Age Analysis of Registered Voters in Durham County, North Carolina, United States of America

Introduction

This project analyzed the distribution of age for registered voters in Durham County, North Carolina. The data used in this analysis was sourced from the North Carolina State Board of Elections. This data was accessed on September 16th, 2024. Please note that this is not a representative sample of eligible voters in Durham County, North Carolina, and the voter file is updated weekly on Saturday mornings. More information regarding North Carolina voter registration data can be found on the North Carolina State Board of Elections' website: https://www.ncsbe.gov/results-data/voter-registration-data

Descriptive Statistics

In [18]:
```
# import packages
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
import os
import zipfile
```

In [19]:
```
# Define Function to Read NC Voter Registration Data
def read_csv_ncvoterdata(voterdata):
    df = pd.read_csv(
        voterdata, sep="\t", header=0, encoding="unicode_escape", low_memory
    )
    return df


# Set File Path Variables for Durham County, NC data in directory
file_zip = "ncvoter32.zip"
file_txt = "ncvoter32.txt"

# Load Data
with zipfile.ZipFile(file_zip) as z:
    with z.open(file_txt) as f:
        df = read_csv_ncvoterdata(f)

# Display the first five rows of dataframe
df.head()
```

Out[19]:

	county_id	county_desc	voter_reg_num	ncid	last_name	first_name	middl
0	32	DURHAM	30456402	BL571211	A AWAD	AWATIF	ABD
1	32	DURHAM	30416806	CA108173	AABID	MALCOLM	
2	32	DURHAM	30432935	EH1369530	AAFREEN	SYEDA	
3	32	DURHAM	30264624	BL383142	AAGAARD	AMBER	
4	32	DURHAM	30264632	BL383141	AAGAARD	BRIAN	I

5 rows × 67 columns

In [12]:

```
# Define Functions to Calculate Mean, Median, and Standard Deviation of Age
def mean_age(df):
    # calculate mean of column with "age" in it
    age_column = [col for col in df.columns if "age" in col]
    if age_column:
        # Assuming there's only one age column in NC voter file data
        column_name = age_column[0]
        # Calculate the mean of the identified column
        result = df[column_name].mean()
        return result
    else:
        result = print("No column containing 'age' found.")
    return result


def median_age(df):
    # calculate median of column with "age" in it
    age_column = [col for col in df.columns if "age" in col]
    if age_column:
        # Assuming there's only one age column in NC voter file data
        column_name = age_column[0]
        # Calculate the mean of the identified column
        result = df[column_name].median()
        return result
    else:
        result = print("No column containing 'age' found.")
    return result


def std_age(df):
    # calculate standard deviation of column with "age" in it
    age_column = [col for col in df.columns if "age" in col]
    if age_column:
        # Assuming there's only one age column in NC voter file data
        column_name = age_column[0]
        # Calculate the mean of the identified column
        result = df[column_name].std()
```

```
        return result
    else:
        result = print("No column containing 'age' found.")
    return result


# Calculate Mean, Median, and Standard Deviation
summary = {
    "Statistic": [
        "Mean Age",
        "Median Age",
        "Standard Deviation of Age",
        "Count of Sample of Registered Voters",
    ],
    "Value (Rounded)": [
        round(mean_age(df), 2),
        round(median_age(df), 2),
        round(std_age(df), 2),
        round(len(df), 2),
    ],
}

# Create DataFrame
summarydf = pd.DataFrame(summary)
print(summarydf)
```

```
                              Statistic  Value (Rounded)
0                              Mean Age            46.98
1                            Median Age            42.00
2             Standard Deviation of Age            19.42
3  Count of Sample of Registered Voters        288837.00
```

Data Processing

The raw dataset provided by the North Carolina State Board of Elections does not include an ordered categorical variable that delineates age groups. The first function "recode_age_groups" takes in a series of numbers and returns age groups represented as mutually exclusive ranges of ages. The second function "make_categorical_agecat" takes in a dataframe and converts a variable "Age Group" into an ordered categorical variable.

In [13]:
```
def recode_age_groups(series):
    if 18 <= series <= 24:
        return "18-24 yrs"
    elif 25 <= series <= 29:
        return "25-29 yrs"
    elif 30 <= series <= 34:
        return "30-34 yrs"
    elif 35 <= series <= 39:
        return "35-39 yrs"
    elif 40 <= series <= 44:
        return "40-44 yrs"
    elif 45 <= series <= 49:
        return "45-49 yrs"
```

```
    elif 50 <= series <= 54:
        return "50-54 yrs"
    elif 55 <= series <= 59:
        return "55-59 yrs"
    elif 60 <= series <= 64:
        return "60-64 yrs"
    elif 65 <= series:
        return "65+ yrs"


def make_categorical_agecat(df):
    df["Age Group"] = pd.Categorical(
        df["Age Group"],
        categories=[
            "18-24 yrs",
            "25-29 yrs",
            "30-34 yrs",
            "35-39 yrs",
            "40-44 yrs",
            "45-49 yrs",
            "50-54 yrs",
            "55-59 yrs",
            "60-64 yrs",
            "65+ yrs",
        ],
        ordered=True,
    )
    return df
```

Data Visualization

To visualize the distribution of age among registered voters in Durham County, North Carolina, I used a histogram created with the matplotlib Python package.

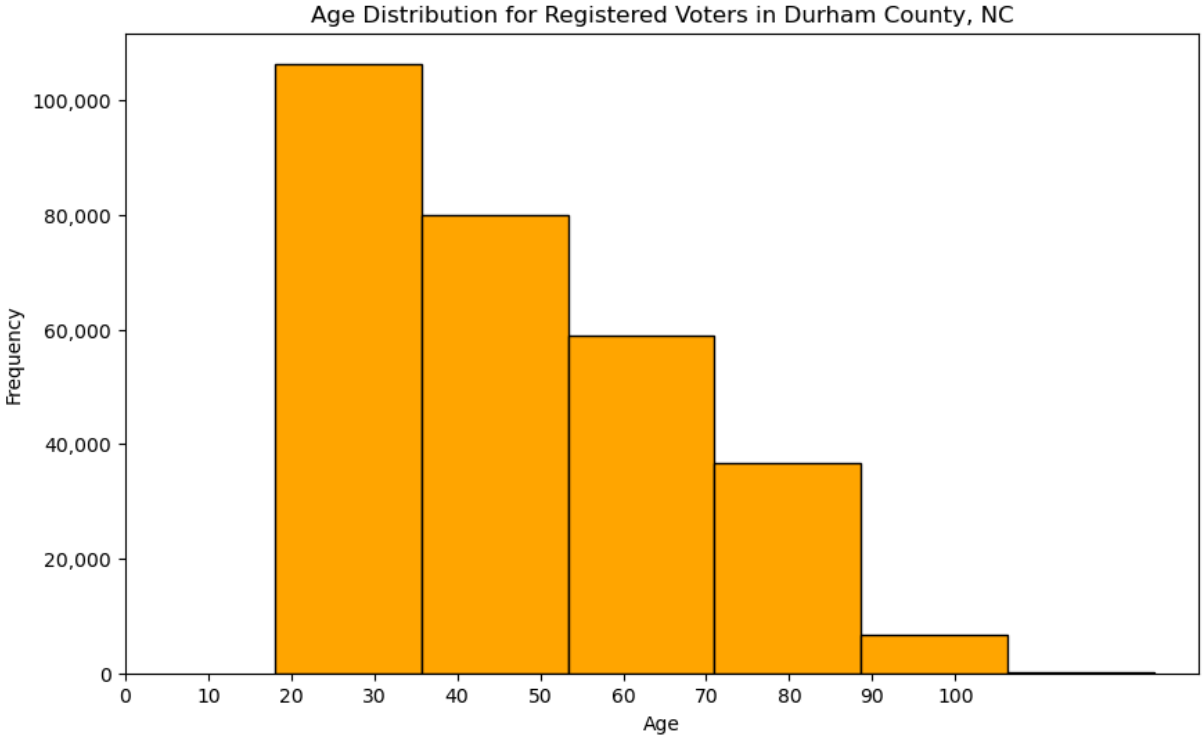
In [14]:
```
def generate_histogram_age(df, plot_name):
    age_column = [col for col in df.columns if "age" in col]
    plt.figure(figsize=(10, 6))
    bins = 6
    plt.hist(df[age_column], color="orange", bins=bins, edgecolor="black")
    plt.title("Age Distribution for Registered Voters in Durham County, NC")
    plt.xlabel("Age")
    plt.ylabel("Frequency")
    plt.gca().yaxis.set_major_formatter(
        ticker.FuncFormatter(lambda x, _: f"{int(x):,}")
    )
    x_ticks = np.arange(0, 110, 10)
    plt.xticks(x_ticks)
    subfolder = "Output Images"
    file_path = os.path.join(subfolder, plot_name)
    plt.savefig(file_path)


def generate_age_gender_pyramid(df, plot_name):
    # Prepare data for plotting
```

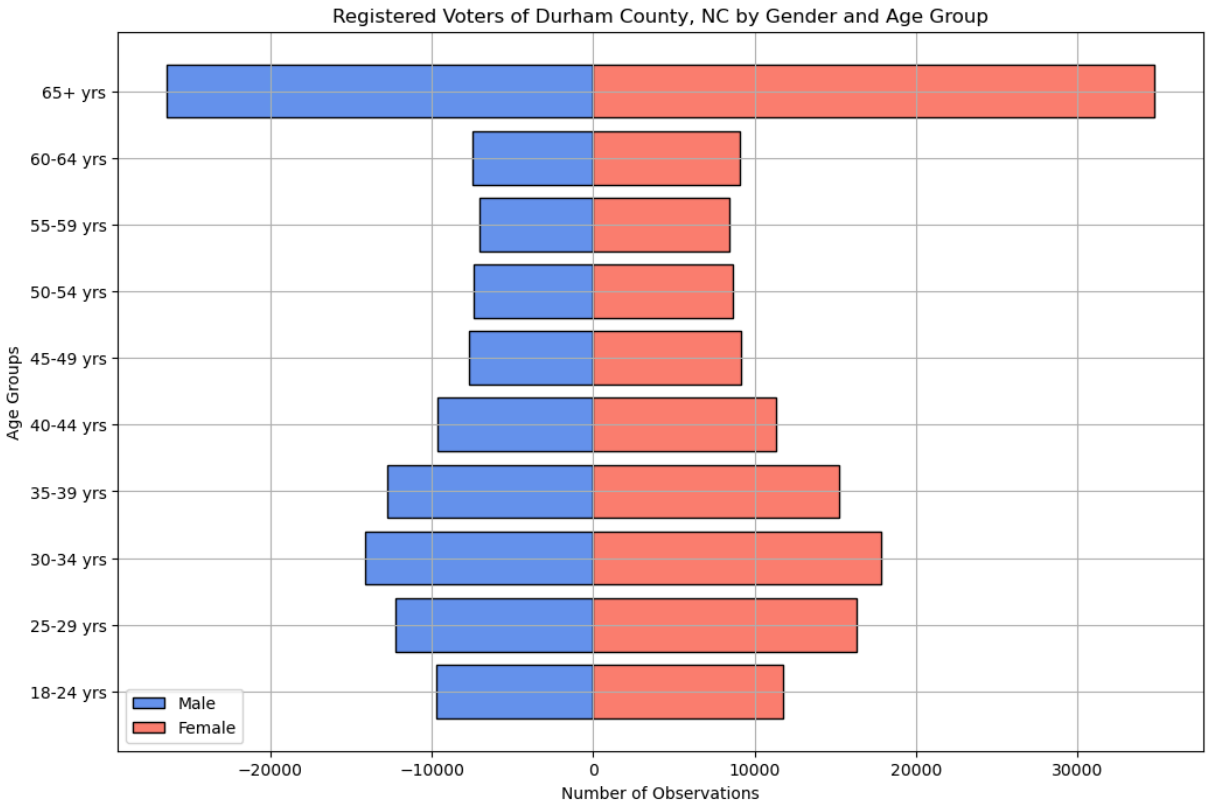
```
    df = pd.DataFrame(df)
    age_gender_counts = (
        df.groupby(["Age Group", "gender_code"], observed=False)
        .size()
        .unstack(fill_value=0)
    )
    age_groups = age_gender_counts.index
    males = age_gender_counts["M"]
    females = age_gender_counts["F"]
    print(age_gender_counts)
    # Convert males to negative values for plotting
    males_negative = -males

    # Create the plot
    fig, ax = plt.subplots(figsize=(12, 8))

    # Plot the population pyramid
    ax.barh(
        age_groups,
        males_negative,
        color="cornflowerblue",
        label="Male",
        edgecolor="black",
    )
    ax.barh(age_groups, females, color="salmon", label="Female", edgecolor="

    # Set labels and title
    ax.set_xlabel("Number of Observations")
    ax.set_ylabel("Age Groups")
    ax.set_title("Registered Voters of Durham County, NC by Gender and Age G
    ax.legend()

    # Add grid for better readability
    ax.grid(True)
    subfolder = "Output Images"
    file_path = os.path.join(subfolder, plot_name)
    plt.savefig(file_path)
```

In [15]:

```
{
    "tags": [
        "hide-input",
    ]
}

df["Age Group"] = df["age_at_year_end"].apply(recode_age_groups)
make_categorical_agecat(df)
# generate histogram of age distribution
generate_histogram_age(df, "age_histogram")
# generate population pyramid of age and gender
generate_age_gender_pyramid(df, "age_gender_pyramid")
```

gender_code	F	M	U
Age Group			
18–24 yrs	11753	9734	6018
25–29 yrs	16320	12216	6039
30–34 yrs	17805	14125	5221
35–39 yrs	15193	12721	3685
40–44 yrs	11346	9639	2381
45–49 yrs	9127	7652	1726
50–54 yrs	8667	7390	1520
55–59 yrs	8404	7065	1316
60–64 yrs	9047	7498	1296
65+ yrs	34735	26378	2820





Conclusion

For this non-representative sample of 600 Tyrell County, NC registered voters, the mean age is 57.48, the median age is 60, and the standard deviation of age is 19.74. Although registered voters tend to be older than the general population, the mean age appears to be higher than expected. It is likely that the true mean age of all registered voters in Tyrell County, NC is lower than 57.48.

Further analysis of voter registration data from the North Carolina State Board of Elections (NCSBE) could be supplemented by building in a function to scrape the zipped files present on the website and download the stored .txt files for analysis. The NCSBE updates the voter registration records weekly on Saturday mornings. Another automation could be built to download, analyze, and visualize these records weekly after they are updated.