How to Perform Quantile Regression in Stata: A Step-by-Step Guide

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Quantile regression is a statistical method used to estimate the relationship between a set of independent variables and a continuous dependent variable at different points of its distribution. In Stata, this can be achieved through the use of the "qreg" command. This command allows the user to specify the desired quantile level and produces results that estimate the effects of the independent variables on the chosen quantile of the dependent variable. This can be particularly useful for examining the relationship between variables in non-normal distributions or in cases where the median or other specific quantiles are of interest. The "qreg" command in Stata provides a simple and efficient way to perform quantile regression and gain insights into the relationships between variables in a dataset.

Perform Quantile Regression in Stata

Linear regression is a method we can use to understand the relationship between one or more explanatory variables and a response variable.

Typically when we perform linear regression, we're interested in estimating the mean value of the response variable based on the value of the explanatory variable. But we could instead estimate the median, or the 0.25 percentile, or the 0.90 percentile, or any percentile we'd like.

This is where quantile regression comes into play. Similar to ordinary linear regression, quantile regression creates a regression equation that predicts some value (e.g. the median, 0.25 percentile, 0.90 percentile, etc.) for a response variable based on the

value of the explanatory variable.

This tutorial explains how to perform quantile regression in Stata.

Example: Quantile Regression in Stata

For this example we will use the built-in Stata dataset called *auto*. First we'll fit a linear regression model using weight as a predictor variable and mpg as a response variable. This will tell us the expected *average* mpg of a car, based on its weight. Then we'll fit a quantile regression model to predict the 0.90 percentile of mpg of a car, based on its weight.

Step 1: Load and view the data.

Use the following command to load the data:

sysuse auto

Use the following command to get a summary of the variables mpg and weight:

summarize mpg weight

```
. sysuse auto
(1978 Automobile Data)

. summarize mpg weight

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
         mpg |         74     21.2973    5.785503         12         41
      weight |         74    3019.459    777.1936       1760       4840
```

Step 2: Perform a simple linear regression.

Use the following command to perform simple linear regression, using weight as the explanatory variable and mpg as the response variable:

regress mpg weight

```
. regress mpg weight

      Source |       SS           df       MS      Number of obs   =        74
-------------+----------------------------------   F(1, 72)        =    134.62
       Model |   1591.9902         1   1591.9902   Prob > F        =    0.0000
    Residual |  851.469256        72  11.8259619   R-squared       =    0.6515
-------------+----------------------------------   Adj R-squared   =    0.6467
       Total |  2443.45946        73  33.4720474   Root MSE        =    3.4389

------------------------------------------------------------------------------
         mpg |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      weight |  -.0060087   .0005179   -11.60   0.000    -.0070411   -.0049763
       _cons |   39.44028   1.614003    24.44   0.000     36.22283    42.65774
------------------------------------------------------------------------------
```

From the output table we can see that the estimated regression equation is:

We can use this equation to find the estimated average mpg for a car, given its weight. For example, a car that weighs 4,000 pounds is estimated to have mpg of 15.405:

predicted mpg = 39.44028 - 0.0060087*(4000) = 15.405

Step 3: Perform quantile regression.

Next, let's perform quantile regression to get the estimated 90th percentile of a car's mpg, based on its weight.

Use the qreg command along with quantile(0.90) to perform this quantile regression:

qreg mpg weight, quantile(0.90)

```
. qreg mpg weight, quantile(0.90)
Iteration  1:  WLS sum of weighted deviations =  80.808183

Iteration  1: sum of abs. weighted deviations =  80.818462
Iteration  2: sum of abs. weighted deviations =  61.133333
Iteration  3: sum of abs. weighted deviations =  55.773684

.9 Quantile regression                          Number of obs =         74
  Raw sum of deviations        90 (about 29)
  Min sum of deviations 55.77368                Pseudo R2     =     0.3803

------------------------------------------------------------------------------
         mpg |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      weight |  -.0072368   .0025281    -2.86   0.006    -.0122766   -.0021971
       _cons |   47.02632   7.879115     5.97   0.000     31.31959    62.73304
------------------------------------------------------------------------------
```

From the output table we can see that the estimated regression equation is:

predicted 90th percentile of mpg = 47.02632 - 0.0072368*(weight)

We can use this equation to find the estimated mpg for a car in the 90th percentile, given its weight. For example, the 90th percentile of mpg for a car that weighs 4,000 pounds is estimated to be 18.709:

predicted 90th percentile of mpg = 47.02632 - 0.0072368*(4000) = 18.079

Recall that our previous linear regression model told us that a car that weighs 4,000 pounds has an estimated

average **mpg of 15.405. Thus, it makes sense that this quantile regression model tells us that a car that weighs 4,000 pounds would need an mpg of 18.079 to be in the 90th percentile of all cars with that particular weight.**

Multiple Quantile Regressions at Once in Stata

It's also possible to perform multiple quantile regressions at once in Stata. For example, suppose we are interested in estimating the 25th percentile, the median (e.g. 50th percentile), and the 90th percentile all at once.

To do so, we can use the sqreg command along with the q() command to specify which quantiles to estimate:

sqreg mpg weight, q(0.25, 0.50, 0.90)

```
. sqreg mpg weight, q(0.25, 0.50, 0.90)
(fitting base model)

Bootstrap replications (20)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
....................

Simultaneous quantile regression                    Number of obs =         74
  bootstrap(20) SEs                                 .25 Pseudo R2 =     0.4733
                                                    .50 Pseudo R2 =     0.4934
                                                    .90 Pseudo R2 =     0.3803
```

mpg	Coef.	Bootstrap Std. Err.	t	P>|t|	[95% Conf.	Interval]
q25						
weight	-.0051724	.0003766	-13.73	0.000	-.0059231	-.0044217
_cons	35.22414	1.268633	27.77	0.000	32.69516	37.75311
q50						
weight	-.0053333	.0005549	-9.61	0.000	-.0064396	-.0042271
_cons	36.94667	1.985909	18.60	0.000	32.98783	40.9055
q90						
weight	-.0072368	.0015364	-4.71	0.000	-.0102997	-.004174
_cons	47.02632	5.500986	8.55	0.000	36.0603	57.99233

Using this output, we can construct the estimated regression equations for each quantile regression:

(1) predicted 25th percentile of mpg = 35.22414 - 0.0051724*(weight)

(2) predicted 50th percentile of mpg = 36.94667 - 0.0053333*(weight)

(3) predicted 90th percentile of mpg = 47.02632 - 0.0072368*(weight)