Happy Countries

How Happy is your Nation?

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What Makes the People of a Country Happy?

Freedom to express themselves?

Pride in their country?

Lower crime rates in the country?

The diversity in the population?

Higher income levels?

Studying Statistics in School?

Healthcare accessibility?

Study Objective:

By studying the data of 27 countries in the year 2013 (or most recent), we investigated what variables contribute to the happiness index assigned to a country.

Statistics Study on Country Happiness

Variables Studied:

Response Variable:

- Country's Happiness Index

Input Variables:

- Gross Domestic Product per Capita
- Press Freedom Index
- % Foreign Born
- Binary Variable: Country has universal health care or not

Countries Studied:

Randomly chosen countries

United States
China
Thailand
India
Greece
Russia
Germany
Canada
Mexico
Argentina
Brazil
Peru
Italy
Australia
New Zealand
South Africa
Nigeria
Ethiopia
Iraq
Saudi Arabia
Sweden
Haiti
Nepal
Iran
Sri Lanka
Japan
Egypt
Denmark
Norway
Afghanistan
Syria

Assumptions

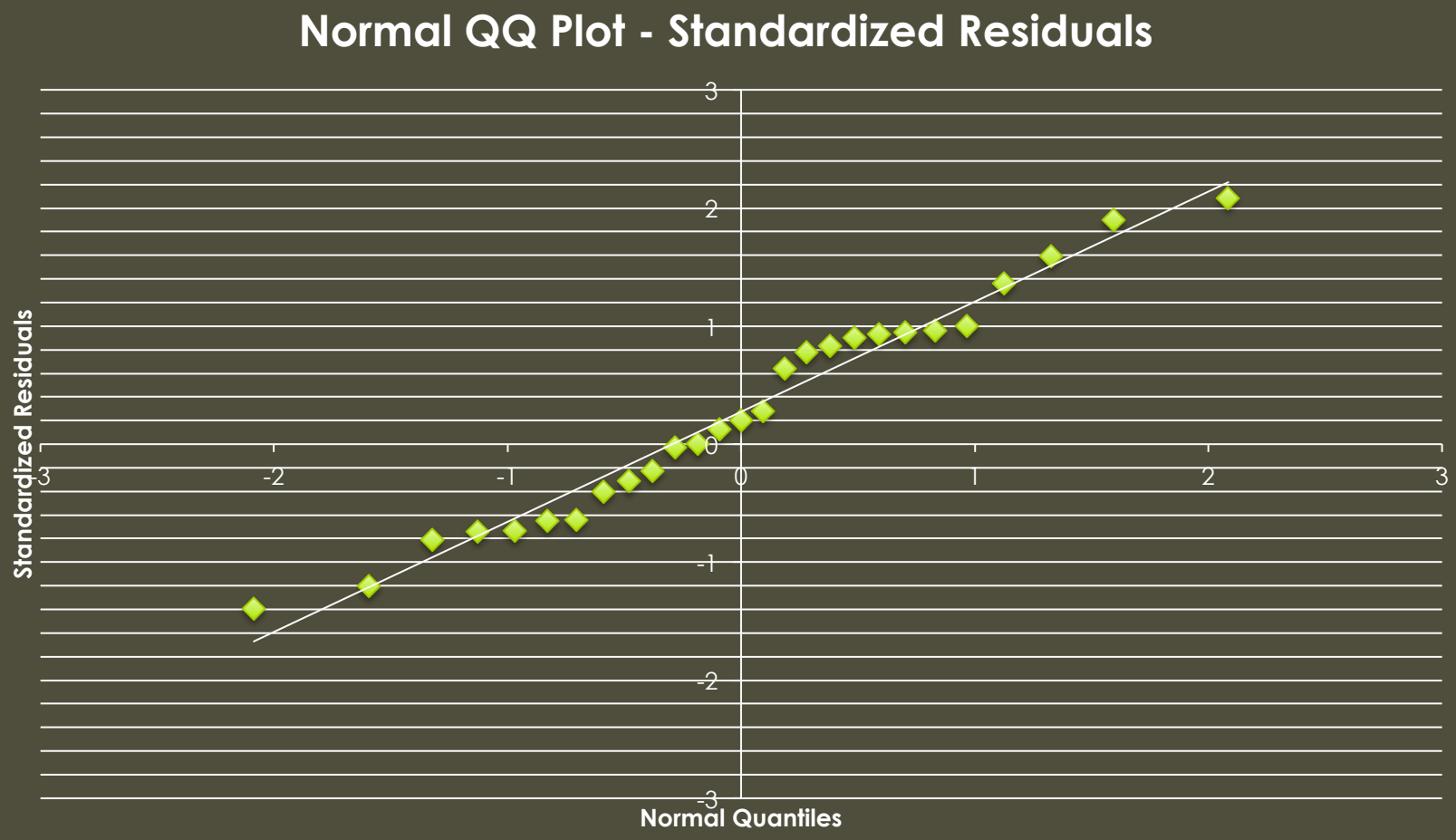
1. Each error r.v. is independent and identically distributed with a mean of zero and variance σ^2

- Since there is no obvious pattern in the Standardized Residual Plot, then the linearity assumption for the error is not violated. This graph shows Homoscedasticity , so the variance is constant for different input variables.

Assumptions

2. Each error r.v. is independent and identically distributed with a mean of zero and variance σ^2.

- Since the standardized residuals fall on the line of the QQ Plot, our normality assumption is justified



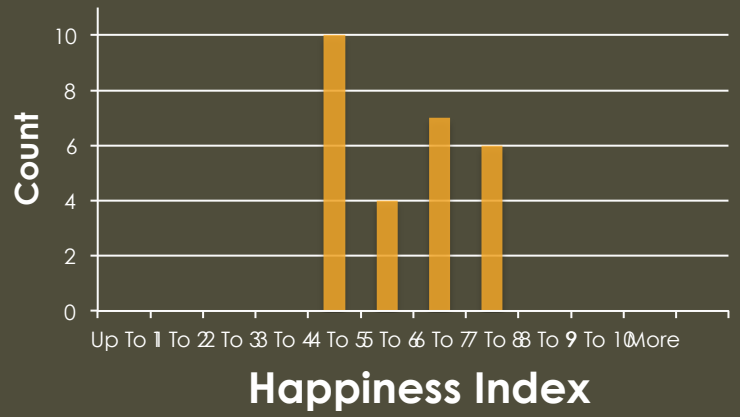
DESCRIPTIVE STATISTICS

Descriptive Statistics

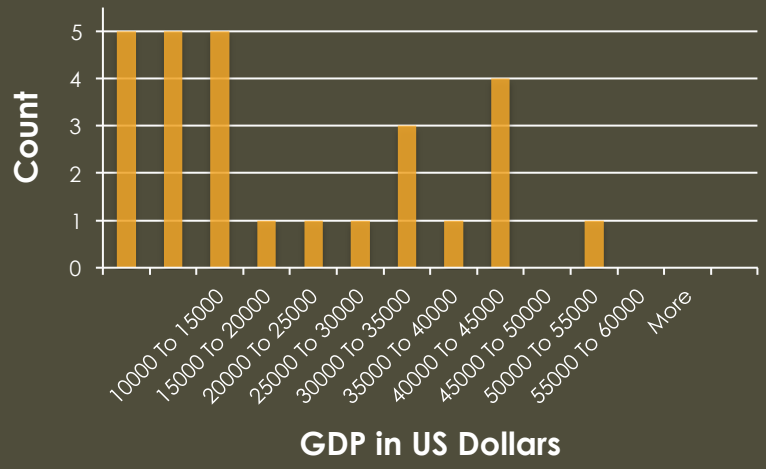
	Happiness Index (out of 10)		GDP in $US (per capita)		Percent Foreign Born (2013)		Press Freedom Index (2013)	
Min	4.151	Sri Lanka	1109	Ethiopia	0.1	China	6.52	New Zealand
Mean	5.789		19627.89		7.507		29.82	
Median	5.776	Peru	11803	Argentina	3.5	Iran	26.76	Mexico
Max	7.48	Sweden	51749	United States	31.4	Saudi Arabia	73.07	China
Standard Deviation	1.112		15655.53		9.071		16.519	

Histograms of Data Sets

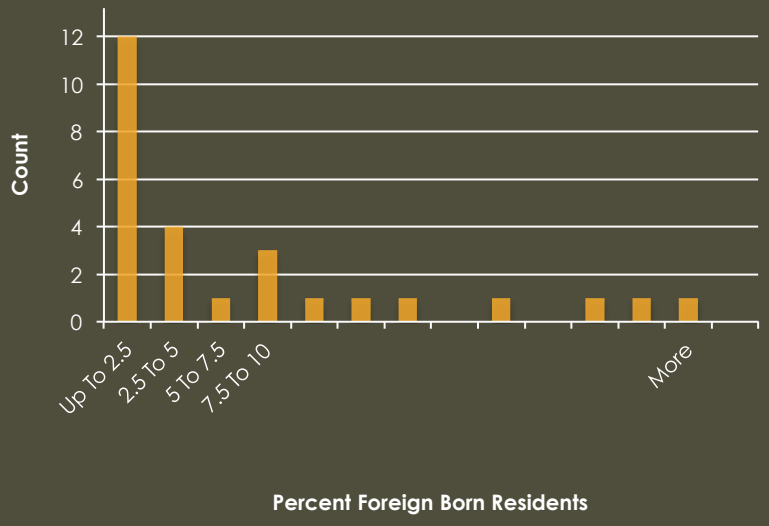
Happiness Index (out of 10)



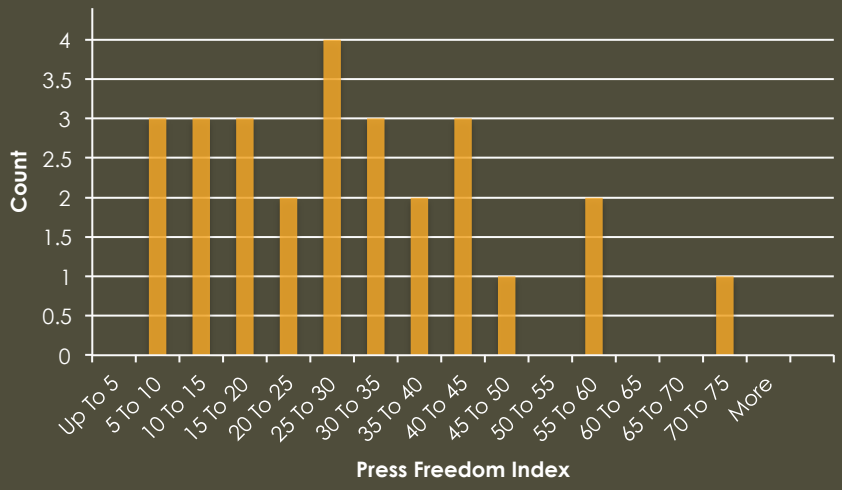
GDP



Percent of Foreign Born Residents



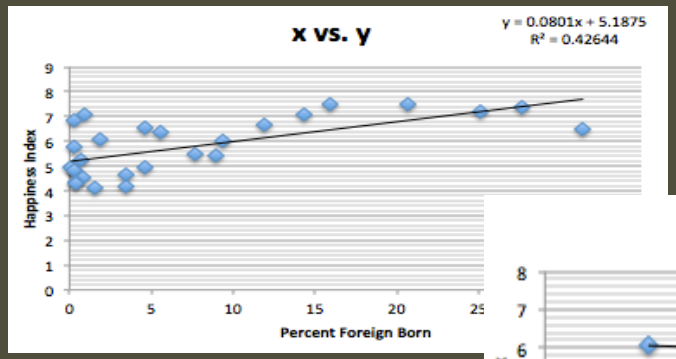
Press Freedom Index

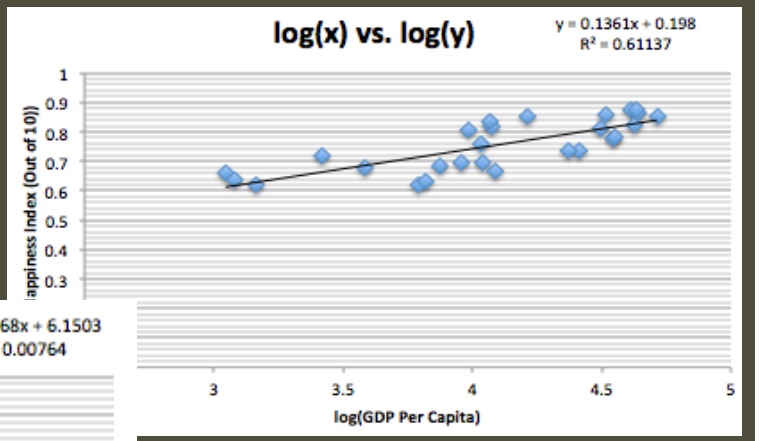


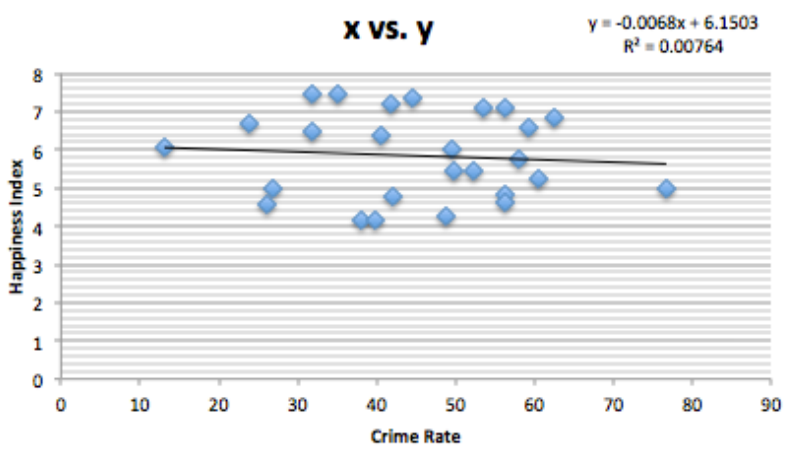
REGRESSION ANALYSIS

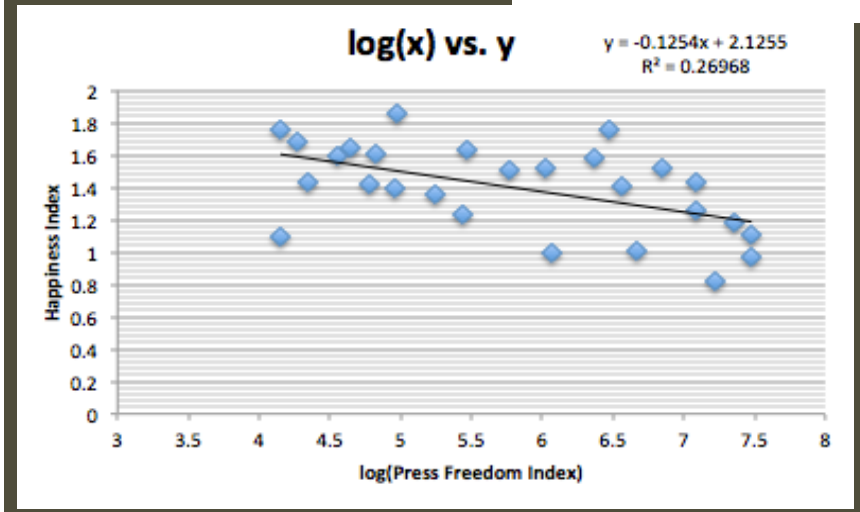
Multiple Linear Regression:

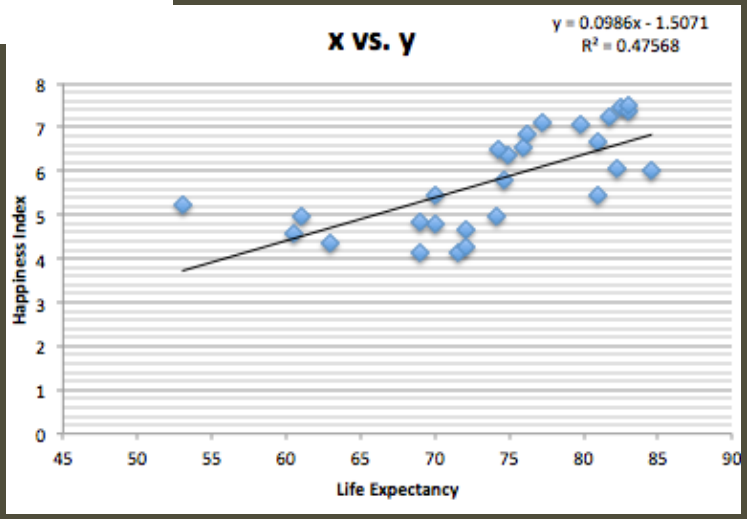
Initial Regression Model Methodology











Multiple Linear Regression:

Initial Regression Model Methodology

1. Tested exponential, log, power, and linear relationship of each factor with the happiness index to determine the relationship of the factor with y that produces the highest R^2

Iteration 1 of Multiple Linear Repression:

FACTOR	VARIABLE	BEST MODEL	R^2
GDP per capita	x_1	Log x_1 vs. Log y	**0.61137**
Press Freedom Index	x_2	Log x_2 vs. y	.26968
Percent Foreign Born	x_3	x_3 vs. y	.42644
Life Expectancy	x_4	x_4 vs. y	.47568
Crime Rate	x_5	x_5 vs. y	.00764

Best R^2

2. After concluding that the highest producing R^2 is for a log(happiness index) relationship with log(GDP), we iterate through each other variable independently to add it to the multiple linear regression. We add the model that produces the best ADJUSTED R^2

Multiple Linear Regression:

Initial Regression Model

The best multiple linear regression model before considering binary variables:

log(Happiness Index) =

0.355509 + 0.10418*Log(GDP) + -0.0013*(Press Freedom) + 0.00163*(Percentage Foreign Born)

With Adjusted $R^2 = 0.65851$

	Coefficients	Lower 95%	Upper 95%	t-statistic	P-level
Intercept	.35509	.08904	.62115	3.33648	.00287
Log GDP	.10418	.03814	.17022	3.9435	.00065
Press Freedom	-.0013	-.00286	.00025	-2.09583	.0473
Percentage Foreign Born	.00163	-.00194	.0052	1.14208	.26517

Multiple Linear Regression:

Regression Model Considering Binary Variables

Wanted to test if a country providing Universal Healthcare will impact the country's happiness index.

Method:

1. Assign a value of 1 or 0 for each data point (whether a country has Universal Healthcare or not).
2. Perform One – Way ANOVA on the binary variable

One - Way ANOVA on Binary: Universal Healthcare or Not:

H_0: All means are equal

H_1: All means are not equal

One - Way ANOVA:

Binary Variables- Provides Universal Health or not

Source of Variation	SS	d.f.	Mean Squares	F ratio	P-value	F critical
Between Groups	0.07156	1	0.07156	14.48429	0.00081	6.17576
Within Groups	0.12351	25	0.00494			
TOTAL	0.19596	26				

One - Way ANOVA on Binary - Universal Healthcare or Not:

At the .05 (or any) significance level, the null hypothesis should be rejected — Whether or not a country has universal healthcare DOES IMPACT the country's happiness level.

Multiple Linear Regression:

Regression Model Considering Binary Variables

	Coefficients	Lower 95%	Upper 95%	t- statistic	p-level
Intercept	.28086	-.00937	.57109	2.4364	.02382
Log (GDP)	.13242	.05169	.21314	4.12972	.00048
Press Freedom	-.00209	-.0041	-.00008	-2.61201	.01628
Percentage Foreign Born	.00183	.00173	.00538	1.29495	.20939
Binary:	-1.05128	-3.36574	1.26317	-1.14358	.26567
Interaction: Binary and log(GDP)	.21673	-.2911	.72455	1.07447	.2948

Multiple Linear Regression:

Final Regression Model

The best multiple linear regression model before considering binary variables:

Log(Happiness) =
+ 0.28086
+ 0.13242*Log(GDP)
- 0.00209*Press Freedom
+ 0.00183*Percentage Foreign
- 1.05128*Universal Healthcare or Not (Binary)
+ 0 .21673*Interaction between Healthcare and Log GDP

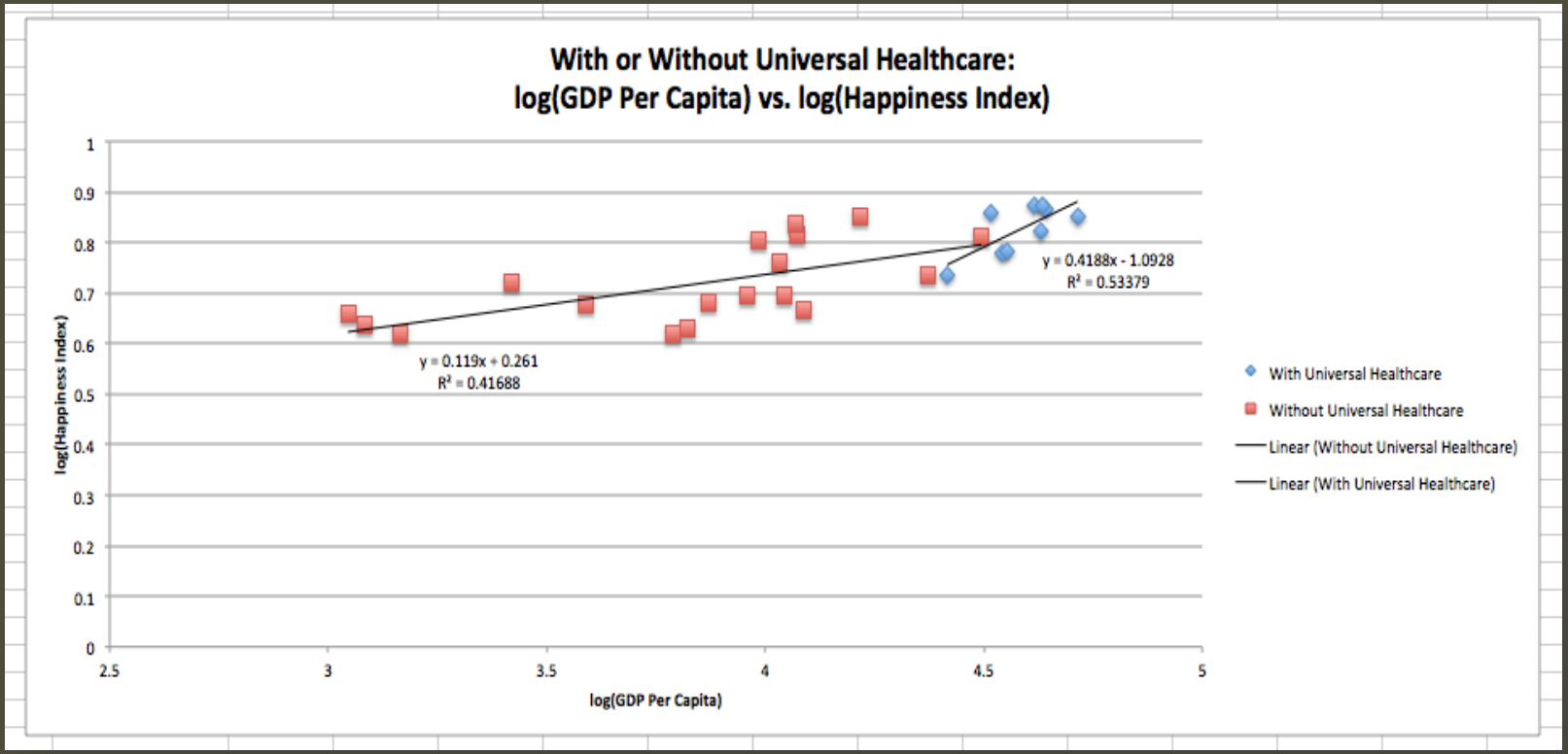
With Adjusted R^2 = 0.66198

Country with Universal Health Care:
Log(Happiness) =
-0.77042
+ 0.34915*Log(GDP)
- 0.00209*Press Freedom
+ 0.00183*Percentage Foreign

Country without Universal Health Care:
Log(Happiness) =
+ 0.28086
+ 0.13242*Log(GDP)
- 0.00209*Press Freedom
+ 0.00183*Percentage Foreign

Multiple Linear Regression:

Final Regression Model



Multiple Linear Regression:

Final Regression Model Interpretation

If the Freedom Press Index increases by 1 (meaning there is less freedom of the press), then the average happiness index decreases by a factor of 0.209%

If the Percent Foreign Born increases by 1, then the average happiness index increases by a factor of 0.183%

Country that provides Universal Healthcare

If the GDP per capita increases by a factor of 1%, then the average happiness index increases by a factor of 0.34915%

When all other factors are 0, the happiness index for a country is exp(-0.77042)

Country that Does Not provide Universal Healthcare

If the GDP per capita increases by a factor of 1%, then the average happiness index increases by a factor of 0.13242%

When all other factors are 0, the happiness index for a country is exp(0.28086)

So Which Countries are the Happiest?

Country	GDP	Press Freedom	Percentage Foreign Born	Healthcare or Not	Actual Happiness Index
Sri Lanka	6146	56.59	1.5	0	4.151
Sweden	42866	9.23	15.9	1	7.480

So…

What makes YOU H☺ppy