

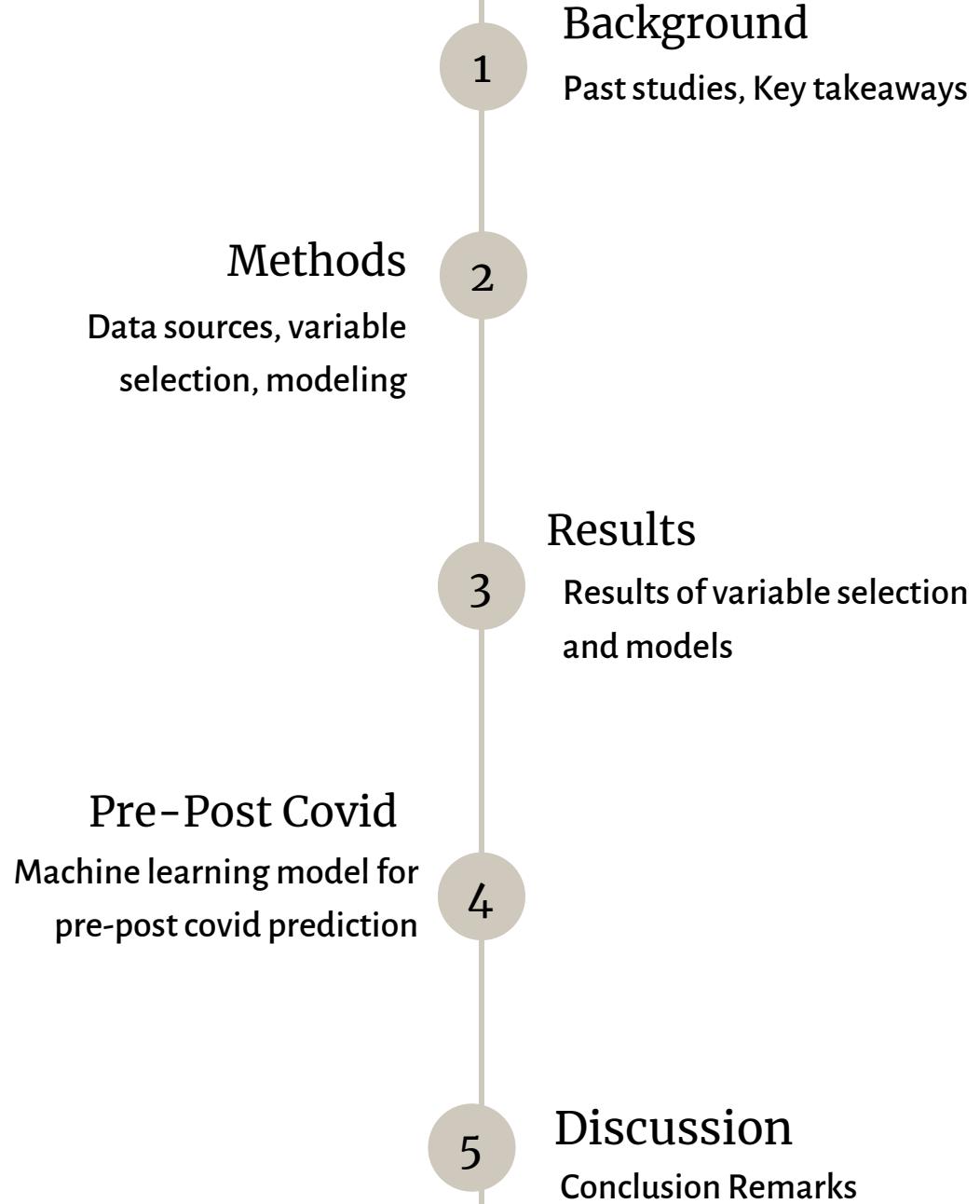
What makes for a Happy Population:



an Economic, Social, Citizen Opinions, and Prosperity Investigation

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Literature Review

- Happiness
- Subjective well-being
- Satisfaction
- Utility
- Well-being
- Welfare

In Europe, happiness is negatively affected by unemployment rate. Spending social resources on unemployment protection and active labour policies have a positive impact on well-being.
(Bonasia et al., 2022)

Subjective well-being varies directly with income, inversely with material aspirations. At the start of the life cycle, higher income groups were happier since they were able to purchase more. However, income growth does not cause well-being to increase. With an increase in income, material aspirations increase relatively equivalent to income growth. The two relations cancel one another.
(Easterlin, 2001)

In Japan, improved conditions for groups targeted by reform correlated with increases in well-being.
(Sarracino et al., 2022)

In developed nations, economic progress buys only a small amount of extra happiness.
(Oswald, 1997)

There is enough evidence that individuals are able and willing to provide meaningful **Self-Reported Happiness** that leads to many new insights on individual happiness and motivations.
(Ferrer-i-Carbonell, 2013)

Data Collection & Merge



World Happiness Report
2005-2021

12 Variables



World Bank
2000-2021

72 Variables

Total of 83 Variables

Data Cleaning, removing
variables with more than
10%, dropping NAs,



First Dataset

2006- 2020

37 Variables

1331 Observations

Final Dataset

2007- 2020

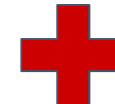
50 Variables

1275 Observations



THE LEGATUM PROSPERITY INDEX™

Creating the Pathways from Poverty to Prosperity



Legatum Prosperity Index

2007-2023

16 Variables

2839 Observations

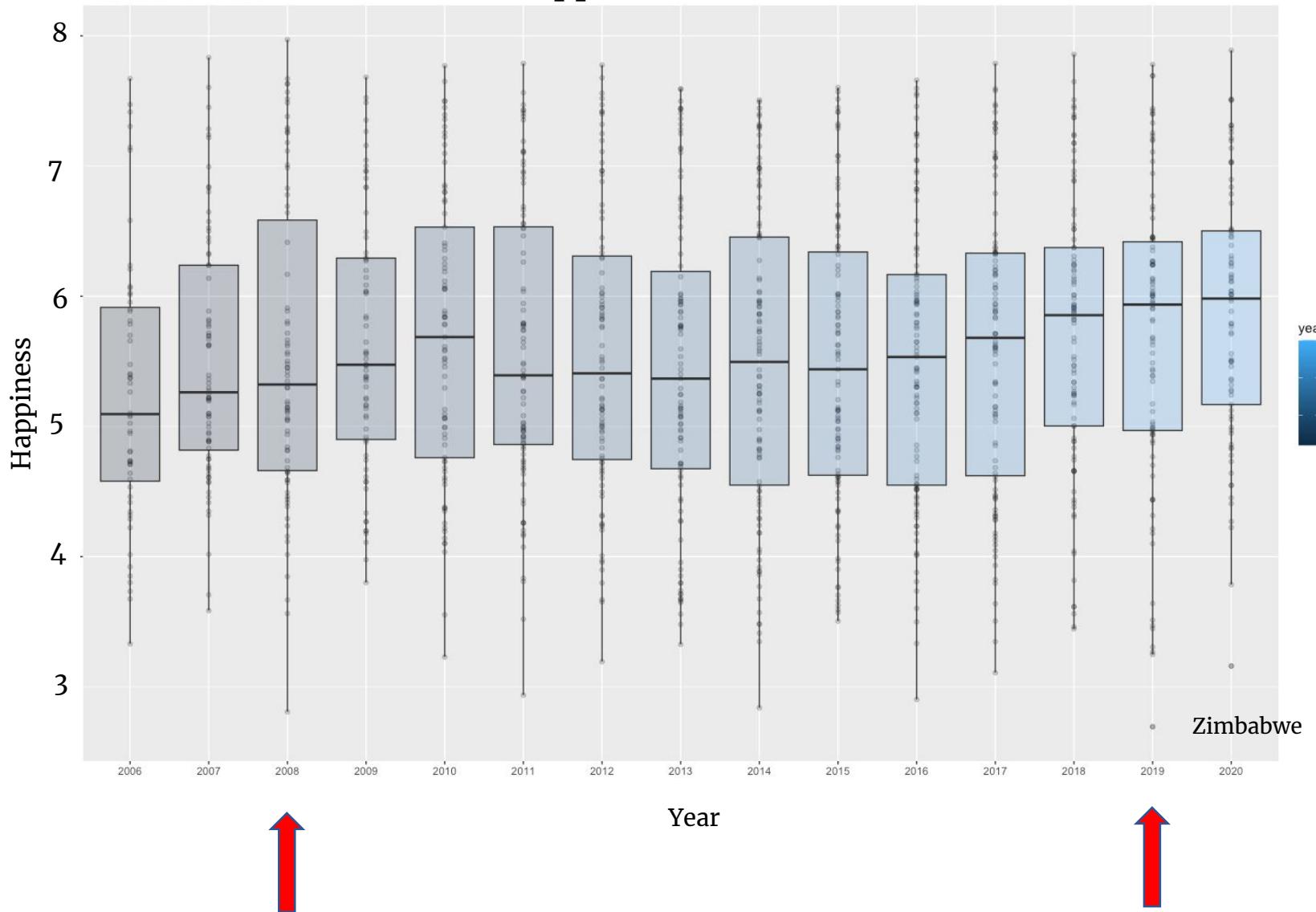
Final Dataset

Happiness (DV)

Life ladder: Imagine yourself on a ladder, from 0 (worse) - 10, which step are you on now

"Please imagine a ladder, with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step of the ladder would you say you personally feel you stand at this time?"

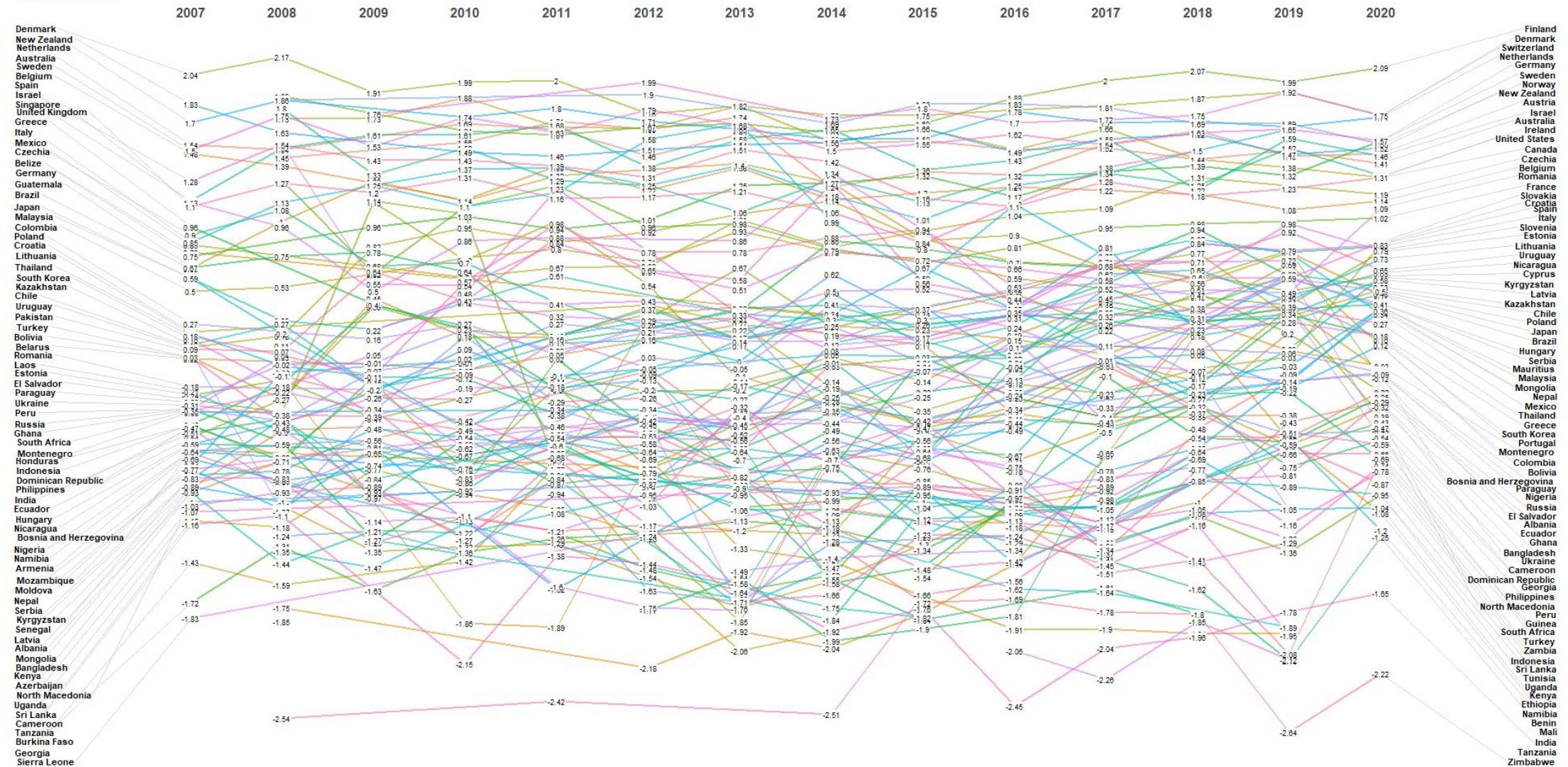
Happiness Over the Years



Final Dataset

Happiness by Country

Happiness in Z scores



Final Dataset

Economic (19 Variables)

Country
year
Life Ladder
Log GDP per capita
Adjusted net national income (current US\$)
Adjusted net national income per capita (current US\$)
Agricultural land (% of land area)
Agricultural land (sq. km)
GDP (constant 2015 US\$)
GDP (current US\$)
GDP per capita (constant 2015 US\$)
GDP growth (annual %)
GDP per capita (current US\$)
Gross savings (% of GNI)
Inflation, consumer prices (annual %)
Labor force, total
Population, total
Mortality rate, infant (per 1,000 live births)
Military expenditure (% of GDP)

Citizen opinions (11 Variables)

Country
year
Life Ladder
Social support
Healthy life expectancy at birth
Freedom to make life choices
Generosity
Perceptions of corruption
Positive affect
Negative affect
Confidence in national government

Social (13 Variables)

Country
year
Life Ladder
Access to clean fuels and technologies for cooking (% of population)
Access to clean fuels and technologies for cooking, urban (% of urban population)
Access to electricity, rural (% of rural population)
Access to clean fuels and technologies for cooking, rural (% of rural population)
Access to electricity (% of population)
Access to electricity, urban (% of urban population)
Urban population (% of total population)
Forest area (% of land area)
Arable land (% of land area)
Individuals using the Internet (% of population)

Final Dataset

Economic (19 Variables)

Country
year
Happiness
Log GDP per capita
Adjusted net national income (current US\$)
Adjusted net national income per capita (current US\$)
Agricultural land (% of land area)
Agricultural land (sq. km)
GDP (constant 2015 US\$)
GDP (current US\$)
GDP per capita (constant 2015 US\$)
GDP growth (annual %)
GDP per capita (current US\$)
Gross savings (% of GNI)
Inflation, consumer prices (annual %)
Labor force, total
Population, total
Mortality rate, infant (per 1,000 live births)
Military expenditure (% of GDP)

Citizen opinions (11 Variables)

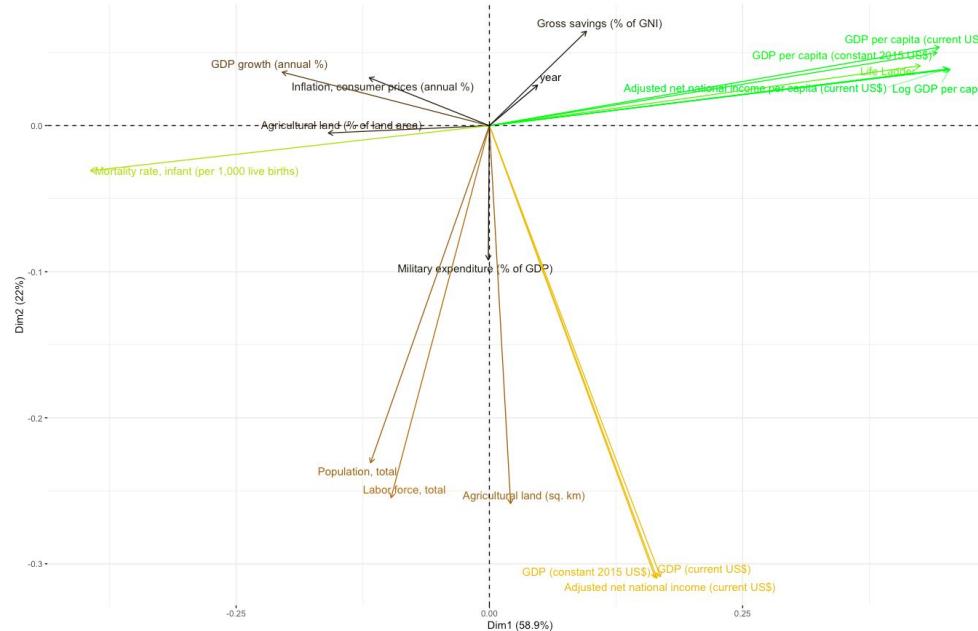
Country
year
Happiness
Social support
Healthy life expectancy at birth
Freedom to make life choices
Generosity
Perceptions of corruption
Positive affect
Negative affect
Confidence in national government

Social-Prosperity (16 Variables)

Country
year
Happiness
Prosperity
Safety and Security
Personal Freedom
Governance
Social Capital
Investment Environment
Enterprise Conditions
Infrastructure and Market Access
Economic Quality
Living Conditions
Health
Education
Natural Environment

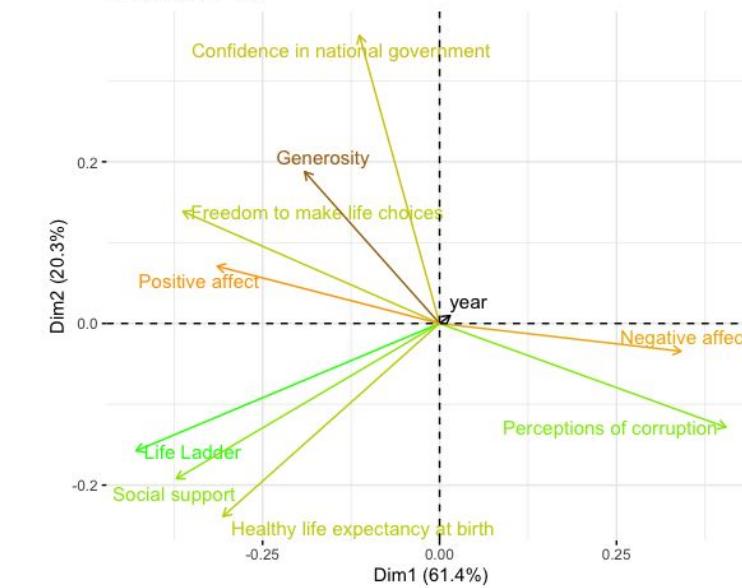
Parameter Selection

Variables - PCA



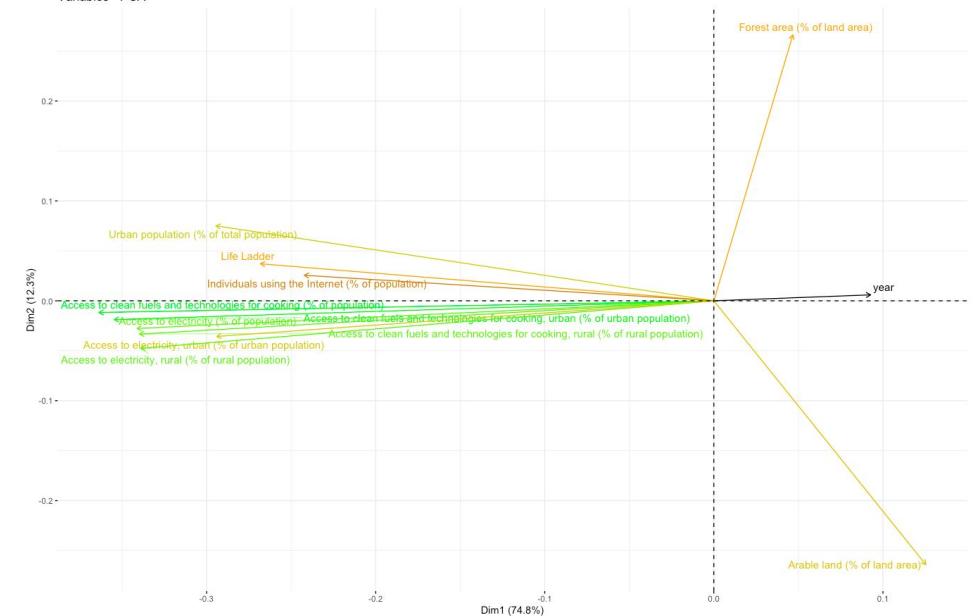
Economic

Variables - PCA



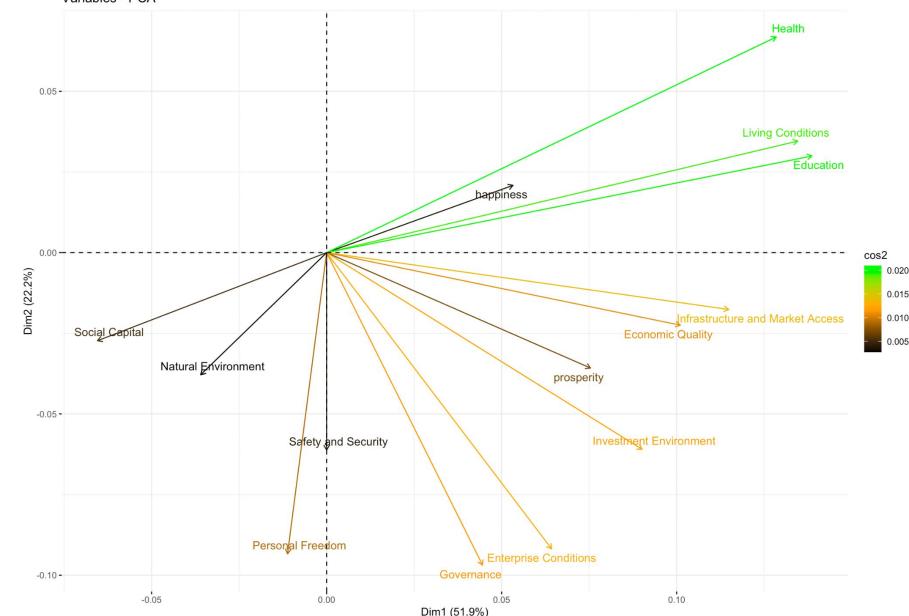
Citizen Opinions

Variables - PCA



Social

Variables - PCA



Prosperity

Modeling

Economic (19 Variables)

Economic on Happiness			
Predictors	Estimates	CI	p
Log GDP per capita	1.65	1.35 – 1.96	<0.001
Agricultural land (sq km)	0.04	-0.58 – -0.65	0.902
GDP growth (annual %)	0.03	0.01 – -0.06	0.012
Gross savings (% of GNI)	0.01	-0.03 – -0.05	0.574
Inflation consumer prices (annual %)	-0.04	-0.06 – -0.02	<0.001
Mortality rate, infant (per 1,000 live births)	-0.09	-0.24 – -0.05	0.215
Labor force, total	-2.35	-2.90 – -1.80	<0.001
N_country_name	120		
N_year	15		
Observations	1331		
AIC	784.263		

Log GDP per capita

GDP growth (annual %)

Inflation, consumer prices (annual %)

Labor force, total

Citizen opinions (11 Variables)

Subjective on Happiness			
Predictors	Estimates	CI	p
Social support	0.20	0.15 – 0.25	<0.001
Healthy life expectancy at birth	-0.26	-0.42 – -0.11	0.001
Freedom to make life choices	0.05	0.01 – 0.09	0.027
Generosity	0.04	0.00 – 0.09	0.045
Perceptions of corruption	-0.11	-0.18 – -0.04	0.002
Positive affect	0.16	0.11 – 0.21	<0.001
Negative affect	-0.03	-0.07 – -0.00	0.059
Confidence in national government	0.05	0.01 – 0.10	0.022
N_country_name	120		
N_year	15		
Observations	1331		
AIC	744.222		

Social support

Healthy life expectancy at birth

Freedom to make life choices

Generosity

Perceptions of corruption

Positive affect

Confidence in national government

Social (13 Variables)

Social on Happiness			
Predictors	Estimates	CI	p
Access to clean fuels and technologies for cooking (% of population)	0.19	-0.01 – 0.39	0.069
Access to electricity (% of population)	-0.12	-0.23 – -0.00	0.053
Forest area (% of land area)	-0.03	-0.45 – -0.40	0.899
Arable land (% of land area)	0.14	-0.12 – 0.41	0.289
Individuals using the Internet (% of population)	0.07	-0.01 – 0.16	0.089
N_country_name	120		
N_year	15		
Observations	1331		
AIC	982.411		

Prosperity (13 Variables)

Prosperity on Happiness			
Predictors	Estimates	CI	p
Safety and Security	0.00	-0.07 – 0.08	0.930
Personal Freedom	-0.06	-0.23 – -0.10	0.443
Governance	0.39	0.15 – 0.64	0.001
Social Capital	-0.00	-0.08 – -0.07	0.962
Investment Environment	0.11	-0.10 – 0.31	0.322
Enterprise Conditions	0.08	-0.04 – 0.19	0.201
Infrastructure and Market Access	-0.11	-0.35 – -0.14	0.379
Economic Quality	0.39	0.28 – 0.50	<0.001
Living Conditions	0.73	0.47 – 0.99	<0.001
Health	-0.54	-0.69 – -0.38	<0.001
Education	-0.18	-0.51 – -0.15	0.288
Natural Environment	0.00	-0.17 – 0.17	0.983
N_country	119		
N_year	14		
Observations	1275		
AIC	785.453		

Governance

Economic Quality

Living Conditions

Health

Modeling

All variables on Happiness			
Predictors	Estimates	CI	p
Social support	0.17	0.12 – 0.22	<0.001
Healthy life expectancy at birth	-0.46	-0.65 – -0.27	<0.001
Freedom to make life choices	0.02	-0.02 – 0.06	0.443
Generosity	0.07	0.03 – 0.11	0.002
Perceptions of corruption	-0.08	-0.15 – -0.01	0.021
Positive affect	0.12	0.07 – 0.17	<0.001
Negative affect	-0.03	-0.07 – -0.01	0.099
Confidence in national government	0.05	0.01 – 0.10	0.013
Log GDP per capita	1.17	0.84 – 1.49	<0.001
Agricultural land (sq km)	-0.06	-0.65 – -0.52	0.828
GDP growth (annual %)	0.02	-0.00 – 0.05	0.065
Gross savings (% of GNI)	0.01	-0.03 – -0.05	0.588
Inflation, consumer prices (annual %)	-0.03	-0.05 – -0.01	0.001
Mortality rate, infant (per 1,000 live births)	-0.43	-0.63 – -0.23	<0.001
Labor force, total	-2.29	-2.87 – -1.70	<0.001
Access to clean fuels and technologies for cooking (% of population)	0.04	-0.18 – -0.25	0.748
Access to electricity (% of population)	-0.13	-0.25 – -0.01	0.037
Forest area (% of land area)	-0.11	-0.49 – -0.27	0.577
Arable land (% of land area)	-0.06	-0.29 – -0.18	0.627
Individuals using the Internet (% of population)	0.01	-0.07 – -0.09	0.760
N_country	120		
N_year	15		
Observations	1331		
AIC	598.712		

Social Support	Social Support
Healthy life expectancy at birth	Healthy life expectancy at birth
Generosity	Generosity
Perceptions of Corruption	Perceptions of Corruption
Positive Affect	Positive Affect
Confidence in Government	Negative Affect
Log GDP per Capita	Log GDP per Capita
Inflation	GDP Growth (annual %)
Mortality Rate	Mortality Rate
Labor Force	Labor Force
Access to electricity	Governance
	Economic Quality
	Living Conditions
	Health

Prosperity, Economic, Citizen's Opinion, Subjective on Happiness			
Predictors	Estimates	CI	p
Safety and Security	-0.07	-0.14 – 0.00	0.063
Personal Freedom	-0.03	-0.19 – 0.12	0.678
Governance	0.35	0.12 – 0.58	0.003
Social Capital	-0.03	-0.10 – -0.04	0.451
Investment Environment	0.04	-0.16 – 0.24	0.694
Enterprise Conditions	0.02	-0.09 – 0.13	0.754
Infrastructure and Market Access	-0.23	-0.49 – -0.03	0.088
Economic Quality	0.25	0.13 – 0.36	<0.001
Living Conditions	0.46	0.17 – 0.74	0.002
Health	-0.23	-0.43 – -0.04	0.020
Education	0.27	-0.07 – 0.60	0.116
Natural Environment	-0.08	-0.25 – -0.08	0.307
Social support	0.15	0.10 – 0.20	<0.001
Healthy life expectancy at birth	-0.37	-0.59 – -0.14	0.002
Freedom to make life choices	0.02	-0.02 – 0.07	0.247
Generosity	0.07	0.03 – 0.11	0.002
Perceptions of corruption	-0.08	-0.15 – -0.01	0.027
Positive affect	0.11	0.06 – 0.15	<0.001
Negative affect	-0.04	-0.08 – -0.00	0.049
Confidence in national government	0.04	-0.01 – 0.08	0.113
Log GDP per capita	0.76	0.36 – 1.16	<0.001
Agricultural land (sq km)	-0.06	-0.64 – -0.51	0.827
GDP growth (annual %)	0.03	0.01 – 0.06	0.012
Gross savings (% of GNI)	-0.00	-0.04 – -0.04	0.908
Inflation, consumer prices (annual %)	-0.02	-0.04 – 0.00	0.067
Mortality rate, infant (per 1,000 live births)	-0.35	-0.59 – -0.12	0.004
Labor force, total	-2.43	-3.05 – -1.81	<0.001
Access to clean fuels and technologies for cooking (% of population)	-0.04	-0.28 – -0.21	0.763
Access to electricity (% of population)	-0.11	-0.24 – -0.03	0.131
Forest area (% of land area)	0.14	-0.27 – 0.55	0.497
Arable land (% of land area)	0.02	-0.23 – 0.27	0.878
Individuals using the Internet (% of population)	0.04	-0.06 – -0.14	0.417
N_country	119		
N_year	14		
Observations	1275		
AIC	534.853		

Modeling

Economic Indicators on Happiness Cross Sectional Analysis

Economic on Happiness																		
Predictors	2015			2016			2017			2018			2019			2020		
	Estimates	CI	p															
(Intercept)	-0.10	-0.22 - 0.02	0.107	-0.08	-0.21 - 0.05	0.250	-0.08	-0.22 - 0.06	0.257	0.04	-0.10 - 0.18	0.569	0.00	-0.13 - 0.13	0.986	0.20	-0.04 - 0.43	0.104
Log GDP per capita	0.69	0.45 - 0.93	<0.001	0.78	0.55 - 1.00	<0.001	0.83	0.58 - 1.07	<0.001	0.77	0.53 - 1.01	<0.001	0.67	0.42 - 0.93	<0.001	0.79	0.56 - 1.02	<0.001
Agricultural land (sq km)	0.15	-0.00 - 0.30	0.056	0.07	-0.08 - 0.22	0.379	0.08	-0.07 - 0.23	0.284	0.05	-0.10 - 0.19	0.521	0.09	-0.06 - 0.23	0.248	0.04	-0.08 - 0.16	0.515
GDP growth (annual %)	-0.04	-0.18 - 0.10	0.615	-0.07	-0.25 - 0.12	0.461	0.13	-0.12 - 0.37	0.308	-0.13	-0.41 - 0.15	0.358	-0.04	-0.30 - 0.22	0.768	0.04	-0.10 - 0.17	0.576
Gross savings (% of GNI)	0.07	-0.07 - 0.21	0.326	0.03	-0.12 - 0.18	0.686	-0.05	-0.21 - 0.10	0.512	-0.07	-0.21 - 0.08	0.364	-0.04	-0.20 - 0.13	0.663	0.08	-0.07 - 0.22	0.286
Inflation, consumer prices (annual %)	-0.37	-0.78 - 0.04	0.074	-0.18	-0.72 - 0.35	0.493	-0.59	-1.29 - 0.11	0.099	-0.36	-1.02 - 0.29	0.273	-0.14	-0.24 - 0.04	0.006	-0.04	-0.07 - 0.01	0.011
Mortality rate, infant (per 1,000 live births)	-0.01	-0.23 - 0.21	0.931	0.05	-0.17 - 0.28	0.632	0.07	-0.19 - 0.33	0.583	0.07	-0.20 - 0.34	0.588	-0.12	-0.39 - 0.15	0.376	0.06	-0.21 - 0.34	0.635
Labor force, total	-0.08	-0.22 - 0.07	0.294	-0.05	-0.20 - 0.09	0.486	-0.10	-0.24 - 0.05	0.197	-0.10	-0.24 - 0.04	0.149	-0.17	-0.31 - 0.03	0.017	-0.13	-0.25 - 0.01	0.041
Observations	103			103			102			98			94			81		
R ² / R ² adjusted	0.669 / 0.645			0.655 / 0.629			0.649 / 0.623			0.638 / 0.610			0.674 / 0.648			0.717 / 0.690		
AIC	195.414			201.744			204.980			189.108			186.870			125.578		

Modeling

Citizen Opinions on Happiness Cross Sectional Analysis

Citizen Opinion on Happiness

Predictors	2015			2016			2017			2018			2019			2020		
	Estimates	CI	p															
(Intercept)	-0.07	-0.17 – -0.02	0.116	-0.13	-0.23 – -0.03	0.011	-0.05	-0.16 – -0.07	0.419	-0.02	-0.14 – -0.11	0.814	-0.12	-0.26 – -0.02	0.096	0.03	-0.10 – -0.16	0.613
Social support	0.32	0.19 – 0.46	<0.001	0.30	0.15 – 0.46	<0.001	0.33	0.17 – 0.50	<0.001	0.41	0.22 – 0.60	<0.001	0.48	0.29 – 0.66	<0.001	0.32	0.16 – 0.48	<0.001
Healthy life expectancy at birth	0.35	0.21 – 0.48	<0.001	0.40	0.26 – 0.55	<0.001	0.32	0.15 – 0.48	<0.001	0.33	0.15 – 0.52	0.001	0.39	0.22 – 0.55	<0.001	0.25	0.07 – 0.44	0.008
Freedom to make life choices	0.12	-0.03 – 0.27	0.126	0.16	-0.02 – 0.35	0.085	0.12	-0.07 – 0.30	0.208	0.09	-0.12 – 0.30	0.406	0.21	-0.03 – 0.46	0.082	0.27	0.07 – 0.47	0.010
Generosity	-0.02	-0.13 – 0.08	0.658	0.08	-0.03 – 0.20	0.154	0.02	-0.10 – 0.13	0.754	0.03	-0.09 – 0.15	0.637	0.03	-0.09 – 0.15	0.636	0.02	-0.10 – 0.14	0.733
Perceptions of corruption	-0.32	-0.45 – -0.20	<0.001	-0.20	-0.33 – -0.06	0.004	-0.29	-0.43 – -0.15	<0.001	-0.27	-0.41 – -0.13	<0.001	-0.24	-0.39 – -0.10	0.001	-0.31	-0.45 – -0.16	<0.001
Positive affect	0.12	0.00 – 0.25	0.047	0.15	0.01 – 0.30	0.039	0.19	0.05 – 0.32	0.008	0.14	0.00 – 0.28	0.047	0.12	-0.03 – 0.26	0.107	-0.05	-0.19 – 0.09	0.508
Negative affect	0.09	-0.02 – 0.20	0.114	0.04	-0.08 – 0.16	0.483	0.01	-0.12 – 0.13	0.929	0.11	-0.02 – 0.23	0.094	0.16	0.01 – 0.31	0.035	-0.11	-0.24 – 0.02	0.102
Confidence in national government	-0.13	-0.26 – -0.01	0.060	-0.24	-0.38 – -0.10	0.001	-0.25	-0.40 – -0.10	0.002	-0.18	-0.34 – -0.03	0.021	-0.18	-0.35 – -0.00	0.045	-0.24	-0.39 – -0.09	0.002
Observations	103			103			102			98			94			81		
R ² / R ² adjusted	0.804 / 0.788			0.787 / 0.769			0.777 / 0.758			0.742 / 0.718			0.794 / 0.774			0.804 / 0.783		
AIC	143.379			153.965			160.909			157.967			146.058			97.789		

Modeling

Prosperity Indicators on Happiness Cross Sectional Analysis

Prosperity on Happiness

Predictors	2015				2016				2017				2018				2019				2020	
	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p	
(Intercept)	-0.07	-0.16 - 0.03	0.175	-0.07	-0.16 - 0.03	0.163	-0.02	-0.12 - 0.09	0.757	0.07	-0.04 - 0.17	0.233	0.02	-0.10 - 0.14	0.691	0.15	0.02 - 0.28	0.026				
Safety and Security	-0.07	-0.23 - 0.08	0.355	-0.15	-0.31 - 0.02	0.075	-0.00	-0.16 - 0.16	0.994	0.06	-0.09 - 0.21	0.420	-0.01	-0.18 - 0.15	0.863	0.03	-0.13 - 0.19	0.679				
Personal Freedom	-0.05	-0.27 - 0.17	0.644	0.20	-0.02 - 0.41	0.079	0.27	0.04 - 0.50	0.022	0.36	0.15 - 0.57	0.001	0.47	0.24 - 0.70	<0.001	0.03	-0.23 - 0.28	0.846				
Governance	0.04	-0.39 - 0.48	0.849	-0.29	-0.72 - 0.14	0.180	-0.34	-0.76 - 0.07	0.103	-0.54	-0.92 - 0.16	0.006	-0.66	-1.07 - 0.26	0.001	-0.04	-0.45 - 0.36	0.833				
Social Capital	0.34	0.21 - 0.47	<0.001	0.30	0.17 - 0.43	<0.001	0.32	0.18 - 0.46	<0.001	0.37	0.24 - 0.50	<0.001	0.33	0.19 - 0.47	<0.001	0.22	0.08 - 0.36	0.002				
Investment Environment	0.05	-0.39 - 0.48	0.835	0.14	-0.30 - 0.57	0.534	-0.05	-0.50 - 0.39	0.811	-0.05	-0.50 - 0.41	0.842	-0.07	-0.55 - 0.40	0.761	0.27	-0.19 - 0.73	0.240				
Enterprise Conditions	-0.07	-0.39 - 0.25	0.681	-0.01	-0.35 - 0.33	0.947	0.07	-0.25 - 0.39	0.668	0.16	-0.15 - 0.46	0.307	0.25	-0.05 - 0.55	0.107	0.07	-0.24 - 0.39	0.652				
Infrastructure and Market Access	-0.04	-0.48 - 0.39	0.837	-0.02	-0.51 - 0.48	0.950	-0.06	-0.55 - 0.44	0.815	-0.17	-0.64 - 0.30	0.467	-0.24	-0.74 - 0.27	0.353	-0.64	-1.15 - 0.13	0.014				
Economic Quality	0.29	0.07 - 0.51	0.010	0.31	0.09 - 0.53	0.007	0.38	0.15 - 0.62	0.002	0.38	0.14 - 0.62	0.003	0.43	0.18 - 0.69	0.001	0.20	-0.03 - 0.44	0.092				
Living Conditions	0.51	0.15 - 0.86	0.006	0.45	0.04 - 0.86	0.033	0.75	0.32 - 1.18	0.001	0.71	0.30 - 1.12	0.001	0.73	0.29 - 1.18	0.002	0.91	0.42 - 1.41	<0.001				
Health	0.11	-0.12 - 0.35	0.341	0.13	-0.12 - 0.37	0.300	0.07	-0.18 - 0.33	0.580	0.05	-0.20 - 0.31	0.676	0.21	-0.07 - 0.48	0.135	-0.17	-0.49 - 0.14	0.279				
Education	-0.20	-0.49 - 0.09	0.167	-0.15	-0.44 - 0.14	0.300	-0.41	-0.73 - 0.10	0.010	-0.36	-0.67 - 0.05	0.024	-0.42	-0.75 - 0.09	0.014	-0.05	-0.39 - 0.30	0.794				
Natural Environment	0.11	-0.04 - 0.26	0.153	0.10	-0.05 - 0.25	0.187	0.07	-0.09 - 0.23	0.389	0.06	-0.09 - 0.20	0.449	0.09	-0.07 - 0.24	0.268	0.14	-0.02 - 0.30	0.095				
Observations	103				103				102				98				94				81	
R ² / R ² adjusted	0.826 / 0.803				0.813 / 0.788				0.807 / 0.781				0.814 / 0.788				0.833 / 0.808				0.805 / 0.771	
AIC	139.013				148.368				153.771				133.710				134.105				105.444	

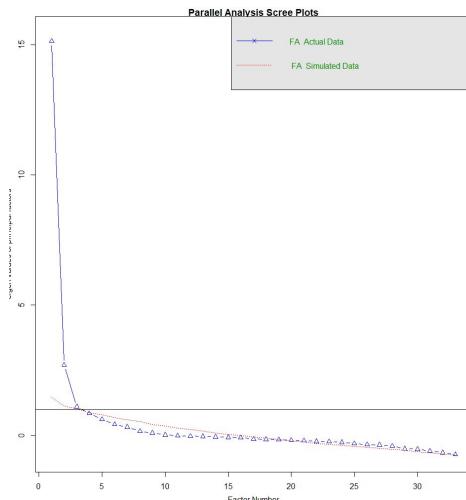
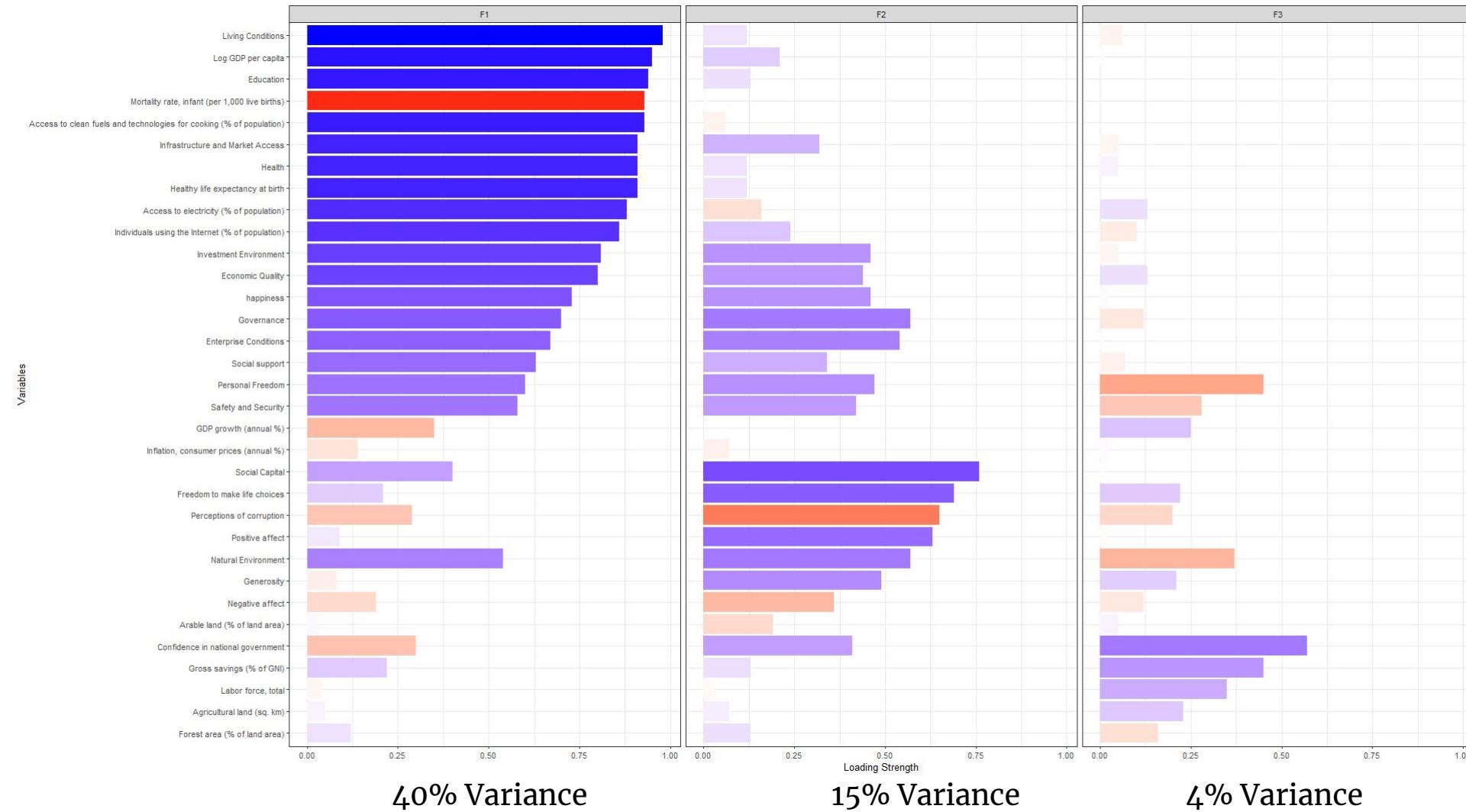
Modeling

All on Happiness																		
Predictors	2015			2016			2017			2018			2019			2020		
	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p									
(Intercept)	-0.06	-0.19 – 0.07	0.334	-0.10	-0.26 – 0.05	0.183	-0.02	-0.24 – 0.19	0.834	0.27	-0.01 – 0.55	0.058	0.18	-0.10 – 0.46	0.214	0.09	-0.41 – 0.59	0.708
Safety and Security	-0.02	-0.21 – 0.18	0.861	-0.08	-0.28 – 0.12	0.415	-0.01	-0.22 – 0.20	0.930	0.14	-0.04 – 0.33	0.126	0.04	-0.14 – 0.22	0.628	0.13	-0.04 – 0.30	0.134
Personal Freedom	-0.20	-0.56 – 0.16	0.275	-0.07	-0.47 – 0.33	0.729	0.21	-0.18 – 0.60	0.276	0.20	-0.16 – 0.56	0.271	0.51	0.18 – 0.85	0.003	-0.24	-0.60 – 0.13	0.200
Governance	0.24	-0.35 – 0.83	0.427	0.19	-0.43 – 0.81	0.538	-0.25	-0.85 – 0.34	0.397	-0.48	-1.04 – 0.09	0.097	-0.76	-1.28 – -0.24	0.005	0.16	-0.36 – 0.68	0.540
Social Capital	0.23	0.01 – 0.45	0.038	0.16	-0.06 – 0.37	0.152	0.05	-0.22 – 0.31	0.734	0.14	-0.12 – 0.40	0.300	0.11	-0.11 – 0.34	0.327	0.22	-0.05 – 0.50	0.112
Investment Environment	0.17	-0.33 – 0.67	0.504	-0.05	-0.55 – 0.45	0.839	-0.17	-0.71 – 0.37	0.536	-0.16	-0.70 – 0.38	0.563	-0.13	-0.67 – 0.41	0.636	0.14	-0.41 – 0.69	0.612
Enterprise Conditions	-0.13	-0.48 – 0.22	0.455	-0.09	-0.46 – 0.27	0.608	0.11	-0.25 – 0.48	0.540	0.29	-0.07 – 0.64	0.112	0.24	-0.10 – 0.58	0.169	0.06	-0.30 – 0.41	0.756
Infrastructure and Market Access	-0.16	-0.68 – 0.35	0.531	0.12	-0.51 – 0.74	0.706	0.09	-0.50 – 0.68	0.764	-0.20	-0.80 – 0.41	0.519	0.03	-0.53 – 0.59	0.917	-0.04	-0.72 – 0.65	0.912
Economic Quality	0.30	0.01 – 0.60	0.045	0.34	0.04 – 0.63	0.026	0.26	-0.06 – 0.58	0.116	0.54	0.18 – 0.90	0.004	0.45	0.10 – 0.80	0.012	0.08	-0.19 – 0.34	0.570
Living Conditions	0.23	-0.47 – 0.94	0.511	0.12	-0.72 – 0.97	0.775	0.88	0.07 – 1.68	0.034	0.99	0.13 – 1.86	0.025	0.51	-0.33 – 1.36	0.231	0.32	-0.57 – 1.21	0.475
Health	0.06	-0.45 – 0.56	0.827	0.05	-0.46 – 0.56	0.839	0.19	-0.35 – 0.72	0.484	-0.01	-0.52 – 0.49	0.953	0.17	-0.40 – 0.73	0.559	-0.19	-0.88 – 0.49	0.570
Education	-0.05	-0.39 – 0.29	0.759	-0.08	-0.43 – 0.27	0.640	-0.28	-0.63 – 0.07	0.121	-0.13	-0.50 – 0.24	0.484	-0.22	-0.60 – 0.16	0.258	0.07	-0.36 – 0.50	0.749
Natural Environment	0.02	-0.20 – 0.24	0.842	0.00	-0.21 – 0.21	0.986	-0.00	-0.22 – 0.22	0.988	0.04	-0.17 – 0.25	0.680	-0.00	-0.20 – 0.19	0.988	0.12	-0.13 – 0.37	0.331
Social support	0.17	-0.02 – 0.35	0.085	0.17	-0.03 – 0.37	0.089	0.20	-0.05 – 0.45	0.110	0.15	-0.15 – 0.46	0.318	0.32	0.10 – 0.54	0.005	0.15	-0.11 – 0.42	0.246
Healthy life expectancy at birth	0.34	-0.14 – 0.83	0.165	0.40	-0.09 – 0.88	0.107	0.22	-0.30 – 0.74	0.405	0.32	-0.18 – 0.82	0.210	0.29	-0.24 – 0.82	0.282	0.13	-0.44 – 0.70	0.639
Freedom to make life choices	0.01	-0.17 – 0.18	0.940	0.08	-0.14 – 0.29	0.470	0.06	-0.16 – 0.29	0.569	0.03	-0.20 – 0.26	0.772	-0.01	-0.28 – 0.27	0.963	0.21	-0.06 – 0.48	0.125
Generosity	-0.08	-0.22 – 0.06	0.278	0.05	-0.10 – 0.19	0.511	-0.00	-0.14 – 0.14	0.972	-0.02	-0.16 – 0.13	0.797	0.01	-0.13 – 0.16	0.843	-0.08	-0.28 – 0.12	0.434
Perceptions of corruption	-0.13	-0.29 – 0.03	0.118	-0.05	-0.24 – 0.13	0.561	-0.19	-0.39 – 0.00	0.053	-0.12	-0.29 – 0.06	0.184	-0.24	-0.41 – 0.07	0.007	-0.08	-0.31 – 0.15	0.475
Positive affect	0.10	-0.06 – 0.27	0.212	0.09	-0.09 – 0.27	0.309	0.13	-0.03 – 0.30	0.113	0.10	-0.07 – 0.28	0.240	0.04	-0.12 – 0.20	0.633	-0.06	-0.25 – 0.13	0.522
Negative affect	0.09	-0.04 – 0.22	0.158	0.07	-0.07 – 0.22	0.306	-0.05	-0.20 – 0.11	0.547	0.02	-0.14 – 0.17	0.826	0.04	-0.12 – 0.20	0.637	-0.07	-0.23 – 0.09	0.390
Confidence in national government	-0.00	-0.19 – 0.18	0.966	-0.13	-0.33 – 0.07	0.199	-0.12	-0.36 – 0.11	0.294	-0.10	-0.32 – 0.11	0.349	-0.01	-0.22 – 0.19	0.912	-0.20	-0.39 – 0.00	0.048
Log GDP per capita	-0.26	-0.72 – 0.19	0.255	0.01	-0.50 – 0.52	0.974	-0.15	-0.68 – 0.39	0.591	-0.20	-0.77 – 0.38	0.498	-0.13	-0.65 – 0.39	0.626	-0.14	-0.80 – 0.53	0.681
Agricultural land (sq km)	0.13	-0.01 – 0.26	0.062	0.04	-0.10 – 0.18	0.574	0.08	-0.06 – 0.22	0.259	0.05	-0.09 – 0.19	0.481	0.11	-0.02 – 0.24	0.110	0.04	-0.09 – 0.17	0.570
GDP growth (annual %)	0.02	-0.11 – 0.14	0.802	-0.19	-0.35 – 0.02	0.026	0.13	-0.11 – 0.36	0.286	-0.07	-0.32 – 0.18	0.582	0.08	-0.18 – 0.34	0.550	0.03	-0.15 – 0.20	0.769
Gross savings (% of GNI)	-0.08	-0.24 – 0.07	0.290	-0.05	-0.20 – 0.09	0.480	-0.05	-0.21 – 0.11	0.533	-0.10	-0.26 – 0.05	0.199	-0.12	-0.28 – 0.04	0.151	-0.01	-0.16 – 0.13	0.856
Inflation, consumer prices (annual %)	-0.14	-0.50 – 0.22	0.444	-0.07	-0.55 – 0.40	0.753	-0.31	-0.91 – 0.30	0.320	0.06	-0.57 – 0.69	0.849	-0.08	-0.16 – 0.00	0.050	-0.03	-0.06 – 0.00	0.064
Mortality rate, infant (per 1,000 live births)	0.30	-0.01 – 0.62	0.056	0.48	0.17 – 0.80	0.003	0.62	0.22 – 1.01	0.003	0.69	0.26 – 1.11	0.002	0.33	-0.03 – 0.69	0.071	0.39	-0.08 – 0.86	0.099
Labor force, total	-0.08	-0.23 – 0.08	0.313	-0.07	-0.23 – 0.08	0.347	-0.03	-0.19 – 0.13	0.703	-0.06	-0.22 – 0.11	0.497	-0.10	-0.25 – 0.06	0.218	-0.10	-0.25 – 0.05	0.203
Access to clean fuels and technologies for cooking (% of population)	-0.02	-0.34 – 0.31	0.920	-0.12	-0.48 – 0.24	0.514	-0.05	-0.43 – 0.33	0.808	-0.09	-0.45 – 0.27	0.617	0.08	-0.30 – 0.45	0.680	-0.14	-0.51 – 0.23	0.442
Access to electricity (% of population)	0.21	-0.10 – 0.53	0.177	0.34	-0.00 – 0.68	0.051	0.10	-0.31 – 0.50	0.635	0.36	-0.02 – 0.74	0.064	0.13	-0.29 – 0.54	0.546	0.42	-0.04 – 0.87	0.072
Forest area (% of land area)	0.04	-0.11 – 0.18	0.632	0.02	-0.12 – 0.16	0.791	-0.03	-0.18 – 0.12	0.690	-0.06	-0.20 – 0.09	0.431	-0.00	-0.14 – 0.14	0.955	-0.04	-0.20 – 0.12	0.604
Arable land (% of land area)	0.12	-0.01 – 0.25	0.073	0.05	-0.07 – 0.18	0.383	-0.00	-0.13 – 0.13	0.968	-0.05	-0.17 – 0.08	0.477	0.00	-0.12 – 0.12	0.997	0.05	-0.08 – 0.19	0.439
Individuals using the Internet (% of population)	0.14	-0.28 – 0.55	0.510	-0.03	-0.44 – 0.38	0.891	-0.07	-0.52 – 0.37	0.747	-0.40	-0.90 – 0.10	0.116	-0.39	-0.89 – 0.11	0.126	-0.01	-0.57 – 0.55	0.970
Observations	103			103			102			98			94			81		
R ² / R ² adjusted	0.873 / 0.814			0.867 / 0.806			0.861 / 0.796			0.866 / 0.799			0.903 / 0.852			0.891 / 0.818		

Clusters

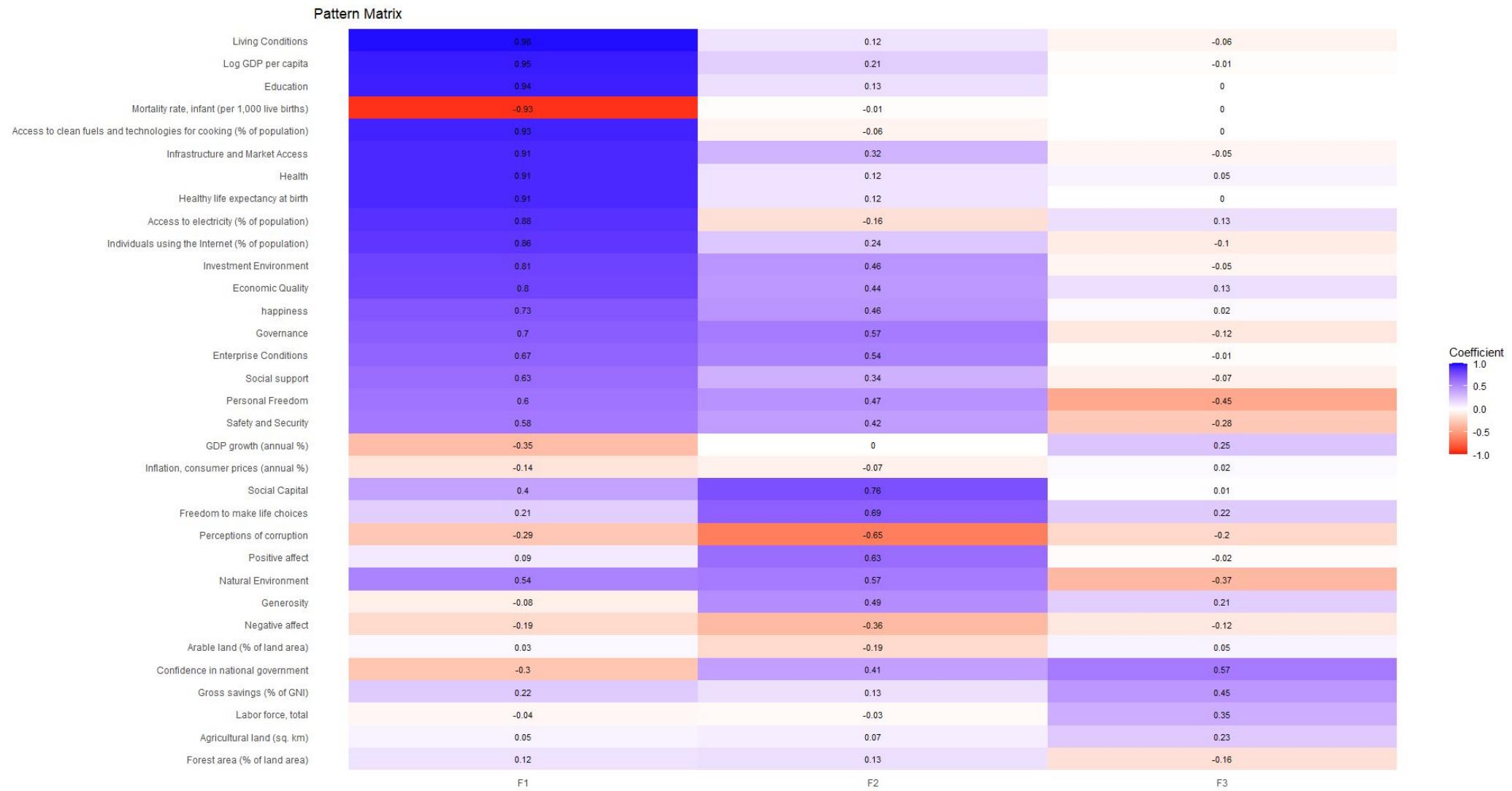
Factor Analysis

- Parallel Analysis to find the nfactors to be 3



Clusters

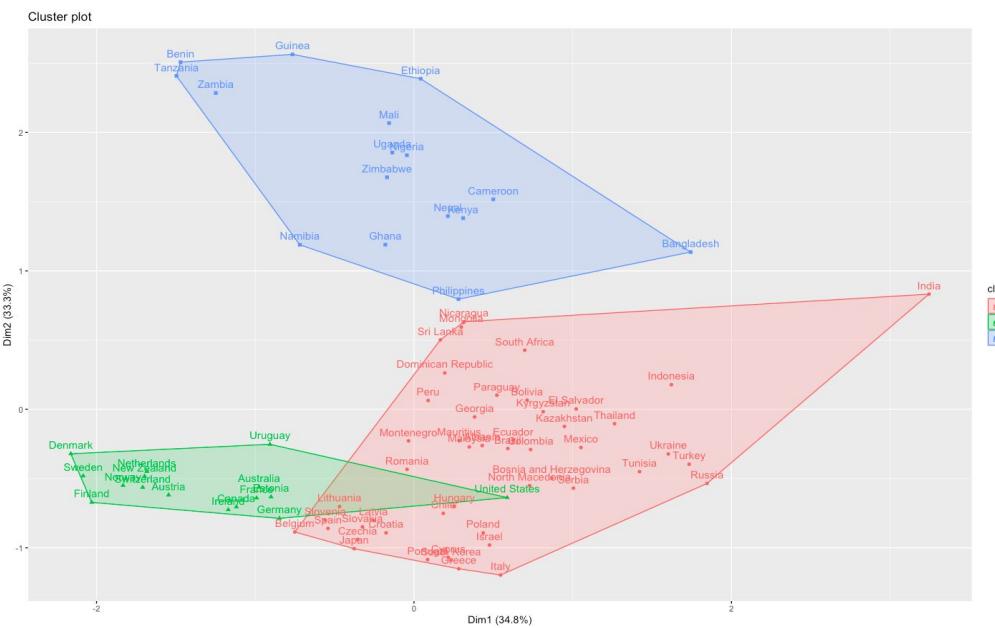
Factor Analysis



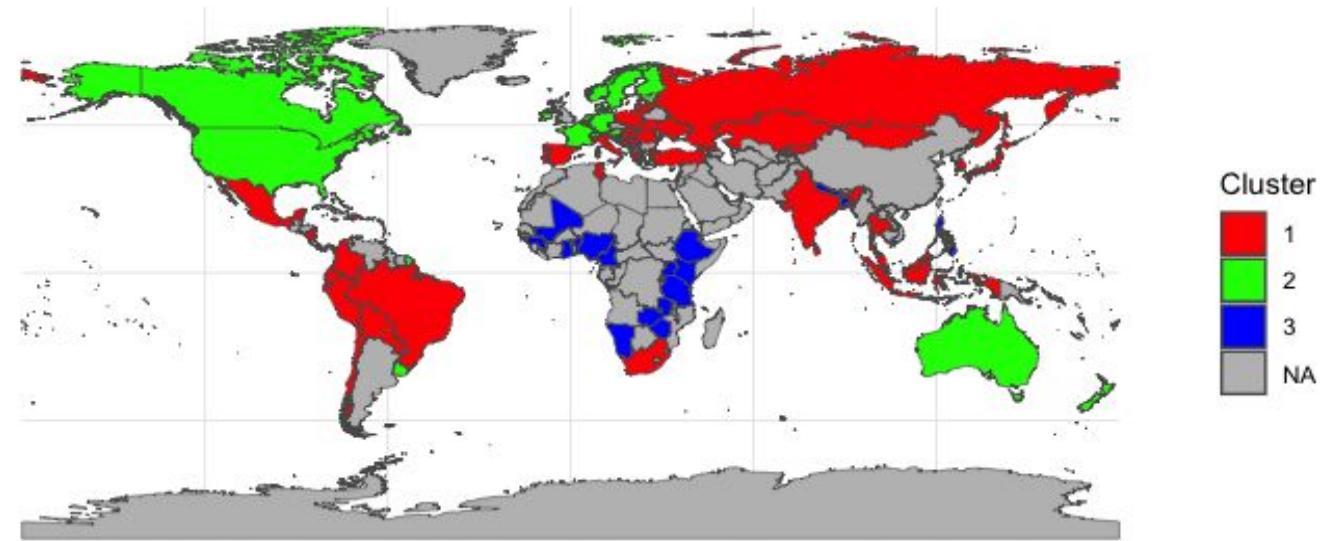
Clusters

PAM Partitioning using Factor Analysis 2020

- 3 Factors were used
- WSS method recommended 3 clusters
- K-Medoid

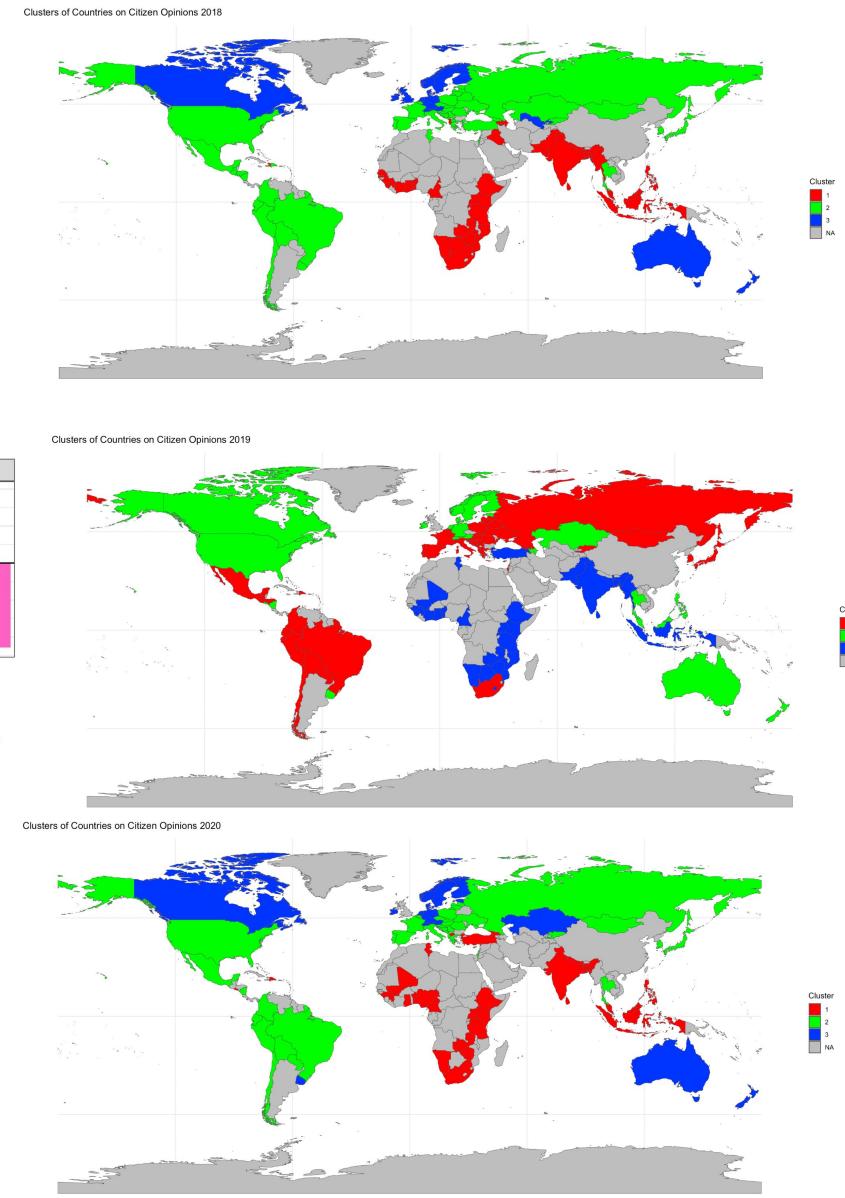
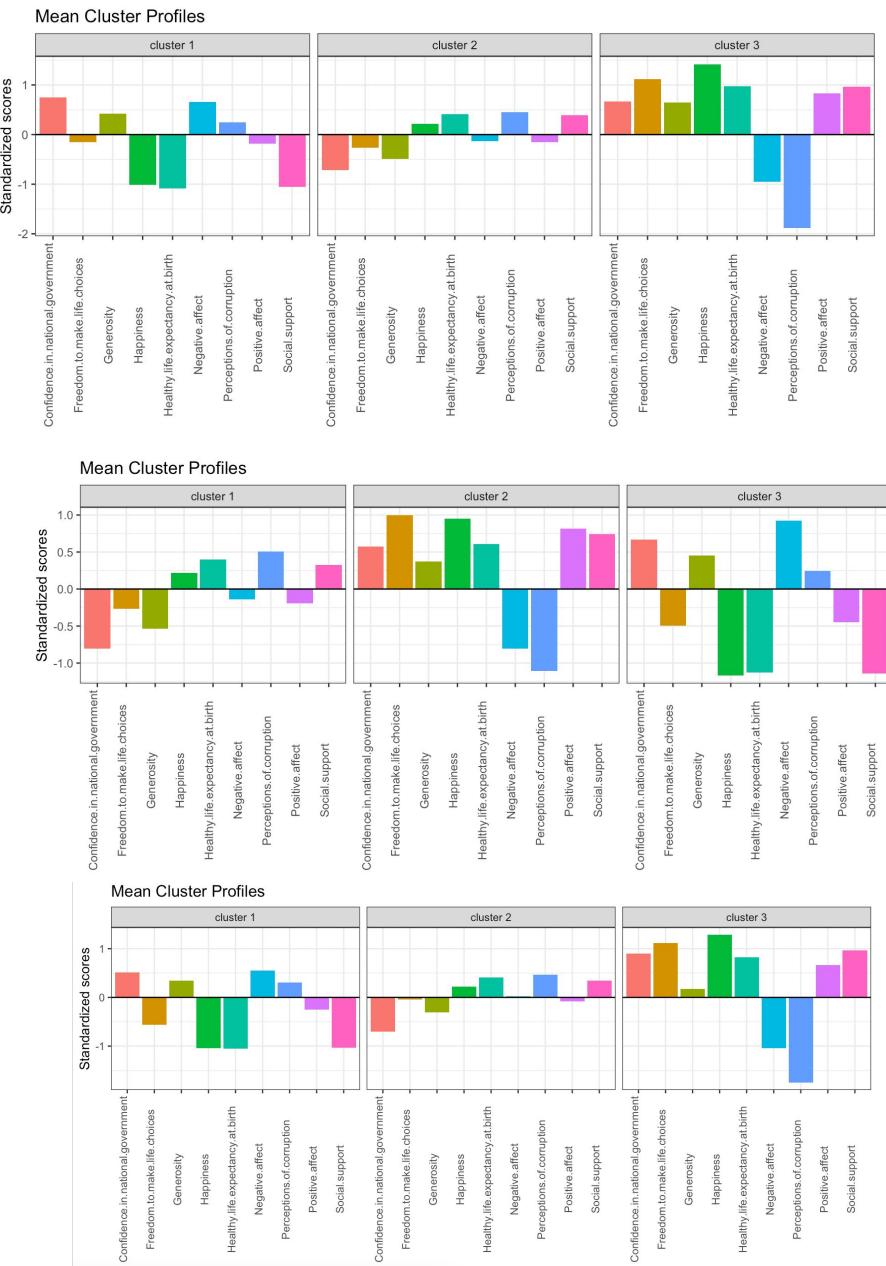


Clusters of Countries on Factor Analysis 2020



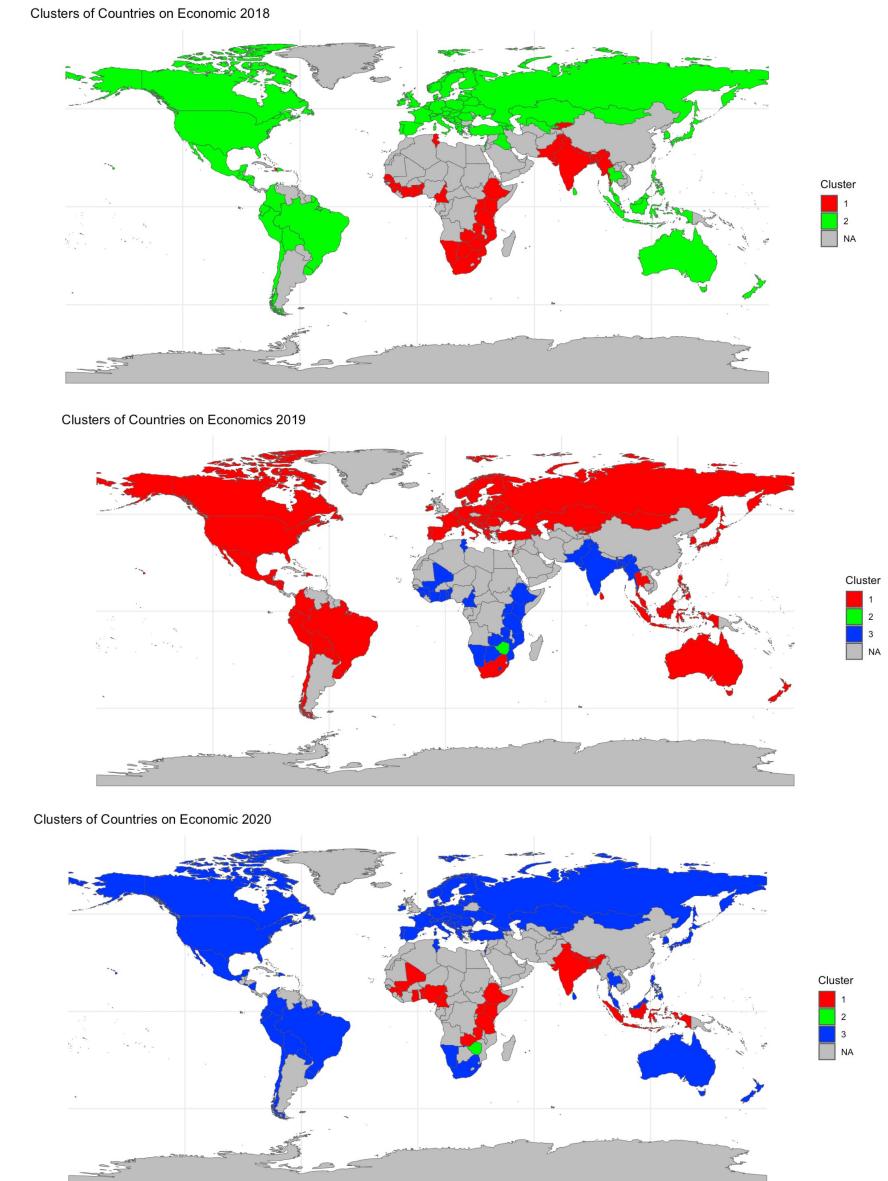
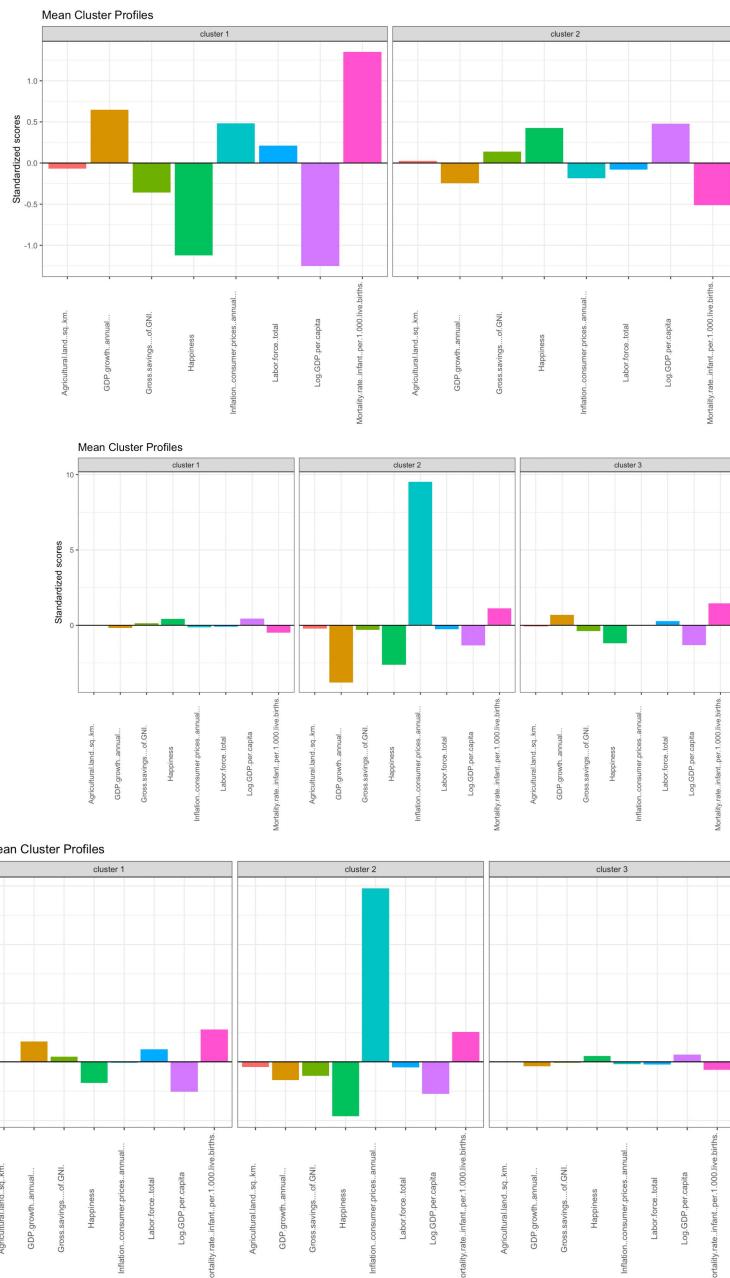
Clusters

PCA Citizen Opinion 2018-2020



Clusters

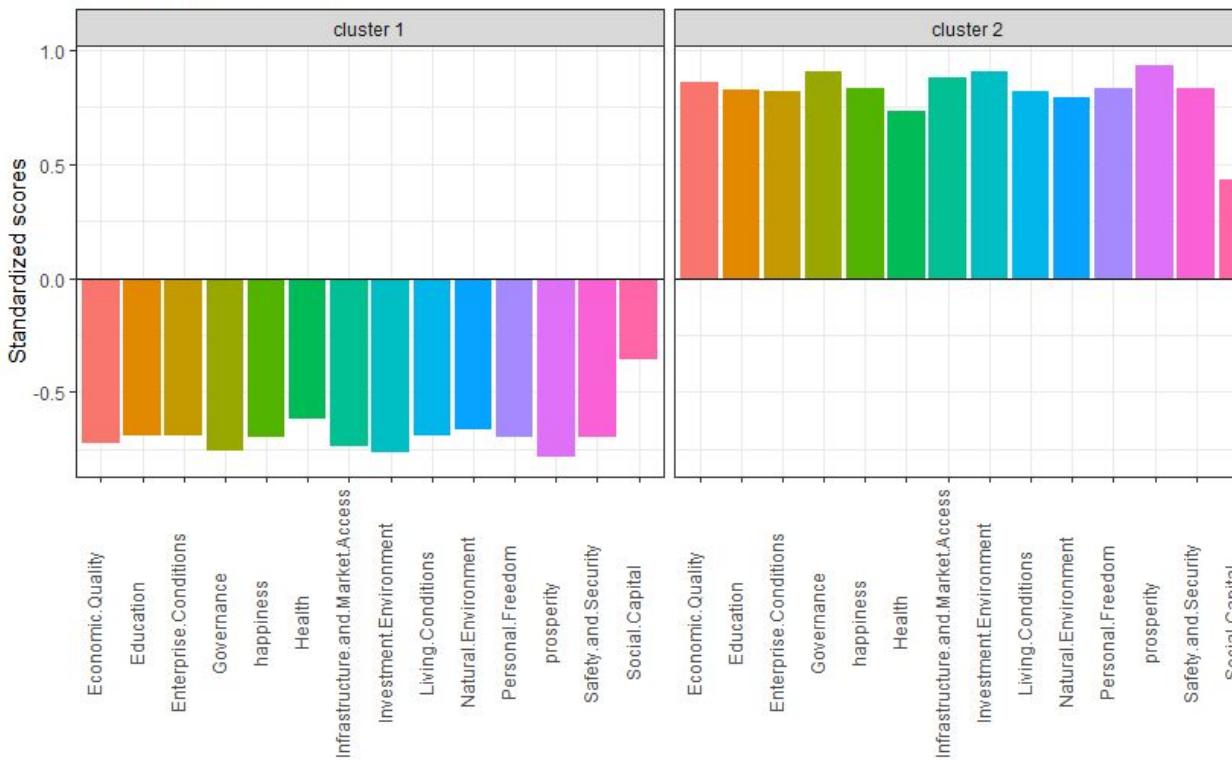
PCA Economic 2018–2020



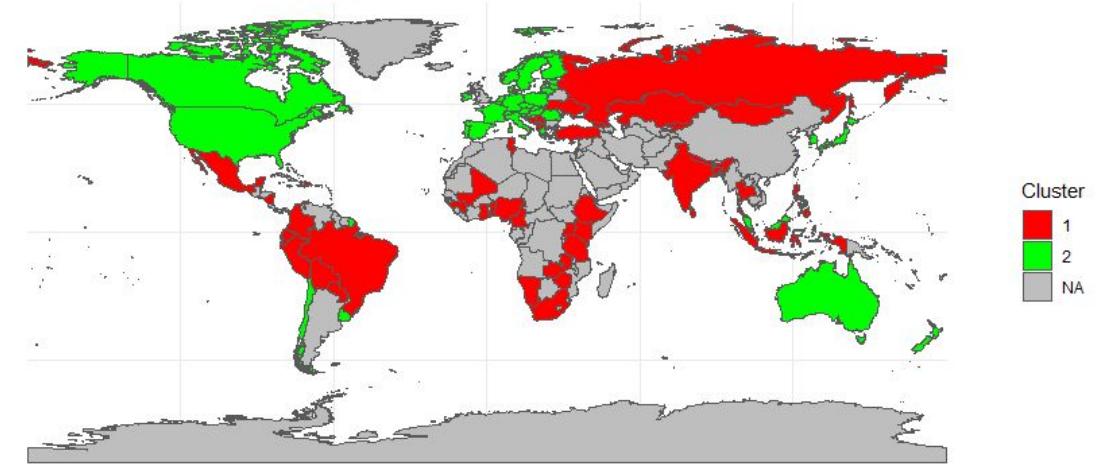
Clusters

PCA Prosperity 2020

Mean Cluster Profiles



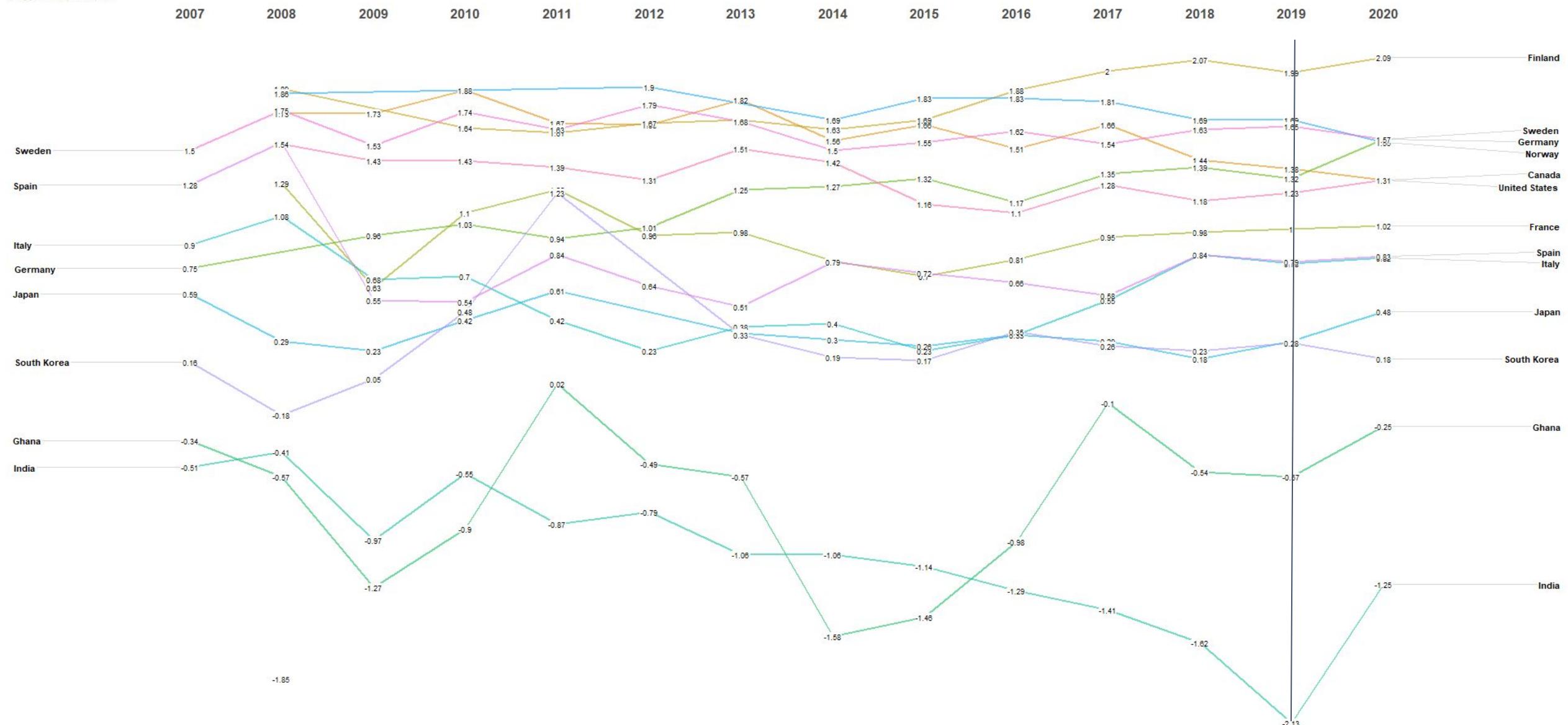
Clusters of Countries on Prosperity 2020



Happiness Over the Years

Happiness by Country

Happiness in Z scores



Random Forest with a grain of salt

Train (2007- 2018)

```
> dim(train_all)
[1] 1100   33
> dim(test_all)
[1] 175   33
```

Test (2019-2020)

RandomForest- predicted values

From 100 trees

```
> rmse
[1] 0.3453435
> mse
[1] 0.1192621
> r_squared
[1] 0.8761406
> cv_r_squared
[1] 0.9085903
> cv_rmse
[1] 0.3040494
```

Random forest results

Cross validation

code

```
# Step 1: Prepare the input variables and target variable
set.seed(1234)
train_X <- train_all[, c(2:48)] # Include the relevant variables
train_y <- train_all$happiness

# Step 2: Train the random forest model
rf_model <- randomForest(train_X, train_y, ntree = 100)

# Step 3: Predict using the trained model
test_X <- test_all[, c(2:48)] # Include the same independent variables
predictions <- predict(rf_model, test_X)

call:
randomForest(x = train_X, y = train_y, ntree = 100, importance = TRUE)
  Type of random forest: regression
    Number of trees: 100
  No. of variables tried at each split: 10

    Mean of squared residuals: 0.08517669
      % var explained: 91.5
      ...

> model_cv
Random Forest

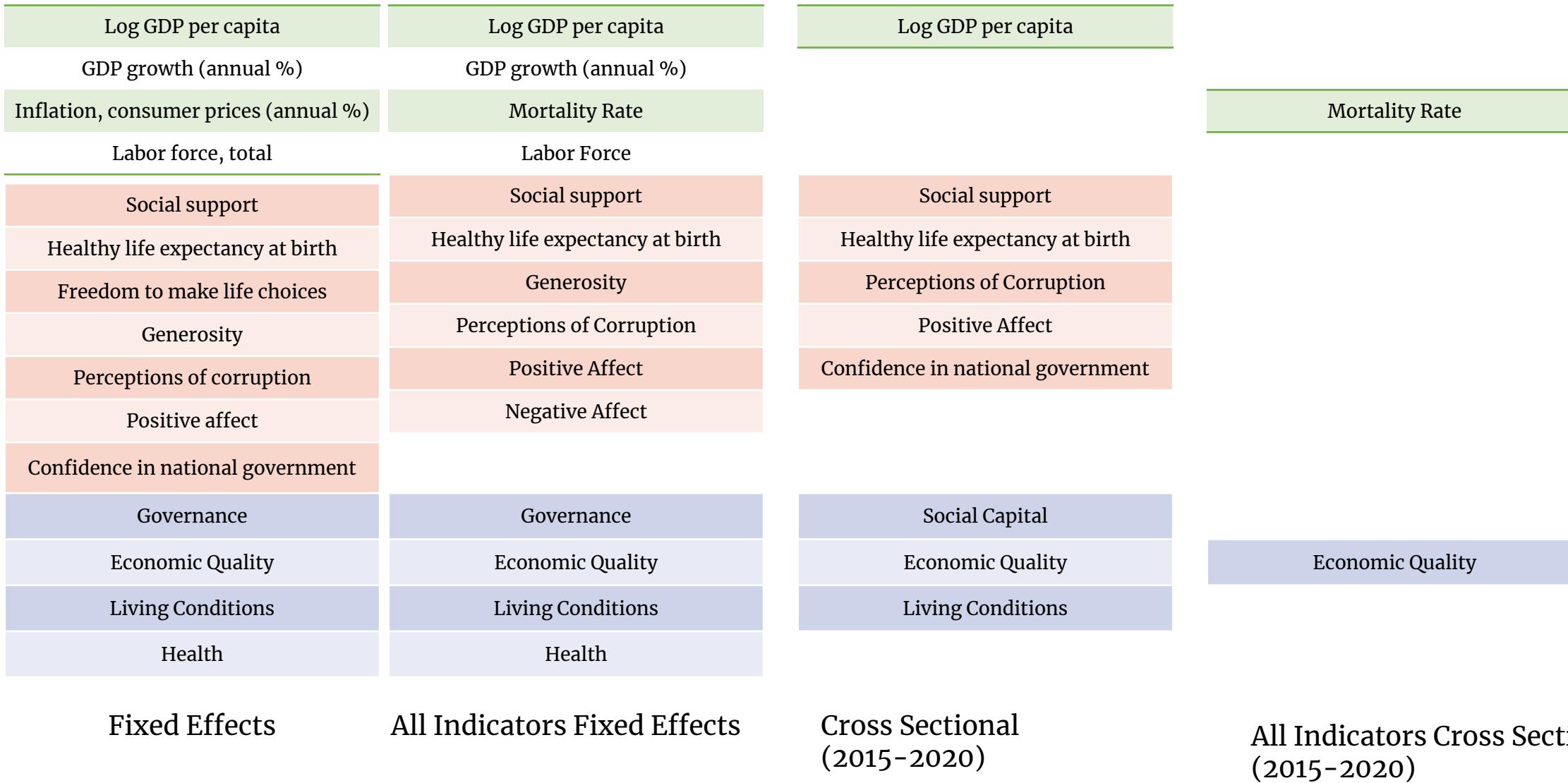
1100 samples
  32 predictor

No pre-processing
Resampling: Cross-validated (5 fold)
Summary of sample sizes: 880, 880, 880, 880, 880
Resampling results across tuning parameters:
```

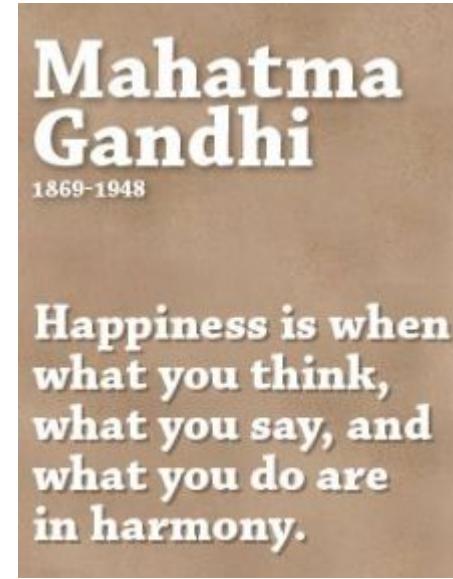
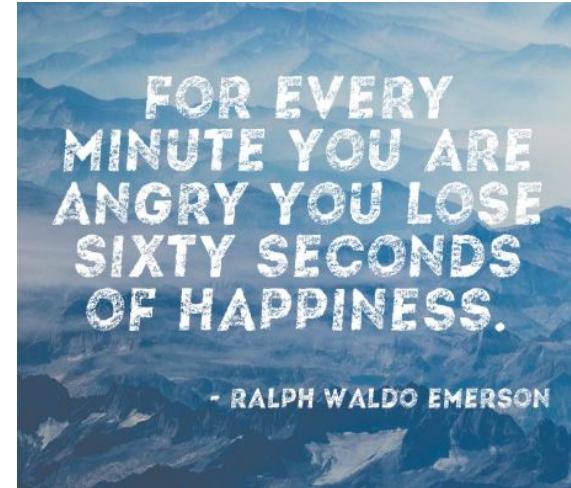
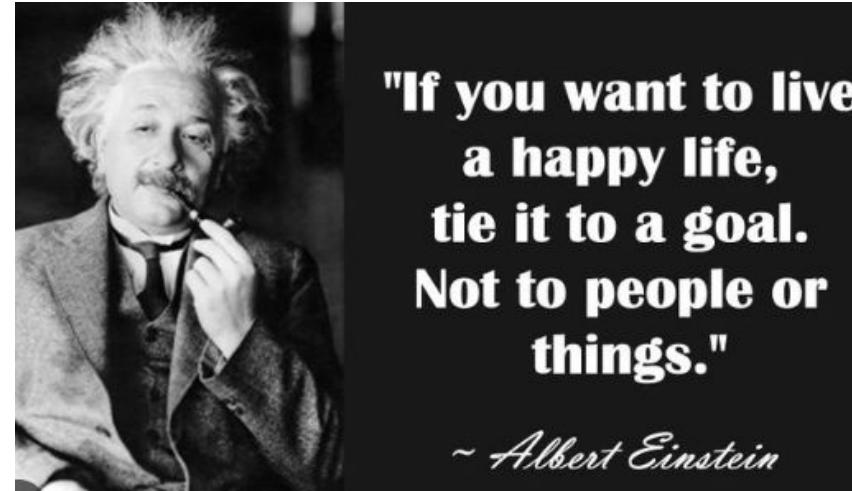
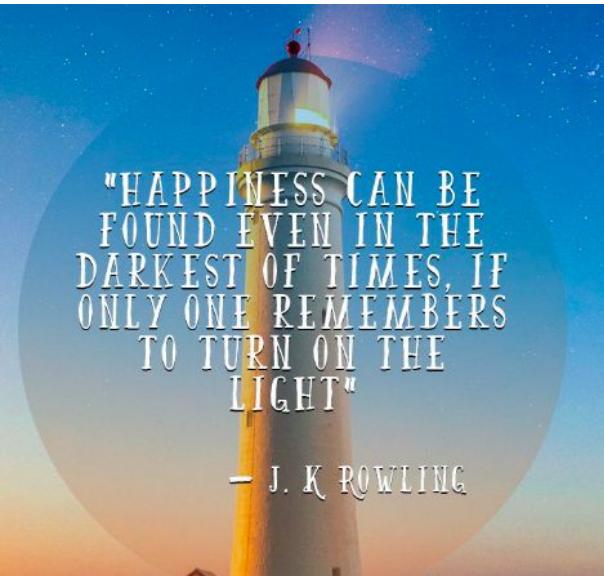
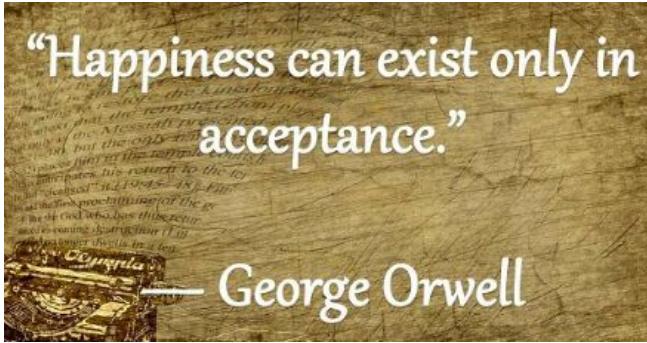
mtry	RMSE	Rsquared	MAE
2	0.3127513	0.9054961	0.2357689
17	0.3040494	0.9085903	0.2233846
32	0.3085542	0.9056935	0.2265398

RMSE was used to select the optimal model using the smallest value. The final value used for the model was mtry = 17.

Concluding Remarks



Concluding Remarks



"Most folks are as happy as they make up their minds to be."
~ Abraham Lincoln

Overall, Happiness is Complex

Special Thanks to the QAC Department for all the support and teachings in the past few years

Capstone Advisor: Professor Maryam Gooyabadi

CADS & Data Minor Advisor: Professor Manolis Kaparakis

Professor Robert Kabacoff

Professor Valerie Nazzaro

Professor Jennifer Rose

Professor Pavel Oleinikov

End



Maryam Gooyabadi

About: Maryam Gooyabadi customizes, designs, and mathematical methodologies to study social norms, culture, or ideologies. Examples include non-parametric clustering, along with other Social conventions such as shared beliefs. Understanding how ideologies form, evolve, and such beliefs could be shaped through targeted interventions.

Assistant Professor of the Practice in Quantitative Analysis



Emmanuel I. Kaparakis

Manolis Kaparakis did his undergraduate work at the University of Connecticut. He is currently teaching at Wesleyan University, where he directs the Quantitative Computing and Informatics Center at Providence College where he taught economics and Quantitative Economics major and served as the chair of the department.

Academic Affiliations

Special Thanks to the QAC Department for all the support and teachings in the past few years



Robert Ira Kabacoff

Robert Kabacoff is a data scientist with many years of experience in data mining, statistical methods, data visualization, predictive analysis, and statistical programming. He is the author of several books and maintains a popular website called [Quick-R](#), which provides articles from start to finish (3rd ed.), a textbook for students to learn how to read and evaluate empirical research, and provides statistical software for data analysis.

Professor of the Practice in Quantitative Analysis

Capstone Advisor: Professor Maryam Gooyabadi
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Professor Robert Kabacoff
Professor Valerie Nazzaro
Professor Jennifer Rose
Professor Pavel Oleinikov



Valerie L. Nazzaro

Valerie Nazzaro is a statistician in the Center for Quantitative Analysis and provides statistical consulting services to researchers.

Valerie Nazzaro began her career as a statistician at the University of Connecticut. Since then, she has worked with researchers from a vast array of fields, including post-doctoral positions with the Center for Quantitative Analysis and techniques for analyzing data pertaining to various fields.

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Academic Affiliations

Assistant Professor of the Practice in Quantitative Analysis

Pavel V Oleinikov

Pavel Oleinikov uses his background in mathematics and statistics to provide statistical consulting services to researchers.