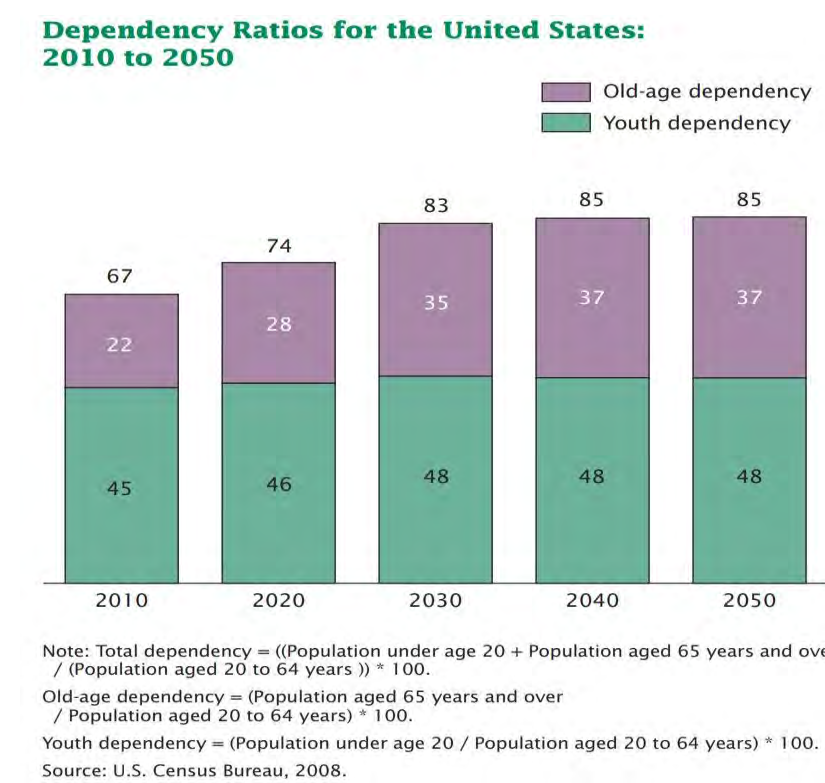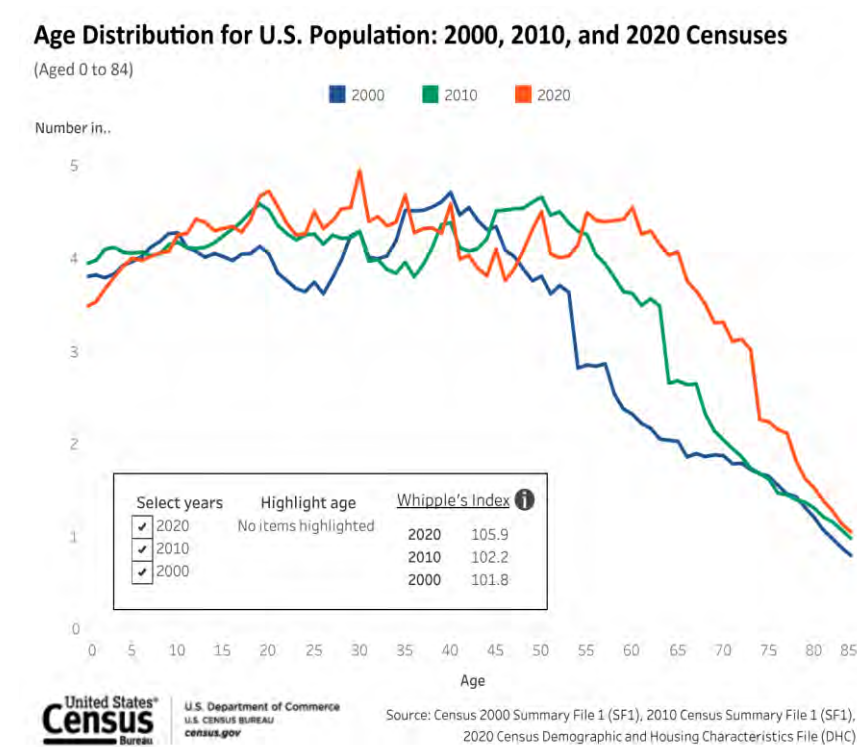# Analysis & Projections of Population Changes in U.S.: 2000-2050
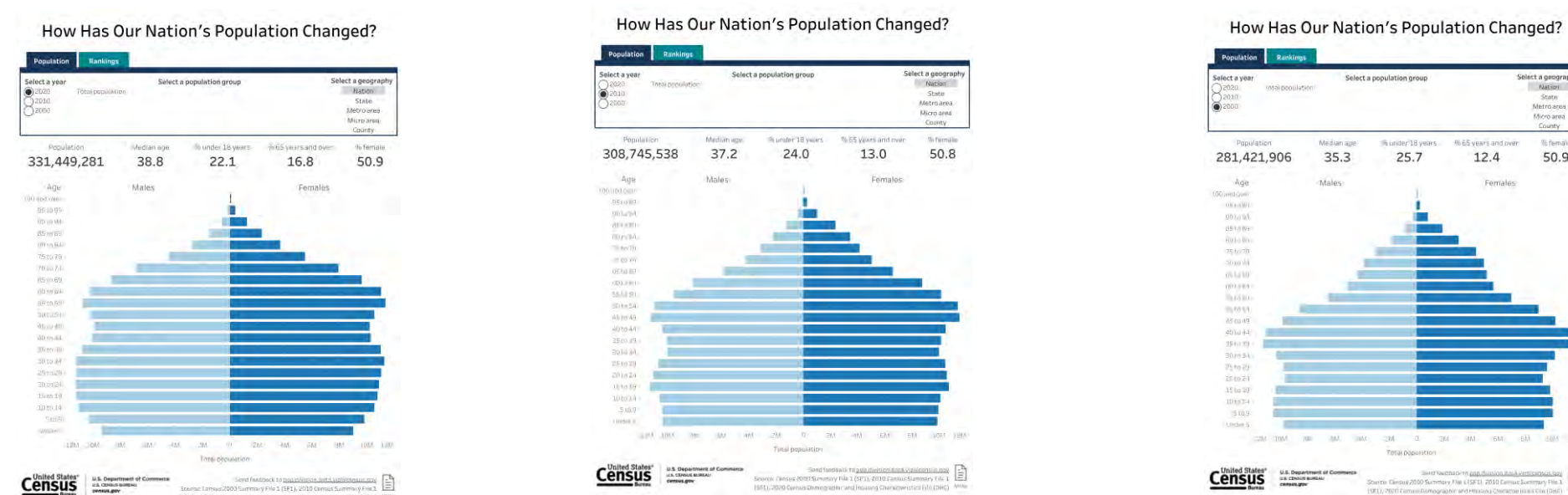
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MAT 495 – Spring 2024
CISA, Polytechnic Applied Mathematics

ASU College of Integrative Sciences and Arts — ARIZONA STATE UNIVERSITY

CISA Student Showcase

Introduction

➢ Between 2000 and 2020, the US experienced significant population growth, with a population of 331 million. Immigration trends and demographic changes, driven by births and deaths, were key drivers. The baby boomer generation's aging has also contributed to this growth. Despite a slowdown, projections suggest continued population growth.

➢ The U.S. Census Bureau predicts a population of 360 million by 2050, requiring analysis of factors like birth rates, death rates, ethnic diversity, age distribution, and gender to understand trends.

Age Distribution for U.S. Population: 2000, 2010, and 2020 Censuses

Dependency Ratios for the United States: 2010 to 2050

Note: Total dependency = ((Population under age 20 + Population aged 65 years and over) / (Population aged 20 to 64 years)) * 100.
Old-age dependency = (Population aged 65 years and over / Population aged 20 to 64 years) * 100.
Youth dependency = (Population under age 20 / Population aged 20 to 64 years) * 100.
Source: U.S. Census Bureau, 2008.

Source: Census 2000 Summary File 1 (SF1), 2010 Census Summary File 1 (SF1), 2020 Census Demographic and Housing Characteristics File (DHC)

Population Data
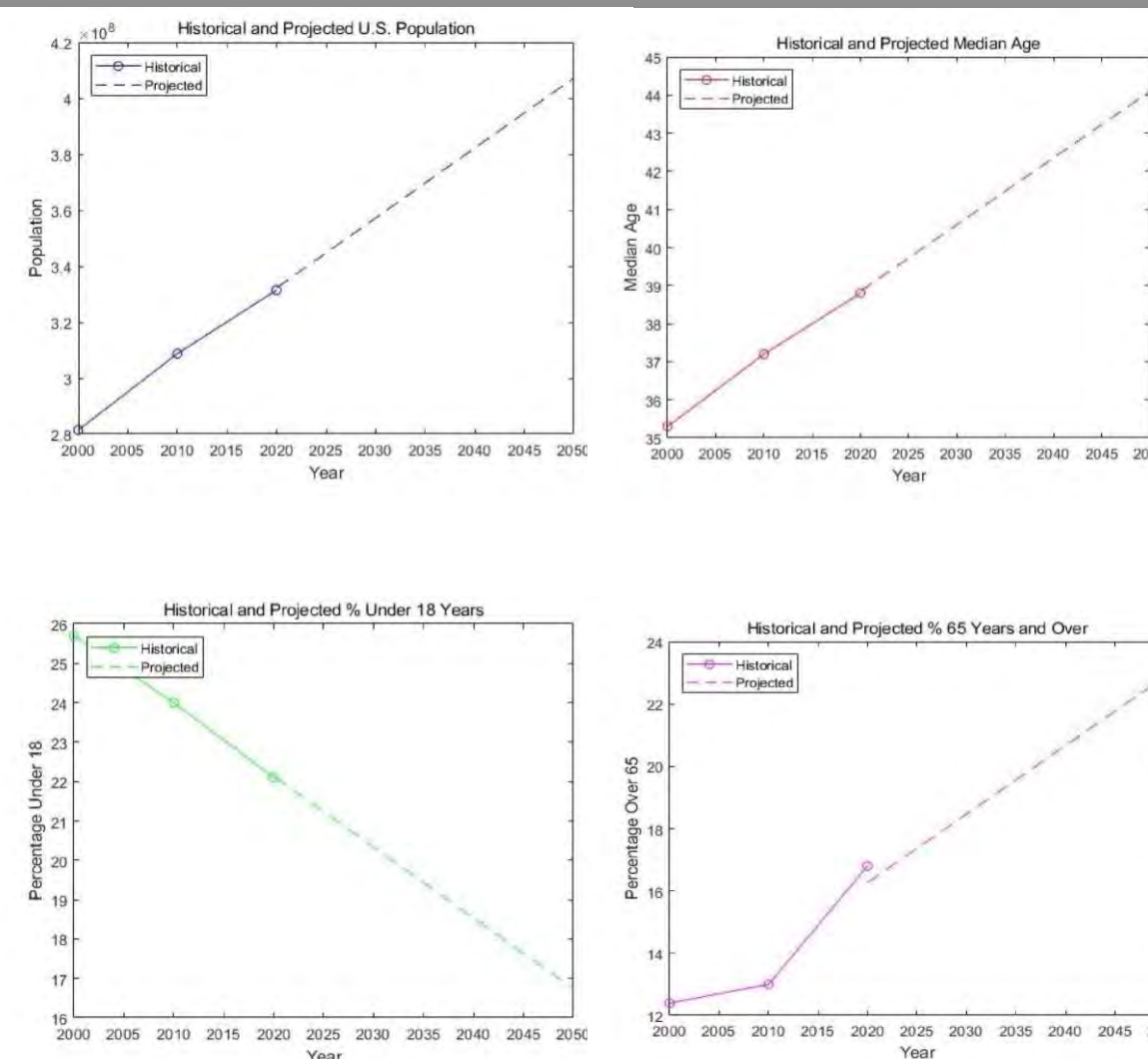

How Has Our Nation's Population Changed?

The charts depict the U.S. population's age, gender balance, and size changes over the past two decades, with males and females comprising around half of the total population between 2000 and 2020.
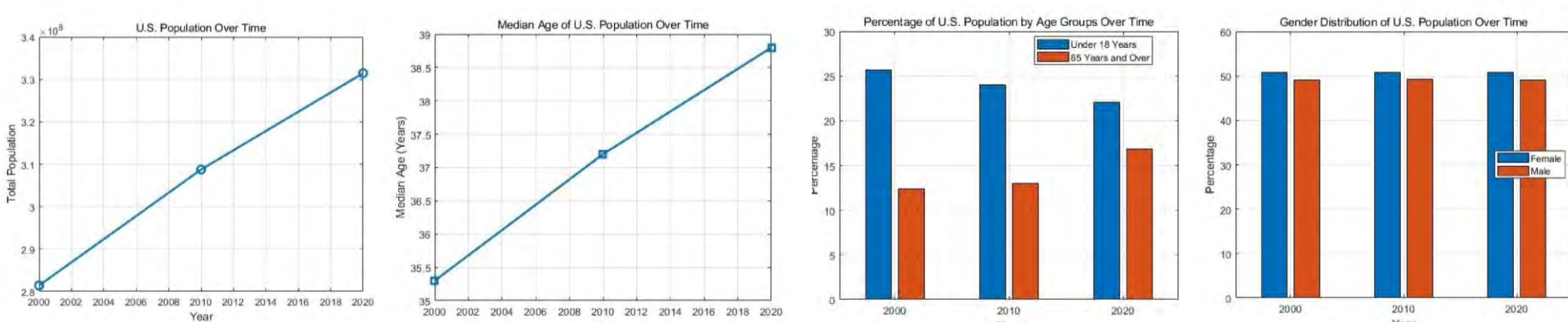

The U.S. Census Bureau has revealed demographic shifts, including an expanding adult population, a declining adult population, and an aging population. The median age has increased from 35.5 to 39 years, impacting welfare, healthcare, and retirement schemes. The data also shows an upward trend in mortality rates, presenting challenges and opportunities for policymakers.

Hypothesis

Historical and Projected U.S. Population

Historical and Projected Median Age

Historical and Projected % Under 18 Years
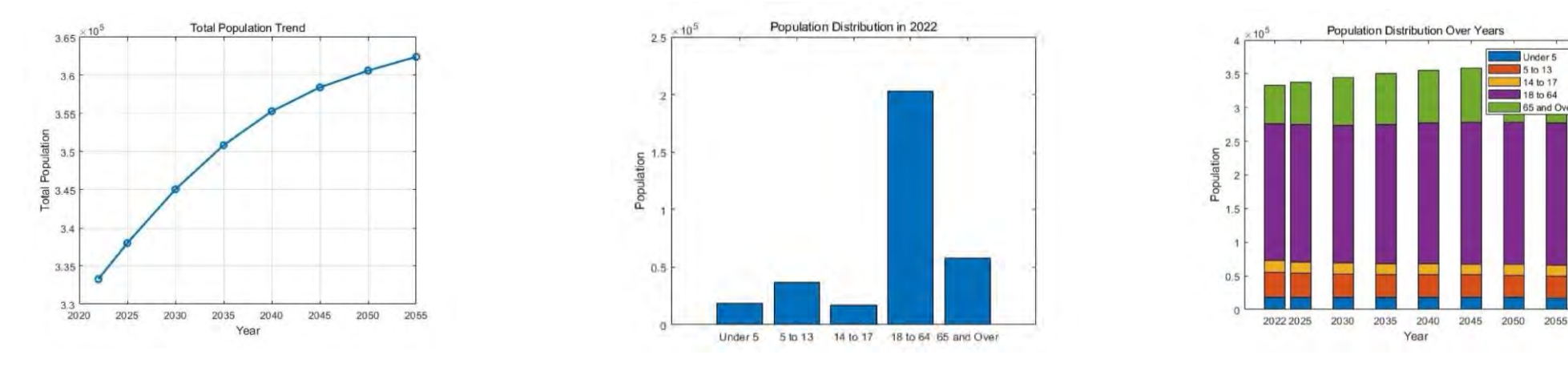
Historical and Projected % 65 Years and Over

➢ **Data Collection:** Historical data on demographic indicators, including total population, median age, proportion of under 18, 65+, and female population, was collected from 2000, 2010, and 2020.

➢ **Linear Model Fitting:** Graphs show historical data of an aging population, decreasing under-18, increasing over 65, and projected future growth, with solid lines for future projections.

➢ **Validation and limitations:** The MATLAB code requires validation by comparing it with data and recognizing its constraints. It ensures estimated demographic percentages stay within a 0% to 100% range, as linear regression assumes a rate of change.

Model I

Projected Overall Growth Rates
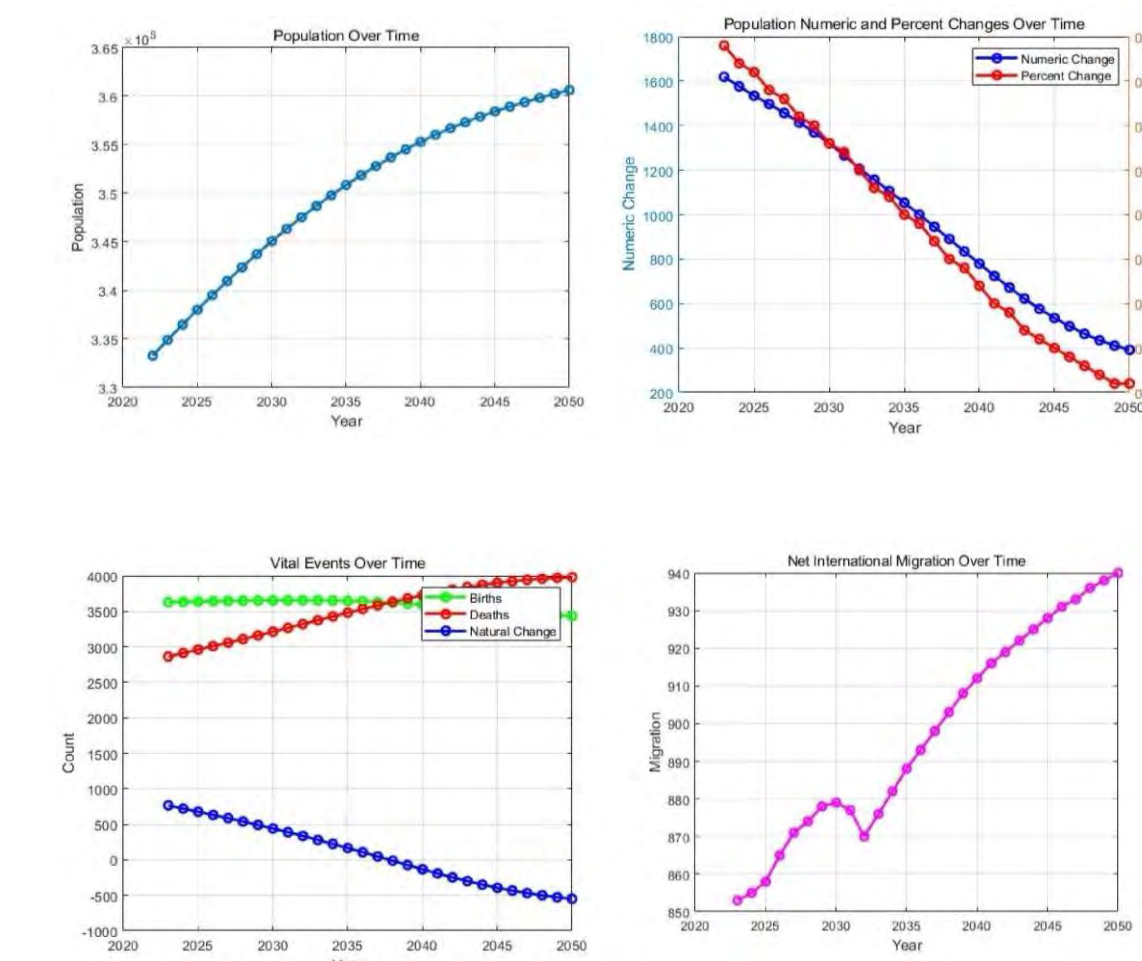
Projected White Population Based on Growth Rates
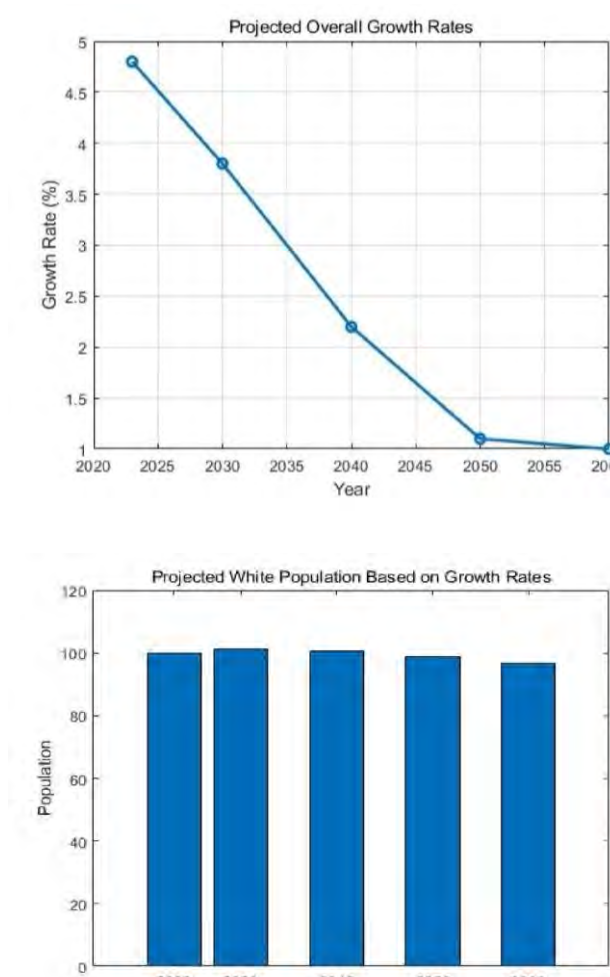
Initial data: The initial preparation phase specifies growth rates for overall and white populations, with the Caucasian population baseline for 2023 serving as the foundation for prognosis.

Equation:

➢ The formula for population growth rate:

$$P_i = P_{i-1} \times \left(1 + \frac{r}{100}\right)$$

Where Pi is the projected population for the current year, Pi-1 is the population for the previous year, and r is the growth rate for the current year.

➢ Overall Population Growth Equation:

$$Growth\ Rate = \frac{Population\ at\ Year\ n - Population\ at\ Year\ (n-1)}{Population\ at\ Year\ (n-1)} \times 100$$

➢ White Population Projection Equation:

$$P_{White,\ Year\ n} = P_{White,\ Year\ (n-1)} \times \left(1 + \frac{r_{white}}{100}\right)$$

Model II

Total Population Trend

Population Distribution in 2022

Population Distribution Over Years

Initial data: The method uses linear plotting for population trends, while age group distribution uses categorical data for each year. Projections use base data starting in 2022, providing age-specific data for forecasting.

Equation:

$$P_{future} = P_{current} + (GR \times P_{current})$$

Where:
P_{future} is the projected future population.
$P_{current}$ is the current population.
GR is the growth rate.

Model III

Population Over Time

Population Numeric and Percent Changes Over Time

Vital Events Over Time

Net International Migration Over Time

Initial data: Population estimates from 2022-2050 are used for modeling, sourced from databases and historical records. Birth and death statistics calculate natural population changes and net international migration.

Equation:

➢ Numeric Change:
$$NumericChange_t = Population_t - Population_{t-1}$$

➢ Percent Change:
$$PercentChange_t = \left(\frac{Population_{t-1}}{NumericChange_t}\right) \times 100$$

➢ Natural Change:
$$NaturalChange_t = Births_t - Deaths_t$$

Conclusions

Between 2000 and 2023, the United States experienced rapid population growth, increasing median age, and greater racial and ethnic diversity. As the baby boomer generation enters the 65 and older population, the aging population is expected to change, leading to increased racial and ethnic diversity.

Citations

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Acknowledgements