PREVIEW PAPER: AVERAGE

The summary has a good overview of the problem, but it does not include a good overview of the results. The team does provide some insight into their conclusion for the third question, though. The summary is longer than a page, but it is double-spaced.

For the first question the team made use of a logistic equation. It was noted that the team estimated a carrying capacity based on a high density population, New York City, which is a good way to average over different types of housing. The results were stated without much discussion about how they were obtained and little analysis of the final model is discussed. The graphs included the approximation as well as the data, which was good, but the graphs were poorly annotated with a minimal caption.

For the second question the team made use of a logistic model for Seattle and discussed the disadvantages of using a logistic equation noting the oscillations in the data for Albuquerque. They concluded that an exponential model was better even though their final model did not adjust for the variations seen in their data. They stated their final results, but it is not clear what function was used to obtain their results.

For the third question the team provided some graphs and stated a number of conclusions. They did not provide a full justification for their conclusions other than noting the trends that were present on separate graphs. The team did provide a response to the issue of unforeseen circumstances which was not present for a number of other entries. The team stated the reasoning that led them to their conclusion about weather related events.

The team did not provide a conclusion and did not include a final discussion relating their results.

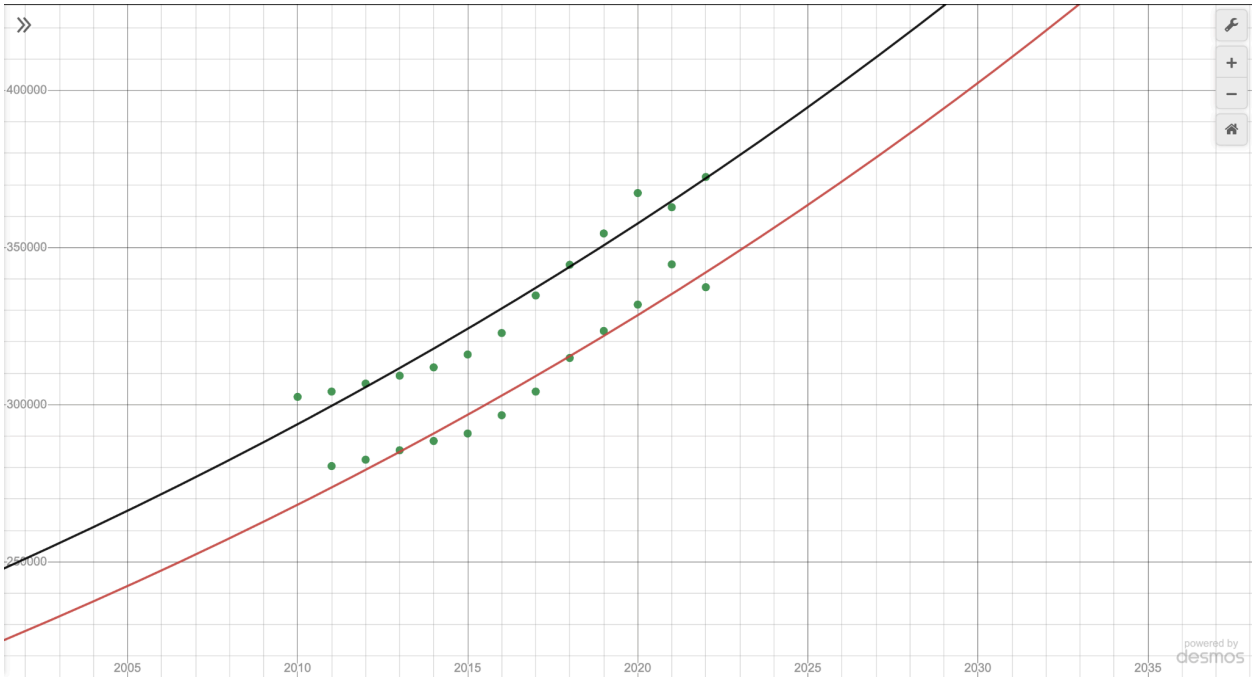
Homelessness will always be a problem as long as there are homes, but the COVID-19 pandemic has exacerbated the issue; homelessness rates are increasing all across the United States, and many major cities are feeling the effects. Another cause is inflation throughout the years, particularly in places like Seattle, where famous tech companies have taken root, leading to population booms and sky-high increases in housing costs that push many residents out of their homes. This report aims to take a closer look at housing and homelessness data in major cities such as Seattle, Washington, and Albuquerque, New Mexico, in search of methods to fight homelessness.

Housing units are an important data point; in both Seattle and Albuquerque, many available home units go entirely unused, and the correlation between total housing units and unused housing units remains consistently strong no matter how many new housing units are constructed. This ever-increasing amount of unused homes indicates that lack of housing is not the driving issue behind climbing homelessness rates—rather, it's more specifically a lack of *affordable* housing. In both cities, the median cost of housing is increasing faster than the median income as a result of inflation. In Albuquerque, the average price of a house has increased by 90% from 2010 to 2023, whereas the average household income has increased by 30%. Seattle fares little better as a result of the presence of industry giant Amazon. In 2010 to 2023 the average household income increased by 91%, house prices more than doubled, all adding up to a rather intimidating 126% increase.

Our findings lead us to one conclusion: to tackle homelessness in places like Seattle, we need to tackle affordability issues first and foremost. The large amount of available housing units that go unutilized prove simple lack of housing isn't the main problem, and natural disasters have surprisingly little correlation with the homeless population. While addressing either of these

issues *could* be beneficial, funding is best allocated to addressing the core of the problem: the thousands of functional but unused housing units and the financial barrier that stops those in need from accessing them. Housing vouchers have proved a successful solution in many places that use them; if we can focus on evening out the inequality between income and house prices in the long term, we can make it easier than ever for the homeless to find a place to call home.

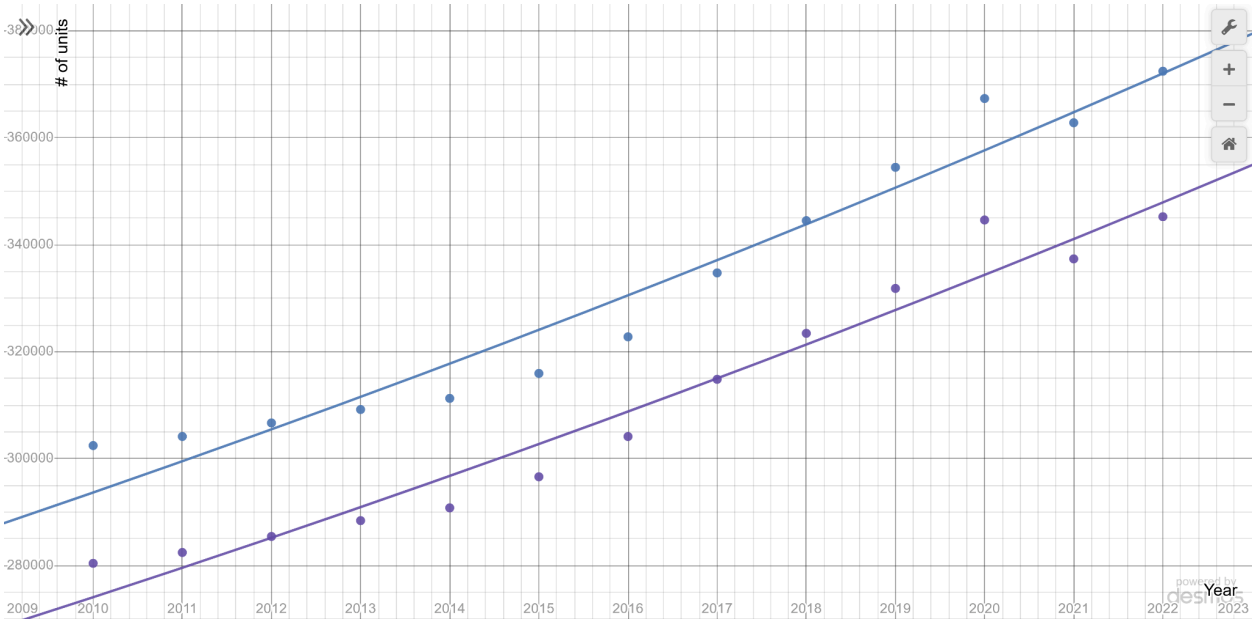
Q1: Create a model that predicts changes in the housing supply in either the two U.S. or two U.K. regions below in the next 10, 20, and 50 years. Indicate your level of confidence in your predictions.



Housing total vs in use (Seattle)

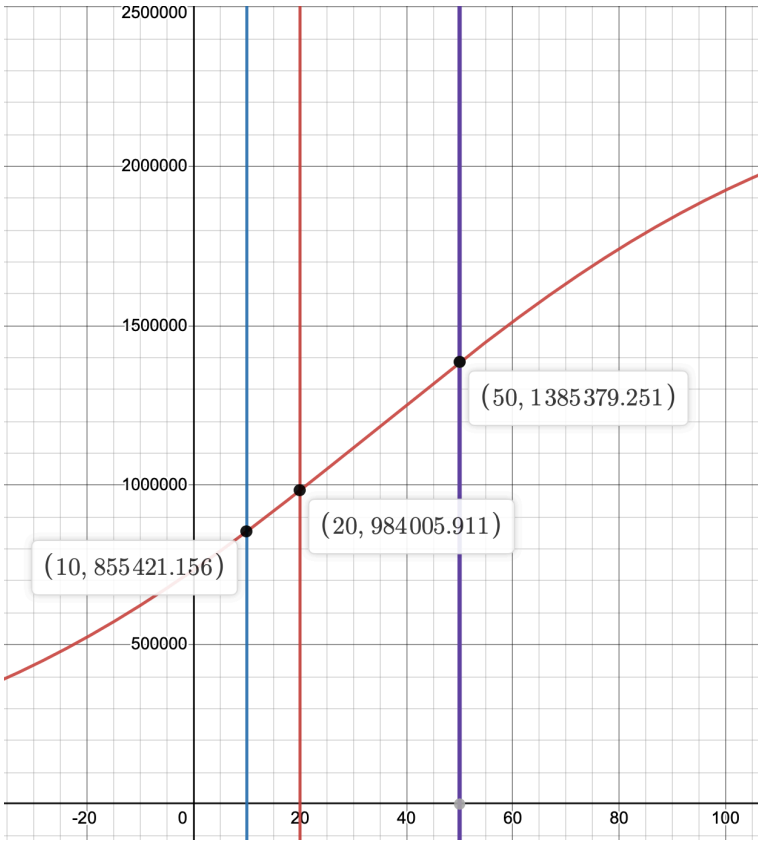
The change in housing supply in Seattle can be represented by comparing the amount of housing with the total population. The graph above illustrates the total housing available in the

city of Seattle represented by the top line, as well as the total number of houses currently occupied represented by the lower line. Taking into account the median number of people per household, one can look at the data and interpret the possible number of people estimated to fit in the available housing that is not being used.



Housing total vs in use (Albuquerque)

This graph depicts the number of housing units in Albuquerque, with the purple points (and accompanying trendline) representing occupied housing units and the blue points and trendline representing housing units in total. In both cases, the number of housing units is steadily increasing. The two datasets show strong correlation and a notable Pearson correlation coefficient of 0.997—in other words, a steady proportion of housing units consistently goes unoccupied.



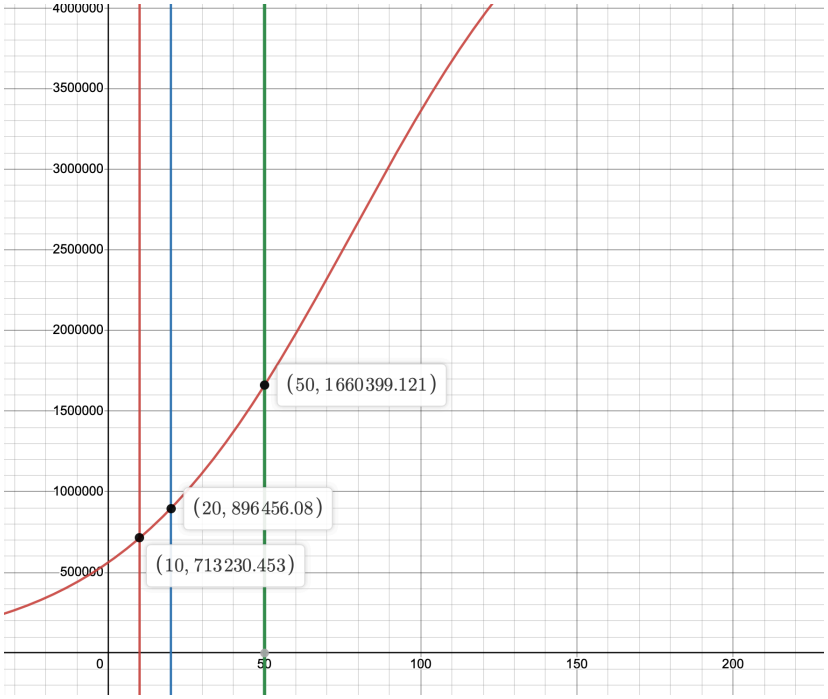
Population forecast for Seattle

One can combine the knowledge of the housing availability and apply it to the forecasted population graph that we made using the Verhulst model. The function that we used was

$P(t) = (KP_\circ * (e^{rt}))/(K + P_\circ * (e^{rt} - 1)$, where P(t)= population size, r= growth rate, K= max number of people possible (Juan Luis Fernández-Martínez, Zulima Fernández-Muñiz, Ana Cernea, Andrzej Kloczkowski).

In order to estimate the maximum number of people that could be in Seattle, the number of square miles in Kings County was calculated and then multiplied by the highest density in a United States city, New York City. When looking at the graph of this, one can see the specific predicted population for every year in Seattle from now until it caps off. In 10 years, the

predicted population is 855,421, in 20 years, the predicted population is 984,006 and, finally, in 50 years, the predicted population is 1,385,379 people.



The same basis was applied for the function on the Albuquerque graph, taking its square mileage and multiplying it by the population density of New York.

It is possible to figure out the amount of people that, in theory, could fit into the unused housing at each of these time points as well. For example, in Seattle, at the 10-year mark, there are 34729 houses not in use, which means if there is a median number of 2.05 people per household, that is space for roughly 71194 people who don't have shelter.

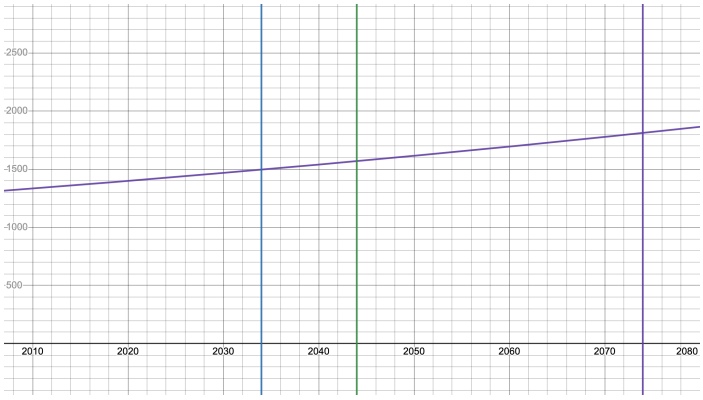
Q2: For the regions you chose in Q1, predict changes in the homeless population in the next 10, 20, and 50 years.

The change in the homeless population in Seattle can be calculated in a similar manner to how the forecasted population graph was made by using the Verhulst model. The main difference between these two cases was the constants used for the carrying capacity, the growth rate, and the current population. In this model, the carrying capacity was determined by multiplying the capped population of Seattle by the rate of homelessness in the city with the greatest rate, that being New York City at 1.2%. The growth rate was calculated by analyzing the change in the homeless population from 2007-2022, and the current population was based on the current population rather than the total population.

This graph shows the increase in the homeless population in future years. Based on previous trends as well as an assumed cap, the data shows that the total homeless population in 10 years will be about 15,276 people, 17,144 in 20 years, and 21,951 in 50 years. These numbers line up well with past trends, taking into account the capacity of the city itself.

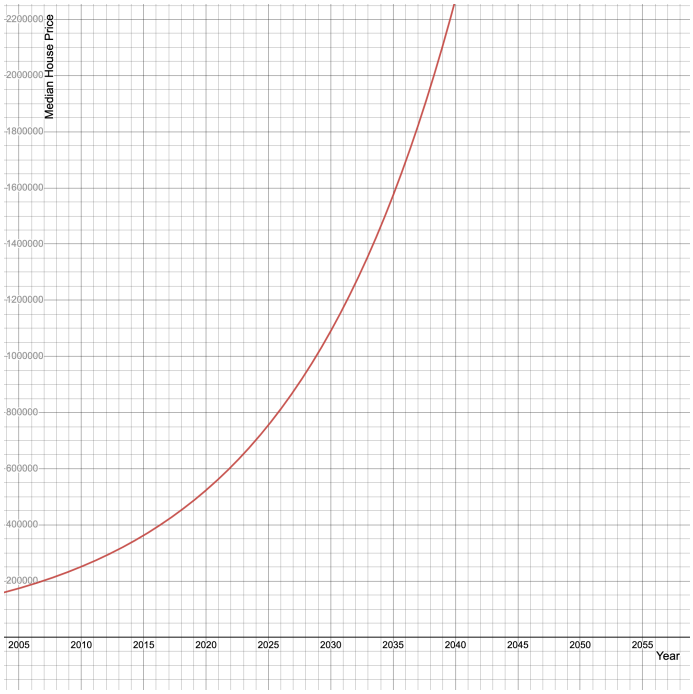
Upon analyzing similar changes in Albuquerque, the Verhulst model did not work well, as the change in the homeless population fluctuated over time due to the limited data set. Instead, the model used is an exponential function to account for the change due to population growth. It

was created based on the data from 2011-2022, removing the data from 2007-2010 due to the inconsistencies from the stock crash in 2008.

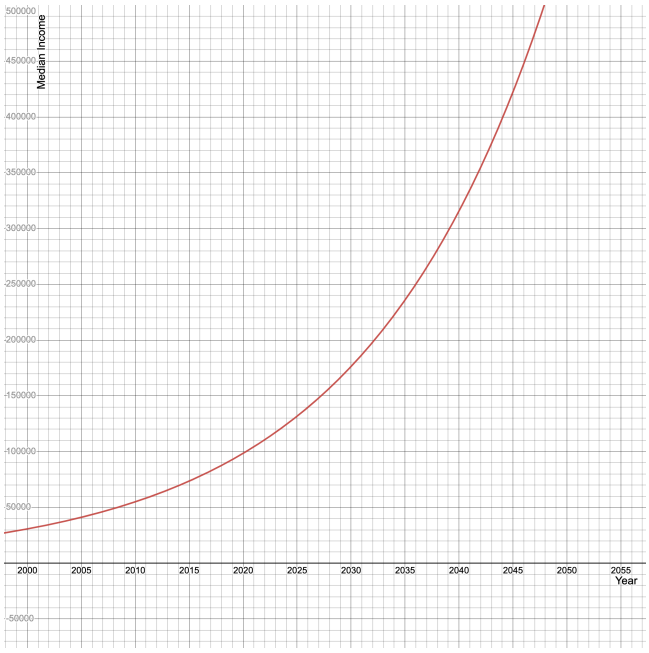


This graph models the increase in the homeless population in Albequerque and projects it to increase to 1,497 in 10 years, 1,570 in 20, and 1,812 in 50. This aligns with the observed fluctuations, taking into account the overall population increase in Albuquerque.

Q3: Considering your results from the first two questions for at least one of the cities, create a model that would help a city determine a long-term plan to address homelessness. How adaptable is your model to unforeseen circumstances like natural disasters, economic recessions, or increased migrant populations?



This graph shows the predicted median house price based on past trends.



Similarly, this graph shows the predicted increase in median income over the years. Comparing these two graphs shows how the median income is not rising at the same rate as the

median housing cost, nor is it on nearly the same scale. This brings to light one of the largest issues of the housing crisis. As seen in the graphs from the first question, the issue is not the sheer amount of housing but rather its affordability. The ideal solution would be to look at the allocation of resources and find a more efficient way to spend the money that is being allocated to outreach programs. For example, in Albuquerque, their rates of homelessness are significantly lower than in Seattle, and the main difference between the two cities is how they allocate their budgets regarding homelessness outreach programs. Albuquerque invests significantly more money into things like housing vouchers with the goal of making housing affordable rather than just trying to get rid of homelessness without tackling the problem at its root. If Seattle's government took a similar approach to how they split up their budget, it could bring positive change to the rate of homelessness in the city. In determining how this model would hold up to external factors, we looked at the effect of natural disasters on homelessness in Seattle. According to the Washington State Department of Labor and Industries, State disasters included a winter storm in 2011. There was a severe winter storm on January 11th that included mudslides, flooding, and landslides. Additionally, in 2012, in January, there was a similar storm followed by a severe storm with flooding and high winds. In 2011, there was a .55% decrease in the total homeless population and a .8% drop in the total population in 2012. In 2011, there was about a 4.1% increase in the total number of homeless people in shelters from 2010 to the total homeless population in 2011. However, despite experiencing two natural disasters, the percentage of homeless people in shelters in 2012 went down by about 1.698%. This data shows that there is little correlation between natural disasters and the total population rate.

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