```
* Linear Regression in SAS;
* Copyright 2013 by Ani Katchova;

proc import out= work.data
datafile= "C:\Econometrics\Data\regression_auto.csv"
dbms=csv replace; getnames=yes; datarow=2;
run;

* Descriptive statistics;
proc means data=data;
var mpg weight1 price foreign;
run;

* Detailed descriptive statistics;
proc univariate data=data;
var mpg;
run;

* Correlations;
proc corr data=data;
var mpg weight1 price foreign;
run;

* Plotting the data;
proc gplot data=data;
plot mpg*weight1;
run;

* Simple linear regression;
proc reg data=data;
model mpg = weight1;
run;

* Multiple linear regression;
proc reg data=data;
model mpg = weight1 price foreign;
run;
```

The SAS System

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
mpg	26	20.9230769	4.7575042	14.0000000	35.0000000
weight1	26	3.0992308	0.6950794	2.0200000	4.3300000
price	26	6651.73	3371.12	3299.00	15906.00
foreign	26	0.2692308	0.4523443	0	1.0000000

The SAS System

The UNIVARIATE Procedure
Variable: mpg

Moments

N	26	Sum Weights	26
Mean	20.9230769	Sum Observations	544
Std Deviation	4.75750419	Variance	22.6338462
Skewness	0.93547297	Kurtosis	1.79270004
Uncorrected SS	11948	Corrected SS	565.846154
Coeff Variation	22.7380715	Std Error Mean	0.93302334

Basic Statistical Measures

Location		Variability	
Mean	20.92308	Std Deviation	4.75750
Median	21.00000	Variance	22.63385
Mode	22.00000	Range	21.00000
		Interquartile Range	6.00000

Tests for Location: Mu0=0

Test		Statistic		p Value
Student's t	t	22.42503	Pr > |t|	<.0001
Sign	M	13	Pr >= |M|	<.0001
Signed Rank	S	175.5	Pr >= |S|	<.0001

Quantiles (Definition 5)

Quantile	Estimate
100% Max	35
99%	35
95%	29

Quantiles (Definition 5)

Quantile	Estimate
90%	26
75% Q3	23
50% Median	21
25% Q1	17
10%	15
5%	14
1%	14
0% Min	14

Extreme Observations

Lowest		Highest	
Value	Obs	Value	Obs
14	15	24	25
14	14	25	6
15	8	26	10
16	18	29	17
16	12	35	24

The CORR Procedure

4 Variables: mpg weight1 price foreign

Simple Statistics

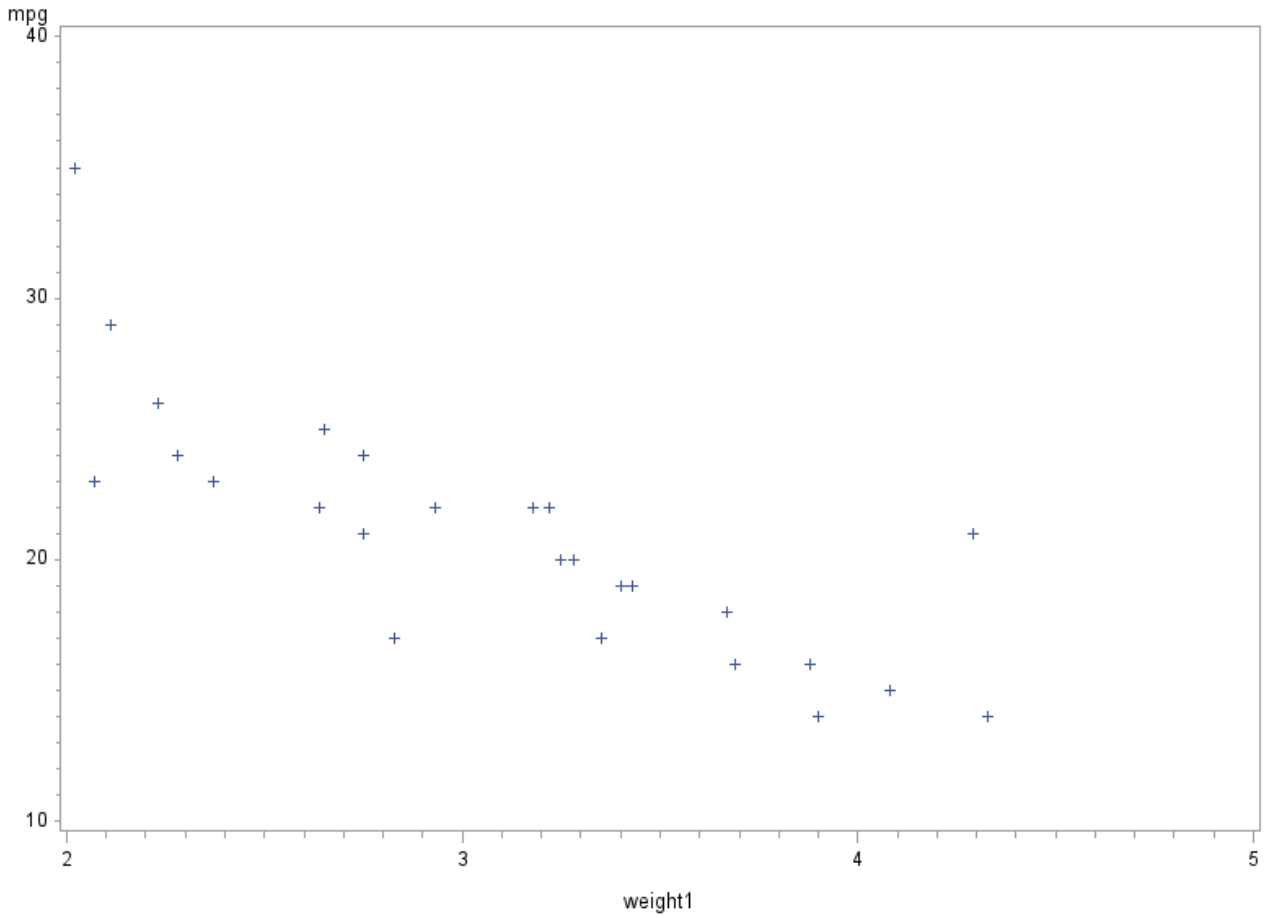
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
mpg	26	20.92308	4.75750	544.00000	14.00000	35.00000
weight1	26	3.09923	0.69508	80.58000	2.02000	4.33000
price	26	6652	3371	172945	3299	15906
foreign	26	0.26923	0.45234	7.00000	0	1.00000

Pearson Correlation Coefficients, N = 26
Prob > |r| under H0: Rho=0

	mpg	weight1	price	foreign
mpg	1.00000	-0.80816	-0.43846	0.40034
		<.0001	0.0251	0.0427
weight1	-0.80816	1.00000	0.55607	-0.60107

Pearson Correlation Coefficients, N = 26
Prob > |r| under H0: Rho=0

	mpg	weight1	price	foreign
	<.0001		0.0032	0.0012
price	-0.43846	0.55607	1.00000	0.08352
	0.0251	0.0032		0.6850
foreign	0.40034	-0.60107	0.08352	1.00000
	0.0427	0.0012	0.6850	



The REG Procedure
Model: MODEL1
Dependent Variable: mpg

Number of Observations Read	26
Number of Observations Used	26

Analysis of Variance

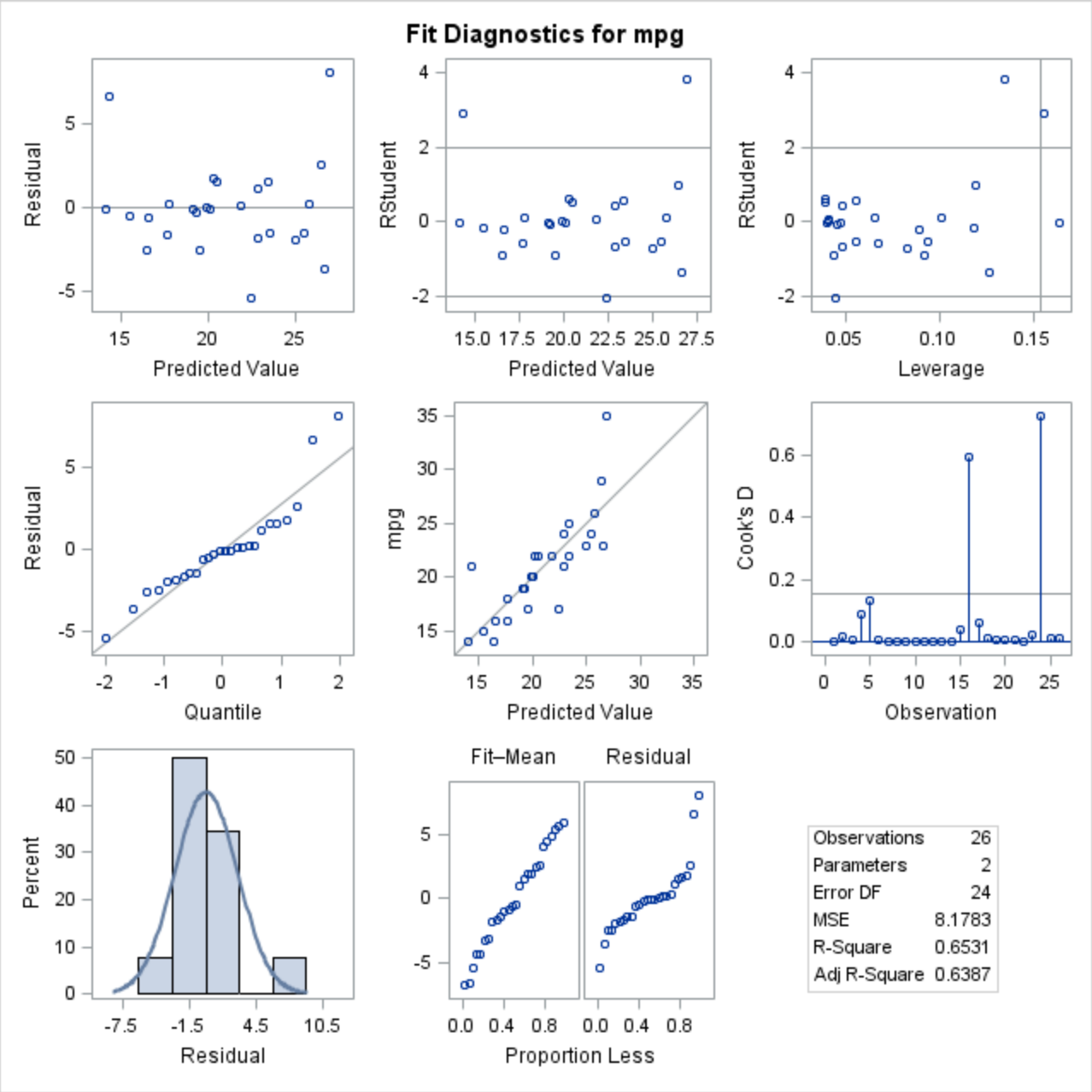
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	369.56777	369.56777	45.19	<.0001
Error	24	196.27838	8.17827		
Corrected Total	25	565.84615			

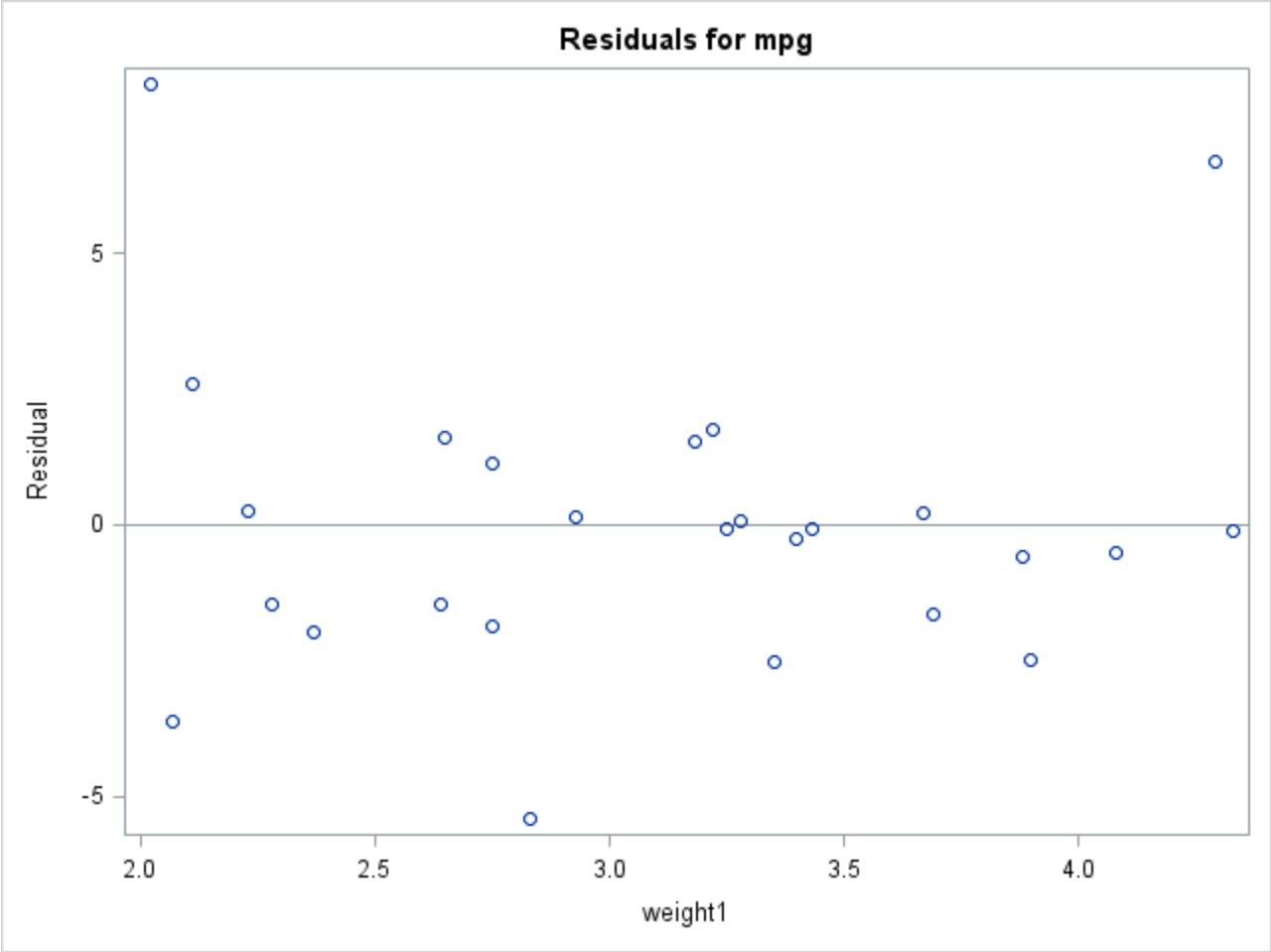
Root MSE	2.85977	R-Square	0.6531
Dependent Mean	20.92308	Adj R-Sq	0.6387
Coeff Var	13.66800		

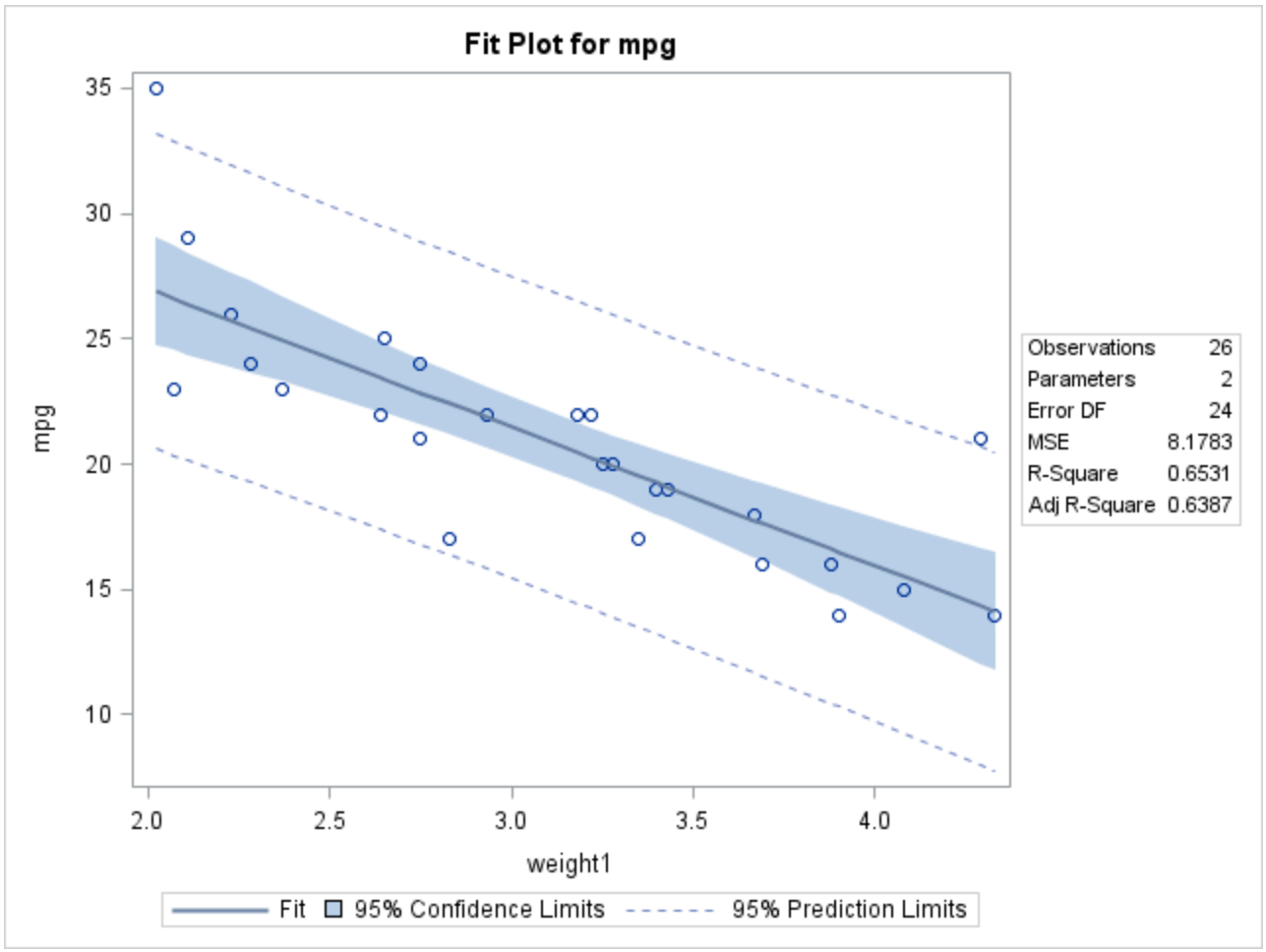
Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	38.06646	2.61118	14.58	<.0001
weight1	1	-5.53150	0.82286	-6.72	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: mpg




Residuals for mpg
Residual
5
0
-5
2.0
2.5
3.0
3.5
4.0
weight1


Fit Plot for mpg
mpg
35
30
25
20
15
10
2.0
2.5
3.0
3.5
4.0
weight1
Observations 26
Parameters 2
Error DF 24
MSE 8.1783
R-Square 0.6531
Adj R-Square 0.6387
Fit
95% Confidence Limits
95% Prediction Limits

The REG Procedure
Model: MODEL1
Dependent Variable: mpg

Number of Observations Read	26
Number of Observations Used	26

Analysis of Variance

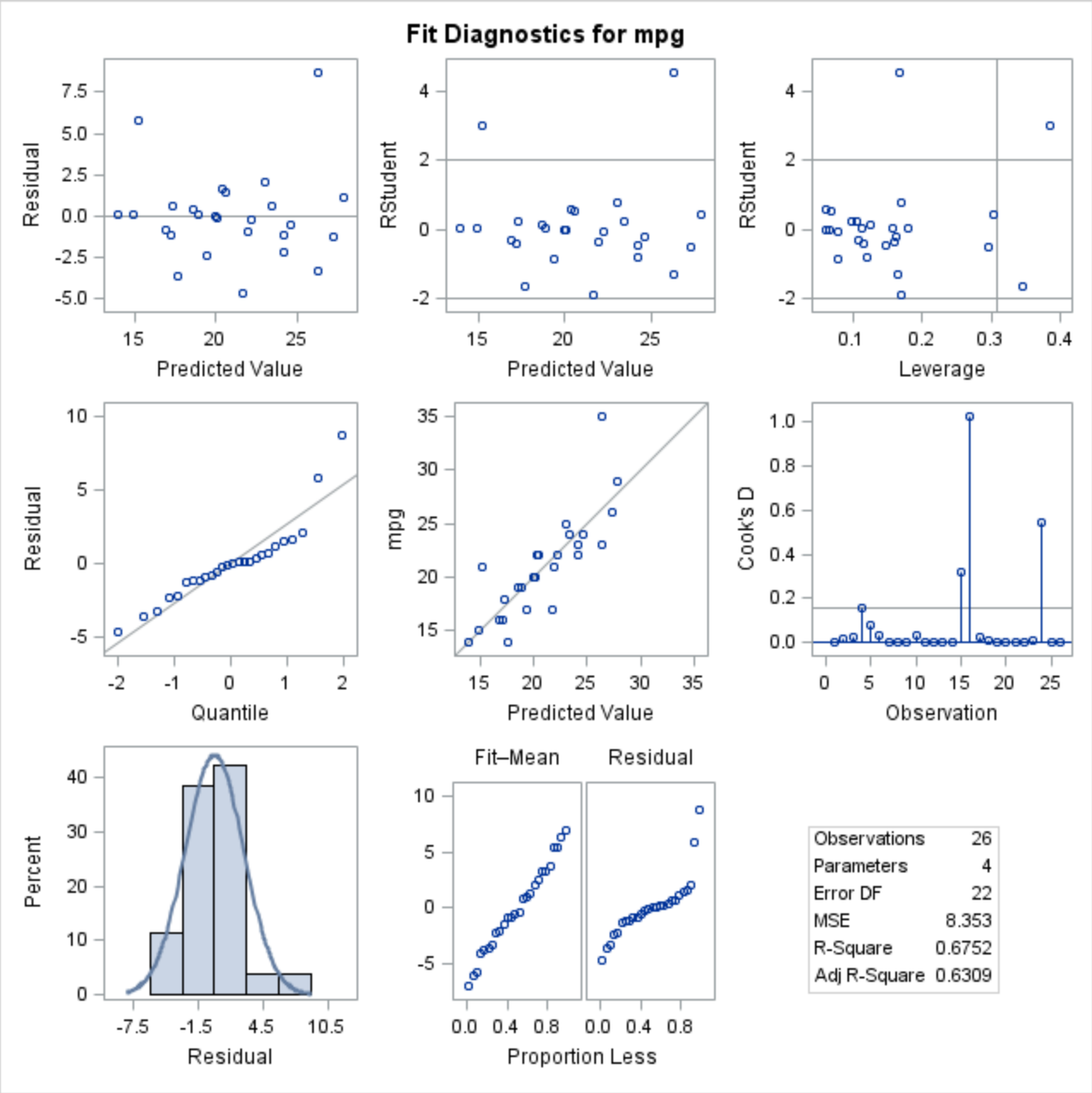
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	382.07964	127.35988	15.25	<.0001
Error	22	183.76652	8.35302		
Corrected Total	25	565.84615			

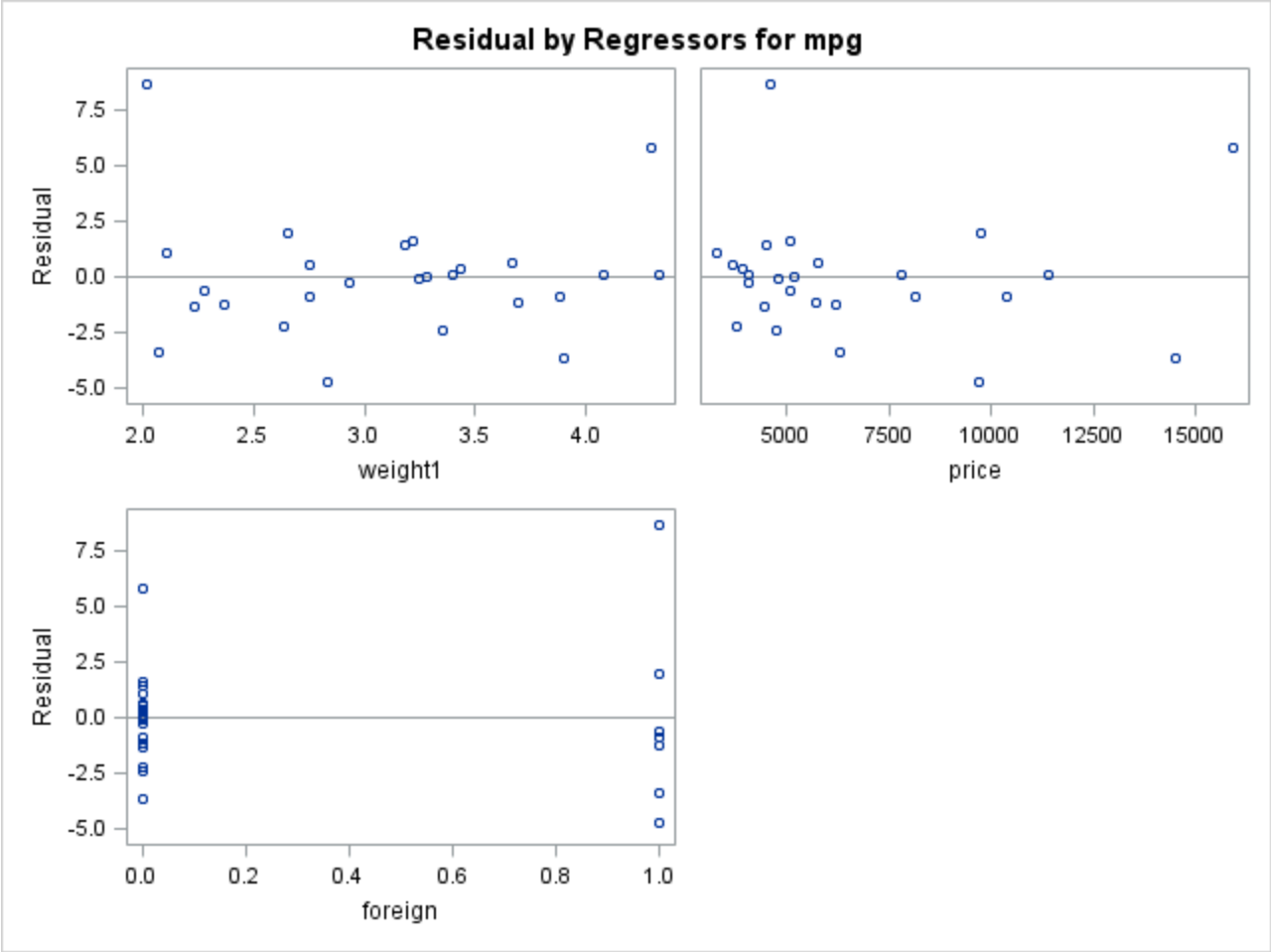
Root MSE	2.89016	R-Square	0.6752
Dependent Mean	20.92308	Adj R-Sq	0.6309
Coeff Var	13.81326		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	42.16620	4.26475	9.89	<.0001
weight1	1	-7.12111	1.60467	-4.44	0.0002
price	1	0.00022578	0.00026535	0.85	0.4040
foreign	1	-2.50713	2.05657	-1.22	0.2357

The REG Procedure
Model: MODEL1
Dependent Variable: mpg




Residual by Regressors for mpg
Residual
7.5
5.0
2.5
0.0
-2.5
-5.0
2.0
2.5
3.0
3.5
4.0
weight1
5000
7500
10000
12500
15000
price
Residual
foreign
0.0
0.2
0.4
0.6
0.8
1.0