**Modeling Data Using Quadratics**

Scientists, economists, statisticians, medical care professionals, engineers and many other people frequently depend on mathematical models to help them make decisions, or to predict future behaviors and outcomes. One method we can use to do this is to observe and analyze a set of known data to create a mathematical equation that models the known information, then use that model as a basis for decision making and problem solving. For this project, you will create a quadratic regression model of a set of data using the Geometer’s Sketchpad software. Using your model, you will predict future trends in the given data.

The tables below show the number of deaths per 100,000 people due to lung cancer in the United States over the 24-year period from 1979 to 2002. (Source: The American Lung Association).

|  |  |
| --- | --- |
| Year | Deaths  Per 100,000 |
| 1979 | 47.8 |
| 1980 | 49.8 |
| 1981 | 50.3 |
| 1982 | 51.7 |
| 1983 | 52.6 |
| 1984 | 53.6 |
| 1985 | 54.6 |
| 1986 | 55.2 |
| 1987 | 56.4 |
| 1988 | 57.1 |
| 1989 | 58.1 |
| 1990 | 59.3 |

|  |  |
| --- | --- |
| Year | Deaths  Per 100,000 |
| 1991 | 59.3 |
| 1992 | 59.3 |
| 1993 | 59.5 |
| 1994 | 59 |
| 1995 | 58.9 |
| 1996 | 58.4 |
| 1997 | 58.1 |
| 1998 | 57.6 |
| 1999 | 56 |
| 2000 | 56.5 |
| 2001 | 55.3 |
| 2002 | 54 |

You will use these figures to create your regression model. For the first part of the project, please complete the following tasks:

1. Using the Geometer’s Sketchpad, create a scatter plot of the data in the tables above showing the number of deaths per 100,000 for each year after 1979. Be certain that you set appropriate scales for the vertical and horizontal axes.
2. Print a copy of your scatterplot, and complete the following.
3. Draw a **smooth curve** (parabola) that comes as close to as many of the data points as possible.
4. Sketch in the curve very lightly using a **pencil**.
5. You may have to make several slight adjustments to the graph, or erase and redraw some parts to get it just right. Take your time, do not try to connect all of the points, and make sure the final graph is a smooth, neat curve. (Note: the graph will not pass through all of the data points perfectly.) This is the model graph for your reference to be used in the development of the rest of the project. You do not need to turn this in.

Please complete tasks 4 – 7 in a word-processed document. This should be in narrative form, describing your processes and showing how you achieved your results.

1. Develop a quadratic equation that models the parabola from your graph. Clearly explain how you developed the model, and show all working clearly using appropriate mathematical notation and terminology. You should use the Equation Editor in Microsoft Word, or the Math Type software for all mathematical notation.
2. Enter your model equation into the same Geometer’s Sketchpad sketch as your original scatterplot. Comment on the “goodness of fit” of your model. (You do not need to print a copy of this sketch.)
3. Using your model, estimate the number of deaths per 100,00 people due to lung cancer in the United States in the following years, showing all calculations and indicating how you achieved your results:
4. 1969 b) 1974 c) 2007 d) 2012
5. Answer the following questions.
6. Do you think these predictions are accurate, based on your graph and your model equation? Justify and explain your answer using the mathematics you developed in the investigation and modeling process.
7. Could you use your graph and model to estimate the number of deaths per 100,000 people due to lung cancer in the United

States in 1930 or 2050? Justify and explain your answer using the mathematics you developed in the investigation and modeling process.

1. Give some reasons as to what you think caused cancer deaths to decrease after 1995. Justify and explain your answers using the mathematics you developed in the investigation and modeling process.

When you have completed the project, submit the .gsp Geometer’s Sketchpad file showing your scatterplot and model graph, and your word-processed narrative document electronically to the location designated by your teacher.