Rent as A Portion of Income in North Carolina

Anqi Zhou, Caroline Pate, Kaitlyn Underwood, Ziyin Zheng

School of Information and Library Science

INLS 641: Data Visualization

Dr. Sidharth Thakur

Dec 3, 2024

Contents

Introduction

In recent years, rent across the United States has risen significantly, a trend that has only worsened due to the economic effects of COVID-19. This project focuses on North Carolina, exploring whether income growth has kept pace with rising rents and identifying the counties where residents are most burdened by these changes. By analyzing and visualizing data on fair market rent and personal income, we aim to highlight the regions in North Carolina where rent affordability is a pressing concern.

This project aims to serve as an investigative tool within the housing sector, providing valuable insights for renters and other stakeholders in or outside of North Carolina. By addressing critical questions such as whether rent growth has outpaced income growth, identifying regional differences in rent burdens, and pinpointing areas in the state that are most and least affected, this project sheds light on the dynamics of housing affordability. These insights are not only crucial for renters but also for anyone seeking to understand the broader economic trends shaping communities across North Carolina.

This project caters to a diverse range of users, each with unique needs and goals. For individuals moving to North Carolina, who may lack familiarity with the state's geography, the data provides a clear comparison of rent rates and income levels across counties, helping them make informed decisions about where to settle. Similarly, in-state movers benefit from detailed insights on specific counties, enabling them to evaluate potential new locations with a deeper understanding of rent burdens and income trends.

Beyond individual renters, the project also serves stakeholders both within and outside North Carolina. Local policymakers and community advocates can leverage granular data to identify trends, shape policies, and advocate for meaningful changes. At the same time,

companies and organizations outside the state can use this information for strategic planning, such as expanding operations or relocating employees. By addressing these varied user needs, the project bridges the gap between raw data and actionable insights, empowering decision-making for individuals and organizations alike.

This tool aims to answer key questions about income and rental trends in North Carolina. It examines per capita personal income across different counties over multiple years and analyzes rental rates for studio, one-bedroom, two-bedroom, three-bedroom, and four-bedroom apartments over the same period. The tool identifies counties with the lowest and highest rental rates, as well as those with the highest and lowest income levels. Additionally, it explores how income compares to rental rates across countries and tracks these comparisons over multiple years, providing a comprehensive view of the relationship between income and housing costs in North Carolina.

Data Wrangling

The data for this project was gathered from two key federal agencies to provide a comprehensive analysis of rent and income trends in North Carolina. The Bureau of Economic Analysis supplied county-level personal income data, offering a detailed view of income patterns across the state. Additionally, the Office of Policy Development and Research (HUD) provided Fair Market Rent (FMR) data, detailing rent costs for housing types ranging from studios to four-bedroom units, organized by county or metro area. While the primary focus of the analysis spans 2020 to 2022, historical data from 2015 onward was incorporated to capture long-term trends. Together, the dataset includes North Carolina income statistics and rent costs, enabling a thorough exploration of the relationship between rent burdens and income levels across the state.

The data cleaning and transformation process focused on refining the dataset to ensure accuracy and usability for analysis. First, the data was filtered to include only records from North Carolina, narrowing the scope to the state of interest. Non-relevant fields, such as county rankings, were removed to streamline the dataset. To provide a broader context for trend analysis, historical data from 2015 to 2020 was incorporated alongside the primary focus years of 2020 to 2022. Rent costs and income data were then standardized and organized, enabling consistent comparisons across counties. Finally, the cleaned datasets were stored in shared Google Sheets for collaboration and exported as .csv or .json files for integration into visualizations, ensuring efficient data management throughout the project.

To uncover meaningful insights, several statistical analyses were conducted. A line graph was generated to illustrate trends in rent and income growth from 2015 to the present, providing a clear comparison to determine whether rent increases have outpaced income growth over time. To explore regional disparities, a choropleth map was developed, displaying rent burdens as a percentage of income across North Carolina's counties. This visualization highlights areas where residents are most impacted by housing costs. Additionally, a detailed data table was created, allowing users to sort and filter rent costs by housing type and income levels, enabling a more granular exploration of the data. Finally, an analysis of the relationship between Fair Market Rent (FMR) and personal income identified counties with the highest and lowest rent burdens, offering targeted insights into the areas most affected by housing affordability challenges.

Intended Visualization Designs

Visual and Interactive Designs

To begin understanding our users' needs, we sketched three different ideas and determined elements to include in our dataset: a choropleth map, an interactive table, and a line chart. The choropleth map provides users a visual of the state of North Carolina which is especially useful for users from outside the state. The interactive table highlights the county that a user selects on the choropleth map, allowing users to quickly access detailed information for decision-making. Finally, a line chart allows users to see trends in data and how it has changed over time. This is especially useful for users who want detailed information on trends over the years.

Following our sketches, we created wireframes using Figma. We tested a bar chart comparing rental rates to income but found it too redundant. Our goal was to create a simple, yet detailed dashboard to provide our users with relevant information to make decisions. This wireframe served as a reference that guided us through our design and development process.

Reason These Designs Were Chosen

The selected visualizations—line graph, choropleth map, and the combination of a choropleth map with an interactive table—are designed to provide a comprehensive understanding of income and rental trends in North Carolina. We selected our visualizations based on the needs of key user groups which include: individuals moving to a county in North Carolina (either in or out of state), local stakeholders (such as government officials), and stakeholders outside the state of North Carolina (such as companies looking to move to the area). The line graph examines how per capita personal income compares to rental rates over time,

showcasing trends from 2015 to 2022. By illustrating rent as a percentage of income, it enables users to evaluate whether income growth has kept pace with rising rents, offering insights into long-term housing affordability.

The choropleth map highlights regional disparities by visualizing rental rates and rent burdens across North Carolina counties. With darker shading representing higher rent burdens, the map allows users to quickly identify counties with the most and least affordable housing. This spatial overview helps pinpoint areas with extreme housing costs, making regional comparisons accessible and intuitive.

The combination of the choropleth map and interactive table provides both a high-level visual overview and detailed data for deeper analysis. The map helps users identify trends across counties, while the interactive table allows for sorting, filtering, and exploring rent costs by housing type and income levels. Together, these tools enable users to analyze the relationship between income and rent in greater detail, supporting informed decision-making and addressing the diverse needs of stakeholders. These tools also help users see detailed and comprehensive data in a streamlined fashion in order for them to make informed decisions.

Design Process

Line Chart

The line chart, created using D3, represented Per Capita Personal Income and Fair Market Rent Values from all counties in the state of North Carolina from 2015-2022. It includes over 8 years of data to give users a comprehensive understanding of changes in trends over time. Rent was shown as a percentage of income by dividing per capita personal income by 12 to

match monthly rent to monthly income. The chart is interactive, allowing users to select the county they would like to view data from and by allowing users to filter by bedroom number.

The line chart aligns with the project's goal by providing users with a clear picture of how data changes over time. The graph includes search and filter features where users can see information for specific counties and can narrow down their search by a specific bedroom type. This allows individuals to quickly and seamlessly glean information on income trends and how they compare to fair market values.

Choropleth Map

The choropleth map represents 2022 data for each North Carolina county in both the Fair Market Rent and Per Capita Personal Income datasets. Annual income data was divided by 12 and then one-bedroom rents were calculated as a percentage of that value to give users a general idea of how much of their income people in each county spend for just themselves on Fair Market rent. This data was then mapped onto a geojson county-level map of North Carolina and color coded by these percentage values using D3. When a county is clicked, a pop-up displays the exact percentage for that county in addition to highlighting the corresponding row in the interactive table below.

The map aligns with the project's goal of highlighting disparities within the state. We found that even using Fair Market rent data, many counties still had one-bedroom apartments that cost close to or over 30% of the monthly per capita personal income. Having this data represented spatially allows users to easily make comparisons and quickly identify outliers in the data.

Interactive Table

The interactive table, created using the DataTables library, serves as a core component for analyzing North Carolina's rent and income data from 2020 to 2022. It dynamically loads data for each year, presenting details such as rent costs for various housing types (studio to four-bedroom) and per capita income across countries. By leveraging JavaScript arrays and dynamic data population, the table ensures scalability and seamless integration with the project's dataset. Its clean, responsive design enhances usability and supports data exploration effectively.

This table aligns with the project's goal of offering actionable insights into rent burdens and income trends across North Carolina. With advanced features such as sorting, searching, and filtering, users can easily compare data across years or focus on specific counties, enabling informed decision-making. By combining functionality and accessibility, the table empowers a wide range of stakeholders—from renters to policymakers—with a user-friendly tool to explore and analyze critical housing data.

Prototype

Final Prototype

The final prototype for our project can be accessed at the following link: Rent Trends Over Time in North Carolina. This interactive tool showcases the exhibitions of our design and development efforts, featuring integrated visualizations that provide insights into rent burdens across North Carolina.

How the Prototype Answers the Key Questions

Our comprehensive visualization framework integrated three analytical tools—a line graph, choropleth map, and interactive table—to explore the complex dynamics of rent burden across North Carolina. This multi-dimensional approach enabled a detailed investigation of rent-to-income relationships, providing both overall insights and subtle local variations.

The line graph analysis revealed a surprisingly stable rent-to-income landscape from 2015 to 2022. Contrary to initial expectations, rent growth did not consistently outpace income growth. Significant variations emerged across housing types, with larger units (3-4 bedrooms) consistently showing higher rent burdens, while studio and 1-bedroom apartments maintained the lowest rent-to-income percentages. This stability suggests a balanced housing market with underlying regional consistency.

The choropleth map provided a powerful spatial visualization of rent burden distribution, highlighting significant geographic disparities. It visually highlights the percentage of rent burden for each county, with darker shades indicating higher burdens. For instance, Johnston County showed a 25.92% rent burden, in stark contrast to Brunswick County's 16.74%. This visualization enabled quick identification of regional economic differences, transforming complex data into an intuitive geographic representation.

Our interactive design, which integrates a choropleth map with an information table, facilitates sophisticated data exploration. The choropleth map offered a high-level spatial overview, while the accompanying interactive table allowed users to filter, sort, and search for specific county-level details. This seamless integration empowered users to cross-reference data between visualizations, discovering subtle insights that might otherwise be overlooked in traditional reporting approaches.

These analytical tools ultimately revealed a comprehensive landscape of North Carolina's housing market. Despite significant county-level variations, the findings demonstrated a consistent underlying pattern in rent-to-income relationships across different housing types. The multi-dimensional visualization approach provided unprecedented insights into the complex dynamics of housing affordability.

Ethical and Societal Considerations

Ethical and societal responsibilities were central to the design and implementation of our project. We focused on data accuracy, accessibility, and responsible communication to ensure the project's relevance and positive impact on diverse audiences.

Data accuracy and integrity were prioritized to maintain the credibility and reliability of our visualizations. We relied on trusted federal data sources, including HUD and BEA, to avoid misleading insights. Transparency was also a key consideration—every step of our data cleaning and transformation process was thoroughly documented to build trust with users and ensure accountability. This commitment to data integrity was critical to producing accurate and actionable insights.

Accessibility and equity were essential components of our project's design. Housing affordability is a neglectable societal issue, particularly for low-income renters and other marginalized groups. To address this, we developed clear, user-friendly visualizations that simplify complex data for diverse audiences, ensuring that users could benefit from the insights provided by our project. This focus on equity ensured that the project could serve those most impacted by rent burdens.

Responsibility in Communication guided how we presented findings to prevent misinterpretation or misuse. For example, we carefully framed high-rent burden areas to avoid

stigmatization of specific communities. Furthermore, we clearly communicated the limitations of our data to enable users, including policymakers and researchers, to make informed decisions. This approach ensured that the project's insights were used constructively to address housing challenges.

By prioritizing data accuracy, accessibility, and responsibility in communication, our project maintained high ethical standards and maximized societal impact. These considerations not only enhanced the quality of our work but also ensured it could serve as a valuable tool for addressing housing affordability and rent burdens in North Carolina.

Reflections

Our team's process in developing the North Carolina Rent Burden Visualization project was characterized by both strategic adherence to our initial plans and adaptive problem-solving. We successfully implemented our core vision of creating three interconnected visualizations: a line graph, a choropleth map, and an interactive table, while also introducing unexpected innovations along the way.

The development process revealed both challenges and strengths in our team's approach. Data preparation emerged as the most complex phase, with significant time invested in merging and cleaning datasets from multiple sources. What we initially anticipated as a straightforward data integration process became a time-consuming exercise in ensuring data consistency and accuracy. Technically, developing the linkage between the table and map involved advanced coding and debugging, which took longer than anticipated and required extensive debugging and collaborative problem-solving. But at the same time, the experience forced our team to develop more sophisticated programming skills and collaborative problem-solving strategies.

Our development process highlighted the importance of flexibility and adaptive thinking. While we largely adhered to our original project scope, we learned to view challenges as opportunities for innovation. The iterative nature of our work allowed continuous refinement, though we recognized the missed opportunity of incorporating user feedback earlier. While the interactive elements significantly enhanced usability, earlier user input could have further improved our approach, underscoring the importance of user-centered design in data visualization.

By the end of this semester, we had not only developed a set of visualizations but also created a comprehensive tool offering meaningful insights into rent burdens across North Carolina. More importantly, we had grown as a team, developing critical skills in collaborative problem-solving, technical implementation, and adaptive design. The project transcended its initial technical objectives, becoming a profound learning experience that demonstrated our ability to navigate complex data visualization challenges. Overall, the project reinforced key lessons about successful project development: the value of flexibility, the importance of collaborative problem-solving, and the need to balance ambitious goals with practical constraints.