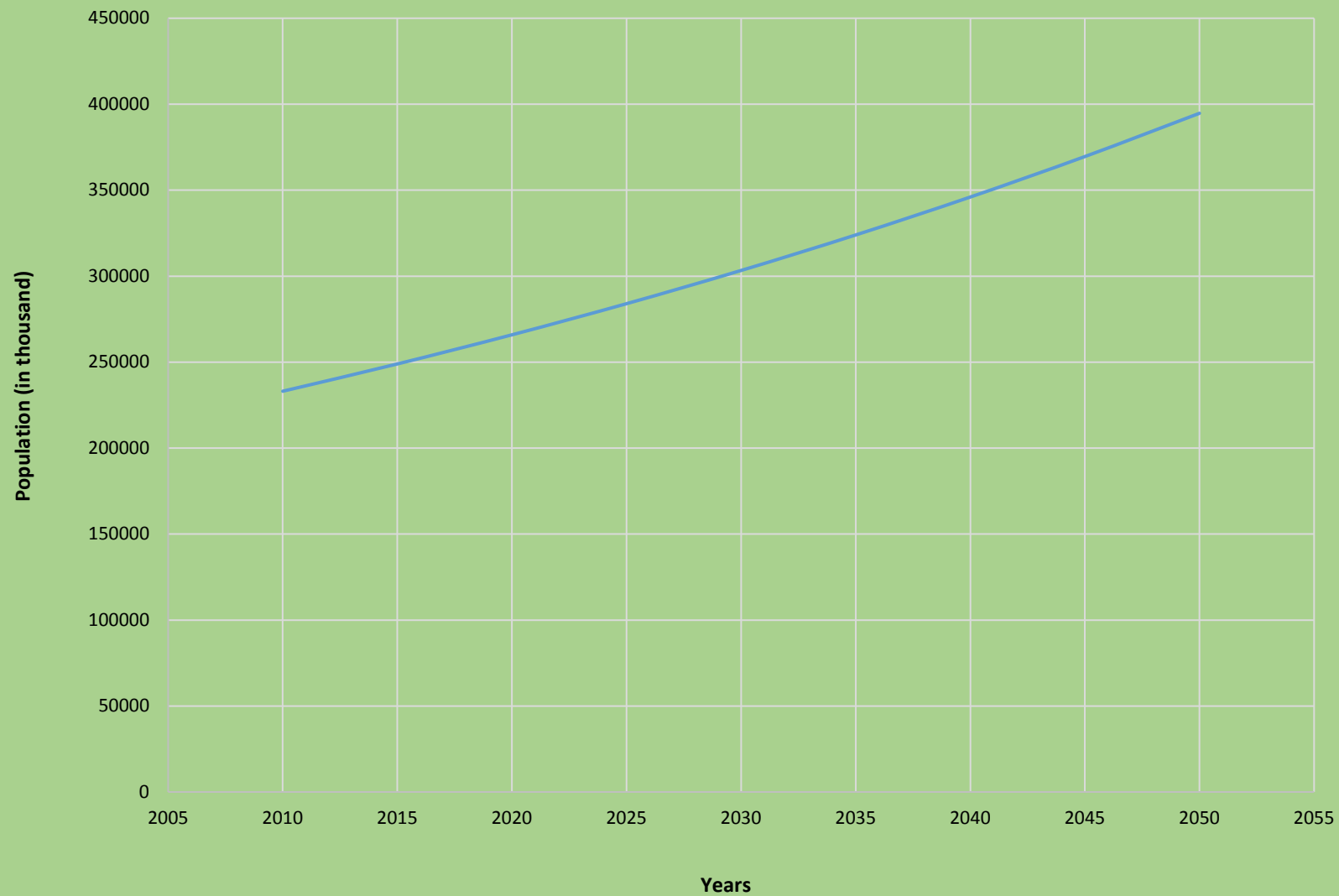


Abdullah Alyami
ENGR 115
Friday 2pm to 5pm
9/9/2016

Initial Population	233082
Growth Rate	0.01317
Starting Year	2010
Time Increment	5

Time (Actual year)	Time (Model year)	Model population
2010	0	233082
2015	5	248947
2020	10	265892
2025	15	283990
2030	20	303321
2035	25	323967
2040	30	346018
2045	35	369570
2050	40	394725
2055	45	421593
2060	50	450289
2065	55	480939

## Population Growth of Madison, WI



Abdullah Alyami
ENGR 115
Friday 2pm to 5pm
42622

Initial Population	233082
Growth Rate	0.01317
Starting Year	2010
Time Increment	5

Time (Actual year)	Time (Model year)	Model population
=B9	0	=B\$7*EXP(\$B\$8*B14)
=A14+\$B\$10	=B14+\$B\$10	=B\$7*EXP(\$B\$8*B15)
=A15+\$B\$10	=B15+\$B\$10	=B\$7*EXP(\$B\$8*B16)
=A16+\$B\$10	=B16+\$B\$10	=B\$7*EXP(\$B\$8*B17)
=A17+\$B\$10	=B17+\$B\$10	=B\$7*EXP(\$B\$8*B18)
=A18+\$B\$10	=B18+\$B\$10	=B\$7*EXP(\$B\$8*B19)
=A19+\$B\$10	=B19+\$B\$10	=B\$7*EXP(\$B\$8*B20)
=A20+\$B\$10	=B20+\$B\$10	=B\$7*EXP(\$B\$8*B21)
=A21+\$B\$10	=B21+\$B\$10	=B\$7*EXP(\$B\$8*B22)

Q1) the doubling time for the population based on the model is between 2060 and 2065 which is about 53 years from the initial starting time. The doubling time from my hand calculation and model match which is 53 years.

Q2) I think the city capacity should be 500,000; by doing the simulations on my model the best rate of grow was 0.0152. the city of Madison is very small and it has one of the most attended universities, people also visit it a lot. The city lack of space where it has two lakes in both sides makes it hard for the people to move arround by cars when they increase. the middle part of the city is limited so no more street can be added or parking space in the future. Also, the chemical levels in some wells from point and nunpoint sources are contaminating the drinking water which puts a limit on how much water is available.

Q3) I think the exponential growth model is a reasonable model for human population growth because I can estimate the population at any time periods using the same methods.

Calculation for Q1	
Initial Pop	233082
Growth rate	0.01317
doubling time	53
population	468436.39
final pop/initial pop	2.0097493

## Population Growth Model

In this analysis I made a growth model technic to demonstrate the growth rate of a population over a five years period. The reason of doing this analysis is that it's very helpful way to predict a population when an engineer wants to build a project one of the times when an engineer might use this technic is when an engineer want to build a waste water treatment plant or any other projects like landfill for human waste.