



# **WORLD HAPPINESS**

Presented by Veronika Titarchuk

# ABOUT THE DATA SET

The happiness scores and rankings use data from the Gallup World Poll.

There are 149 countries (observations), 6 regressors and a response.

Ladder score is a response, GDP (gross domestic product), social support, healthy life expectancy, freedom of life choices, generosity and perception of corruption.

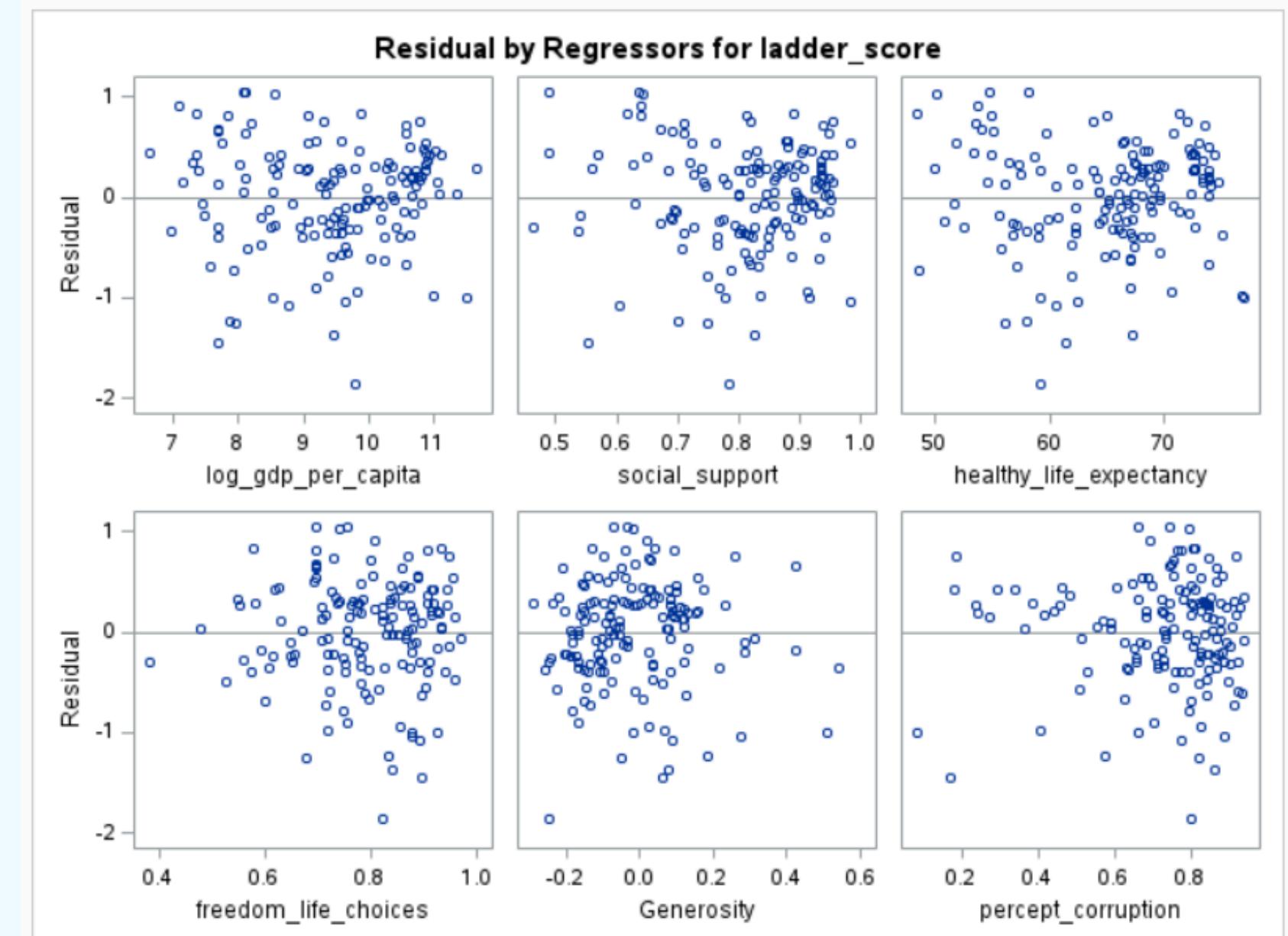
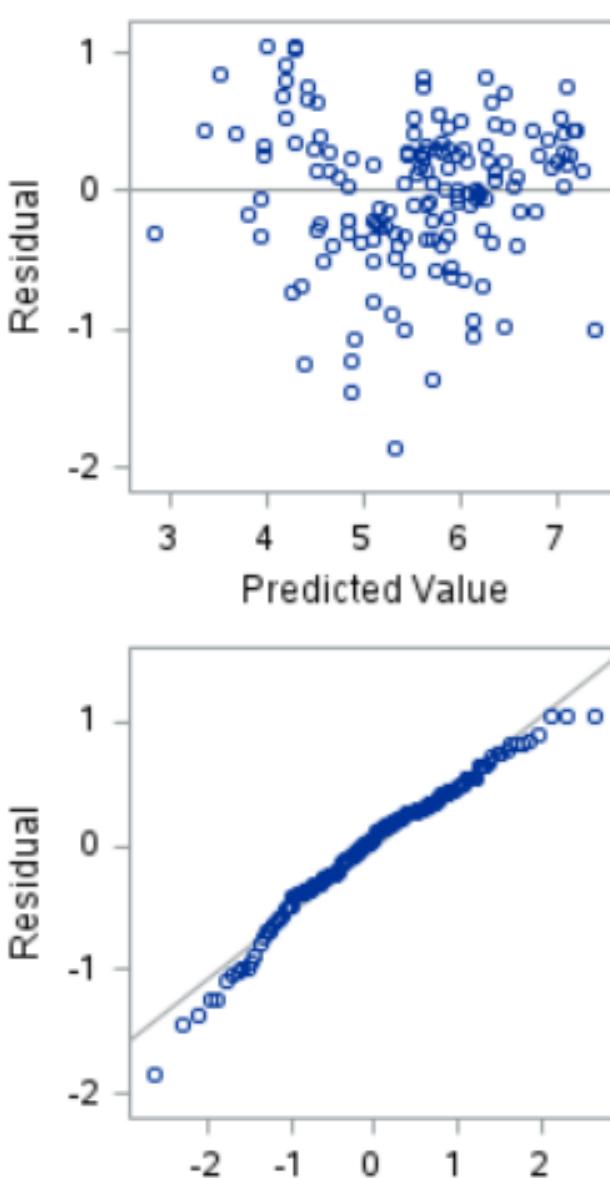
# INITIAL MODEL

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	129.01566	21.50261	73.27	<.0001
Error	142	41.67449	0.29348		
Corrected Total	148	170.69015			

Root MSE	0.54174	R-Square	0.7558
Dependent Mean	5.53284	Adj R-Sq	0.7455
Coeff Var	9.79136		

Parameter Estimates						
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	Variance Inflation
Intercept	1	-2.23722	0.63049	-3.55	0.0005	0
log_gdp_per_capita	1	0.27953	0.08684	3.22	0.0016	5.10489
social_support	1	2.47621	0.66822	3.71	0.0003	2.97220
healthy_life_expectancy	1	0.03031	0.01333	2.27	0.0245	4.09935
freedom_life_choices	1	2.01046	0.49480	4.06	<.0001	1.58581
Generosity	1	0.36438	0.32121	1.13	0.2585	1.18098
percept_corruption	1	-0.60509	0.29051	-2.08	0.0391	1.36712



<b>Sum of Residuals</b>	<b>0</b>
<b>Sum of Squared Residuals</b>	<b>41.67449</b>
<b>Predicted Residual SS (PRESS)</b>	<b>46.95230</b>

Number in Model	Adjusted R-Square	R-Square	C(p)	AIC	BIC	MSE	Variables in Model
6	0.7455	0.7558	7.0000	-175.8345	-173.1492	0.29348	log_gdp_per_capita social_support healthy_life_expectancy freedom_life_choices Generosity percept_corruption
5	0.7450	0.7536	6.2868	-176.4903	-174.0150	0.29407	log_gdp_per_capita social_support healthy_life_expectancy freedom_life_choices percept_corruption
5	0.7396	0.7484	9.3383	-173.3505	-171.1329	0.30033	log_gdp_per_capita social_support healthy_life_expectancy freedom_life_choices Generosity
4	0.7382	0.7453	9.1559	-173.5112	-171.4543	0.30195	log_gdp_per_capita social_support freedom_life_choices percept_corruption
5	0.7381	0.7470	10.1689	-172.5071	-170.3582	0.30204	log_gdp_per_capita social_support freedom_life_choices Generosity percept_corruption

R squared predicted = 72.49%

# SELECTION OF THE MODEL

Backward elimination

Stepwise

Variable Generosity Removed: R-Square = 0.7536 and C(p) = 6.2868

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	128.63799	25.72760	87.49	<.0001
Error	143	42.05216	0.29407		
Corrected Total	148	170.69015			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-2.11039	0.62112	3.39486	11.54	0.0009
log_gdp_per_capita	0.26400	0.08584	2.78150	9.46	0.0025
social_support	2.50670	0.66835	4.13665	14.07	0.0003
healthy_life_expectancy	0.02936	0.01332	1.42899	4.86	0.0291
freedom_life_choices	2.13266	0.48342	5.72327	19.46	<.0001
percept_corruption	-0.66778	0.28549	1.60889	5.47	0.0207

Bounds on condition number: 4.9779, 74.284

All variables left in the model are significant at the 0.1000 level.

Stepwise Selection: Step 5

Variable healthy\_life\_expectancy Entered: R-Square = 0.7536 and C(p) = 6.2868

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	128.63799	25.72760	87.49	<.0001
Error	143	42.05216	0.29407		
Corrected Total	148	170.69015			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-2.11039	0.62112	3.39486	11.54	0.0009
log_gdp_per_capita	0.26400	0.08584	2.78150	9.46	0.0025
social_support	2.50670	0.66835	4.13665	14.07	0.0003
healthy_life_expectancy	0.02936	0.01332	1.42899	4.86	0.0291
freedom_life_choices	2.13266	0.48342	5.72327	19.46	<.0001
percept_corruption	-0.66778	0.28549	1.60889	5.47	0.0207

Bounds on condition number: 4.9779, 74.284

All variables left in the model are significant at the 0.1500 level.

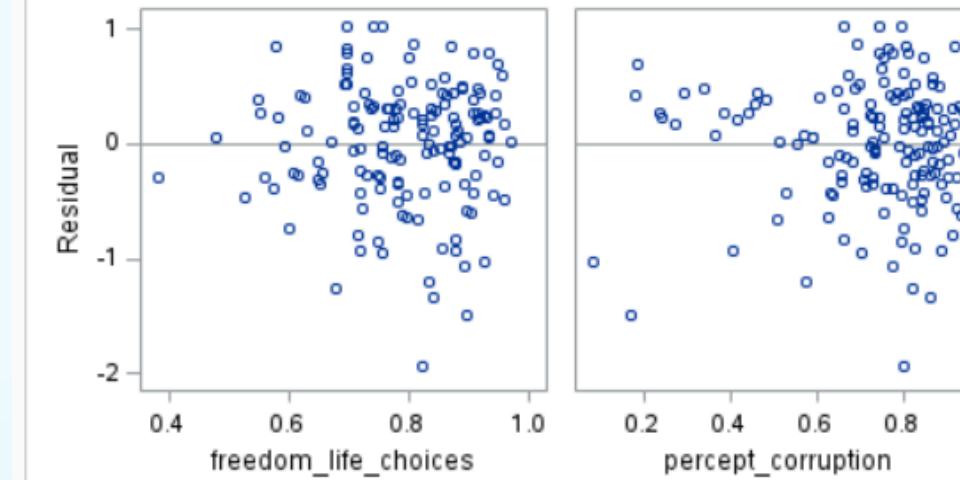
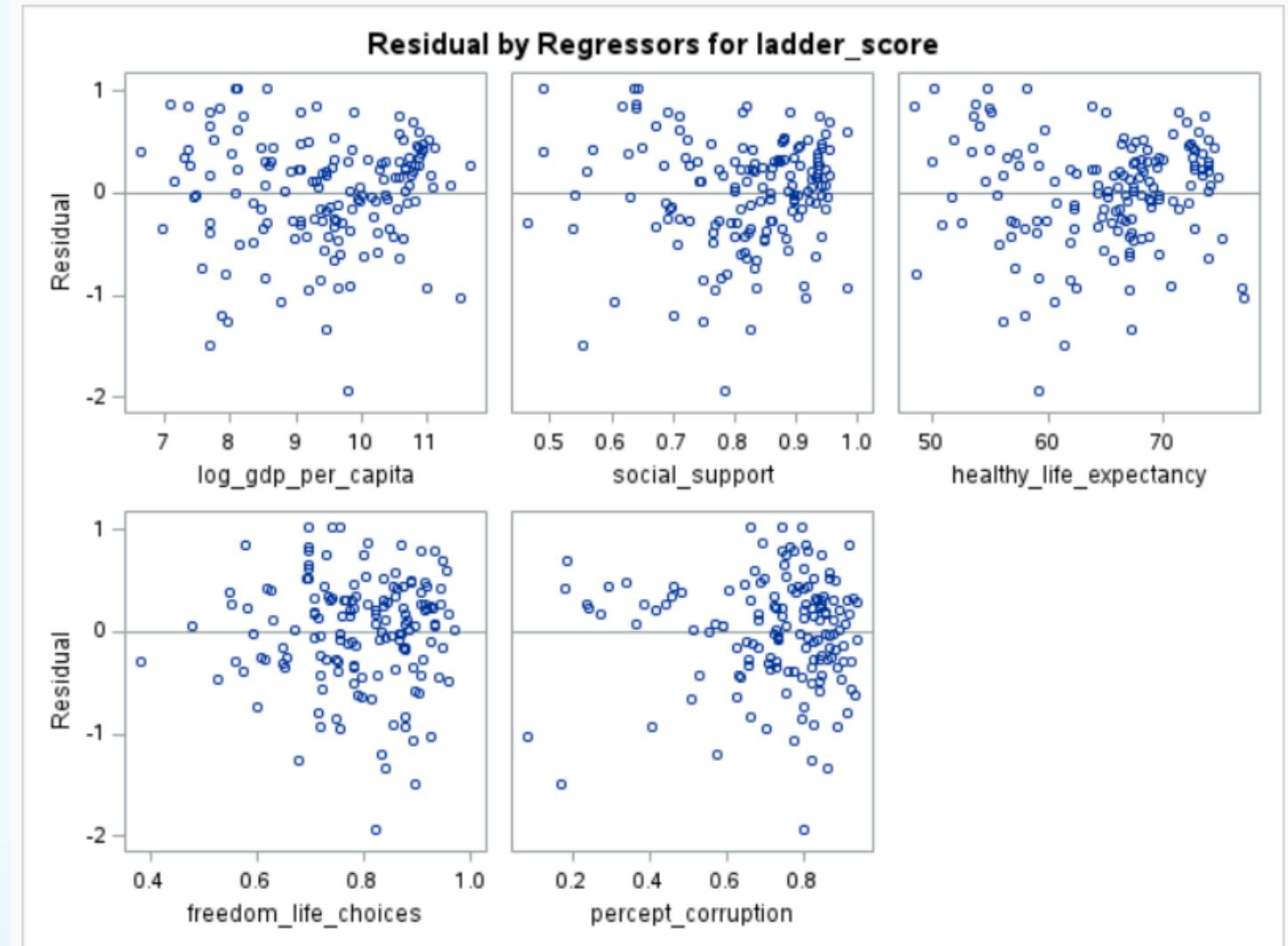
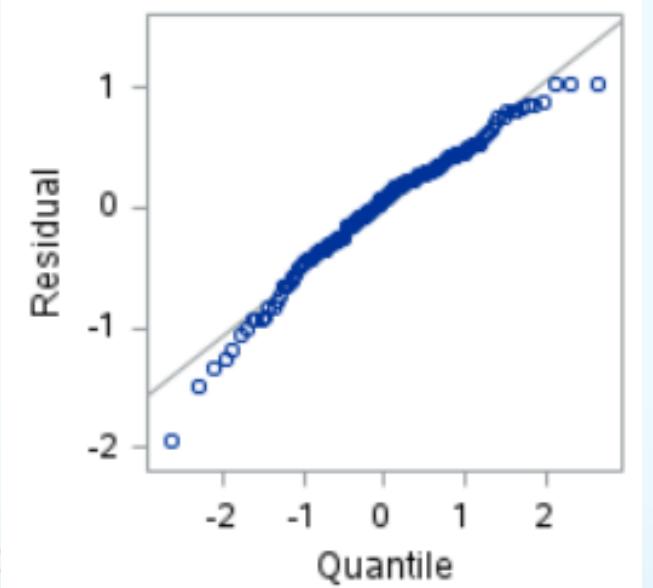
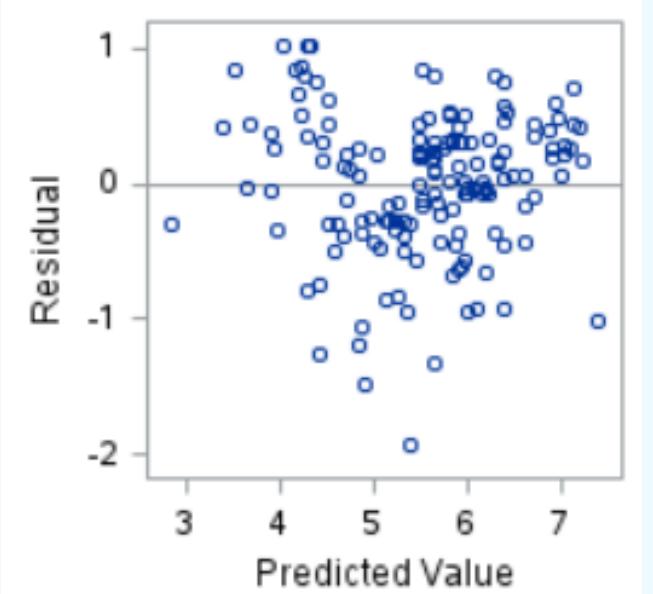
No other variable met the 0.1500 significance level for entry into the model.

Generosity is not a significant variable.

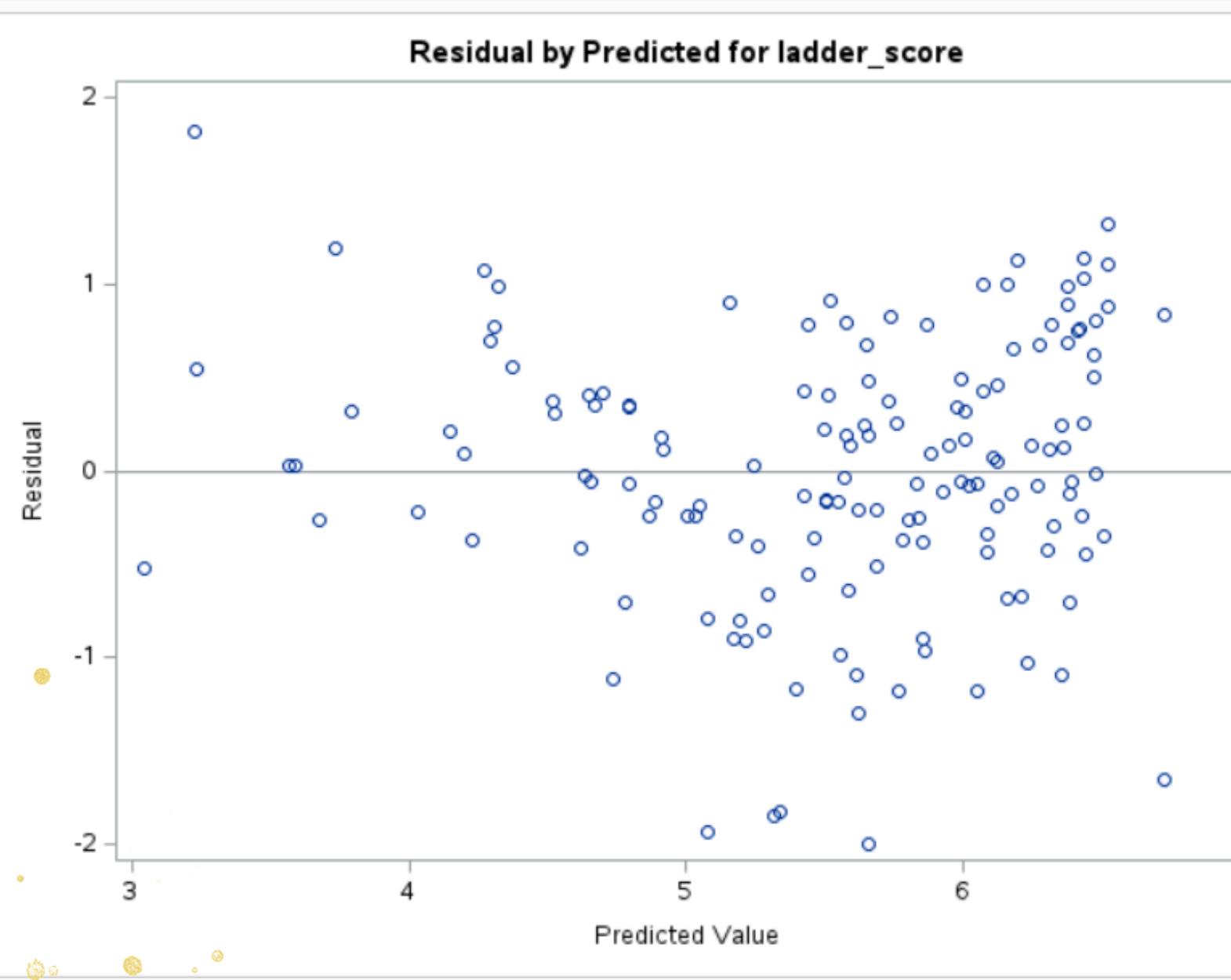
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	128.63799	25.72760	87.49	<.0001
Error	143	42.05216	0.29407		
Corrected Total	148	170.69015			

Root MSE	0.54228	R-Square	0.7536
Dependent Mean	5.53284	Adj R-Sq	0.7450
Coeff Var	9.80117		

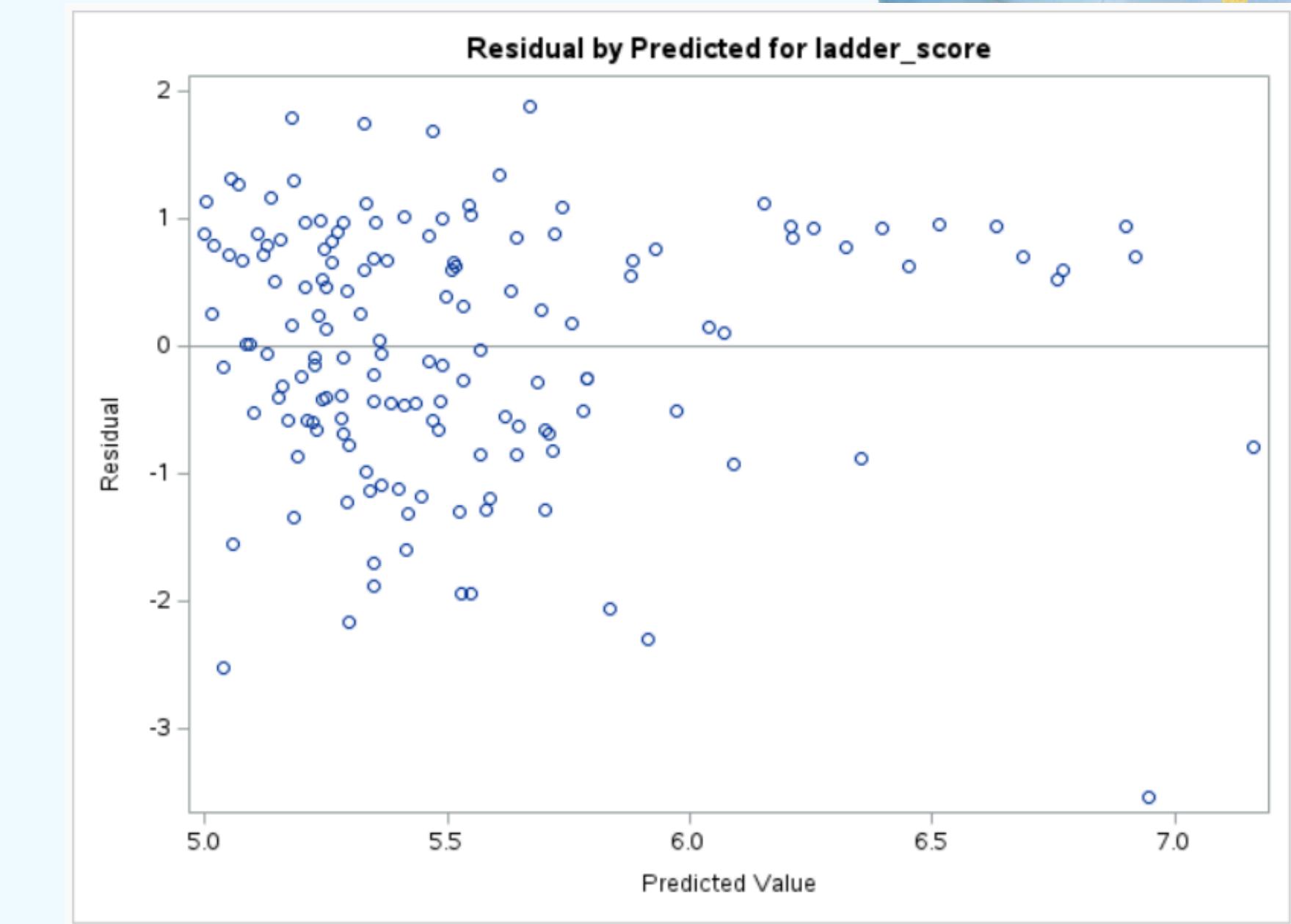
Parameter Estimates						
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	Variance Inflation
Intercept	1	-2.11039	0.62112	-3.40	0.0009	0
log_gdp_per_capita	1	0.26400	0.08584	3.08	0.0025	4.97792
social_support	1	2.50670	0.66835	3.75	0.0003	2.96739
healthy_life_expectancy	1	0.02936	0.01332	2.20	0.0291	4.08316
freedom_life_choices	1	2.13266	0.48342	4.41	<.0001	1.51065
percept_corruption	1	-0.66778	0.28549	-2.34	0.0207	1.31766



**Residual by Predicted for ladder\_score**



**Residual by Predicted for ladder\_score**

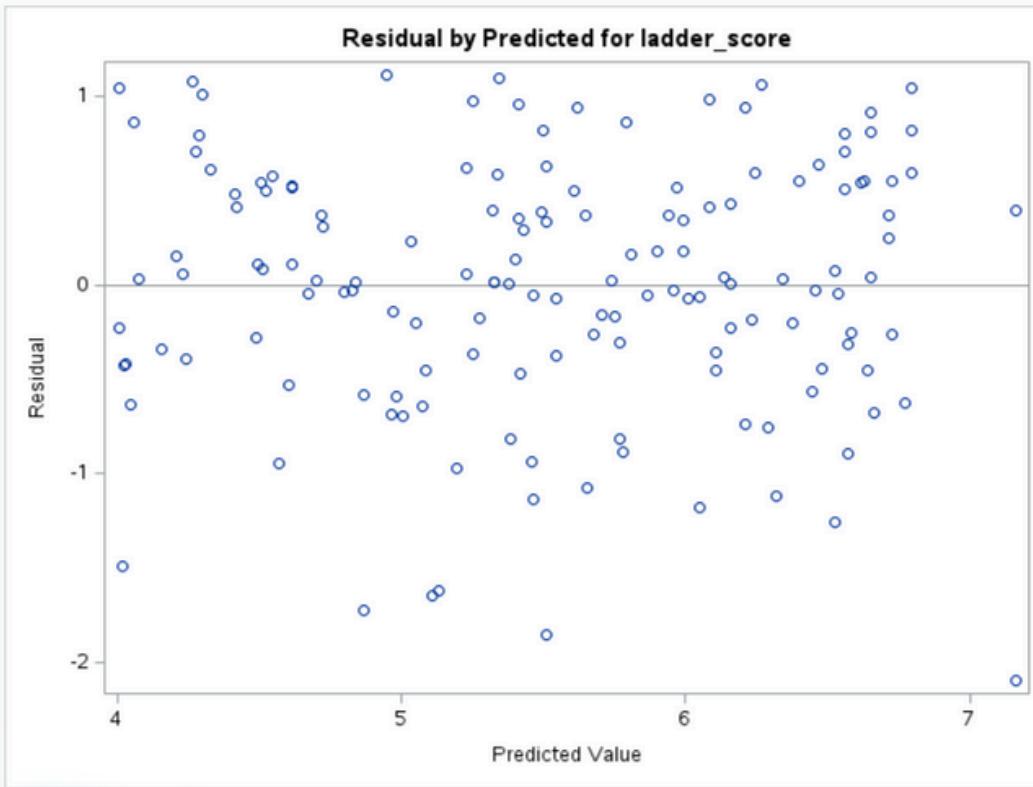


Social support

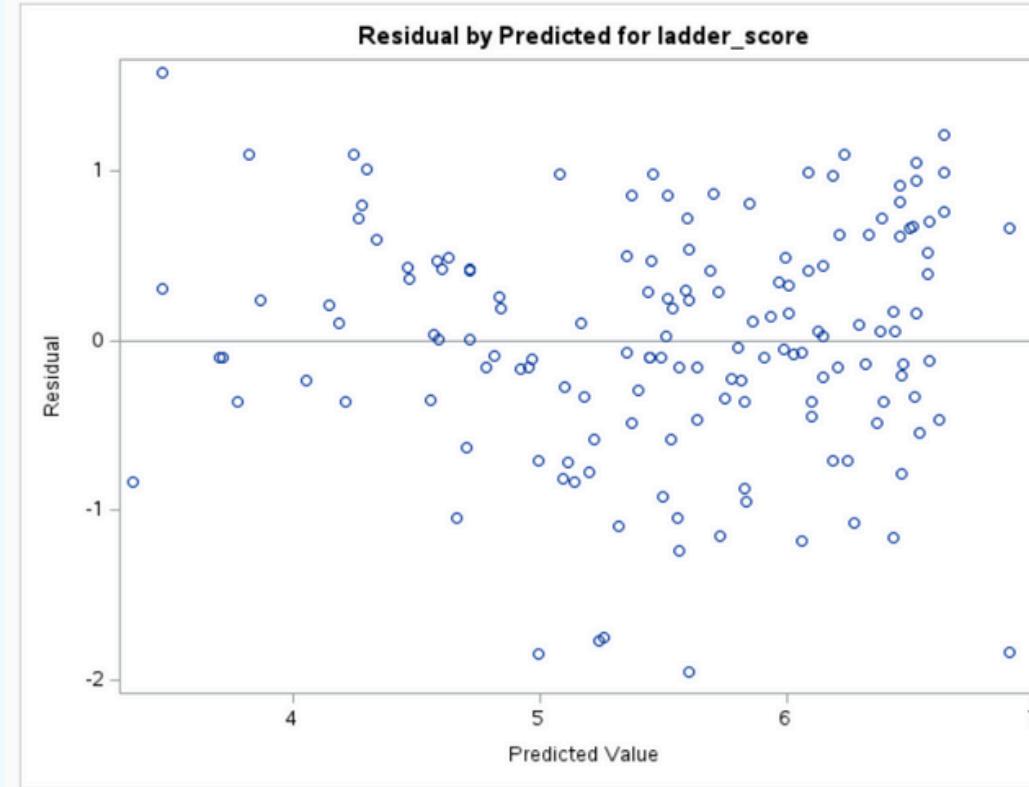
Perception of corruption

# TRANSFORMATIONS

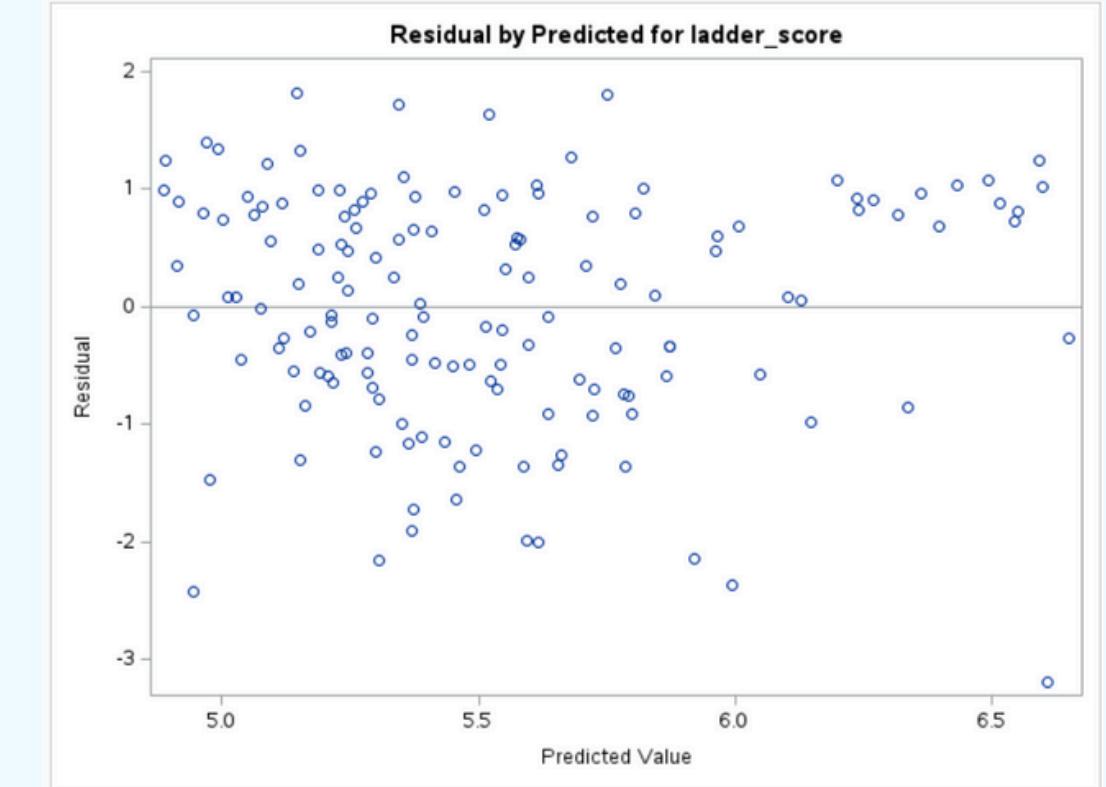
```
data final.happiness3;  
  set final.happiness;  
  social_support_sqr = social_support**2;  
  percept_corruption_sqr = (percept_corruption)**2;  
  ladder_score_new = (ladder_score)**(1.5);  
run;
```



Social support + Social  
support squared



Social support squared



Perception of corruption  
squared

# Model after data transformation

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	130.35666	21.72611	76.49	<.0001
Error	142	40.33349	0.28404		
Corrected Total	148	170.69015			

Root MSE	0.53295	R-Square	0.7637
Dependent Mean	5.53284	Adj R-Sq	0.7537
Coeff Var	9.63254		

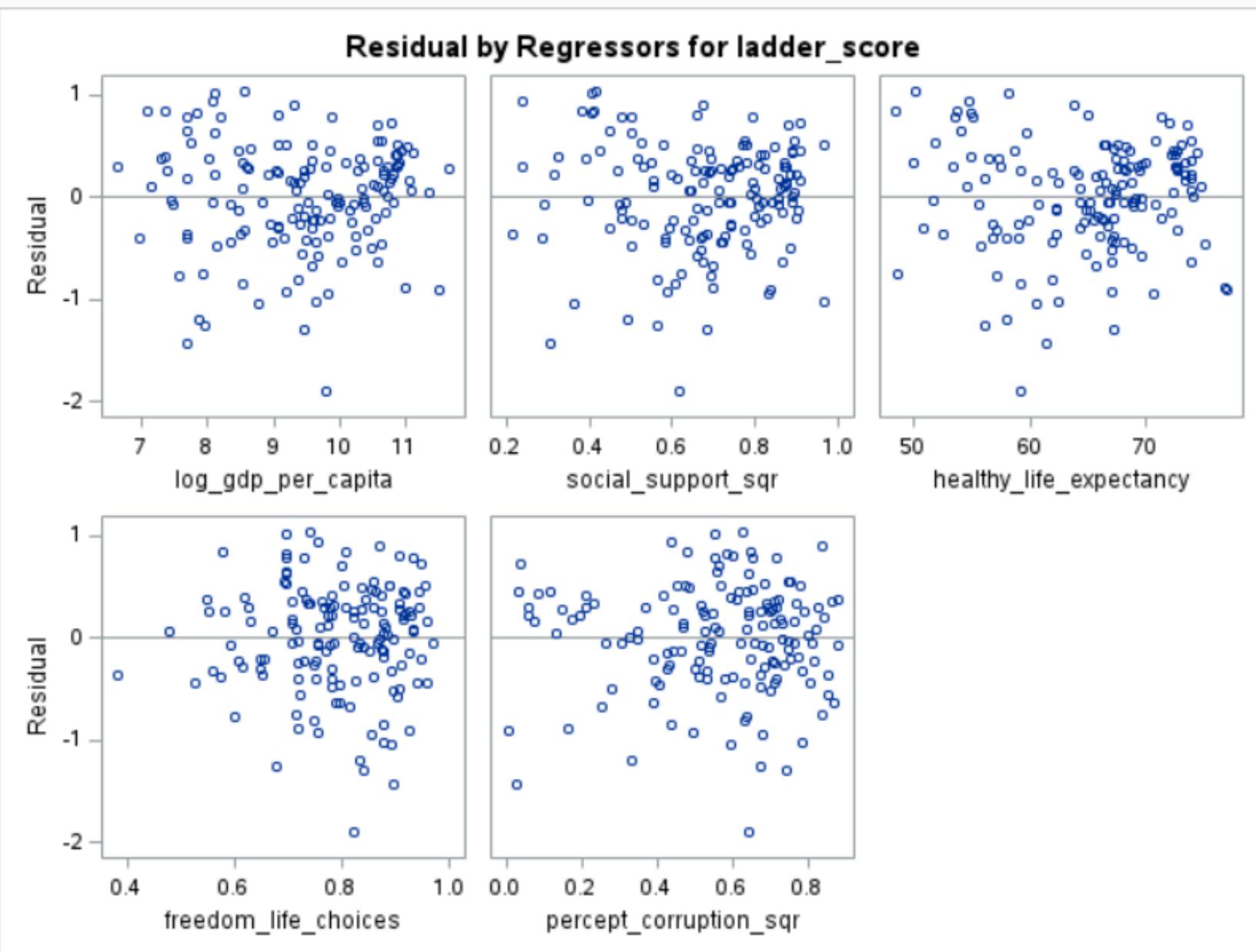
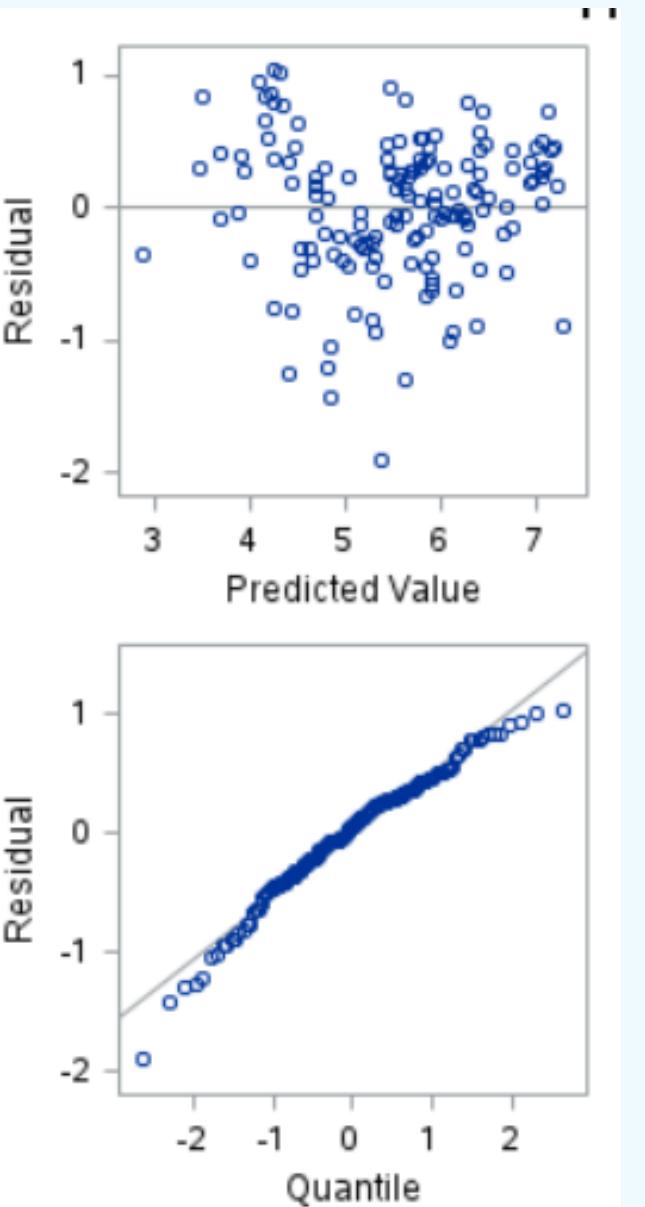
Parameter Estimates						
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	Variance Inflation
Intercept	1	1.35861	1.70665	0.80	0.4273	0
log_gdp_per_capita	1	0.24732	0.08457	2.92	0.0040	5.00267
social_support	1	-7.13354	4.37971	-1.63	0.1056	131.92642
social_support_sqr	1	6.48613	2.89882	2.24	0.0268	135.21077
healthy_life_expectancy	1	0.02809	0.01310	2.14	0.0337	4.08710
freedom_life_choices	1	2.14819	0.47437	4.53	<.0001	1.50597
percept_corruption_sqr	1	-0.46934	0.23851	-1.97	0.0510	1.36824

# Final model

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	129.60313	25.92063	90.21	<.0001
Error	143	41.08702	0.28732		
Corrected Total	148	170.69015			

Root MSE	0.53602	R-Square	0.7593
Dependent Mean	5.53284	Adj R-Sq	0.7509
Coeff Var	9.68805		

Parameter Estimates						
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	Variance Inflation
Intercept	1	-1.21958	0.64169	-1.90	0.0594	0
log_gdp_per_capita	1	0.24913	0.08505	2.93	0.0040	5.00181
social_support_sqr	1	1.81827	0.43829	4.15	<.0001	3.05557
healthy_life_expectancy	1	0.02836	0.01317	2.15	0.0330	4.08645
freedom_life_choices	1	2.08646	0.47557	4.39	<.0001	1.49635
percept_corruption_sqr	1	-0.57571	0.23072	-2.50	0.0137	1.26566



<b>Sum of Residuals</b>	0
<b>Sum of Squared Residuals</b>	41.08702
<b>Predicted Residual SS (PRESS)</b>	45.15028

Number in Model	Adjusted R-Square	R-Square	C(p)	AIC	BIC	MSE	Variables in Model
5	0.7509	0.7593	6.0000	-179.9499	-177.4499	0.28732	log_gdp_per_capita social_support_sqr healthy_life_expectancy freedom_life_choices percept_corruption_sqr
4	0.7446	0.7515	8.6356	-177.1964	-175.1041	0.29458	log_gdp_per_capita social_support_sqr freedom_life_choices percept_corruption_sqr
4	0.7418	0.7488	10.2267	-175.5992	-173.6144	0.29775	log_gdp_per_capita social_support_sqr healthy_life_expectancy freedom_life_choices
4	0.7378	0.7448	12.5797	-173.2681	-171.4389	0.30245	social_support_sqr healthy_life_expectancy freedom_life_choices percept_corruption_sqr
3	0.7332	0.7387	14.2601	-171.6935	-170.0194	0.30765	log_gdp_per_capita social_support_sqr freedom_life_choices

R squared predicted = 73.55%

# Detecting outliers and influential points

Interesting fact that almost all outliers are the countries that are in Asia or Sub-Saharan Africa.

**GDP** influential observations:

Ivory Coast (Sub-Saharan Africa), Benin (Sub-Saharan Africa), Sierra Leone (Sub-Saharan Africa), Yemen (Middle East and North Africa), Botswana (Sub-Saharan Africa), Rwanda (Sub-Saharan Africa).

**Freedom of life choices** influential observations:

Guatemala (Latin America and Caribbean), Hong Kong S.A. (East Asia), Lebanon (Middle East and North Africa), Sierra Leone (Sub-Saharan Africa), Yemen (Middle East and North Africa), Lesotho (Sub-Saharan Africa), Botswana (Sub-Saharan Africa).

# Results

Freedom to make decisions in life has a major impact on people's happiness.

The second factor, social support, is practically as important as freedom of choice in terms of significance. Though, we have to remember that now all the values are squared. But social support from the beginning was a significant regressor.

# THANK YOU

"World happiness report"