CMMC 2022

Columbia Mathematical Modeling Contest

5:30PM, Thursday, January 20 – 8:30AM, Monday, January 24

Background[1]

In the city, residential trash and recycling are collected by the Sanitation Department for residential buildings, while private commercial collection companies are used to collect trash from commercial establishments such as stores and restaurants.

Once garbage is picked up, it's sent to various landfills and incinerators, many of which are located in other states, such as Ohio, Pennsylvania and South Carolina. In fact, since the closing of the city's Fresh Kills landfill on Staten Island in 2001, nearly all of the city's trash is sent outside of the city to be disposed of in landfills and incinerators. The city has been criticized for polluting areas where the garbage goes, many of which tend to be located near impoverished neighborhoods such as Newark's Ironbound district.

The dirty details

- 2,000 tons: the estimated amount of recycling picked up each day
- 10,000 tons: the estimated amount of garbage thrown out by New Yorkers each day
- 40,000 tons: the estimated amount of compost collected by the city each year before the pandemic, which is sold to community groups and landscapers.
- 1.7 million tons: the estimated amount of greenhouse gasses emitted by the city's trash each year, according to a report from the Mayor's Office of Sustainability in 2017.
- 6.4 million tons: the amount of garbage produced by the construction and demolition industry in 2019.
- $409 million: the cost to ship the city's waste outside of New York in 2019.

How the city's waste contributes to climate change

As garbage decomposes, it releases the greenhouse gas known as methane, which is even more harmful to the environment than carbon dioxide. That means that cutting down on waste is of paramount importance.

What about composting?

Basically since it was founded, the city has been trying to reckon with its waste problem by attempting to reduce waste and implement an organic waste collection system to make use of food and yard scraps, which account for a third of residential waste. While the city's (organic waste collection) program was put on pause during the pandemic, it's expected to return once again in August.

However, even when the program was up and running, the city only collected about 13,000 tons of organic waste, which is about 1.2% of the 1 million tons of organic waste produced by

[1] Adapted from "How does NYC's waste management system work?" by Amanda Luz Henning Santiago

the city each year. Part of the problem is that the program is entirely voluntary and requires residents to sign up to participate in it, as opposed to other cities such as San Francisco and Seattle where organic waste separation is mandatory.

The Problem

The accumulation and mismanagement of garbage is an increasing problem for the city of New York. Without proper disposal and management, piling garbage can lead to public health issues and unpleasant littering across the concrete jungle.

The former New York City mayor, Bill de Blasio, committed to having zero waste be sent to landfills by 2030. To achieve this, the city must rethink how it manages its waste. Now, more than ever, creative solutions are needed. The challenge is for you to make a compelling argument for your selected method(s) of waste management practice, supported by a mathematical model, and to propose the solution to the City of New York by writing an open letter to the Mayor, Eric Adams. In addition, you will submit a detailed paper describing your research. You also have the opportunity to present your work at the 2022 Columbia Undergraduate Research Symposium should you wish.

Objective

You are asked to think creatively about how waste in the city can be managed (not necessarily reduced) such that there are social, environmental, and financial benefits. Consider ideas such as (re)introducing composting, (re)opening a landfill, public campaigns to reduce waste, waste diversion programs (think: Too Good to Go), optimizing the existing collection and disposition system, improving the transportation system, creating work for under-employed groups, and anything else. Think outside the box - this is your chance to get creative!

Once you have decided on your proposed plan, model the social, environmental, and/or financial benefits and the feasibility of your idea, as well as the level of impact your proposed change will bring to the city's waste management practices. Comment on how these benefits and costs differ between various boroughs (think about the demographics of each borough). Once you have developed your waste management system model, apply your model to at least one particular borough to support your findings and discuss the scalability (to larger or smaller waste management systems) and adaptability (to other boroughs) of your model.

Your Submission

Your PDF submission of no more than 25 total pages should include:

- Name page: containing the names of the members of your team. Your names should not appear anywhere else in the document. When sent for review to the CMMC committee, the first page will be removed from the document.
- One-page abstract.
- Table of contents.
- Your solution.
- One- to two-page open letter to the Mayor, Eric Adams.
- References list.

Deadlines

The contest ends on **Monday morning**.

- **Complete** your report by 8:30AM on Monday, Jan 24th.
- **Email** your report (pdf) to dragomir@math.columbia.edu by 9AM on Monday, Jan 24th.

Good Luck!