Air Quality In NYC Train Stations

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Introduction

- 5,225,675 people use the MTA trains on average every weekday (MTA, 2009).

- Particulate Matter is a broad class of chemically and physically diverse substances that exists as either liquid droplets or solid particles ranging from many sizes (EPA, 2009).

Introduction continued

- Particulate Matter
  - Can cause:
    - increased respiratory symptoms (i.e. irritation of the airways, coughing, or difficulty breathing)
    - decreased lung function
    - aggravated asthma
    - the development of chronic bronchitis
    - irregular heartbeat
    - nonfatal heart attacks
    - premature death

Introduction continued

- Particulate Matter:
  - Coarse particles, also known as PM_{10}, are between 2.5 and 10 micrometers in diameter.
  - Fine particles, also known as $PM_{2.5}$, are smaller than 2.5 micrometers in diameter.

Introduction Continued

- EPA (the National Ambient Air Quality Standards)
  - PM exposure should not exceed:
    - 150 $\mu g/m^3$ of PM_{10} in a 24-hour time period
    - 35 $\mu g/m^3$ of $PM_{2.5}$ in a 24-hour period

Project Design Chart

Scientific Problem

What are the PM levels in NYC train platforms, are they safe, and why are they the way they are?

Hypothesis

Due to construction, stations like and near 96th street will have high concentrations exceeding the EPA Standards.

148th street will have high levels because it is near a bus depot, which is currently going under construction.

Project Design Chart

Objectives
Determine the PM levels in the train stations along the 3 train.
Compare these levels to the ranges determined by the EPA.
Determine possible causes and effects of these PM levels.

Independent Variable
The train platforms

Dependent Variable
PM concentrations

Constants
Procedure for taking measurements

Project Design Chart

Assumptions

Sample time is sufficient to get a good sense of the PM concentrations

P.M. sensor maintains the same calibration throughout the experiment

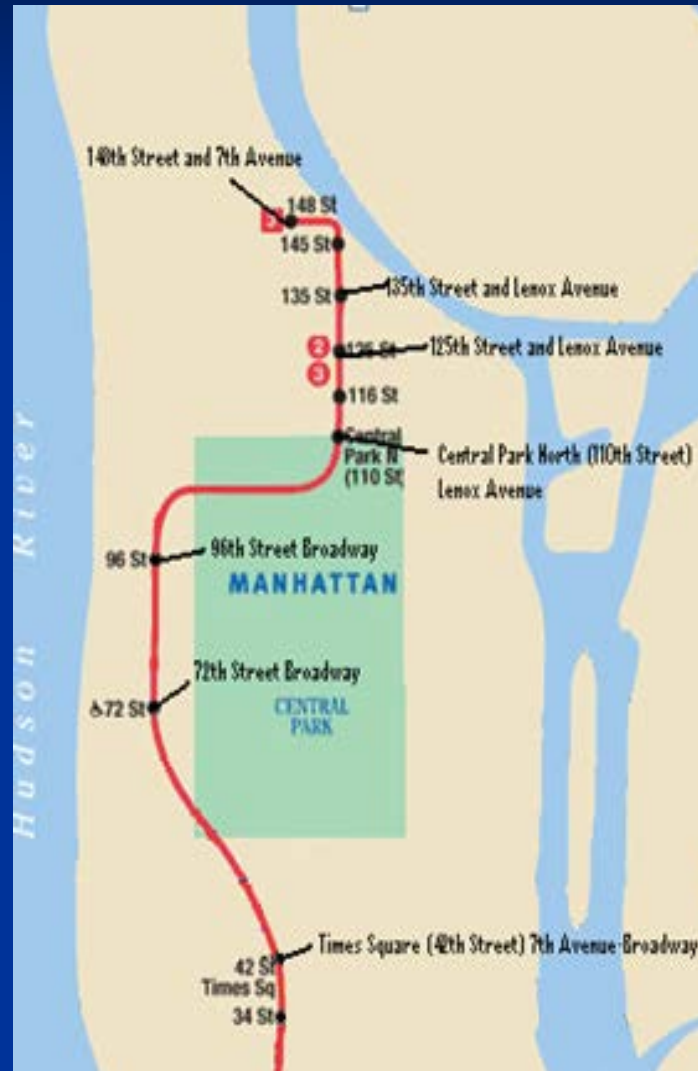The PM levels are independent of time of day.

Limitations

Materials and the precision of the meters

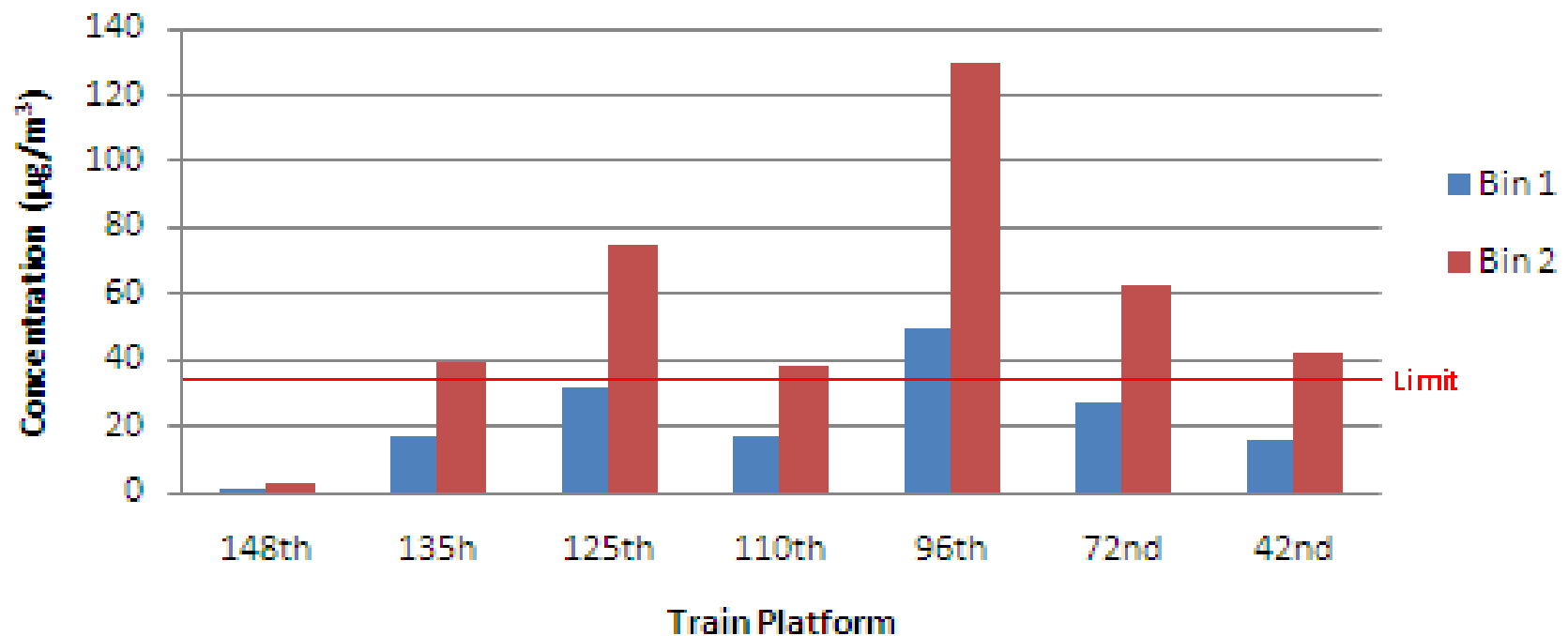Amount of time that measurements are taken for
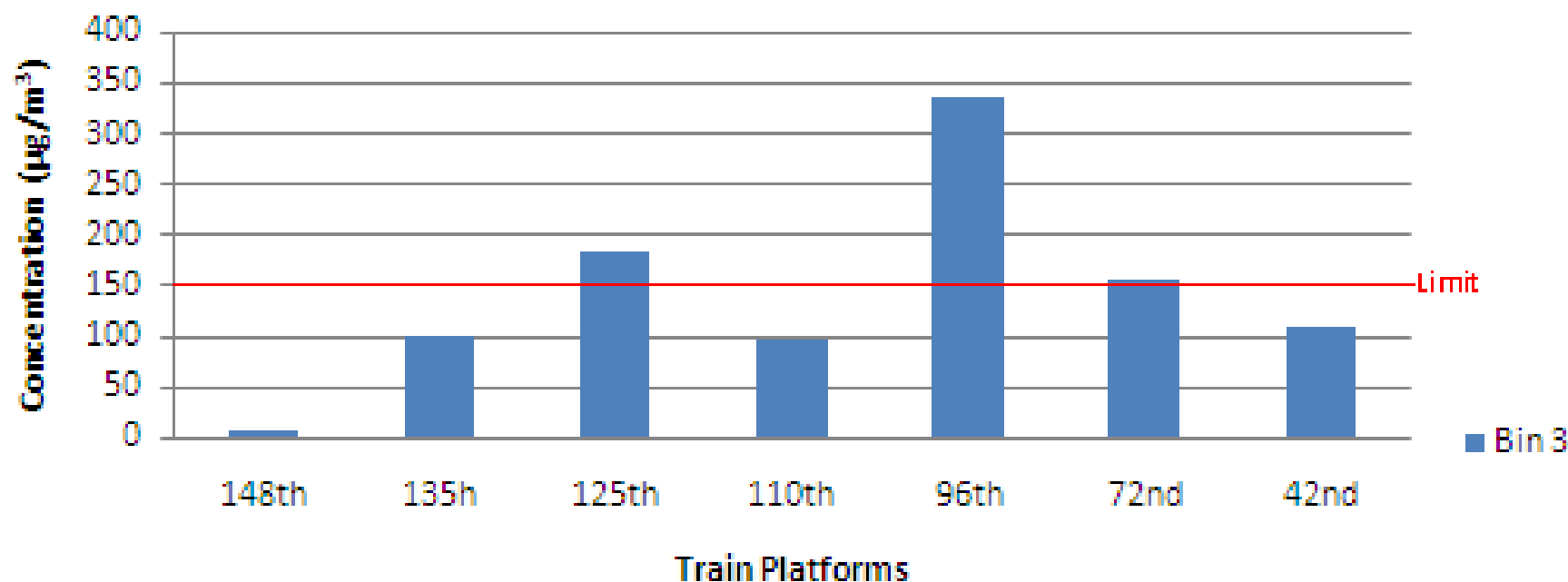
Procedures

Procedures

Results

- Figure 1

Average PM$_{2.5}$ Concentrations in NYC MTA Train Platforms (Red Line), April 14, 2010
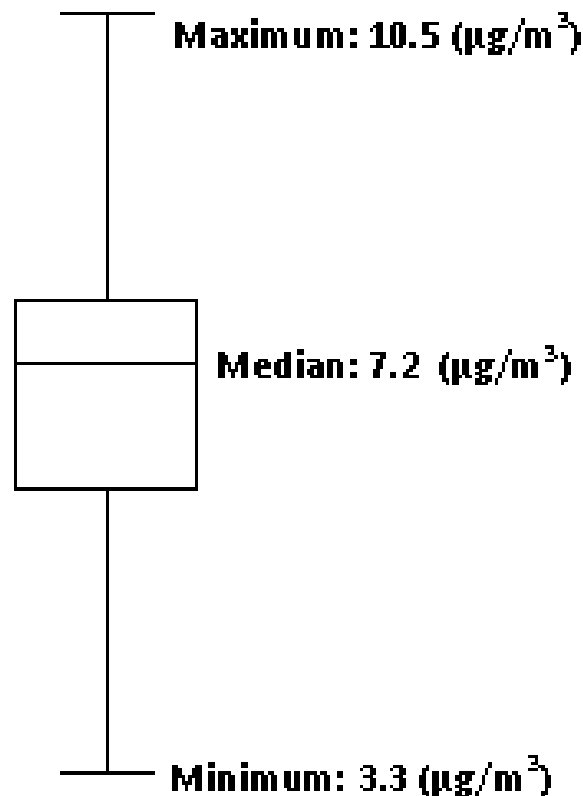
Results continued

- Figure 2

Average PM_{10} Concentrations in NYC MTA Train Platforms (Red Line), April 14, 2010
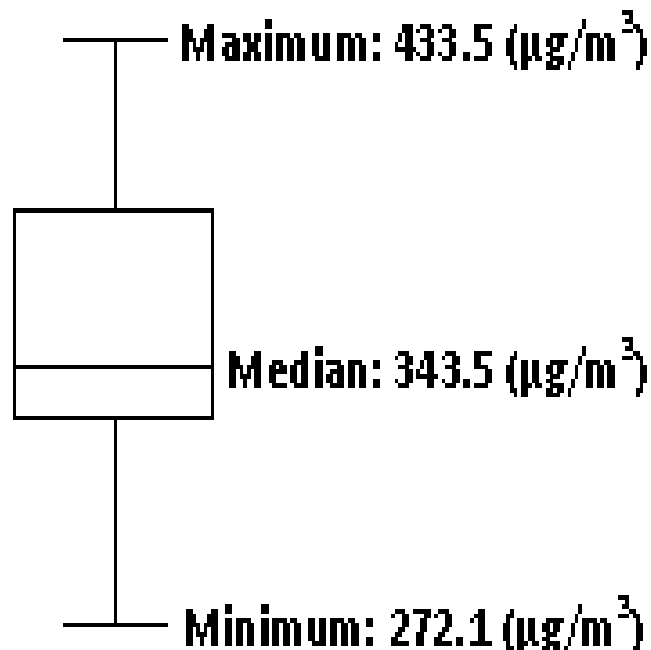
Results continued

- **Figure 3**

Maximum: 10.5 (μg/m^3)

Median: 7.2 (μg/m^3)

Minimum: 3.3 (μg/m^3)

PM_{10} Concentrations in the NYC MTA 148th Street Station (Red Line), April 14, 2010

Results continued

- **Figure 4**

Maximum: 433.5 ($\mu g/m^3$)

Median: 343.5 ($\mu g/m^3$)

Minimum: 272.1 ($\mu g/m^3$)

PM_{10} Concentrations in the NYC MTA 96th Street Station (Red Line), April 14, 2010

Results Explained

- 96th street had the highest PM concentration in all bins (as seen in figures 1-3), with average levels reaching 334.79 $\mu g/m^3$

- The 125th street and 72nd street station had the second highest concentrations, followed by 42nd street.

- The 148th street station had the best air quality, with averages only going as high as 7.18368 $\mu g/m^3$.

Results Explained continued

- Out of all of the train stations tested
  - six out of seven were at one point violating the EPA standards.
    - 72nd street station (bin 3 at 155.031 $\mu g/m^{3)}$
    - 96th street station (bin 3 at 334.792 $\mu g/m^3$)
    - 110th street station (bin 2 at 38.7941 $\mu g/m^3$)
    - 125th street station (bin 3 at 184.627 $\mu g/m^3$)
    - 135th street station (bin 2 at 39.6813 $\mu g/m^3$)

Analysis of Results

- 96th street did have the highest concentration
- 148th street was not amongst the highest and was instead the lowest.

Analysis of Results

- Construction leads to high levels of PM (Thurston, 2009)
  - Reason why 96th street had such high levels
- Indoor places tend to have higher concentration than the outdoors (Ligman et al., n.d.)
  - Reason why 148th had relatively low levels with respect to the other stations.

Analysis of Results

- 110th had some of the lowest levels possibly because it's located at Central Park.

- 125th had high levels possibly because its located in Harlem, a place known to have high PM (Warbelow, n.d.).

Analysis of Results

- Passengers who wait at the 96th street station are at an increased risk of getting health problems associated with high exposure to PM.

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Suggestions for Improvement

- Make sure that all materials are running perfectly.

- Try obtain data on more than one day or more than once in a day (i.e. morning vs. afternoon)

- Try to figure out when construction on a site is being done and when it isn't.

Suggestions for Improvement

- Control the set up to make sure that the bag doesn't influence the readings of the meter.

- Take measurements in the opposite direction to ensure that the time of day doesn't effect the results.

Suggestions for Future Ideas

- Try to figure out a correlation between outside of the station and the station itself.

- Compare different train lines with each other (i.e. the red line vs. the green line).

- Check PM levels in stations at low levels.

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