Project 2: Predicting the World Primary Energy Consumption

Predicting what the world's population will be in 2050 is a difficult task. But, predicting the world primary energy consumption is far more complicated task. Unfortunately, it is also a task that we cannot ignore. We have seen in California when there is not enough energy to meet the demand, the results are disastrous. Rolling blackouts not only have impacted Californians, but also the rest of the nation and world itself. As difficult and inaccurate the process may be in predicting the future energy needs of the world, it is an extremely important task since it takes many years to build power plants and to bring them on-line. Other related issues with energy consumption are supply and the cost.

In this project, you will examine the issue of primary energy consumption from a global perspective, keeping in mind that how the energy consumption increases will have a profound effect on all of us locally. In part 1, you will examine the primary energy consumption figures for the last thirty-six years (1970 – 2005). You will then examine six regression models (i.e., "equations that are fitted to match the data") and then try to use one of those models to predict the primary energy consumption in the future. In part 2, you will read the article, "Highlights, World Energy Consumption" available at my website and address some issues raised by that article and compare their predictions with yours.

The next eight pages of this handout have the raw data and the regression models with the corresponding graphs. In all of these models, $x = 1$ corresponds to 1970. The r^2 number just measures how closely the model fits the data; the closer r^2 is to one, the better the fit. Take some time to examine those pages and then answer the questions on page 10 and 11.

World Primary Energy Consumption, 1970 – 2005

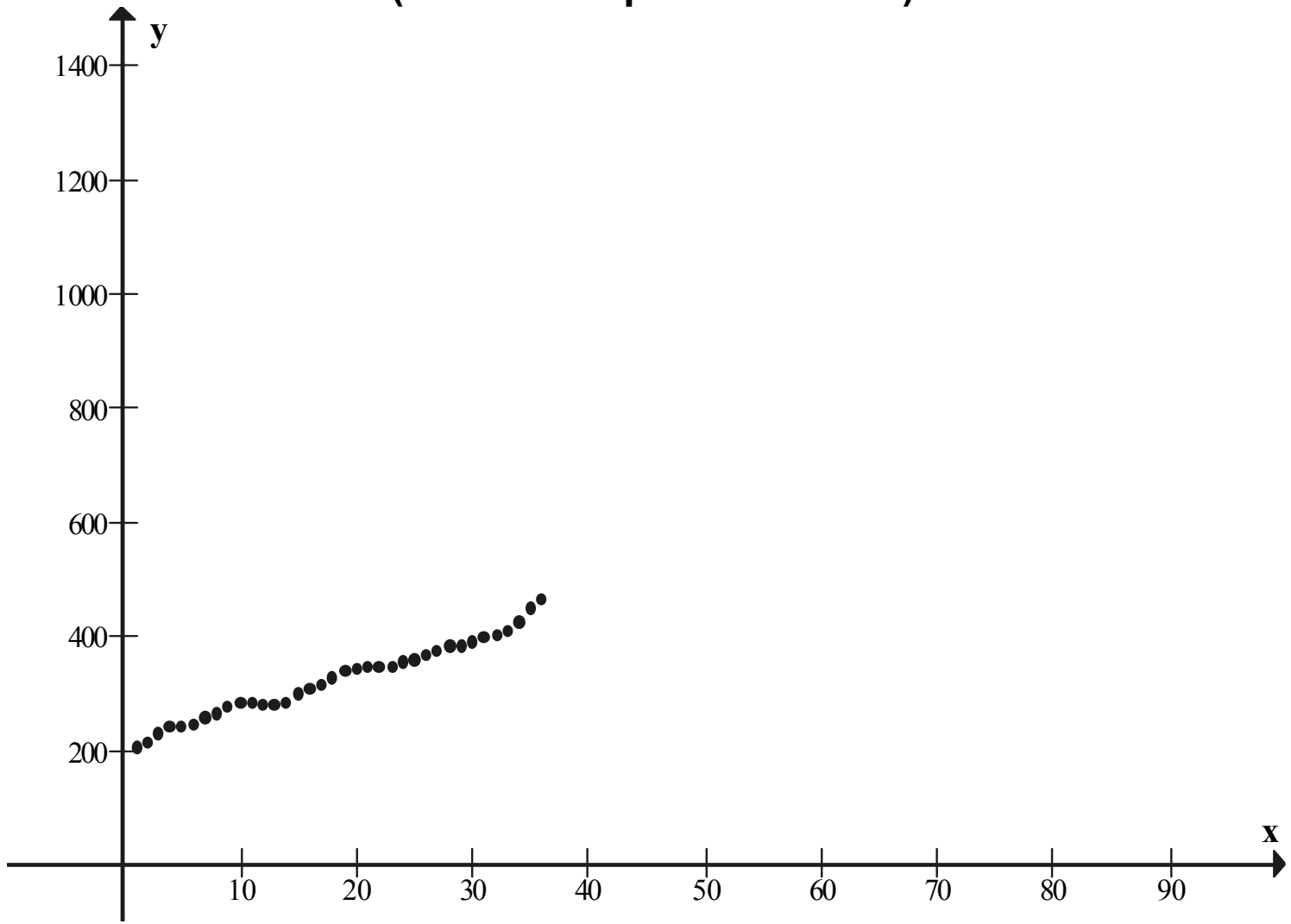
(Quadrillion (10^{15}) Btu)

Year	x years after 1969	Energy Consumption	Year	x years after 1969	Energy Consumption
1970	1	207.01	**1990**	21	347.42
1971	2	214.90	**1991**	22	347.99
1972	3	228.12	**1992**	23	348.42
1973	4	239.87	**1993**	24	353.54
1974	5	241.99	**1994**	25	357.43
1975	6	244.10	**1995**	26	365.05
1976	7	255.75	**1996**	27	374.94
1977	8	263.59	**1997**	28	381.10
1978	9	274.51	**1998**	29	382.14
1979	10	285.54	**1999**	30	389.79
1980	11	283.48	**2000**	31	398.13
1981	12	281.13	**2001**	32	402.29
1982	13	280.87	**2002**	33	410.71
1983	14	284.57	**2003**	34	426.64
1984	15	299.85	**2004**	35	447.61
1985	16	308.49	**2005**	36	462.80
1986	17	316.17	**2006**	37	
1987	18	326.03	**2007**	38	
1988	19	338.26	**2008**	39	
1989	20	344.28	**2009**	40	

Source: Energy Information Administration
International Energy Annual 2005

World Primary Energy Consumption (quadrillion btu): 1970 – 1999

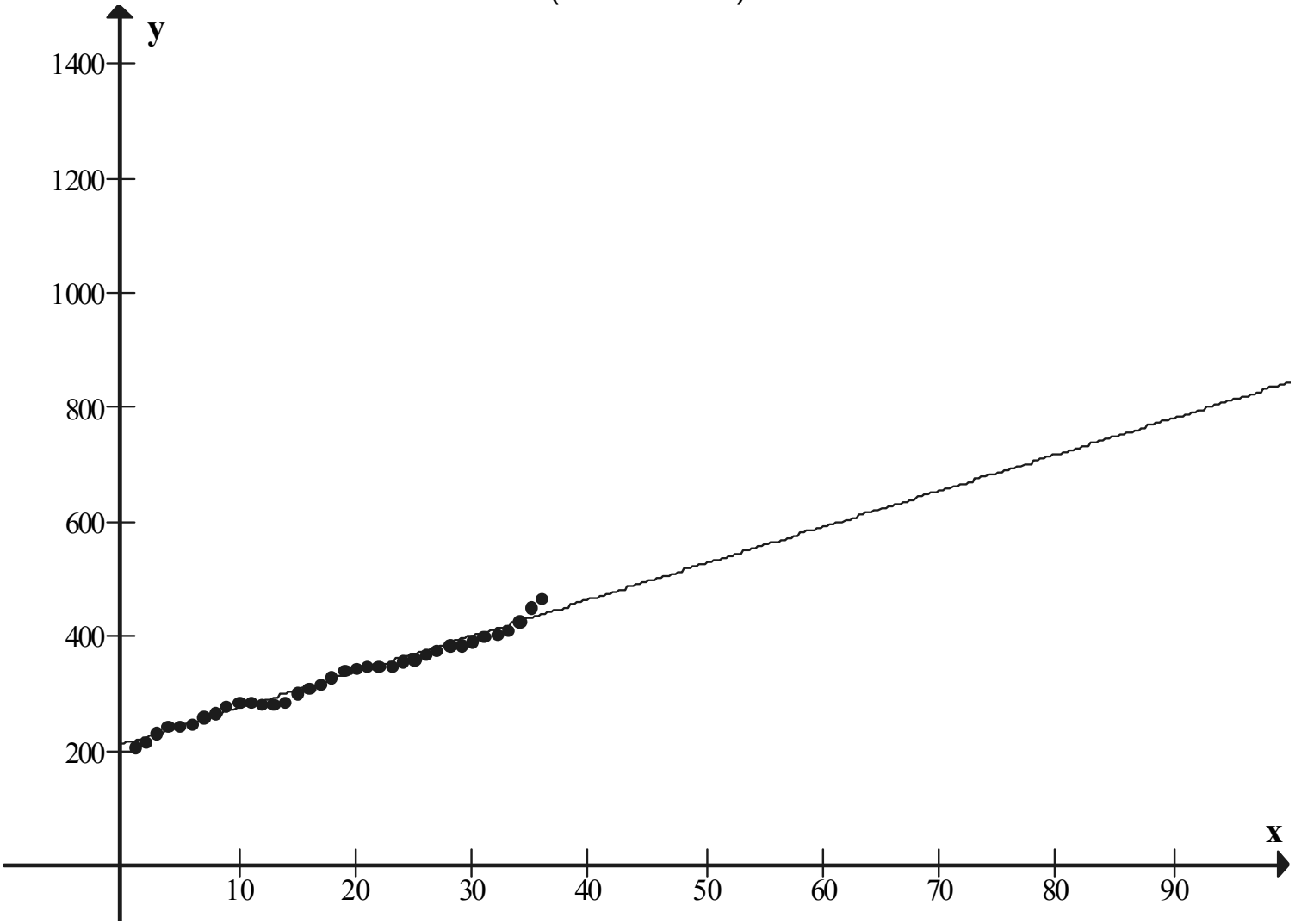
(x= 1 corresponds to 1970)



Linear Regression

$y = 6.339066924x + 208.1303175$

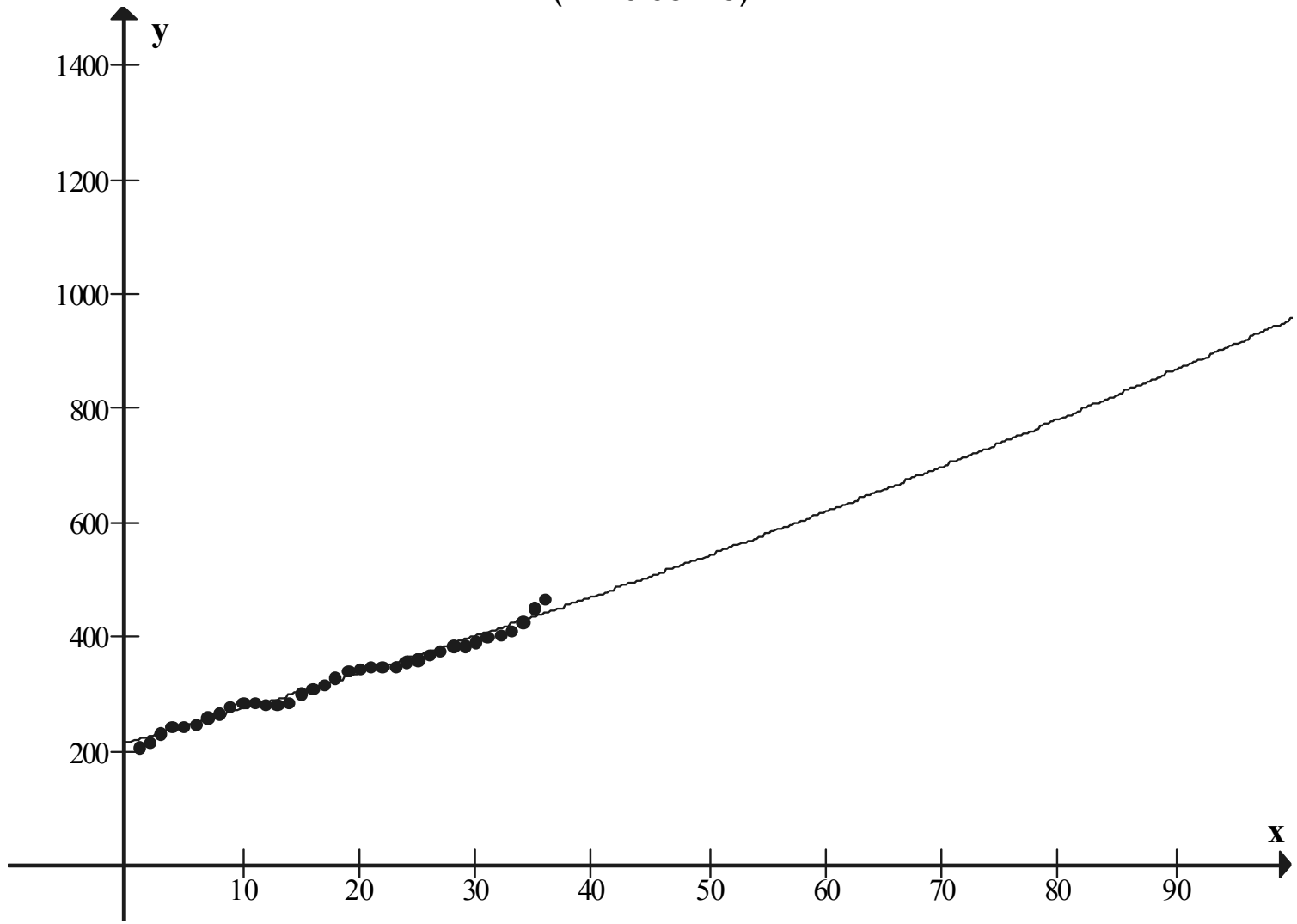
$(r^2 = 0.98361)$



Quadratic Regression

$y = 0.0172554498x^2 + 5.70061528x + 212.1738445$

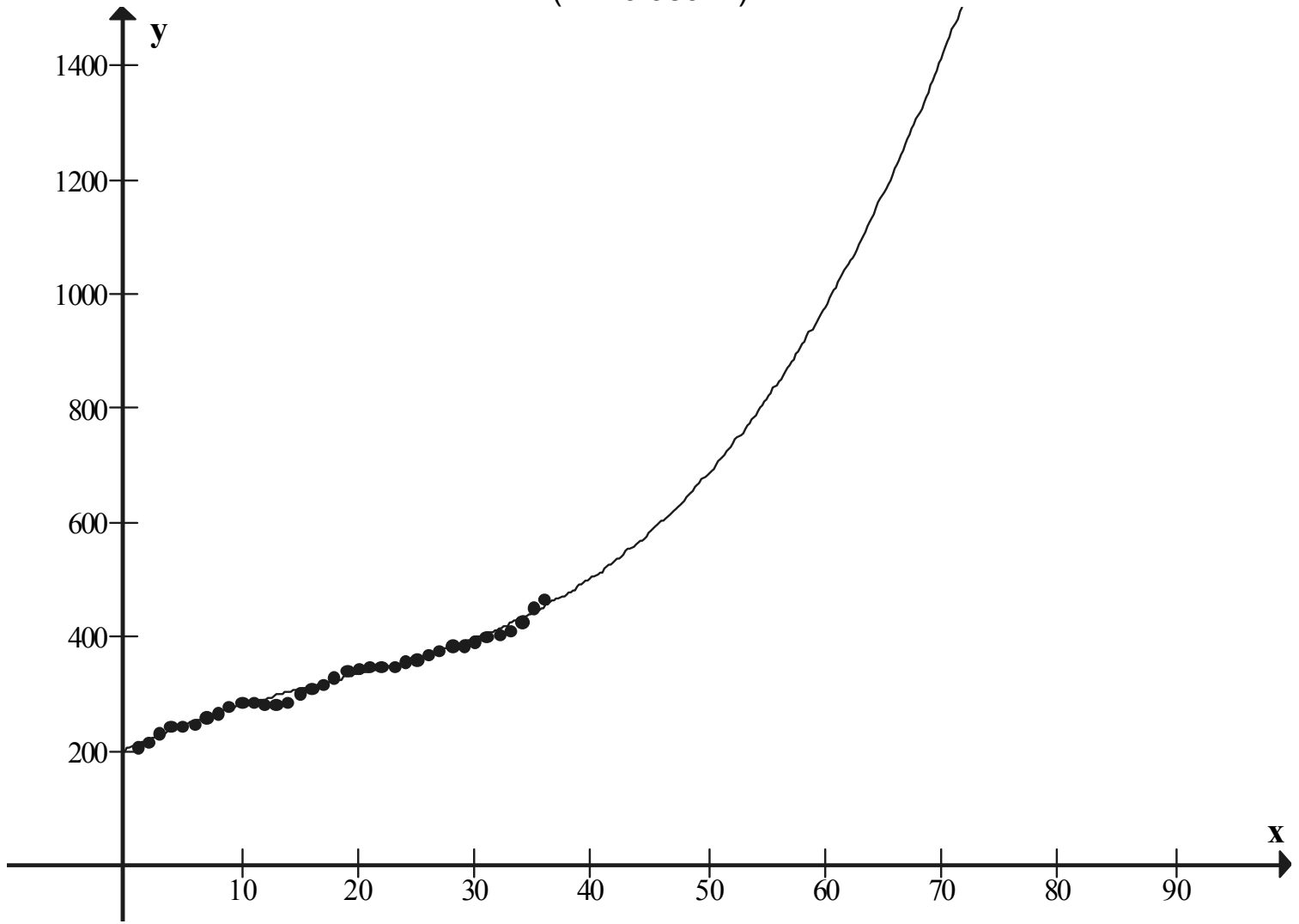
$(r^2 = 0.98423)$



Cubic Regression

$y = 0.0056372655x^3 - 0.29956127836x^2 + 10.39476623x + 196.7181538$

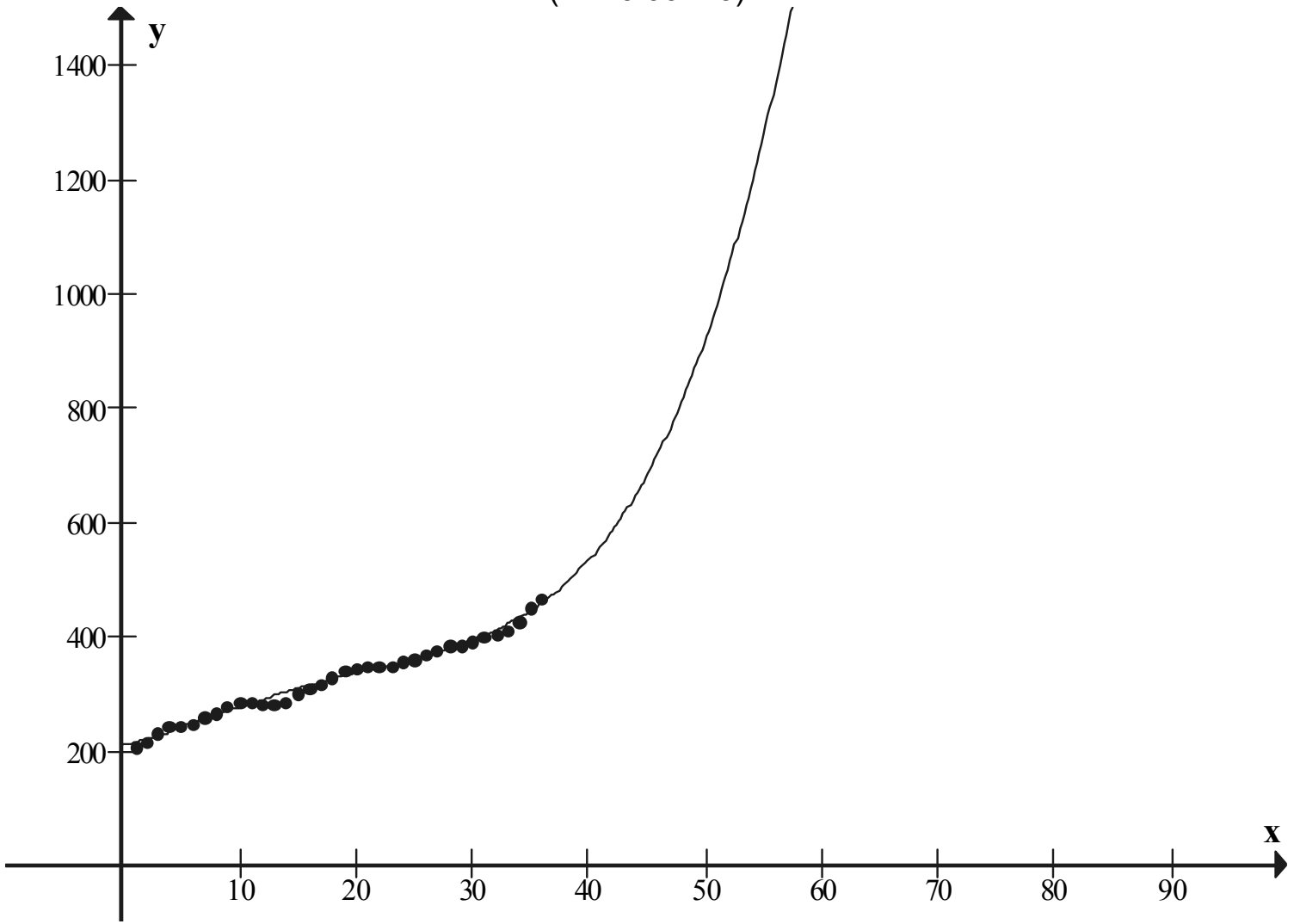
$(r^2 = 0.98977)$



Quartic Regression

$y = 0.0003235452624x^4 - 0.01830508395x^3 + 0.2792347061x^2 + 5.51394729x + 206.8560286$

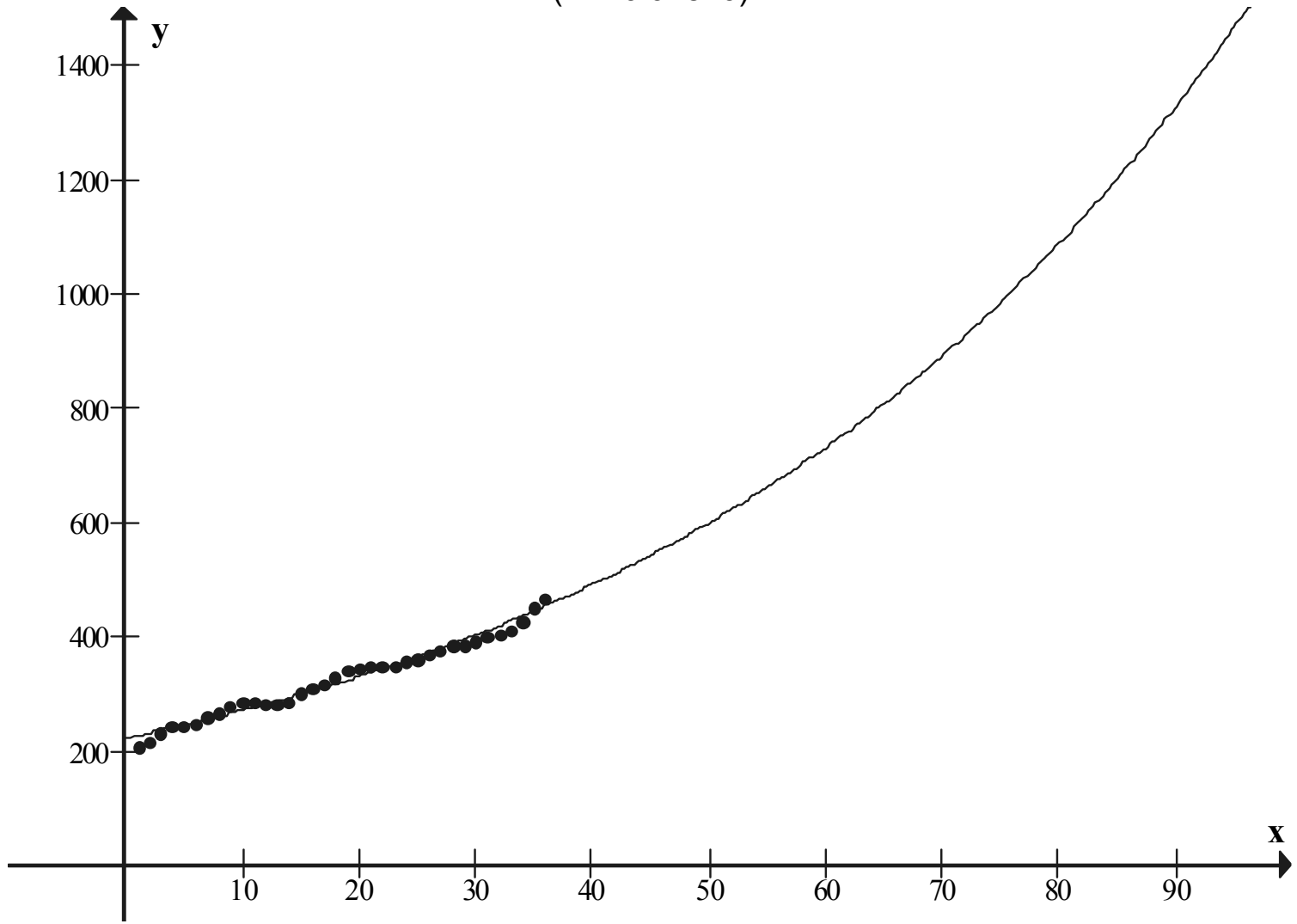
$(r^2 = 0.99126)$



Exponential Regression

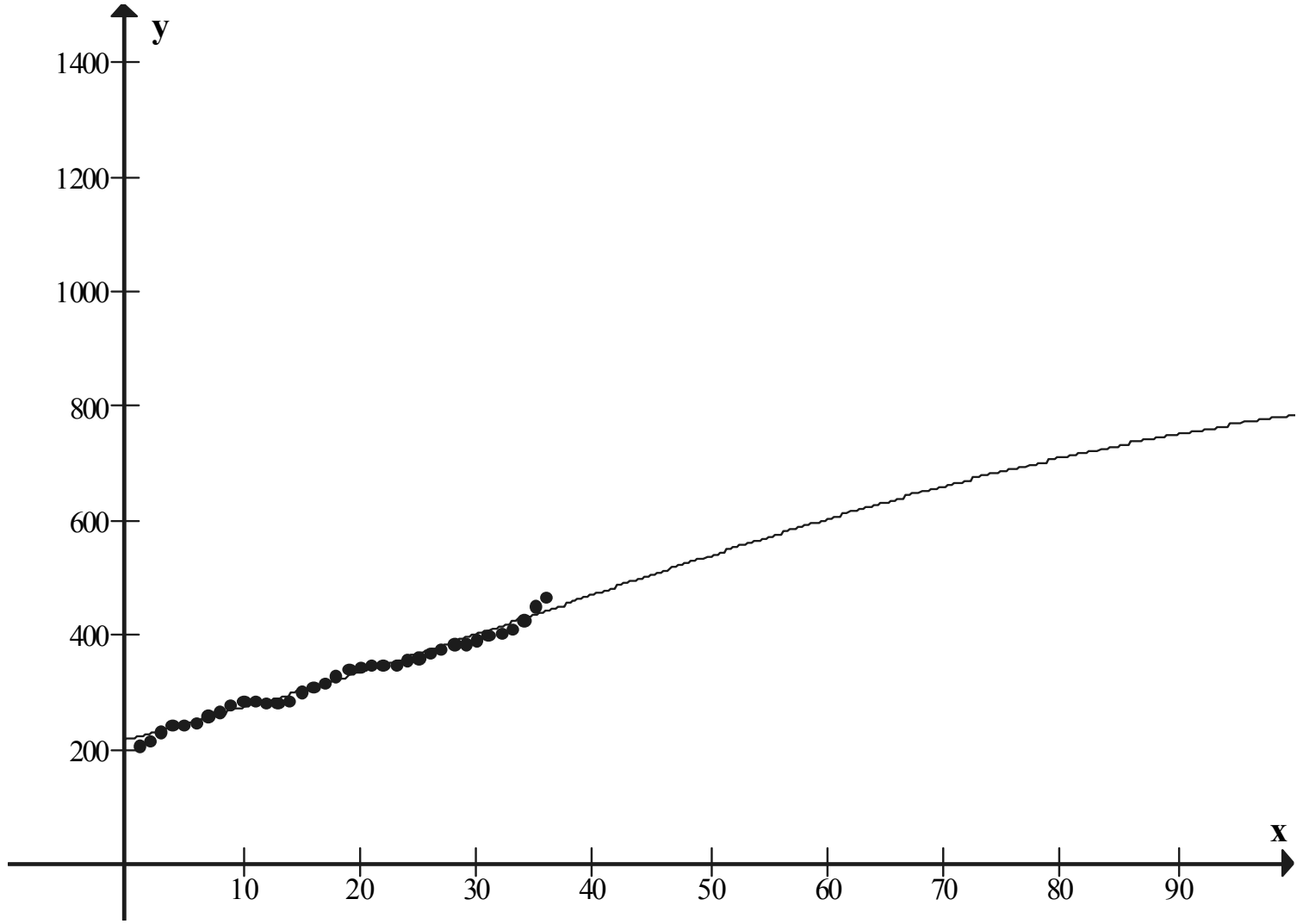
$y = 220.2616857e^{0.0199333475x}$

$(r^2 = 0.97826)$



Logistics Regression

$$y = \frac{891.9973968}{(1 + 3.137746323\, e^{-0.0310812361x})}$$



Answer the following questions on a separate piece of paper:

Part 1

1) In examining the data and the six regression models, which model would you use to predict the world primary energy consumption in the future? Why?

2) Which of the six models would be unrealistic to use? Why?

3) Using the model you picked in question 1, calculate the world primary energy consumption for the years 2010, 2015, 2020, and 2025 (x = 41, 46, 51, and 56).

4) The table below is the predicted world primary energy consumption for the years 2010, 2015, 2020, and 2025 done by the Energy Information Administration. Calculate the percent difference between your predictions and Energy Information Administration and write a one sentence comment on those differences.

$$\left(\frac{\text{Your Prediction} - \text{EIA's}}{\text{EIA'}} \bullet 100\%\right)$$

Year	x years after 1969	Energy Consumption (10^{15} Btu)	Year	x years after 1969	Energy Consumption (10^{15} Btu)
2010	41	511.1	**2020**	51	607.0
2015	46	559.4	**2025**	56	653.7

5) Using the model you selected in question 1, calculate the world primary energy consumption for the year **2030**. Is this reasonable? Why or why not?

6) Using the model you selected in question 1, calculate the world primary energy consumption for the year **2050**. Is this reasonable? Why or why not?

Part II

On my website, there is the article "International Energy Outlook" produced by the Energy Information Administration. To access it, go to www.countingbear.com and click on Math 1325 Written Projects. Then, click article "Highlights: International Energy Outlook 2007" below Written Project #2. Please read the entire article and then answer the following questions:

7) What factors make it impossible to predict the world energy consumption for years after 2030?

8) What was the most interesting and/or alarming prediction in this article? Why? How should this issue be addressed?

9) An executive of a corporation makes the following statement: "We are assuming that the world energy consumption will be double by the year 2050." Is this a reasonable statement? Why?