A Population Model for XXXXXX, XX.

XXXXXXXX XXXX
Math 241
Month, Day, Year.

Introduction

This project concerns modeling a population using data we were able to find at `wikipedia.org` about the author's hometown of XXXXXX, XX.

First, however, we shall tell the reader a little bit about XXXXXX. While it is not a large town, there is a lot history there. It started out as a mining camp by migrants seeking their fortune. They named the town XXXXXX since the area's terrain reminded them of their homeland [3].

It is a thoroughfare for many adventure seekers as it is a gateway to many sought-after destinations including XXXXXXXX National Park, XXXX Lake, and The XXXXXXX Wilderness to name a few. In the 20th century, timber took the place of mining as a principal economic driver of the region. However, since the 1990s, timber has been on the decline. Today, tourism fuels a large part of the economy of the region. Moreover, urban flight has caused the population to increase at historically unprecedented rates This was especially true in the 1980s, and the population continues to grow.

The above image is a recent photograph of XXXXXX, XX [3].

Now that the reader is more familiar with the author's hometown, we shall describe the main task of this project. We are asked to do the following:

1. Predict the size of the population of XXXXXX, XX in 2030.

2. Predict the rate at which the population is growing (or shrinking) in 2030.

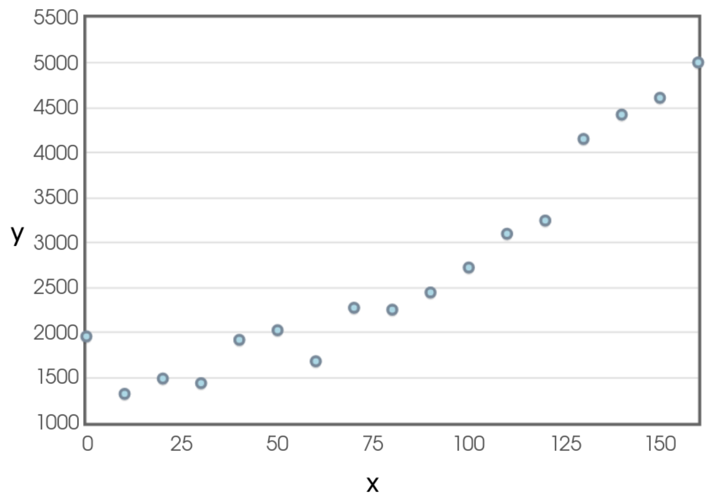
Population

We shall first analyze the data we found in order to predict the size and rate of population growth of XXXXXX, XX. We used demographic data provided by Wikipedia [3], which is given below.

Historical population		
Census	Pop.	%±
1860	1,960	—
1870	1,322	−32.6%
1880	1,492	12.9%
1890	1,441	−3.4%
1900	1,922	33.4%
1910	2,029	5.6%
1920	1,684	−17.0%
1930	2,278	35.3%
1940	2,257	−0.9%
1950	2,448	8.5%
1960	2,725	11.3%
1970	3,100	13.8%
1980	3,247	4.7%
1990	4,153	27.9%
2000	4,423	6.5%
2010	4,610	4.2%
2020	5,003	8.5%
U.S. Decennial Census[16]		

We note that this same data is also available at `https://factfinder.census.gov`.

To analyze the above data, we used the website `http://holt.blue` [2], to generate our plots and to calculate the statistical models we will use to make our prediction for the population of XXXXXX, XX in 2030.

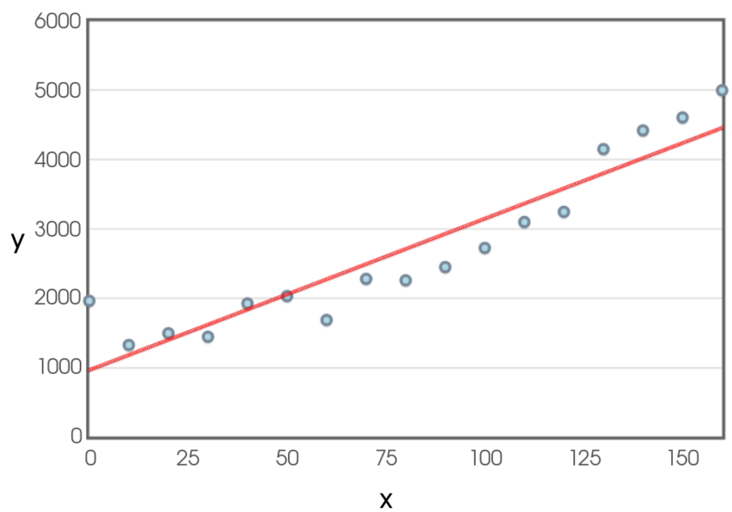


In the above figure, y denotes the number of people and x denotes number of years since 1860.

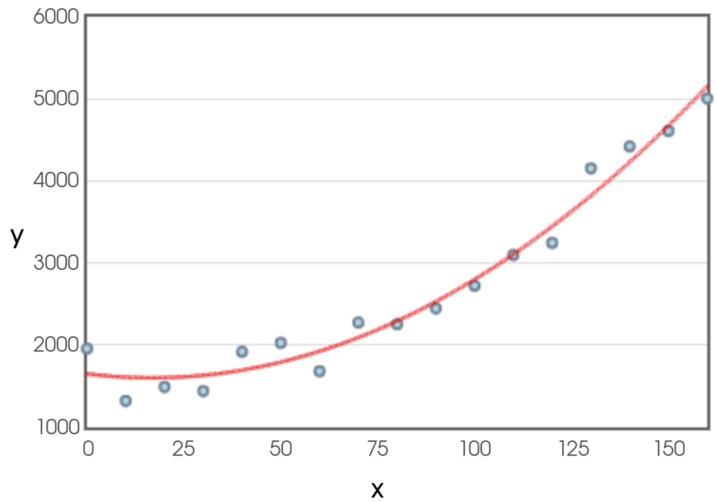
Since the data at first glance look like they could be linear, we first fitted a linear model,

$$y = 21.8801x + 961,$$

which is plotted as the red line along with the population data.



Noticing that the model consistently underpredicts at the ends, and overpredicts in the middle, we decided to try a quadratic model instead. Running a least-squares regression on the data we obtained the following figure which contains both the data and the quadratic curve of best fit in red.



The equation for the quadratic curve of best fit to four decimal places is

$$y = 0.1729x^2 - 5.7898x + 1652.7492.$$

Comparing both models visually, the reader can see that the quadratic model seems to be a better fit to the data than the linear model.

We note that we also tried fitting cubic and quartic (fourth degree) polynomial models, but none of these offered any extra predictive power, and the fit did not appear to be any better. Thus, we concluded that the quadratic model was the best model to use to make our prediction.

At this point, we may now answer the questions about the overall rate of growth of XXXXXX,XX and its predicted population for the year 2030.

In the year 2030, that is $x = 170$ for our model, we predict that XXXXXX, XX will have 5665 residents. We obtained this number by evaluating the model at $x = 170$: $y = 0.1729(170)^2 - 5.7898 \cdot 170 + 1652.7492 \approx 5665$ rounding to the nearest whole number.

We now estimate the rate at which the population of XXXXXX, XX will be growing in 2030. To find the rate of change of population with respect to time, we find the derivative of y with respect to x of our quadratic model:

$$\frac{dy}{dx} = \frac{d}{dx}(0.1729x^2 - 5.7898x + 1652.7492)$$

$$= 0.1729 \cdot 2x - 5.7898$$

$$= 0.3458x - 5.7898.$$

The last is an approximation to four decimal places. Evaluating the derivative function $y' = 0.3458x - 5.7898$ at $x = 170$, we obtain $y'(170) \approx 52.9962$, or about 53 people per year.

Summary and Conclusions

We have modeled the population of XXXXXX, XX using census data. We explored multiple models for each in order to find the model which best represents the data. Among the models available to us, we concluded that a quadratic model was the best for describing the population dynamics of XXXXXX, XX. From our quadradic model, we estimate that the population of XXXXXX, XX will be somwhere approximately 5665 people and that it will be growing by about 53 people per year.

References

[1] Gilbert Strang, *Calculus: Volume 1*, Open Stax: `https://openstax.org/details/books/calculus-volume-1`, 2018.

[2] Holt.Blue Statistical Software Suite, available at `http://holt.blue`

[3] Wikpedia Data for XXXXXX, XX: `https://en.wikipedia.org/wiki/XXXXXX,_XX`

[4] Desert Research Institute Data, available at `https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca8353`