


Every Life Matters:

Creating an optimized system to boost efficiency and minimize stress for staffs at New York Hospitals

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The starting point...

COVID-19 in New York has been circulating on the news a lot lately...

- The alarming rise of new cases
- The alarming death rate
- Healthcare workers using masks and other equipment
- Dr. Breen's suicide

So we started thinking...

- Can we create system to treat more patients in a less stressful, smarter way?

We did some reading...and
this is what the
researchers said:

Prior Research

Resource scheduling:

- Optimization based on current limitations
- Proper sequencing of tasks

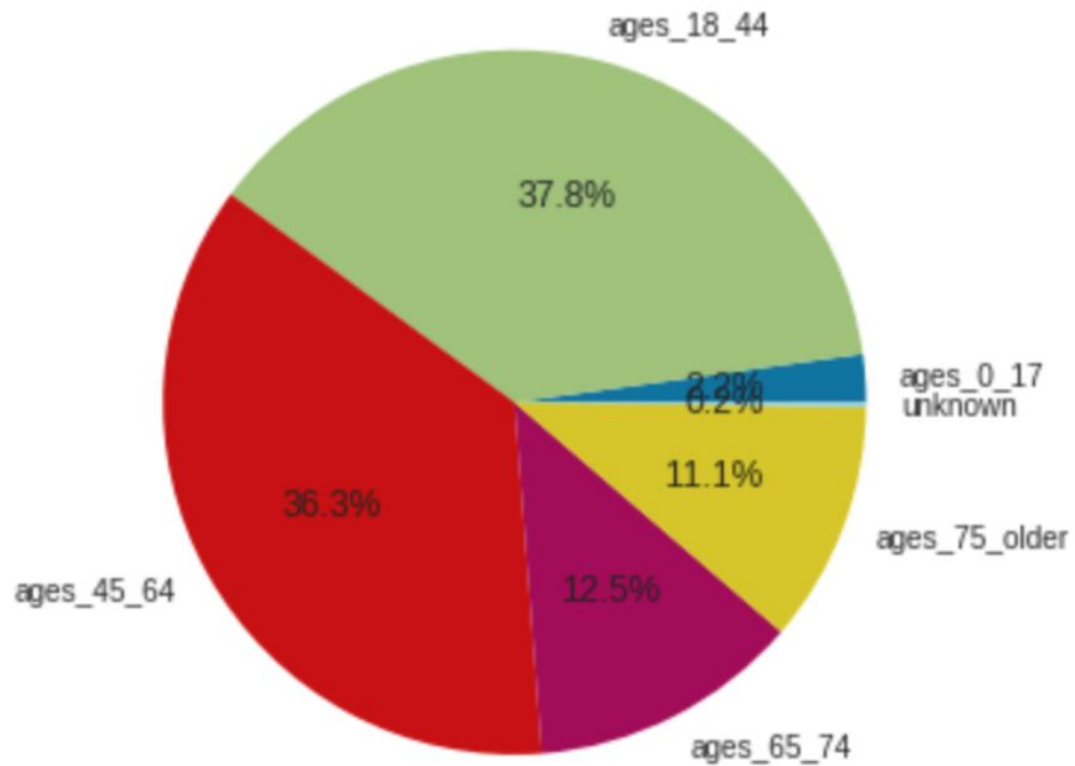
Integer Linear Programming

- Indivisibility of units
- Finite resources

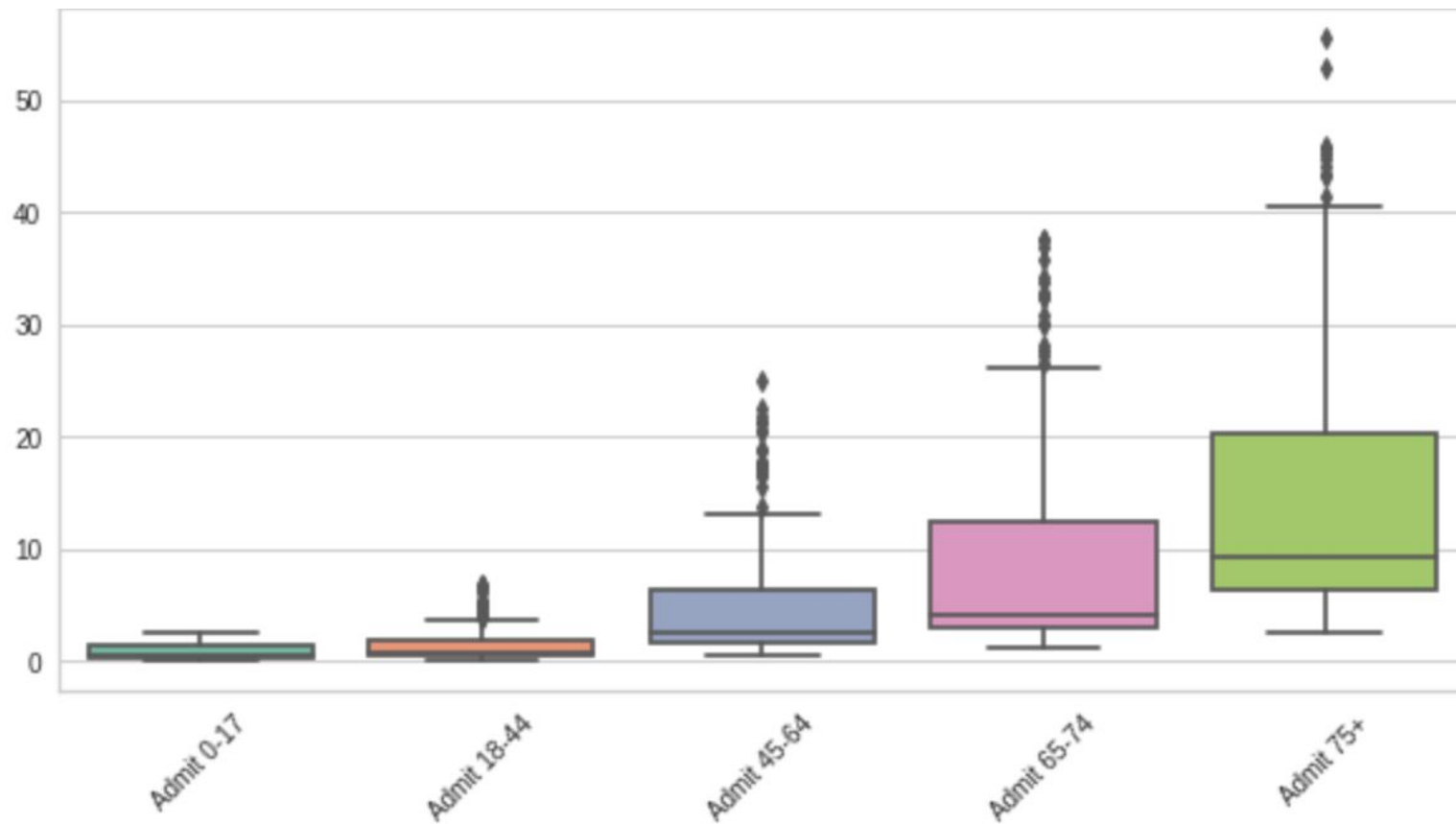
Discrete-time-based Linear Programming

- Limited historical data
- Unpredictability
- Quality solutions

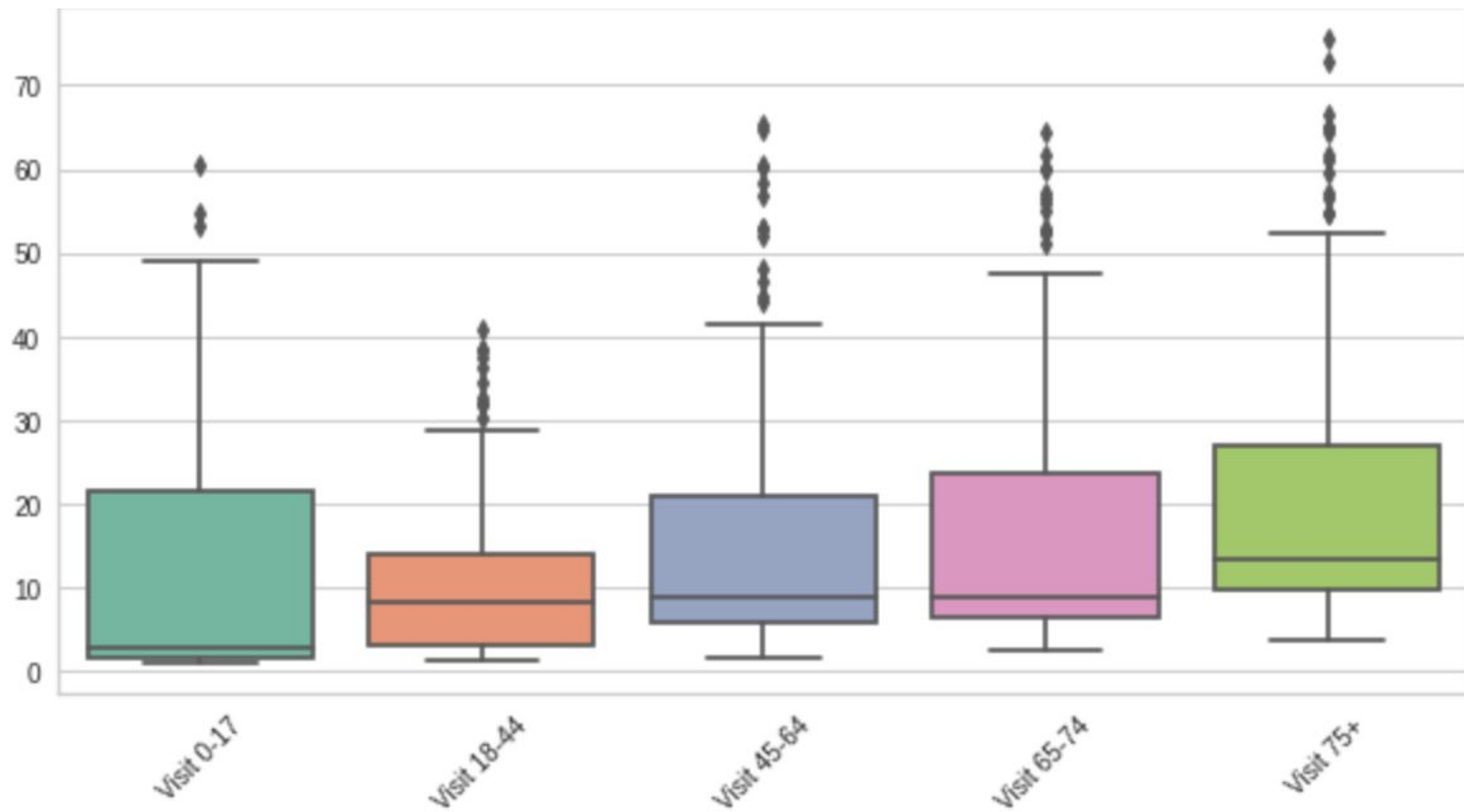
Data Analysis



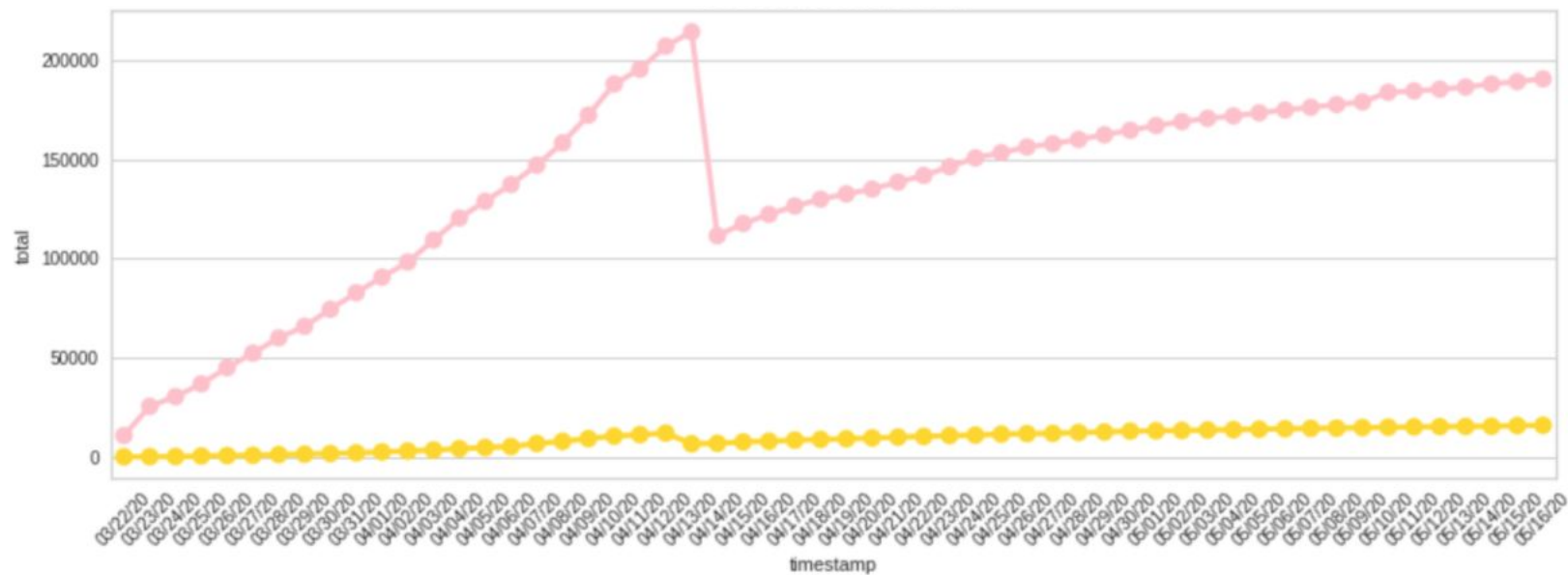
Proportion of cases from COVID-19 in each age group



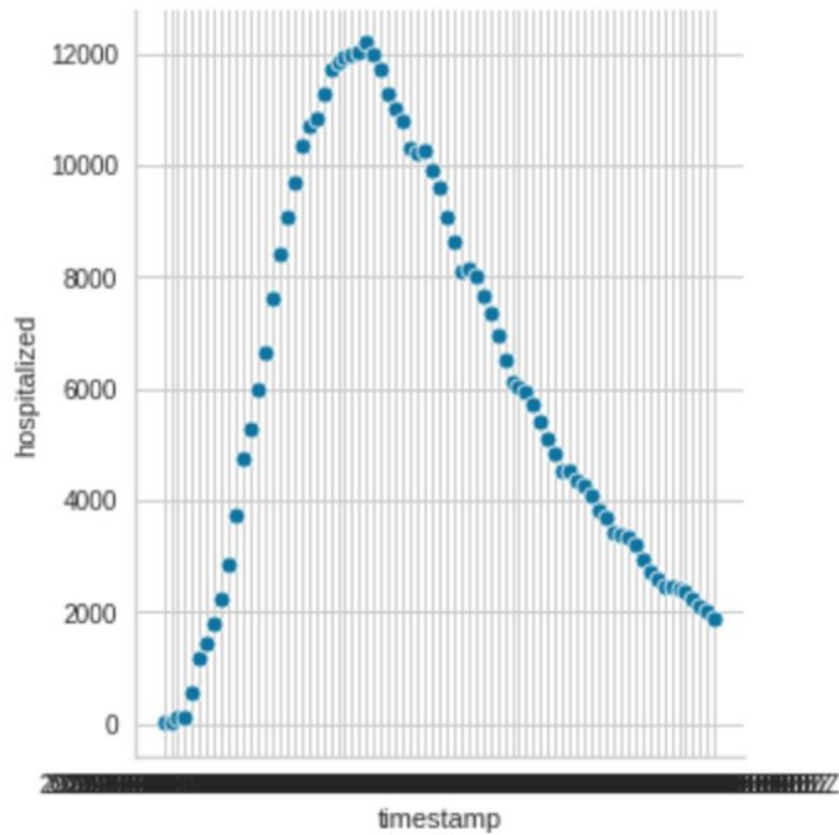
Box plot of Daily Admit Rate by age group



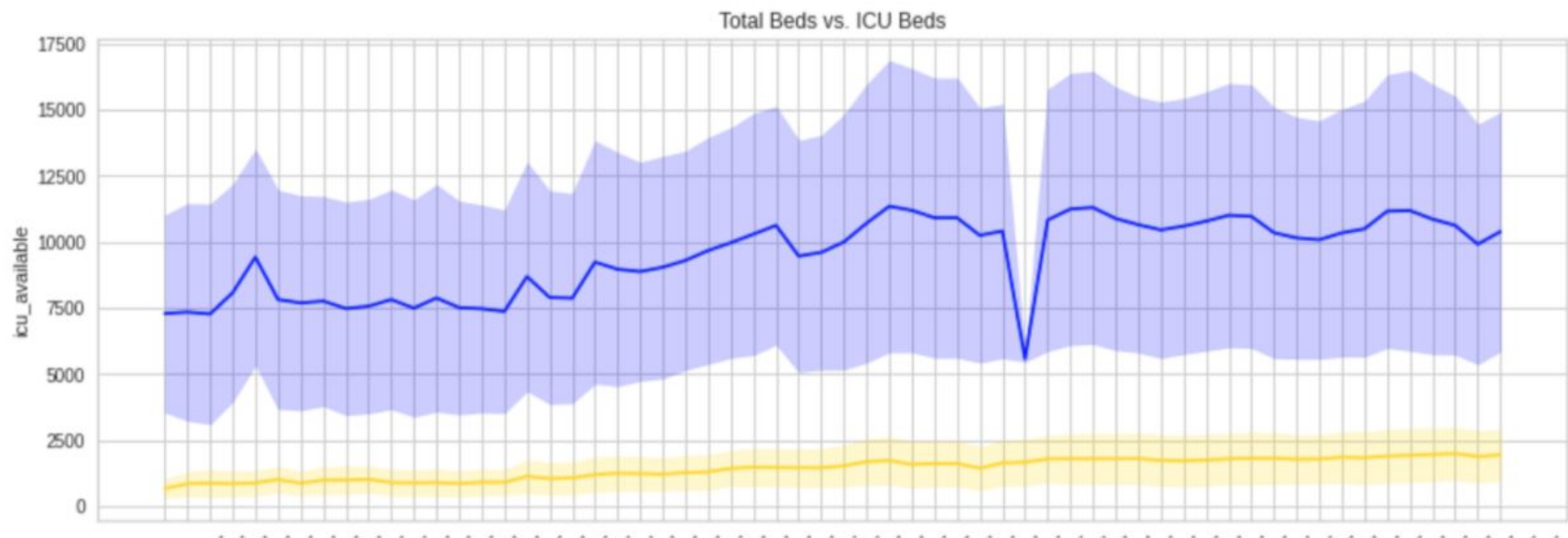
Box plot of Daily Visit Rate by age group



Line plot of Case and deaths over time



Daily number of Hospitalization Over Time



Total Beds vs. ICU Beds Over Time

Turning our knowledge
into models...

Decision Variables	Manhattahn	Brooklyn	Bronx	Queens	Staten Island
Additional Covid Patients to Accommodate	1303	420	216	60	100

Constraints	# of Available Beds for Covid19	5631	1968	1315	792	319
	# of ICU Beds Used	390	105	54	15	20
	# of Available ICU Beds for Covid19	391	105	54	15	20
	# of Max Accommodation	34749	15835	8296	14926	3012

Objective Function
constraints

$z = x_1 + x_2 + x_3 + x_4 + x_5$
 $x_1, x_2, x_3, x_4, x_5 \leq [5631, 1968, 1315, 792, 319]$
 $0.3 * x_1 \leq 390$
 $0.25x_2, 0.25x_3, 0.25x_4 \leq [5631, 105, 54, 15, 319]$
 $0.2 * x_5 \leq 20$
 $x_1, x_2, x_3, x_4, x_5 \leq [34749, 15835, 8296, 14926, 3012]$

NYC may accommodate 2099 more serious cases that require hospitalization

Objective Function	
MAXIMIZE	2099

Key Data					
# of Available Beds	8983	3141	2098	1264	510
# of ICUs	750	202	104	30	39
# of Total Doctors	8465	3875	2153	3434	714
# of Intensivists	846	387	215	343	71
# Regular Doctors	4233	1938	1076.8	1717.4	357.4
# of Existing Patients	6720	3143	2248	1893	479
Max Patients	41469	18978	10544	16819	3491

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Screenshot of our optimization model

Future Research

Moving Forward

Average Length of Patient Stay

- Collection of patient medical history
- Collection of patient demographic data

Patient Prioritization

- Criteria for patients
- Establishment of weighted variables