

Case Study #2: Tuberculosis Cases

SDG #3 Good Health and Well Being

Goal 3 hopes to ensure healthy lives and promote well-being for all ages. It has the following outcome targets: reduction of maternal mortality; ending all preventable deaths under five years of age; fight communicable diseases; ensure reduction of mortality from non-communicable diseases and promote mental health; prevent and treat substance abuse; reduce road injuries and deaths; grant universal access to reproductive care, family planning and education; achieve universal health coverage; and reduce illnesses and deaths from hazardous chemicals and pollution.

Directions: Complete the following parts. You should upload the Excel file with all your work. You can either type your responses to the questions in Excel or in this document. All work is to be submitted to Canvas by 11:59 pm on March 26, 2024.

Background: Tuberculosis (TB) is caused by a bacterium called *Mycobacterium tuberculosis*. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body such as the kidney, spine, and brain. If not treated properly, TB disease can be fatal. A total of 1.3 million people died from TB in 2022. Worldwide, TB is the second leading infectious killer after COVID-19. TB bacteria spread through the air from one person to another. In 2022, an estimated 10.6 million people fell ill with tuberculosis worldwide, including 5.8 million men, 3.5 million women and 1.3 million children. TB is present in all countries and age groups. TB is curable and preventable. The US currently spends \$13 billion annually to prevent, diagnose, and treat tuberculosis. The UN has set a goal to “end the epidemic of tuberculosis” in all countries by 2030. The data provided is number of tuberculosis cases in the United States between 1980 and 2021.

Data source: <https://www.cdc.gov/tb/statistics/reports/2022/table1.htm>

Part 1: Quadratic model for tuberculosis cases - use the "TB Cases Quadratic" tab

1. Reformat the data so that 1980 is $x = 0$ (1 pt)
2. Create a scatterplot for the data (1 pt)
3. Put a quadratic trendline on the scatterplot and display the equation (1 pt)
4. Find the estimated y values (2 pts)
5. Find the residual squared values (2 pts)
6. Calculate the total error (orange box) (1 pt)
7. Use the trendline to estimate the value for 2030 (1 pt)

Part 2: Exponential model for tuberculosis cases - use the "TB Cases Exponential" tab

1. Reformat the data so that 1980 is $x = 0$ (1 pt)
2. Create a scatterplot for the data (1 pt)
3. Put an exponential trendline on the scatterplot and display the equation (1 pt)
4. Find the estimated y values (2 pts)
5. Find the residual squared values (2 pts)
6. Calculate the total error (orange box) (1 pt)
7. Use the trendline to estimate the value for 2030 (1 pt)

Part 3: Compare and analyze the different trendlines.

1. Which trendline has more error? How many times more error does it have? **(1 pt)**
2. What are the values for the y-intercept in each trendline? Interpret the meaning for each y-intercept and discuss how that meaning relates to the actual data. **(4 pts)**
3. What is the vertex of the quadratic trendline? Interpret the meaning of the vertex and discuss how that meaning relates to the actual data. **(2 pts)**
4. What is the equation of the horizontal asymptote for the exponential function. Interpret the meaning of the horizontal asymptote. **(2 pts)**
5. The 2030 target is to “end the epidemic of tuberculosis” in all countries. The World Health Organization will consider the epidemic of tuberculosis to have ended if the number of cases in 2030 is 80% of the number of cases in 2015. Using the 2015 data, this would be 1907 cases in 2030. Based on your answers from #7 in Part 1 and Part 2, are either of the estimates close to this? **(2 pts)**
6. Between 2019 and 2020, the number of tuberculosis cases dropped significantly. The cases then rose in 2021 and 2022. Why do you think this happened? **(1 pt)**