**City of Rockville Population Projection**

**and**

**Dashboard Project**

Montgomery College

Data 205 Capstone Project Course

CRN 22017: Professor Jane Valentine

In Partnership with

the City of Rockville Planning and Community Development Services

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Mentors: Manisha Tewari, Abe Bruckman, and Willie Choi

**Fall 2024**

**Purpose**

This project is being completed in Fall 2024, as part of the Data 205 Capstone course at Montgomery College, in collaboration with the City of Rockville’s Planning and Community development Services Department.

**Primary Objective**

**Primary Objectives**  
This project aims to achieve the following two key objectives:

1. **Develop a Public Dashboard**: Design an interactive Power BI dashboard for the City of Rockville, which will be featured on the city’s official website. The dashboard will visualize essential data related to demographics, economics, housing, and other key metrics of the city.
2. **Developing Population Projection by Age Group**: Perform an analysis based on the projection trend across different age groups in order to support strategic and administrative decisions. This analysis will compare at least two sets of census datasets to identify demographic trends and assess their impact on housing affordability.

**Part I: The Dashboard Project**

The dashboard was created using data on population, housing, economic, poverty, and social characteristics from the U.S. Census Bureau and the American Community Survey (2020 and 2022).

**Tools**

The data was downloaded from the Census Bureau in Excel format and aggregated within the same format. Microsoft Power BI was then used to build the dashboard.

The dashboard consists of four pages: **Demographic Characteristics**, **Economic Characteristics**, **Housing Characteristics**, and **General Indicators**. Each page features distinct visualizations highlighting key metrics relevant to the respective themes.

The final product of the dashboard has been submitted to the city of Rockville, planning and community services and distributed for internal review as follows.

“City staff Manisha Tewari, Abe Bruckman and Willie Choi partnered with two Montgomery College interns, Nancy Condon and Tigist Wujira as a part of the capstone project with the [Data Science Program at Montgomery College](https://www.montgomerycollege.edu/academics/programs/data-science/index.html). The students successfully completed a project with census data to prepare dashboards for the City that highlights its demographic, economic and social conditions using visualization techniques. The dashboard can be viewed [here](https://app.powerbigov.us/view?r=eyJrIjoiNjFmNGE1MjAtOTczMS00MmM3LTk1ZDQtZWRhNGM3ZTNlNTRkIiwidCI6ImM0MWFmMWZhLWU5NTUtNDc1NS1iODQ2LWE0ZTM1NjMzMGFjZiJ9).”

***\*Note:*** *the dashboard has been published on the official website of the city of Rockville under*[**Community Data & Trends | Rockville, MD - Official Website**](https://www.rockvillemd.gov/610/Community-Data-Trends) **.**

**Part II: Population Projection**

While the City of Rockville has population estimates for upcoming years, the lack of detailed data on the growth of individual cohort groups complicates planning efforts. The city aims to enhance its understanding of population projections segmented by age groups to better support strategic initiatives. This data is particularly critical for addressing the ongoing housing crisis, as it enables the city to anticipate the future needs of diverse population segments, including young families, working adults, and seniors.

To address this, the city initiated this project to envision how its demographics might shift in the coming years. By reviewing the results of this project, Rockville can make informed decisions about housing development, resource allocation, and infrastructure improvements, ensuring that the needs of all age groups are met effectively and sustainably.

**Techniques**

**The Hamilton-Perry Method**

The standard cohort-component method typically requires data on birth rates, death rates, and migration rates. However, census data alone does not provide complete information in these areas. To address this limitation, we employed the Hamilton-Perry method.

The primary advantage of the Hamilton-Perry method is its relatively modest data requirements compared to the traditional cohort-component approach. Instead of relying on detailed mortality, fertility, and migration data alongside total population figures, the Hamilton-Perry method only requires data from the two most recent censuses. This streamlined approach enables us to generate robust projections while working within the constraints of available data.

The Hamilton–Perry method projects population by age and sex using cohort-change ratios (CCR) computed from data in the two most recent censuses. In our analysis, we used the 2010 and 2020 censuses.

The formula for calculating the CCR is:

nCCRx

Where:

* +y, l: Population aged x+y to x+y+n in the most recent census(l).
* ,b: Population aged x to x+n + n in the second most recent census (b)
* y: Number of years between the two most censuses (l-b)

For example, the 30–34-year-old men in 2010 then we can calculate a rate of change by looking at the 40–44-year-old men in 2020. We can apply this rate of change to the 30–34-year-old men in 2020 to get a projected value of 40 44-year-old in 2030.

* **(using 2010 and 2020 census data):**  
  For the population aged 30–34 in 2010: 5CCR30

The basic formula for projecting population using the Hamilton–Perry method is:

+z = nCCRx \*

2030Projection40-44 = 5CCR30 \* 5P30, 2020

For more details refer appendix A and appendix B on the reference page at the end of the report.

The above formula applies to almost all ages groups except for the youngest cohort. For the cohorts aged 0-10, we used the Child-Woman Ratio (CWR).

**CWR Formulas:**

* **For 0–4 age group (2020):**
* **For 5–9 age group (2020):**

For more information refer appendix C on the reference page at the end of the report.

**Analysis of Results**

Here is an overview of the estimated and projected demographic shift trends for selected age cohorts across the decades:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Estimated** | | **Projected** | |  | **Percent** | | | |
| Age Cohort | **2010** | **2020** | **2030** | **2040** |  | **2010** | **2020** | **2030** | **2040** |
| Age 0-4 | 4,002 | 3,576 | 4,100 | 4,593 |  | 6.5% | 5.3% | 5.6% | 5.7% |
| Age 5-14 | 7,070 | 7,578 | 7,743 | 8,731 |  | 11.6% | 11.3% | 10.6% | 10.8% |
| Age 15-24 | 6,500 | 7,682 | 8,269 | 8,387 |  | 10.6% | 11.5% | 11.3% | 10.4% |
| Age 25-44 | 18,992 | 20,183 | 23,059 | 26,085 |  | 31.0% | 30.1% | 31.5% | 32.4% |
| Age 45-64 | 16,103 | 16,685 | 16,477 | 17,540 |  | 26.3% | 24.9% | 22.5% | 21.8% |
| Age 65+ | 8,542 | 11,413 | 14,257 | 15,509 |  | 13.9% | 17.0% | 19.3% | 19.2% |
| **Total** | 61,209 | 67,117 | 73,905 | 80,845 | **Growth rate** | **\_\_** | 9.6% | 10.1% | 9.4% |

The total population is expected to increase by **20.4% over 20 years**, indicating a significant upward trend.

In 2020, the 30-34 age group was the largest cohort, representing 8.21% of the population. Logically, the 40-44 age group would be expected to be still the largest decade later. However, the 2030 projection indicates that the 30-40 age group will be still the largest, representing 8.48% of the population. Notably, the 30-34 cohort in 2030 corresponds to the 20-24 cohort from 2020. Due to a lack of detailed data on mortality and migration rates, we cannot determine the exact reason for the demographic shift.

In both the 2030 and 2040 projections, more than 19% of the population will be aged 65 and older. In contrast, the 25 to 44 age group consistently accounts for over 30% of the population across the decades.

A graph of a graph showing the number of cohort projections

Description automatically generated with medium confidence

**The Five-Year Estimations**

The Hamilton-Perry method operates under the key assumption that age-specific change ratios remain constant over time. This means that if the change ratio for the age group 10-14 is determined to be 1.06 when projecting the population for the 20-24 age group in 2030, the same change ratio of 1.06 will be applied to project the 20-24 age group for subsequent intervals, such as 2040.

This assumption simplifies the projection process by holding the relationship between successive age groups steady over time, irrespective of external factors or demographic shifts. For the purposes of this paper, we adopted this assumption to project the population in 5-year intervals as well. While this approach ensures consistency in the projections, it is worth noting that actual demographic dynamics might deviate from this assumption due to factors such as migration, changes in birth and death rates, or policy interventions. Nonetheless, the Hamilton-Perry method provides a practical and reliable framework for short- to medium-term population forecasting in the absence of detailed data.

To estimate population values at five-year intervals, we utilized interpolation methods. This approach involved using mathematical techniques to generate intermediate data points between known values, enabling us to create a smooth and continuous representation of the population trends. By applying these methods, we ensured that the estimated data accurately reflected the projected changes for each age group over the specified intervals, providing a reliable foundation for further analysis and planning.

Refer the GitHub page for the interpolation code on python: [Data205\_Project/Interpolation\_RV.ipynb at main · Twujira/Data205\_Project](https://github.com/Twujira/Data205_Project/blob/main/Interpolation_RV.ipynb)

**Results in table and charts:**

A screenshot of a graph

Description automatically generated

**The line chart below shows**:

* Despite variations within each cohort, both males and females exhibit a positive linear trend over time.
* The female population exceeds the male population by at least 10% at various points in time.
* Based on our projections, from 2020 to 2040, the female population is expected to grow by 23%, while the male population will grow by only 17.7%.

*\*Note: The Y-axis on the line chart starts at 25,000.*

A graph with numbers and a red line

Description automatically generated

**Accuracy of the projection**

The Hamilton-Perry method is particularly suitable when components of change, such as birth, death, and migration rates, are unavailable, as is often the case for sub-counties or regions. Although Rockville is not a county, its population size falls within the 75th percentile of county populations. For the purposes of this paper, we have chosen to treat Rockville as a county.

“At the level of U.S. counties or their equivalents, the Hamilton-Perry method has demonstrated strong performance, with reported errors ranging from 6% to 16% in previous comprehensive nationwide evaluations conducted in the U.S. (Sprague 2013; Hauer 2019) and Australia (Wilson 2016).” (Baker, Swanson, Tayman, 2021)

“At the sub-county level, this method has been considered particularly advantageous because it helps avoid challenges associated with using incompletely geocoded administrative data sources (Baker et al., 2013, 2014, 2017” (Baker, Swanson, Tayman, 2021)

**Conclusion**

While the error range of 6% to 16% is generally acceptable for broad planning purposes, it is important to recognize that this method may not accurately capture rapid demographic shifts or unusual local trends. This limitation is particularly relevant in areas experiencing high population volatility due to factors such as migration, economic disruptions, or policy changes.

However, in the case of Rockville, the growth rate has historically been relatively stable, with no significant indicators of abrupt demographic fluctuations. This consistency in population dynamics reduces the likelihood of deviations from the projections generated by the Hamilton-Perry method. Therefore, we can conclude that the results are reliable and suitable for use in planning and decision-making, particularly for short- to medium-term initiatives.

**Recommendations**

Given that over 19% of the population will be aged 65 and older by 2040, city officials should prioritize planning for affordable and accessible senior housing developments, including options for assisted living. Additionally, enhancing social services and recreational programs tailored to the needs of the elderly population is essential to improve their quality of life and foster community engagement.

With the 25-44 age group consistently representing over 30% of the population, the city should invest in initiatives that attract and retain this economically productive demographic. Key actions include developing career advancement programs, offering incentives for businesses to hire locally, and fostering a robust job market. Furthermore, addressing housing affordability is crucial to ensure this age group can live and work in the city, thereby supporting long-term economic stability and growth.

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**Appendix A: Estimated and projected population**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2010 Estimates | | 2020 Estimates | | 2030 Projected | | 2040 Projected | |
| Cohort Age | 2010  Male | 2010 Female | 2020  Male | 2020 Female | 2030  Male | 2030 Female | 2040 Male | 2040 Female |
| 0 to 4 years | 2,031 | 1,971 | 1,827 | 1,749 | 2,095 | 2,005 | 2,347 | 2,246 |
| 5 to 9 years | 1,950 | 1,837 | 1,877 | 1,884 | 2,162 | 2,170 | 2,406 | 2,415 |
| 10 to 14 years | 1,641 | 1,642 | 1,954 | 1,863 | 1,758 | 1,653 | 2,015 | 1,895 |
| 15 to 19 years | 1,642 | 1,487 | 1,965 | 1,926 | 1,891 | 1,975 | 2,179 | 2,275 |
| 20 to 24 years | 1,718 | 1,653 | 1,816 | 1,975 | 2,162 | 2,241 | 1,945 | 1,988 |
| 25 to 29 years | 2,245 | 2,258 | 2,382 | 2,473 | 2,851 | 3,203 | 2,744 | 3,285 |
| 30 to 34 years | 2,326 | 2,587 | 2,663 | 2,847 | 2,815 | 3,402 | 3,352 | 3,859 |
| 35 to 39 years | 2,446 | 2,503 | 2,549 | 2,699 | 2,705 | 2,956 | 3,237 | 3,829 |
| 40 to 44 years | 2,224 | 2,403 | 2,193 | 2,377 | 2,511 | 2,616 | 2,654 | 3,125 |
| 45 to 49 years | 2,249 | 2,454 | 2,051 | 2,265 | 2,137 | 2,442 | 2,268 | 2,675 |
| 50 to 54 years | 2,069 | 2,227 | 1,985 | 2,232 | 1,957 | 2,208 | 2,241 | 2,430 |
| 55 to 59 years | 1,741 | 1,990 | 2,026 | 2,260 | 1,848 | 2,086 | 1,925 | 2,249 |
| 60 to 64 years | 1,560 | 1,813 | 1,784 | 2,082 | 1,712 | 2,087 | 1,688 | 2,064 |
| 65 to 69 years | 1,096 | 1,346 | 1,460 | 1,762 | 1,699 | 2,001 | 1,549 | 1,847 |
| 70 to 74 years | 777 | 951 | 1,245 | 1,494 | 1,424 | 1,716 | 1,366 | 1,720 |
| 75 to 79 years | 639 | 864 | 859 | 1,216 | 1,144 | 1,592 | 1,332 | 1,808 |
| 80 to 84 years | 511 | 743 | 575 | 836 | 921 | 1,313 | 1,054 | 1,508 |
| 85 years and over | 475 | 1,140 | 676 | 1,290 | 878 | 1,569 | 1,224 | 1,817 |
| Total | **29,340** | **31,869** | **31,887** | **35,230** | **34,670** | **39,235** | **37,526** | **43,321** |

**Appendix B: Ratios of change**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age in 2010 | Age in 2020 | 2010  Male | 2020  Male | Change Ratio |
| 0 to 4 years | 10 to 14 years | 2,031 | 1,954 | 0.962 |
| 5 to 9 years | 15 to 19 years | 1,950 | 1,965 | 1.008 |
| 10 to 14 years | 20 to 24 years | 1,641 | 1,816 | 1.107 |
| 15 to 19 years | 25 to 29 years | 1,642 | 2,382 | 1.451 |
| 20 to 24 years | 30 to 34 years | 1,718 | 2,663 | 1.550 |
| 25 to 29 years | 35 to 39 years | 2,245 | 2,549 | 1.135 |
| 30 to 34 years | 40 to 44 years | 2,326 | 2,193 | 0.943 |
| 35 to 39 years | 45 to 49 years | 2,446 | 2,051 | 0.839 |
| 40 to 44 years | 50 to 54 years | 2,224 | 1,985 | 0.893 |
| 45 to 49 years | 55 to 59 years | 2,249 | 2,026 | 0.901 |
| 50 to 54 years | 60 to 64 years | 2,069 | 1,784 | 0.862 |
| 55 to 59 years | 65 to 69 years | 1,741 | 1,460 | 0.839 |
| 60 to 64 years | 70 to 74 years | 1,560 | 1,245 | 0.798 |
| 65 to 69 years | 75 to 79 years | 1,096 | 859 | 0.962 |
| 70 to 74 years | 80 to 84 years | 777 | 575 | 0.784 |
| 75 years and over | 85 years and over | 1,625 | 676 | 0.416 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age in 2010 | Age in 2020 | 2010 Female | 2020 Female | Change Ratio |
| 0 to 4 years | 10 to 14 years | 1,971 | 1,863 | 0.945 |
| 5 to 9 years | 15 to 19 years | 1,837 | 1,926 | 1.048 |
| 10 to 14 years | 20 to 24 years | 1,642 | 1,975 | 1.203 |
| 15 to 19 years | 25 to 29 years | 1,487 | 2,473 | 1.663 |
| 20 to 24 years | 30 to 34 years | 1,653 | 2,847 | 1.722 |
| 25 to 29 years | 35 to 39 years | 2,258 | 2,699 | 1.195 |
| 30 to 34 years | 40 to 44 years | 2,587 | 2,377 | 0.919 |
| 35 to 39 years | 45 to 49 years | 2,503 | 2,265 | 0.905 |
| 40 to 44 years | 50 to 54 years | 2,403 | 2,232 | 0.929 |
| 45 to 49 years | 55 to 59 years | 2,454 | 2,260 | 0.921 |
| 50 to 54 years | 60 to 64 years | 2,227 | 2,082 | 0.935 |
| 55 to 59 years | 65 to 69 years | 1,990 | 1,762 | 0.885 |
| 60 to 64 years | 70 to 74 years | 1,813 | 1,494 | 0.824 |
| 65 to 69 years | 75 to 79 years | 1,346 | 1,216 | 0.903 |
| 70 to 74 years | 80 to 84 years | 951 | 836 | 0.879 |
| 75 years and above | 85 years and over | 2747 | 1,290 | 0.4696 |

**Appendix C: Child-Woman Ratio**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2020 Estimate | | |  |  | 2030 projection |  |
| Boys (A) | | Potential Mothers (B) | | CWR (A/B) [C] | Potential Mothers (D) | Projection (C\*D) |
| 0 to 4 Years | 1,827 | Age 15 to 44 | 14,297 | =0.128 | 16,393 | 0.128\*16,393  =2,095 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2020 Estimate | | |  |  | 2030 projection |  |
| Girls (A) | | Potential Mothers (B) | | CWR (A/B) [C] | Potential Mothers (D) | Projection (C\*D) |
| 5 to 9 Years | 1,877 | Age 20 to 49 | 14,636 | =0.128 | 16,860 | 0.128\*16,860  =2,162 |

\*The same computation is applied to the 0 to 4 and 5 to 9 age group of the girls’ population.

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