





# Population Predictions

Name \_\_\_\_\_ Date \_\_\_\_\_

Populations shift for different reasons. A person may move to a new job, a factory may close or perhaps a family is seeking a better climate. At the beginning of the 1900's, only 2 in 10 people around the world lived in urban areas. By 2010, 5 in 10 live in urban areas, and this proportion continues to grow each year. City planners and community leaders work together to make decisions about things like commercial developments, building new schools or closing old ones. Careful analysis of population trends can help decision-makers. Using polynomial regression functions, mathematical models can be used to predict the future. Often in the case of population changes, polynomial functions (as opposed to other functions) are strong estimates.

In this assignment, you will analyze or create polynomial models for each of the cities and use them to make decisions.

## Salt Lake City, Utah

1. Since hosting the 2002 Winter Olympics, the population of Salt Lake City has been interesting. The population is modeled by the function  $y = 4t^3 + 115t^2 - 1341t + 182580$  where  $t = 0$  represents the year 2000. Use the model to answer the questions.
  - a. Describe the function. Is it strictly increasing or decreasing? Does it have a local maximum or local minimum?
  - b. The actual population of Salt Lake City in the year 2000 was 182,779. Use the model to find the estimated population in 2000. How does the estimate compare to the actual population?
  - c. The actual population of Salt Lake City in the year 2010 was 185,547. Use the model to find the estimated population in 2010. How does the estimate compare to the actual population?
  - d. Based on the model, what is the predicted population for Salt Lake City in the year 2020? Describe the results of your calculations and interpret what it may mean for the city.

## St. Louis, Missouri



2. At the turn of the century, St. Louis, Missouri's population has went through drastic changes. The population is modeled by the function  $y = 53t^3 - 1861t^2 + 13512t + 328630$  where  $t = 0$  represents the year 2000. Use the model to answer the questions.
- Describe the function. Is it strictly increasing, decreasing? Does it have a local maximum or local minimum?
  - The actual population of St. Louis in the year 2000 was 346,904. Use the model to find the estimated population in 2000. How does the estimate compare to the actual population?
  - The actual population of St. Louis in the year 2010 was 319,102. Use the model to find the estimated population in 2010. How does the estimate compare to the actual population?
  - Based on the model, what is the predicted population for St. Louis in the year 2020? Describe the results of your calculations and interpret what it may mean for the city.

## Shrinking Cities

3. Use the data from the table to determine polynomial models for each city that best fit the data. Your models may be different than someone else's depending on the degree of the polynomial that you choose.

	2000	2002	2004	2006	2008	2010	2012	Polynomial Models
Baltimore, MD	648,654	642,246	641,004	640,961	638,091	620,971	621,342	
Buffalo, NY	292,210	287,139	281,757	274,470	271,220	261,179	259,384	
Detroit, MI	945,297	928,870	924,016	918,849	912,633	711,744	701,475	
Gary, IN	102,489	100,311	98,567	96,845	96,007	80,233	79,170	
Youngstown, OH	81,720	79,196	77,148	75,033	73,091	66,831	65,405	

Use your polynomial models to make predictions about population in the near future.

	2014	2016	2018	2020
Baltimore, MD				
Buffalo, NY				
Detroit, MI				
Gary, IN				
Youngstown, OH				

- a. Based on the models, which city is shrinking the most rapidly? Provide evidence to support your reasoning.
  
- b. Based on the models when would you expect...
  - i. Gary's population to be below 70,000?
  
  - ii. Baltimore's population to be below 600,000?
  
  - iii. Detroit's population to be equal to Baltimore's?

## Growing Cities

4. Use the data from the table to determine polynomial models for each city that best fit the data. Your models may be different than someone else's depending on the degree of the polynomial that you choose.

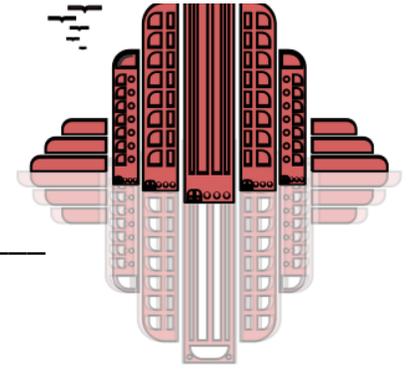
	2000	2002	2004	2006	2008	2010	2012	Polynomial Models
Austin, TX	656,562	680,899	692,102	718,912	750,525	790,390	824,205	
Boise, ID	195,589	199,535	199,125	200,228	204,778	206,349	212,303	
Orlando, FL	194,723	199,358	209,401	224,824	232,321	238,893	249,562	
Raleigh, NC	290,184	313,829	332,778	363,267	393,692	406,267	423,179	
San Jose, CA	903,540	900,840	901,283	918,619	948,686	955,225	982,765	

Use your polynomial models to make predictions about population in the near future.

	2014	2016	2018	2020
Austin, TX				
Boise, ID				
Orlando, FL				
Raleigh, NC				
San Jose, CA				

- a. Based on the models, which city is growing the most rapidly? Provide evidence to support your reasoning.
- b. Based on the models when would you expect...
- i. Raleigh's population to be over 500,000?
  - ii. Boise's population to be over 225,000?
  - iii. Austin's population to be equal to San Jose's?

# Urban Sprawl



Name \_\_\_\_\_ Date \_\_\_\_\_

Mathemagicaland is a thriving city made up of various diverse communities. Many of these communities operate independent of Mathemagicaland and have their own schools and public services. A large commercial contractor, Sustainable Industries, has brought forward a plan to build a state-of-the-art eco-friendly shopping mall. The mall will be 100% energy efficient and will be a point of pride in the growing community. While Sustainable Industries has a clear focus to have a positive impact on the community, its main goal is to make a lot of money. Sustainable Industries would like to build in a growing community and would like to be its central retail location.

Mathemagicaland has a number of other shopping areas sprinkled throughout their city, but that's not stopping every community from throwing their hat in the ring. As a member of Mathemagicaland's Task Force for Urban Development your job is to make a recommendation to Sustainable Industries. Where should the shopping mall be built and why?

In this assignment, you will analyze or create polynomial models for each of the cities and use them to make decisions.

	2000	2002	2004	2006	2008	2010	2012
Bigglesworth	16,754	15,985	15,210	15,004	14,879	14,452	13,874
Cheshire	32,261	32,518	32,902	33,350	34,393	34,618	35,368
Figaro	34,873	35,676	36,479	38,621	39,354	40,355	40,988
Garfield	33,587	34,103	34,867	35,149	34,420	33,898	33,713
Heathcliff	22,421	22,874	24,393	25,904	27,159	28,086	28,220
Olive	34,007	33,911	33,393	33,101	32,574	32,106	33,032
Snowbell	31,738	32,105	32,839	33,849	34,124	35,879	36,190
Sylvester	15,003	14,482	14,019	13,741	13,399	13,425	13,532



# Modeling



	<b><i>Increasing or Decreasing Population?</i></b>	<b><i>Polynomial Model</i></b>
Bigglesworth		
Cheshire		
Figaro		
Garfield		
Heathcliff		
Oliver		
Snowbell		
Sylvester		

The distance between each community and the nearest shopping mall is seen below. Use your polynomial models to make predictions for the 2020 population for each community.

	<b><i>Miles to Nearest Shopping Mall</i></b>	<b><i>Predicted 2020 Population</i></b>
Bigglesworth	18	
Cheshire	8	
Figaro	0	
Garfield	21	
Heathcliff	12	
Oliver	0	
Snowbell	16	
Sylvester	9	