

MATH202: Quadratic Models (Electricity Usage)

Data on house size (square feet) and monthly electricity usage (kilowatt-hours) from 10 randomly selected homes in a particular area are collected and are shown below. We wish to predict the electricity usage based on the house size.

Size	Usage
1290	1182
1350	1172
1470	1264
1600	1493
1710	1571
1840	1711
1980	1804
2230	1840
2400	1956
2930	1954

1. Write down the quadratic regression model.
2. Write down the least-squares regression equation.
3. Fill in the blanks: The actual electricity figures differ from their estimated values by about _____ kw-hours on average. The mean prediction error applying the quadratic model to these data is about _____ kw-hours. About 95% of the electricity figures are about _____ hw-hours from the estimated parabola.
4. Use the residual plots to comment on whether or not the regression assumptions are reasonable.
5. Is this model useful for predicting electricity usage? Write out the hypothesis test.
6. Is the squared term statistically significant? Write out the hypothesis test. What else do the results of this test tell you?
7. Using the estimated quadratic model, predict electricity usage for a 2500 ft² house. Repeat for a 5000 ft² house.

Regression Analysis: USAGE versus SIZE

The regression equation is
 $USAGE = 579 + 0.540 SIZE$

Predictor	Coef	SE Coef	T	P
Constant	578.9	167.0	3.47	0.008
SIZE	0.54030	0.08593	6.29	0.000

S = 133.438 R-Sq = 83.2% R-Sq(adj) = 81.1%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	703957	703957	39.54	0.000
Residual Error	8	142445	17806		
Total	9	846402			

Regression Analysis: USAGE versus SIZE, SIZESQ

The regression equation is
 $USAGE = -1216 + 2.40 SIZE - 0.000450 SIZESQ$

Predictor	Coef	SE Coef	T	P
Constant	-1216.1	242.8	-5.01	0.002
SIZE	2.3989	0.2458	9.76	0.000
SIZESQ	-0.00045004	0.00005908	-7.62	0.000

S = 46.8013 R-Sq = 98.2% R-Sq(adj) = 97.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	831070	415535	189.71	0.000
Residual Error	7	15333	2190		
Total	9	846402			

Obs	Fit	SE Fit	95% CI	95% PI
1	1968.4	24.4	(1910.8, 2026.1)	(1843.7, 2093.2)
2	-472.5	501.8	(-1659.0, 714.0)	(-1664.1, 719.1)XX

XX denotes a point that is an extreme outlier in the predictors.

Values of Predictors for New Observations

Obs	SIZE	SIZESQ
1	2500	6250000
2	5000	25000000

