a restaurant, then the outcome of each inspection must be some kind of grade. However, this is not the case; for example, the majority of grades for initial inspections are missing, while an ‘A’ is the

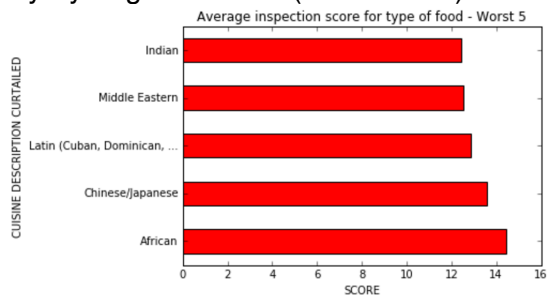
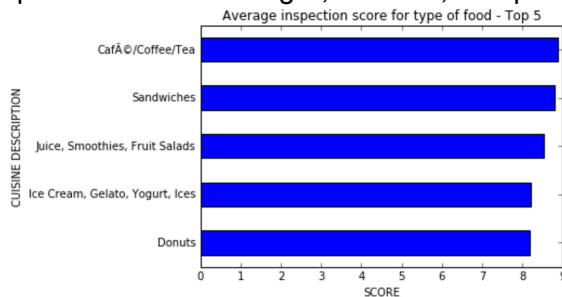
second most frequent. Only two types of inspections result in a letter grade: initial inspections for which the restaurant earns an 'A' and re-inspections that result in an 'A', 'B' or 'C'. This means that restaurants that do not earn an 'A' at initial inspection have no grade. Is it not possible that establishments could simply perform poorly for months or years, endangering customers – all of whom are unaware since grading for the inspections is not recorded – until a re-inspection concludes with a passable grade? Not entirely! While restaurants can receive abysmal scores without having published grades, the DOHMH can close the establishment if it continues to perform poorly and is a public health concern. Furthermore, non-graded inspections may still have a published score accessible to the public, which can increase awareness of potential violations and general health concerns.

“...the majority of grades for initial inspections are missing... Restaurants that do not earn an A at initial inspection have no grade”



Featured: Top 5 & Worst 5, plus a shocking fact!

All of the discoveries on inspection types and grading policies were just the appetizers and are sure to make any reader hungry for information regarding the best kinds of cuisine to consume, from a safety standpoint. Upon first glance, restaurants that serve Creole/Cajun, Hotdog/Pretzels, and Soups had the lowest mean scores (between 6 and 7 for the three) – a reflection of good performance during inspections, whereas restaurants that offered primarily Chilean, Southwestern, and African food had the highest mean scores (from 14 to 18), suggesting poor inspection performance. However, it is important to note that while these results are indicative of the most recent scores for restaurants matching those cuisine descriptions, the majority of the top and worst performers had low cuisine description occurrences (e.g. between 2 and 22 total scores used to calculate the mean) compared to other cuisine types that have hundreds or thousands of instances from different restaurants and should, in theory, have lower variance. The two figures below display the actual best and worst food types when considering only those with a high number* of occurrences. Cuisines with the highest mean scores (therefore, worst inspection performance) consist of a variety of foreign food. More interesting are the types of food belonging to the top 5. While they might not come with tremendous health benefits, donuts and ice cream are associated with the lowest mean inspection scores. Firm believers of the claim that breakfast is the most important meal of the day now have more reason to rejoice and can do so safely, with copious amounts of sugar, caffeine, and partially-hydrogenated oils (i.e. trans fat)!



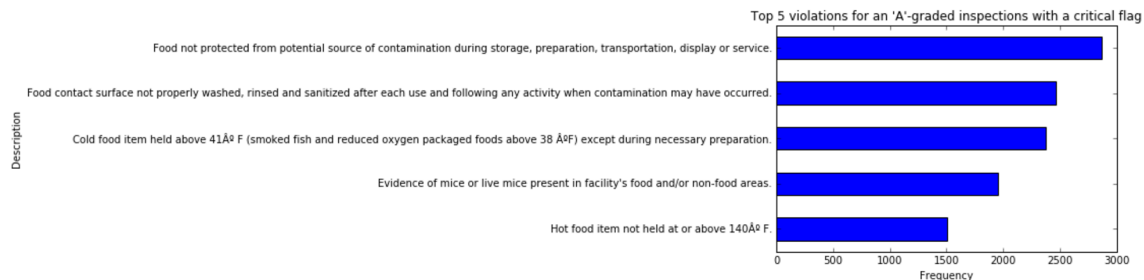
* at least 50 occurrences

The juicy burger and fries or the quinoa salad from last month can easily be forgotten shortly after consumption because the many things that go right with the food we eat are often taken for granted. Despite the fact that employees at restaurants are usually well trained and handle food efficiently out of habit, something can go wrong at any stage before a meal arrives on one's plate. Inspectors are tasked with identifying those areas of improvement, and, as can be seen from the NYC inspection data, some violations are much more common than others. Out of 96 unique violations, 40% of all inspections for any restaurant that resulted in a 'C' or 'B' grade were due to the facility not being vermin-proof, improper temperature conditions for cold food, improper materials used for non-food contact surfaces, or evidence of mice. 20% of all inspections culminating in an 'A' grade had improper materials used for non-food contact surfaces as the top cited violation. Combined with the finding that 82.5% of all 'A'-graded restaurants in their most recent inspection have a critical violation that could cause serious illnesses, there is no guarantee that a high grade is synonymous with safety. If that leaves a bad taste in your mouth, the next section will be your dose of mint.

“82.5% of all ‘A’-graded restaurants in their most recent inspection have a critical violation that could cause serious illnesses!”

Percentage of 'A'-graded inspections with a critical flag 82.48

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Latest Stories: A Historical “Not Big Data, but Not Tiny Data” approach

It is apparent that the DOHMH conducts numerous inspections, and there are multiple inspections and scores/grades for each restaurant even though the grading system began in 2010. This is not exactly “Big Data,” but it also isn’t “Tiny Data;” there is enough for an adequate exploration of how restaurants perform over time. Calculating mean inspection scores for each year, then comparing the earliest year’s mean with the latest

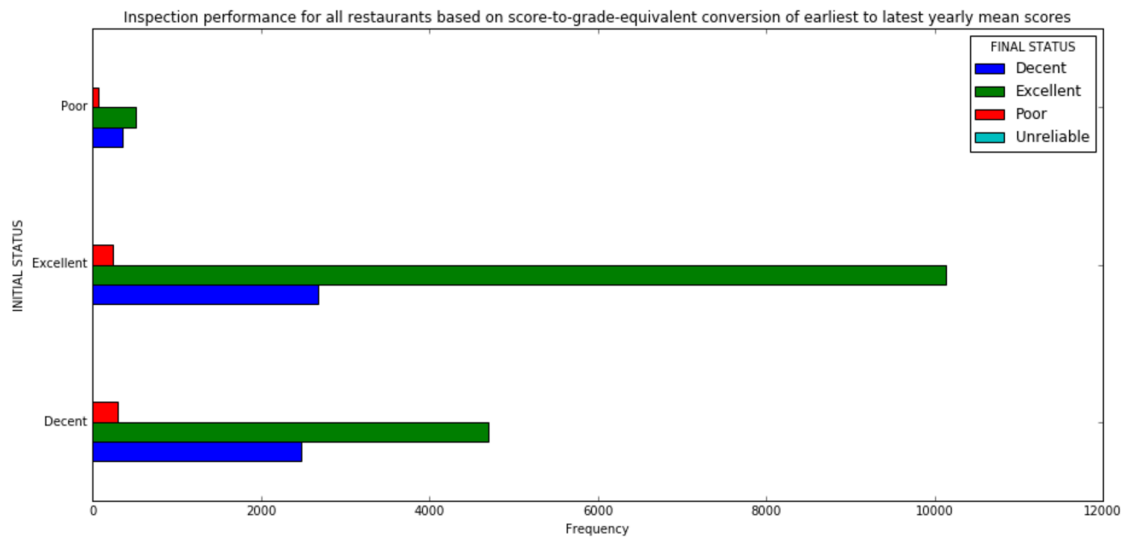
“Only 8% of restaurants with poor initial results continued to perform poorly”

year’s mean per restaurant is a simple approach to determine the overall sanitary status of a restaurant and whether it improved.

The good news for consumers is that out of 21,489 restaurants that had scores for at least two distinct years, 11,740 (54.6%) improved from their earliest year

while 815 (3.8%) achieved the same mean score for the most recent year. While it seems that only half of the restaurants improved, the results grouped by score-to-grade-equivalent conversion paint a more positive picture. 77.6% of restaurants with excellent (~grade 'A') initial results maintained excellent results – fewer than 2% had poor (~grade 'C') recent results. 96% of restaurants that originally had decent (~grade 'B') initial results either continued to perform decently or had excellent results.

The bad news is... nonexistent in this section! Instead, there is great news; 92% of all restaurants with poor initial results improved, meaning they had decent or excellent results during the most recent year's inspections. All of the results are summarized below:



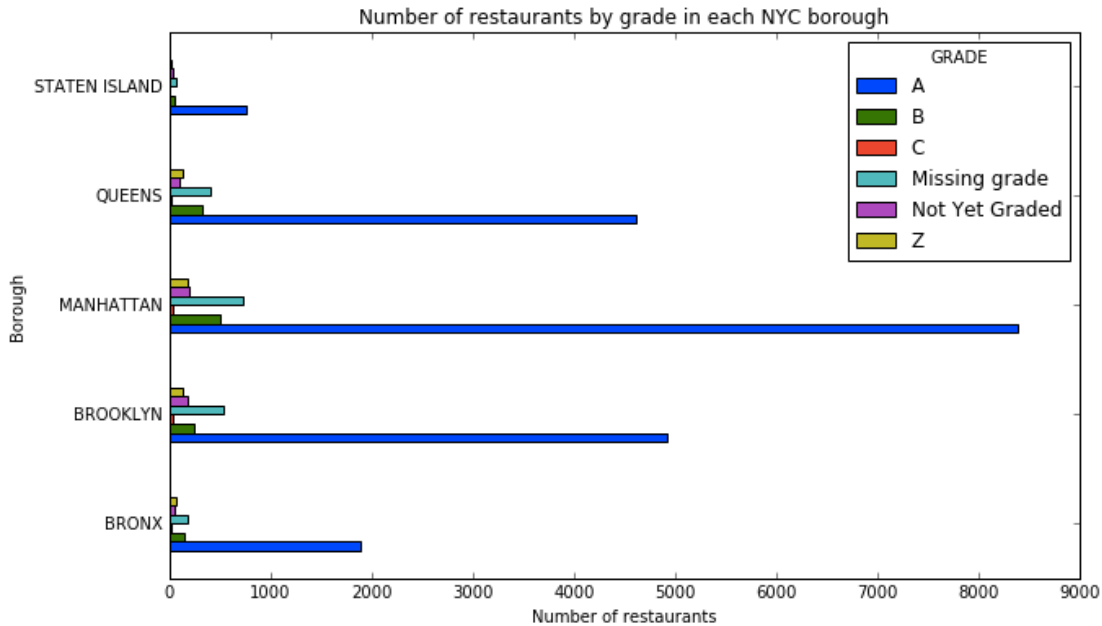
Where to go? Boroughs to explore

Visiting New York City does not necessarily mean exploring Manhattan only. The Big Apple consists of five amazing boroughs – Manhattan, Bronx, Brooklyn, Queens and Staten Island -- that attract tourists all year round. Each borough has a charm of its own

“All five boroughs share a very similar restaurant grade and score profile”

and is known for its different attractions and personality. But how about restaurant cleanliness and safety? Are the boroughs similar or are there some boroughs tourists should avoid?

As shown in the graph below, all five boroughs share a very similar restaurant grade and score profile. For each borough, approximately 80% of restaurants are graded 'A' and very few (below 1%) are graded 'C'. However, it is worth to note that over 10% of restaurants are not graded yet (“Missing grade”, “Not Yet Graded” or “Z”).



As explained previously on how restaurants are graded based on their scores, grades are not the best measures of a restaurant’s sanitation. 80% of restaurants graded ‘A’ would result in an average of grade A per borough. This finding does not give a complete picture; so, score – a better alternative to grades – was analyzed. Boroughs were then examined and compared. The average score and the variability around the average are described in the table below:

NYC Boroughs	Average score*	Score variability**
Manhattan	10.57	6.77
Bronx	10.72	6.71
Queens	10.90	6.53
Brooklyn	11.04	7.28
Staten Island	11.09	7.10

* Mean ** Standard deviation

From this, Manhattan seems to be the most sanitary (lowest average score) and Staten Island looks the least clean (highest average score). However, the average scores of all boroughs revolve around 11, the upper bound of a grade A. With a score variability of 7 around the average of 11 means that tourists can possibly end in B graded restaurants in any boroughs.

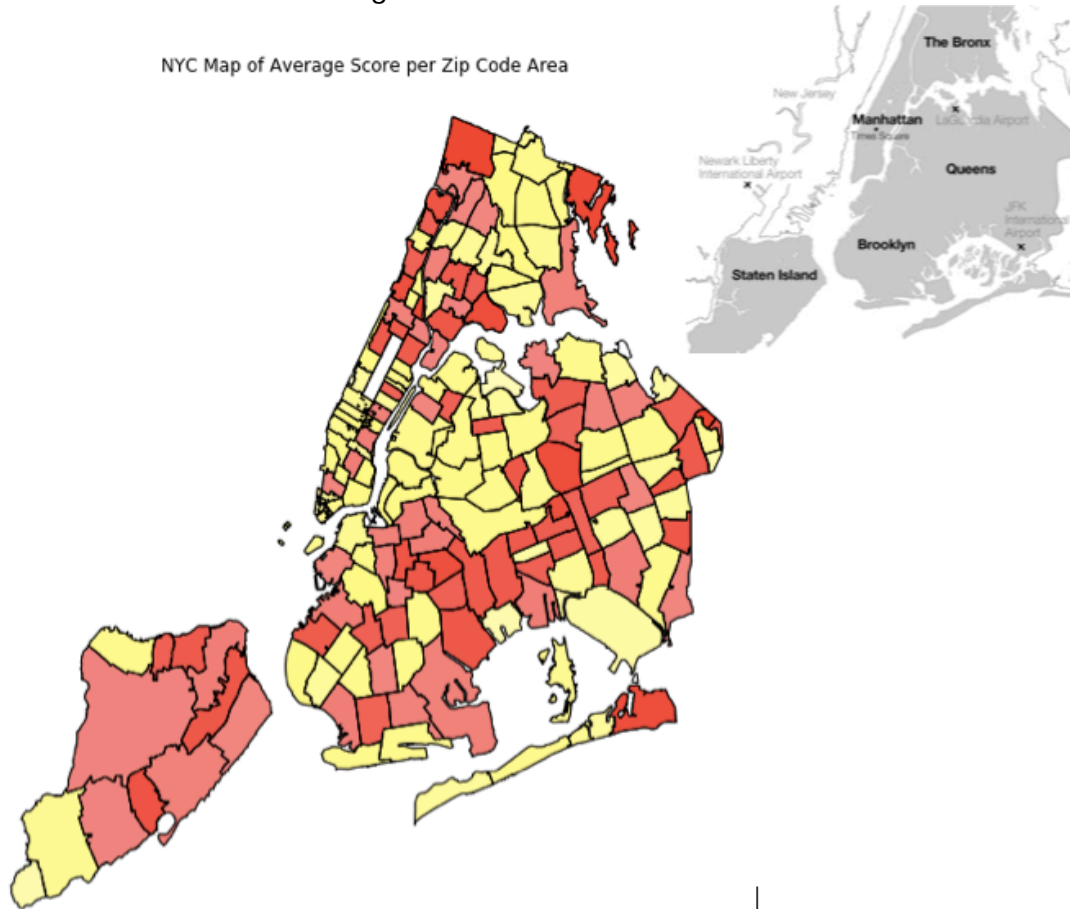
Thus, judging the sanitation level per borough may not be the right approach for tourists when deciding in which borough they should explore their dining options. A better approach to find an area for your dining adventure would be to have a look at by neighborhoods and zip code areas within each borough.

“Sanitation level per borough may not be the right approach for tourists when deciding in which borough they should explore their dining options”

A Picture Is Worth A Thousand Words

The average score for each zip code area is visualized here in a NYC map. A second map of the boroughs limits is on the right side of the map as reference. Note the average scores have been adjusted for better visualization and highlight of areas with bad grades (see Behind the Scenes section for details).

- Shade level: The darker the shade, the higher/worse score.
- Color: Yellow color represents the average scores that falls within the grade A and red color within grade B and C.



Fun facts:

- The blank/white rectangular space in Manhattan is the famous Central Park. No restaurants and thus, no score.
- In Manhattan, in the Midtown and Downtown areas, the West side is more sanitary than the East side, as expected. The red shaded sections are indeed near the East village and Chinatown.
- In Manhattan, the North area (Harlem and above) is mostly red shaded area.
- Brooklyn area near Manhattan seems quite sanitary but this degrades rapidly in deeper Brooklyn.
- Staten Island is mostly red but more towards the grade 'B' than 'C.'
- Bronx South side is worse but improves in the North area.

Behind the scenes – details for data scientists

For the curious data scientists, PJ and Hyera's team have summarized how they have discovered the findings in this travel information guide on restaurant sanitations. For details, a lab notebook is available on their GitHub account (see Appendix C).

A. Dataset:

- From the raw dataset publically available on NYC Department of Health and Mental Hygiene site, 3 dataframes were created in order to process the data in a way that is well suited for analyses:
 1. Dataframe 1 (DF1)- Parsing date and removal of invalid dates:
'INSPECTION DATE' is parsed during read-in from the original data (saved as 'NYCdata.csv') then, the index is set to these dates. Only datetime values above "1900-01-01" were considered. Used for determining:
 - a. the most common reasons (i.e. violations) by grade
 2. Dataframe 2 (DF2) – DEDUPLICATION: Duplicate inspection dates were removed so that multiple violations or comments for the same inspection day do not result in over-counting corresponding types of inspections or scores/grades. Used for determining:
 - a. the most frequent types of inspections
 - b. when different kinds of inspections are most common
 - c. how restaurants perform over time
 3. Dataframe 3 (DF3) – DEDUPLICATION: Duplicate restaurant IDs were removed from the previous dataframe so that the same restaurant does not result in over-counting corresponding number of restaurants. Used for determining:
 - a. Which types of foods have the lowest scores
 - b. The percentage of 'A'-graded restaurants with critical flags as well as the most common reasons
 - c. Average grades and scores per borough and zip code

B. Discoveries:

- To find the most frequent types of inspections, since the column "INSPECTION TYPE" contained more than one type, the different types were separated and columns for each type were created for a better analysis by type.
- To better understand when the main types of inspections occur and with what frequency, DF2 was used. 'DAY OF WEEK,' 'SEASON,' and 'INSPECTION TYPE COMBINED' columns were created from the index date and the original inspection type column, then value counts of each time period were plotted for each re-categorized inspection type.
- To determine which food types have the best and worst scores, first DF3 was grouped by 'CUISINE DESCRIPTION', then the highest and lowest mean scores were plotted. A change was later made to include only values from

'CUISINE DESCRIPTION' that had greater than 50 occurrences, so that there is the opportunity for multiple restaurants with the same food types to be taken into consideration.

- To find out the most common violations for specific grades, values in 'VIOLATION DESCRIPTION' from DF1 were shortened before plotting value counts when grouped by 'GRADE' to ensure proper formatting,
- To discover the percentage of 'A'-graded restaurants with critical flags, value counts of 'CRITICAL FLAG' when the 'GRADE' was 'A' were examined from DF3, then value counts of 'VIOLATION DESCRIPTION' for those cases were plotted.
- To determine how restaurants performed in their most recent year's inspection(s) compared to their inspection(s) in their earliest year, the following steps occurred:
 - o For each restaurant, a 'means' dataframe was created to contain the mean score for each year, if it exists. Then, if there are at least two yearly means, a comparison was made and saved to a dictionary that was later used to create a dataframe with the restaurant ID and whether it improved, got worse, or stayed the same. The yearly means were also converted into a status that was meant to be the equivalent of a grade: 'Excellent' ~ 'A,' 'Decent' ~ 'B,' and 'Poor' ~ 'C,' and this detailed status was also created into a dataframe for further perusal (see below).
 - o Different combinations of the percentage of restaurants with excellent/decent/poor results initially and excellent/decent/poor results during their most recent year that had scored inspection data were calculated and plotted. Basically, the results are value count plots of score-to-grade-equivalent conversions from yearly mean scores.
- To analyze the number of restaurants per grade, the DF3 was used to count a restaurant only once. The data was grouped by borough (column 'BORO') and the value counts of grades was performed.
- To compute the average score per borough, the DF3 was also used. But first, the scores data with strange values were examined and adjusted (negative score) before performing the calculation of the average per borough using groupby. The average scores per zip codes were performed next using the groupby method per zip code.

C. Map:

- The average scores were adjusted to highlight the areas with bad grades ('B and 'C') for a better visualization purpose. The scores within the range of B were loaded by a factor of 1.5 and within C range, by a factor of 2. Then once the average scores per zip code were performed, we realized that it was still not sufficient to visualize the difference between average scores. Thus, a second loading was added to the grade B range scores (1.25) and to the grade C range scores (1.5).
- Geopandas were used for reading the geospatial data and plotting the map.
- Data with zip codes not found in the geospatial NYC dataset were removed from the plot. There were only 7 zip codes removed.

Appendix A:

Dataset:

1. NYC restaurant grades
 - a. Source: NYC Department of Health and Mental Hygiene (DOHMH)
 - b. Source link: <https://nycopendata.socrata.com/Health/DOHMH-New-York-City-Restaurant-Inspection-Results/xx67-kt59>
 - c. Size: ~170 MB (when exported as a .csv file)
2. NYC zip code boundaries data (shapefiles)
 - a. Source: NYC Open Data
 - b. Source link: <https://data.cityofnewyork.us/Business/Zip-Code-Boundaries/i8iw-xf4u>
 - c. Size: 1.44 MB (zip file)

Appendix B:

Additional information:

1. How scoring and grading is conducted
 - a. Source: NYC Department of Health and Mental Hygiene (DOHMH)
 - b. Source link: <http://www.nyc.gov/html/doh/downloads/pdf/rii/how-we-score-grade.pdf>
 - c. Pages: 1
2. Food Service Establishment Inspection Procedures (Chapter 23 of Health Code)
 - a. Source: NYC Department of Health and Mental Hygiene (DOHMH)
 - b. Source link: <http://www.nyc.gov/html/doh/downloads/pdf/about/healthcode/health-code-chapter23.pdf>
 - c. Pages: 35

Appendix C:

Authors GitHub repository links for this project:

- PJ Hardas: https://github.com/prhardas/Python_Project2_NYCinspection
- Hyera Moon: https://github.com/Hyeramoon/Python_project_NYC_restaurant_inspection