

# Exponential Growth Report

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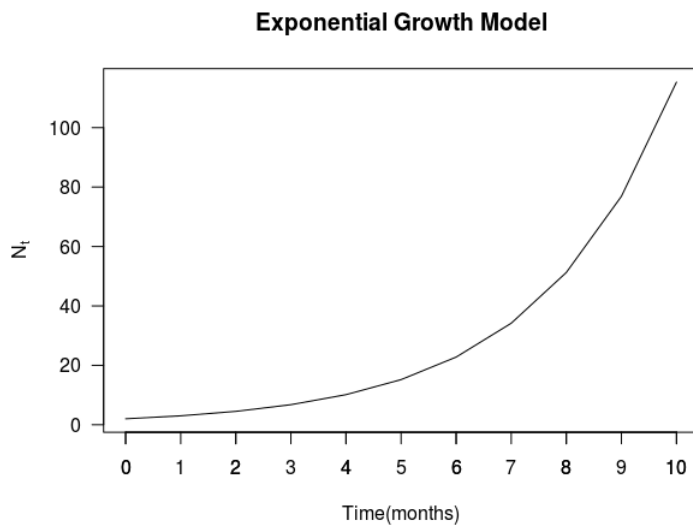
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## 1 A Brief Introduction

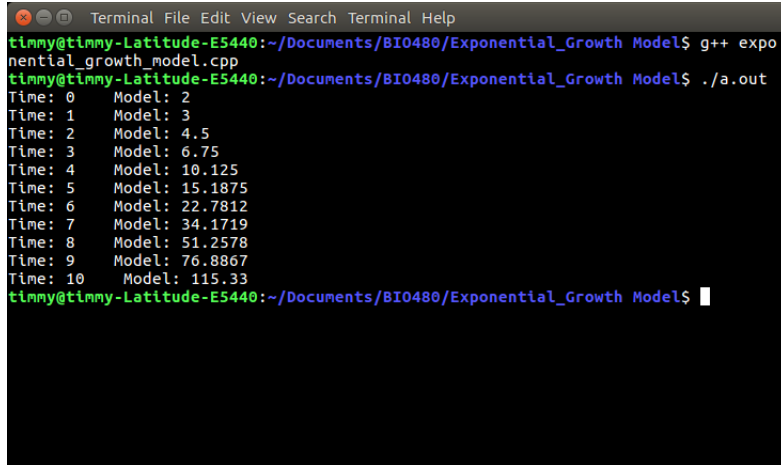
An exponential growth model observed was represented by the equation  $N_{t+1} = N_t + rN_t$ ; where  $N_t$  represents population,  $r$  represents growth rate and  $t$  represents time. In this lab, the equation represents the rate at which the population produces their offspring is dependent on the total population size. The case for this lab, the initial reproduction rate of the rodents is set to 50% per month.

## 2 Results

### 2.0.1 Graph



## 2.0.2 Console

A terminal window titled 'Terminal' with a menu bar (File, Edit, View, Search, Terminal, Help). The prompt is 'timmy@timmy-Latitude-E5440:~/Documents/BIO480/Exponential\_Growth\_Model\$'. The user enters 'g++ exponential\_growth\_model.cpp'. The prompt changes to 'timmy@timmy-Latitude-E5440:~/Documents/BIO480/Exponential\_Growth\_Model\$'. The user enters './a.out'. The program outputs a table of values for Time (0 to 10) and Model (2 to 115.33).

```
timmy@timmy-Latitude-E5440:~/Documents/BIO480/Exponential_Growth_Model$ g++ exponential_growth_model.cpp
timmy@timmy-Latitude-E5440:~/Documents/BIO480/Exponential_Growth_Model$ ./a.out
Time: 0      Model: 2
Time: 1      Model: 3
Time: 2      Model: 4.5
Time: 3      Model: 6.75
Time: 4      Model: 10.125
Time: 5      Model: 15.1875
Time: 6      Model: 22.7812
Time: 7      Model: 34.1719
Time: 8      Model: 51.2578
Time: 9      Model: 76.8867
Time: 10     Model: 115.33
timmy@timmy-Latitude-E5440:~/Documents/BIO480/Exponential_Growth_Model$
```

## 3 Conclusion

From the graph above, we can clearly see the exponential growth. The graph shows an upward trend over a period of 10 months. The population grows at a rate depending on the proportion of the current size. This model does not take age and geographical considerations. As such, this is an example of a density independent model.

## 4 Appendix

### 4.0.1 C++ Code for Exponential Growth Model

```
1 // Name: Timmy Nguyen
2 // Date: 1-30-2016
3 // Assignment 1: Exponential Growth Model
4 // Biol 480 Spring 2016
5
6 #include <iostream>
7 #include <iomanip>
8 #include <string>
9 // For output file writing.
10 #include <fstream>
11 using namespace std;
12
13 // # of Months: 10
14 const int length = 10;
15
16 // Spacing function for formatting
17 string spacing()
18 {
19     string spacing_ = "    ";
20     return spacing_;
21 }
22
23 int main()
24 {
25     // Given reproductive rate
26     double r = 0.5;
27
28     // Initial time
29     double t = 0.0;
30
31     // Initial Population
32     double *N_array;
33     N_array = new double[length];
34     N_array[0] = 2;
35
36     /**
37      * @brief Exponential Growth Equation
38      * @details Output prediction observation values
39      * @return prediction data
40      */
41     for (int i = 0; i < 11; ++i)
```

```

42 {
43     N_array[i + 1] = N_array[i] + r * N_array[i];
44 }
45
46 /**
47  * @brief Output file
48  * @details write to a separate file
49  * @return written data.
50  */
51 ofstream outFile;
52 outFile.open("input.txt");
53
54 for (int i = 0; i < 11; ++i)
55 {
56     outFile << t << spacing() << N_array[i] << endl;
57     t++;
58 }
59
60 outFile.close();
61 delete [] N_array;
62
63 return 0;
64
65
66 }

```

#### 4.0.2 R Code for Generating Graph

```

1 mydata = read.table(file.choose())
2 colnames(mydata)<-c("Time(months)", "Model")
3
4 plot(mydata[,1:2], type="l", main="Exponential Growth Model"
5       , xlab="Time(months)", ylab =expression("N" [t]), las=1)
6 axis(side=1, at=c(0:10))

```