CMMC 2025 (March)

Columbia Mathematical Modeling Contest

12:00 PM, Monday, March 17 – 8:00 PM, Friday, March 21

Background[1]

New York City is experiencing an escalating affordable housing crisis, one of the most pressing challenges affecting its residents. For millions of New Yorkers, finding stable and affordable housing is becoming increasingly difficult, as rents have surged while incomes have failed to keep pace. This growing disparity has left nearly 50% of working-age households unable to meet basic living expenses, impacting nearly 3 million people.

As a result, housing insecurity is rising, with many families forced to make impossible choices between rent, food, healthcare, and other essential needs. Homelessness has reached critical levels, straining emergency shelter systems and leaving thousands without stable living conditions. The lack of affordable housing not only affects individuals and families but also weakens communities, disrupts local economies, and limits social mobility.

The housing crisis is driven by multiple complex factors, including:

- A widening gap between income growth and rising rents, making home affordability increasingly unattainable.
- The limitations of Area Median Income (AMI) calculations, which fail to accurately reflect neighborhood-level economic realities.
- A shortage of sustainable and affordable housing developments, exacerbated by regulatory and financial constraints.
- The underutilization of vacant office spaces, which could be repurposed for housing but face significant logistical and policy barriers.

Several policy proposals have been discussed to address these issues, including:

- Revising the AMI metric to better reflect neighborhood-level income distributions.
- Implementing Rent Guarantee Insurance (RGI), either privately or publicly, to prevent evictions and reduce homelessness.
- Targeted Universal Basic Income (UBI) programs to alleviate rent burdens for at-risk households.
- Incentivizing office-to-residential conversions to increase housing supply.
- Adjusting tax credits and subsidies to make affordable housing developments more viable.

Addressing this crisis requires bold, data-driven policy solutions that not only increase housing availability but also ensure affordability and long-term stability for residents. CMMC challenges teams to analyze the affordability crisis through a mathematical modeling approach and propose innovative, actionable strategies to help reshape the future of housing in NYC.

[1]Sources: United Way of New York City, *NYC True Cost of Living Report*; Independent Budget Office of New York City, *DHS Budget and Homeless Shelter Costs.*

Objective

Your team is responsible for developing a quantitative model that evaluates housing affordability in NYC, forecasts future housing demand, analyzes policy interventions, and proposes an optimal strategy to address the crisis. Your team will write a persuasive, action-oriented one-page letter summarizing your findings and policy recommendations, addressed to the mayor or the appropriate city agency. Here are the specific focus points for your team:

1. **Measuring Housing Affordability.** Develop a metric to assess affordability across NYC neighborhoods, incorporating key factors such as median income, rent prices, cost of living, and government subsidies. Specifically, your team should define an affordability index that captures indicators like the median rent-to-income ratio, household savings, and housing stability. Additionally, your team should evaluate the effectiveness of the existing Area Median Income (AMI) metric and compare it to alternative measures that more accurately reflect neighborhood-level income disparities.
2. **Predicting Future Housing Demand.** Build a forecasting model to estimate housing needs over the next 5-10 years. This model should account for key factors such as population growth, migration patterns, economic conditions, and urban development trends. Additionally, your team should incorporate external influences such as economic trends, inflation, employment shifts, and post-pandemic real estate market adjustments to provide a realistic projection of future housing demand.
3. **Simulating Policy Impacts.** Analyze the effects of different policy interventions on affordability, housing supply, and overall economic stability in NYC. Teams should select at least two of the following policy interventions and assess their potential impact:
    - Policy A: Rent Guarantee Insurance (RGI). Evaluate the impact of private vs. public RGI programs on eviction rates, rent stability, and overall costs. Consider whether a public RGI program could help reduce fiscal burdens (e.g., shelter costs) while improving housing security for at-risk households.
    - Policy B: Targeted Universal Basic Income (UBI). Assess how a targeted UBI program could alleviate rent burden while remaining fiscally sustainable. Compare its cost-effectiveness to existing shelter expenditures and other government housing assistance programs.
    - Policy C: Office-to-Residential Conversions. Analyze the feasibility of converting vacant office buildings into affordable housing. Consider the economic viability, zoning restrictions, environmental implications, and impact on property tax revenue associated with these conversions.
    - Policy D: Tax Incentives for Mixed-Income Developments Investigate how adjusting property tax exemptions could encourage developers to include more affordable units in new projects. Simulate the trade-offs between developer participation, housing supply expansion, and overall city revenue.
4. **Optimizing a Policy Strategy.** Based on the analysis, propose a policy recommendation that effectively balances affordability, feasibility, and economic sustainability. The recommendation should be supported by data-driven insights and consider potential economic and social trade-offs to ensure practical implementation.

Submission Guidelines

Each team must submit a **single PDF document** containing their full solution, limited to **20 pages** (excluding the required AI usage disclosure, if applicable). The submission should be structured as follows:

1. **Title page.** Include the names and UNIs of all team members. This page will be removed before evaluation to ensure anonymity during the review process.
2. **One-page summary.**
3. **Your solution.** A detailed explanation of your affordability metric, forecasting model, and policy simulations and recommendations.
4. **One-page policy letter to the mayor of New York City.**
5. **References.**

Any use of **AI tools** must be disclosed in a separate section that does not count toward the 20-page limit.

Deadlines

The contest ends on **Friday, March 21, 2025**.

- **Complete** your report by 8:00 PM on Friday, March 21.
- **Email** your report (pdf) to dragomir@math.columbia.edu by 9:00 PM on Friday, March 21.

Good Luck!