

The Happiness Formula
Capstone Econometrics
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I. Introduction

Our research will attempt to create a formula for happiness on the basis of existing data that correlate various factors with self-reported happiness. This topic is inspired by the increasing academic discussions surrounding mental health, happiness, and how human experiences can be quantified through research.

II. Literature Review

The concept of happiness and the human pursuit of it is fundamental to both individual and societal well-being. It is enshrined as a right in the U.S. Declaration of Independence and has been sought after for thousands of years. Accordingly, researchers found that happiness improves social relationships, increases wealth, longer lives, and greater contributions to society. Yet, these studies only provide insight into the benefits of happiness, not the factors that contribute to its increase. In response, researchers began conducting studies correlating various factors with happiness: wealth, age, sex, religion, income, country, relative geographical location - urban vs suburban, weather, marital status, et cetera.

Published in the *Proceedings of the National Academy of Sciences*, Matthew Killingsworth's paper "Experienced well-being rises with income, even above \$75,000 per year" studied happiness and well-being through an app called "Track Your Happiness." The app measured both experienced well-being (by asking "How do you feel right now?" on a scale from "very bad" to "very good") and evaluative well-being (by asking "Overall, how satisfied are you with your life?" on a scale from "not at all" to "extremely.") By iterating this process with 33,000+ participants between the ages of 18 and 65, he collected over 1.7 million data points. He then analyzed the data by calculating average well-being for individuals and correlating it with income. With the extensive amount of data Killingsworth collected, his study concluded that well-being rises with income through all income levels, with no inflection point at which income stopped mattering.

In "Wealth and happiness" by Claudia Senik and published in the *Oxford Review of Economic Policy*, the insatiable link between income and happiness is expanded to include wealth and happiness. Senik defends the usage of subjective measures of happiness such as surveys because of their (1) stable structure, wherein variables reflecting marriage, divorce, unemployment, etc. are correlated with subjective well-being as expected, (2) cross-rater validity tests, wherein the level of happiness declared by an individual is consistent with feedback from friends and family,

and (3) panel data, wherein the same individuals are followed over a long period of time. This paper brings light to the positive relationship between countries with higher GDPs and level of happiness and life satisfaction. Furthermore, it establishes that there is no consensus on a wealth threshold where income is no longer correlated with increased levels of happiness. A notable nuance that Senik points out is that economic development results in both positive and negative side-effects on well-being – it reduces child mortality, extends life expectancy, and increases levels of education, but also increases pollution, inequality, working hours, et cetera. Through our research, it is crucial to point out the intermediate factors influencing the final reported happiness levels.

Then, in “Is Happiness U-Shaped Everywhere? Age and Subjective Well-Being in 132 Countries,” David G. Blanchflower of Dartmouth University utilized 109 data files and 444 country estimates to evaluate the graphical shape of happiness correlated with age. He concluded a well-being U-shape in one hundred and twenty-eight advanced and developing countries. Blanchflower found that despite shorter life expectancies in developing countries, the U-shapes have similar minima as those in advanced countries regardless of how well-being is measured. His methodology is as follows: (1) OLS regression where the dependent variable is a measure of well-being, (2) a re-estimation controlling for gender, education, marital and labor force status, among other variables, and (3) a re-estimation by plotting a single year of age variables in place of age and age squared terms (to make sure the quadratic is appropriate).

Conducted in 2014 by Amir Mehrdadi, Shahnaz Sadeghian, Ashraf Direkvand-Moghadam and Ataollah Hashemian, “Factors Affecting Happiness: A Cross-Sectional Study in the Iranian Youth” is a cross-sectional study conducted in Iran among the younger population, 15 to 29 year olds, to identify the factors influencing happiness. They surveyed a total of 500 people, and found that there was a significant relationship between happiness and location, employment status and physical activity. There was not a significant relationship between gender, marital status and education level with happiness among participants.

III. Hypothesis

We hypothesize that factors that are practically uncontrollable, namely high socioeconomic status, national gross domestic product, and life expectancy, are factors that increase happiness.

IV. Experimental Design

Theoretical Model:

$$\text{Happiness} = 0.0898 * e^{\text{Income}} + 0.105 * \text{Life Expectancy} + 7.03 * \ln [\text{GDP per Capita}]$$

As the topic of happiness has been extensively researched, we vetted through a plethora of variables to analyze: personal income, geographical location (urban vs suburban), political party preference, age, sex, ethnicity, weather, occupation, marital status, country gross domestic product, and life expectancy.

Of these variables, there is no past literature that formulates an equation illustrating the impact of uncontrollable, yet quantitative variables such as life expectancy, country gross domestic product, and personal income.

The first variable is personal income; while an individual can strive to change this value, it is essentially limited to the industry average for any given career. To linearize personal income v happiness, an exponential transformation was required.

The second variable is GDP per capita, which is a country's gross domestic product divided by its total population. Likewise, an individual cannot significantly influence this variable, yet it still impacts their happiness levels. The original data for GDP per capita v happiness was nonlinear and required a logarithmic transformation to enable a slope calculation.

The third variable is life expectancy at birth by country, which is not a variable any individual can control or significantly influence. In total, there are 152 data points, each with a corresponding life expectancy and happiness level. No linearization was required to calculate the slope for life expectancy v happiness.

Through analyzing these three variables, we ultimately yielded a happiness equation or "formula" that describes the impact of uncontrollable factors on happiness.

V. Analysis

For each of our variables, we looked through existing research to find the relevant data collected by researchers and analyzed them to fit our own uses. We inputted our data into Google Docs to more easily analyze it, got rid of data points with missing properties and repeated data points, and linearized data when necessary.

Table 1. Data for income versus happiness by income bracket.

Income	% Very Happy	% Fairly Happy	% Not Too Happy	Very Happy Linearized
<\$10k	35	44	21	3.555348061

\$10k-\$20k	42	42	15	3.737669618
\$20k-\$30k	43	52	5	3.761200116
\$30k-\$40k	55	41	4	4.007333185
\$40k-\$50k	46	36	9	3.828641396
\$50k-\$75k	55	40	5	4.007333185
\$75k-\$100k	60	36	4	4.094344562
\$100k-\$150k	60	40	0	4.094344562
\$150k-\$250k	70	30	0	4.248495242
\$250k-\$500k	83	17	0	4.418840608
\$500k+	100	0	0	4.605170186

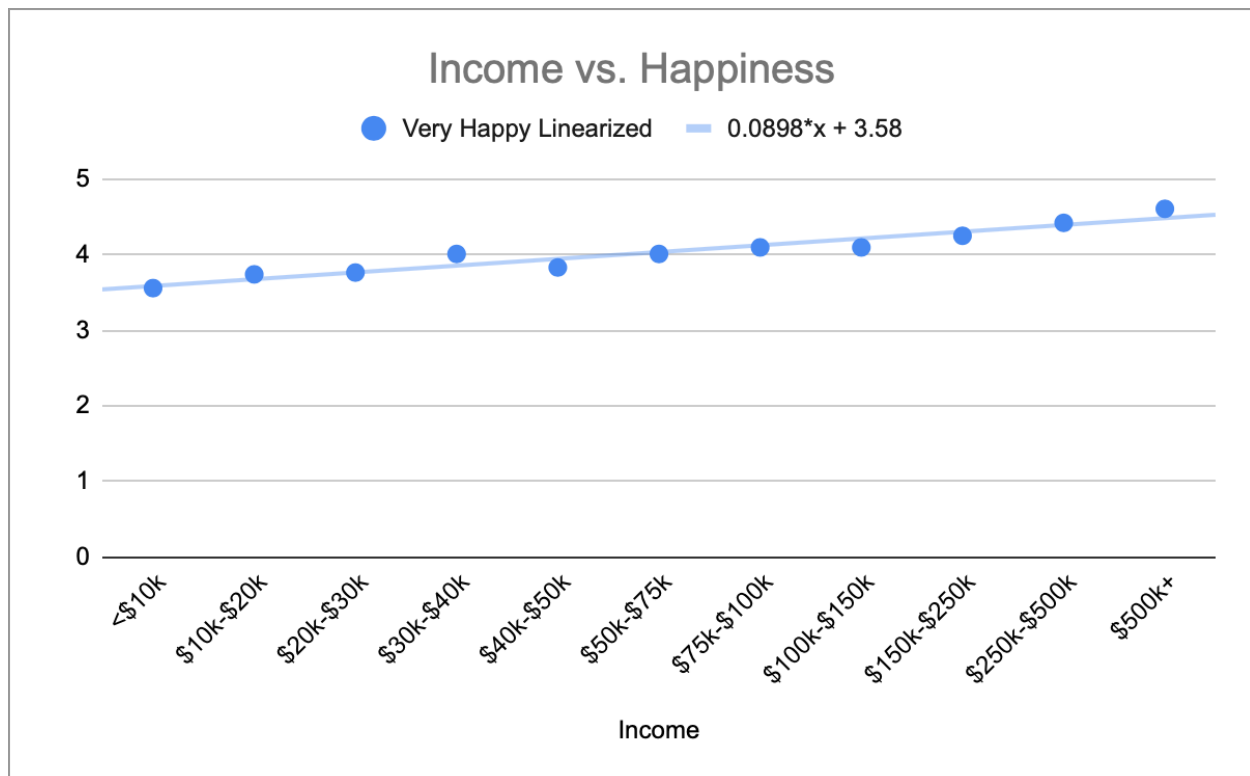


Figure 1. Linearized graph for income versus happiness by income bracket.

Table 2. Data for GDP per capita versus happiness.

Country	GDP per capita	Happiness Linearized	Original Happiness
Afghanistan	1979	23.8	2.38

Albania	13295	53.7	5.37
Algeria	10682	47.5	4.75
Argentina	19687	59.0	5.90
Armenia	12593	54.9	5.49
Australia	48698	71.4	7.14
Austria	51936	72.1	7.21
Azerbaijan	13700	51.7	5.17
Bahrain	40933	61.7	6.17
Bangladesh	4818	52.8	5.28
Belarus	19148	58.2	5.82
Belgium	48210	68.4	6.84
Benin	3323	44.1	4.41
Bhutan	10909	50.8	5.08
Bolivia	7932	55.6	5.56
Bosnia and Herzegovina	14340	55.2	5.52
Botswana	16040	34.7	3.47
Brazil	14064	61.1	6.11
Bulgaria	22384	56.0	5.60
Burkina Faso	2161	47.4	4.74
Burundi	731	37.7	3.77
Cambodia	4192	43.8	4.38
Cameroon	3576	52.4	5.24
Canada	45857	70.3	7.03
Central African Republic	929	34.8	3.48
Chad	1520	42.5	4.25
Chile	23325	61.5	6.15
China	16411	57.7	5.77
Colombia	13441	57.1	5.71
Comoros	3141	46.1	4.61

Congo	3449	52.1	5.21
Costa Rica	19679	70.0	7.00
Cote d'Ivoire	5174	52.6	5.26
Croatia	26465	65.1	6.51
Cyprus	37655	62.6	6.26
Democratic Republic of Congo	1072	43.1	4.31
Denmark	55938	75.1	7.51
Dominican Republic	17003	51.7	5.17
Ecuador	10329	53.5	5.35
Egypt	11951	44.7	4.47
El Salvador	8057	54.6	5.46
Estonia	35638	64.5	6.45
Eswatini	8393	44.0	4.40
Ethiopia	2297	45.5	4.55
Finland	47261	78.9	7.89
France	42026	67.1	6.71
Gabon	14400	49.1	4.91
Gambia	2159	51.6	5.16
Georgia	14089	51.2	5.12
Germany	50922	73.1	7.31
Ghana	5305	53.2	5.32
Greece	27287	57.9	5.79
Guatemala	8393	62.6	6.26
Guinea	2671	47.7	4.77
Haiti	2773	36.2	3.62
Honduras	5138	59.3	5.93
Hong Kong	56154	52.9	5.29
Hungary	31008	60.4	6.04
Iceland	52280	75.8	7.58

India	6118	42.2	4.22
Indonesia	11445	53.5	5.35
Iran	12433	48.7	4.87
Iraq	9255	47.9	4.79
Ireland	89689	70.4	7.04
Israel	38341	72.0	7.20
Italy	38992	64.9	6.49
Jamaica	8742	63.1	6.31
Japan	41380	61.2	6.12
Jordan	9817	40.9	4.09
Kazakhstan	25337	61.7	6.17
Kenya	4220	45.5	4.55
Kosovo	10776	62.9	6.29
Kuwait	49854	61.1	6.11
Kyrgyzstan	4707	62.5	6.25
Laos	7806	52.8	5.28
Latvia	29932	62.3	6.23
Lebanon	11649	40.2	4.02
Lesotho	2280	35.1	3.51
Liberia	1354	51.2	5.12
Libya	10282	53.3	5.33
Lithuania	36732	63.9	6.39
Luxembourg	110261	74.0	7.40
Madagascar	1510	43.4	4.34
Malawi	1487	38.7	3.87
Malaysia	26435	54.3	5.43
Maldives	13049	52.0	5.20
Mali	2217	49.9	4.99
Malta	39222	61.6	6.16
Mauritania	4983	41.5	4.15

Mauritius	19470	60.1	6.01
Mexico	17888	59.6	5.96
Moldova	12325	58.1	5.81
Mongolia	11471	60.1	6.01
Montenegro	18279	57.2	5.72
Morocco	6916	48.0	4.80
Mozambique	1229	49.3	4.93
Myanmar	4544	44.3	4.43
Namibia	8894	44.5	4.45
Nepal	3800	54.5	5.45
Netherlands	54210	75.0	7.50
New Zealand	42404	72.6	7.26
Nicaragua	5280	61.1	6.11
Niger	1197	50.0	5.00
Nigeria	4917	55.0	5.50
North Macedonia	15848	50.5	5.05
Norway	63586	72.9	7.29
Pakistan	4623	44.4	4.44
Palestine	5394	44.8	4.48
Panama	25382	60.9	6.09
Paraguay	12335	56.5	5.65
Peru	11261	60.0	6.00
Philippines	7954	50.8	5.08
Poland	32238	61.4	6.14
Portugal	32181	57.7	5.77
Qatar	85266	63.8	6.38
Romania	28833	61.3	6.13
Russia	26456	55.0	5.50
Rwanda	2099	32.7	3.27
Saudi Arabia	44328	65.6	6.56

Senegal	3300	54.9	5.49
Serbia	18210	60.4	6.04
Sierra Leone	1648	34.5	3.45
Singapore	93397	63.8	6.38
Slovakia	30330	65.2	6.52
Slovenia	36548	64.6	6.46
Somalia	830	46.7	4.67
South Africa	11466	49.5	4.95
South Korea	42251	57.9	5.79
Spain	36215	65.0	6.50
Sri Lanka	12537	42.1	4.21
Sweden	50683	73.1	7.31
Switzerland	68393	75.1	7.51
Tajikistan	3658	53.7	5.37
Tanzania	2635	37.9	3.79
Thailand	17287	58.8	5.88
Togo	2108	41.8	4.18
Trinidad and Tobago	23728	61.9	6.19
Tunisia	9728	47.3	4.73
Turkey	28385	48.6	4.86
Turkmenistan	15538	54.7	5.47
Uganda	2178	46.4	4.64
Ukraine	12377	52.7	5.27
United Arab Emirates	67119	64.6	6.46
United Kingdom	41627	68.0	6.80
United States	60236	70.3	7.03
Uruguay	21608	63.1	6.31
Uzbekistan	6994	61.5	6.15
Venezuela	8200	54.7	5.47
Zambia	3270	48.4	4.84

Zimbabwe	2745	31.6	3.16
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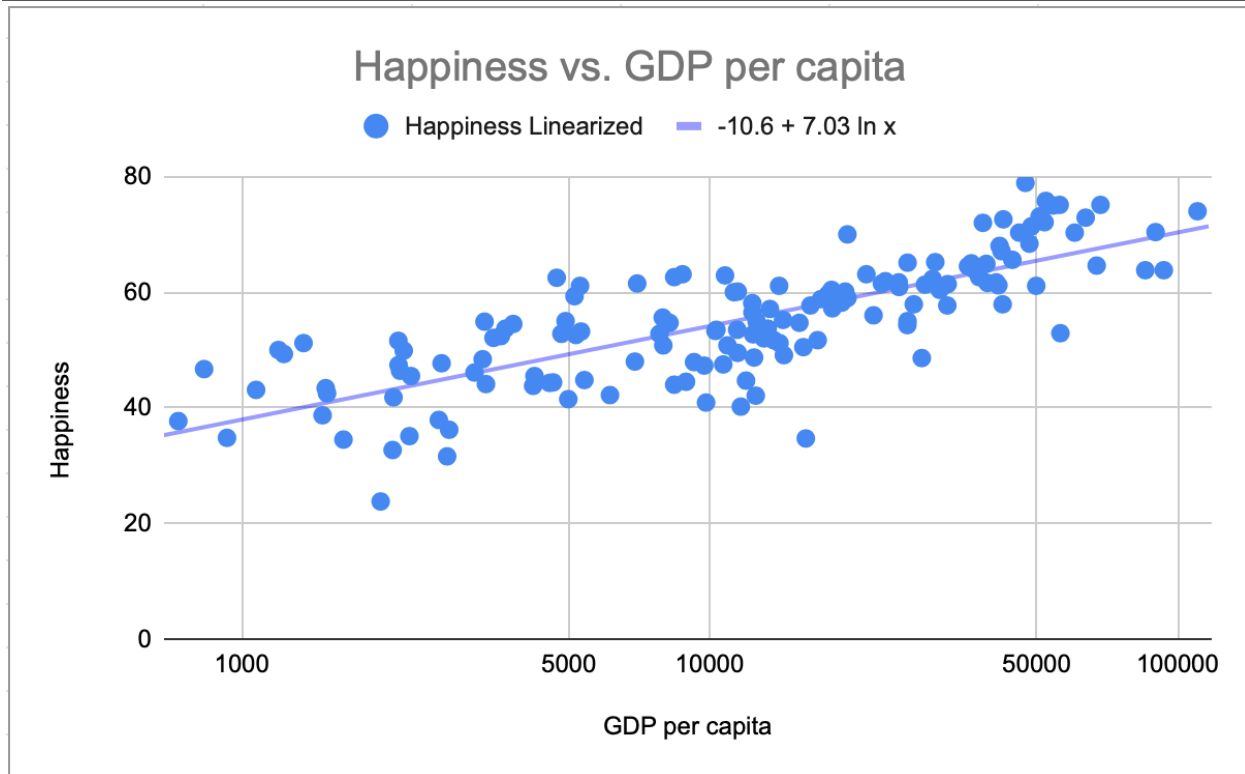


Figure 2. Data for GDP per capita versus happiness.

Table 3. Data for life expectancy at birth versus happiness.

Country	Life Expectancy at Birth	Happiness
Afghanistan	63.38	3.89
Albania	78.03	4.61
Algeria	76.09	5.34
Angola	59.40	3.79
Argentina	76.07	6.70
Armenia	74.47	4.35
Australia	82.79	7.31
Austria	81.18	7.08
Azerbaijan	72.27	5.15
Bahrain	76.76	6.01

Bangladesh	71.51	4.63
Belarus	73.56	5.72
Belgium	80.97	6.90
Belize	74.03	5.96
Benin	60.61	3.63
Bhutan	70.42	5.08
Bolivia	70.28	5.83
Bosnia and Herzegovina	76.86	5.12
Botswana	67.86	3.76
Brazil	74.99	6.55
Bulgaria	74.58	4.87
Burkina Faso	59.92	4.42
Burundi	60.12	2.90
Cambodia	68.64	4.16
Cameroon	57.58	5.04
Canada	82.03	7.41
Central African Republic	50.88	2.69
Chad	53.14	4.32
Chile	79.65	6.53
China	75.93	5.30
Colombia	76.53	6.39
Congo	63.10	4.69
Costa Rica	79.56	6.85
Cote d'Ivoire	56.06	4.45
Croatia	77.89	5.21
Cyprus	80.35	5.44
Czechia	78.69	6.61
Democratic Republic of Congo	59.25	3.90
Denmark	80.47	7.51
Dominican Republic	73.24	5.06

Ecuador	76.14	5.96
Egypt	71.30	4.76
El Savador	72.41	6.02
Estonia	77.78	5.63
Ethiopia	65.05	4.57
Finland	81.20	7.45
France	82.22	6.36
Gabon	64.91	4.66
Georgia	72.97	4.12
Germany	80.77	7.04
Ghana	62.77	3.99
Greece	81.55	5.62
Guatemala	73.25	6.46
Guinea	59.60	3.50
Haiti	62.48	3.57
Honduras	74.50	4.84
Hong Kong	84.04	5.50
Hungary	76.01	5.34
Iceland	82.48	7.50
India	68.61	4.34
Indonesia	70.77	5.04
Iran	75.8	4.75
Iraq	69.93	4.49
Ireland	81.34	6.83
Israel	82.34	7.08
Italy	82.83	5.85
Jamaica	74.10	5.31
Japan	83.88	5.88
Jordan	74.08	5.41
Kazakhstan	71.32	5.95

Kenya	64.80	4.36
Kuwait	75.13	6.15
Kyrgyzstan	70.88	4.91
Latvia	74.73	5.88
Lebanon	78.77	5.17
Lesotho	51.04	3.81
Liberia	62.27	2.70
Libya	72.12	5.62
Lithuania	74.92	5.71
Luxembourg	81.64	6.70
Madagascar	65.54	3.59
Malawi	61.95	3.87
Malaysia	75.46	6.32
Mali	57.51	4.58
Malta	81.90	6.61
Mauritania	63.94	3.92
Mauritius	74.50	5.61
Mexico	74.90	6.24
Moldova	71.48	6.02
Mongolia	69.11	4.98
Montenegro	76.45	5.13
Morocco	75.73	5.16
Mozambique	57.21	4.55
Myanmar	65.81	4.22
Namibia	62.12	4.57
Nepal	69.52	4.81
Netherlands	81.72	7.32
New Zealand	81.71	7.42
Nicaragua	73.65	5.92
Niger	60.63	3.67

Nigeria	53.11	4.93
North Macedonia	75.41	4.98
Norway	81.91	7.60
Pakistan	66.58	4.82
Palestine	73.44	4.70
Panama	77.78	6.61
Paraguay	73.66	5.56
Peru	75.79	5.58
Philippines	70.64	5.55
Poland	77.86	6.01
Portugal	81.22	5.08
Qatar	79.52	6.38
Romania	75.48	5.78
Russia	71.46	6.00
Rwanda	67.45	3.48
Saudi Arabia	74.65	6.34
Senegal	66.75	4.62
Serbia	75.31	5.32
Sierra Leone	52.94	4.91
Singapore	82.88	6.62
Slovakia	76.83	6.16
Slovenia	80.67	5.74
Somalia	55.92	5.35
South Africa	62.65	4.89
South Korea	82.10	5.78
South Sudan	56.85	4.07
Spain	82.98	6.38
Sri Lanka	76.32	4.61
Sudan	64.43	4.41
Sweden	82.25	7.29

Switzerland	83.14	7.57
Syria	69.91	3.46
Taiwan	79.74	6.45
Tajikistan	70.14	5.12
Tanzania	63.11	5.66
Thailand	76.09	6.20
Togo	59.93	3.77
Tunisia	75.92	5.13
Turkey	76.53	5.51
Turkmenistan	67.70	5.79
Uganda	61.37	4.24
Ukraine	71.53	3.96
United Arab Emirates	77.28	6.57
United Kingdom	81.05	6.51
United States	78.91	6.86
Uruguay	77.37	6.63
Uzbekistan	70.93	5.97
Venezuela	72.58	5.57
Vietnam	75.11	5.08
Yemen	66.08	2.98
Zambia	61.74	4.84
Zimbabwe	59.53	3.70

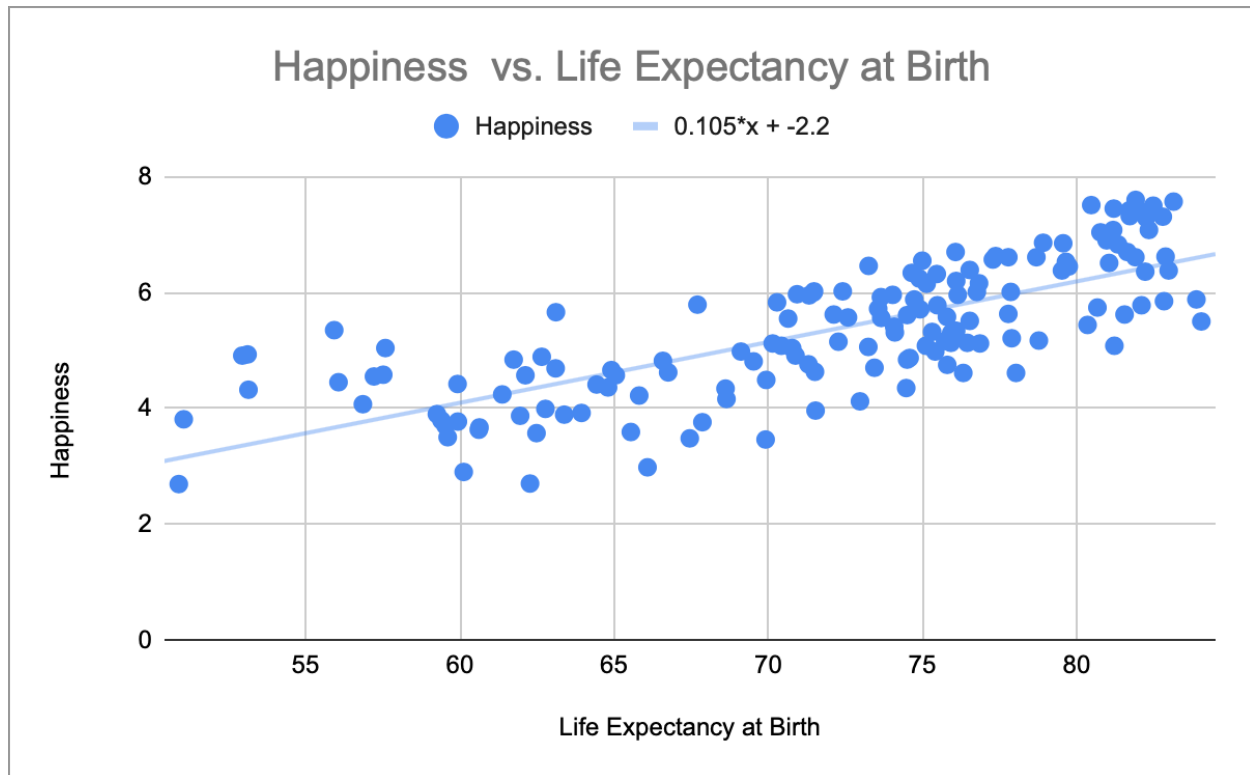


Figure 3. Data for life expectancy at birth versus happiness.

VI. Conclusion

By analyzing the R^2 values of each variable's correlation to happiness, we can see that our model is significant. Our R^2 value for individual income v happiness was 0.921; our R^2 value for GDP per capita v happiness was 0.612; our R^2 value for life expectancy v happiness was 0.576.

With more time and resources, we'd ideally look at more variables that could potentially affect reported happiness levels. While we were able to analyze personal income, GDP per capita, and life expectancy at birth, there were other variables such as age and weather, for which we were unable to find sufficient accessible data.

As our model is statistically significant, its primary implication is that factors out of an individual's control can have quantitative, tangible effects on their happiness. Ultimately, this result suggests an inequality in the pursuit of happiness and contributes a new, expandable "happiness formula" to existing literature.

Bibliography

- Blanchflower, David G. "Is Happiness U-Shaped Everywhere? Age and Subjective Well-Being in 132 Countries." *NBER*, 13 Jan. 2020, <https://www.nber.org/papers/w26641>.
- Conkle, Ann. "Serious Research on Happiness." *Association for Psychological Science - APS*, 1 Aug. 2008, <https://www.psychologicalscience.org/observer/serious-research-on-happiness>.
- Credits Michele W. Berger Writer , et al. "Money Matters to Happiness-Perhaps More than Previously Thought." *Penn Today*, 20 Jan. 1970, <https://penntoday.upenn.edu/news/money-matters-to-happiness-perhaps-more-than-previously-thought>.
- Goetz, Stephan J., et al. "County-Level Determinants of Mental Health, 2002–2008 - Social Indicators Research." *SpringerLink*, Springer Netherlands, 22 Oct. 2014, <https://link.springer.com/article/10.1007/s11205-014-0792-6>.
- Mehrdadi, Amir et al. "Factors Affecting Happiness: A Cross-Sectional Study in the Iranian Youth." *Journal of clinical and diagnostic research : JCDR* vol. 10,5 (2016): VC01-VC03. doi:10.7860/JCDR/2016/17970.7729
- Ortiz-Ospina, Esteban, and Max Roser. "Happiness and Life Satisfaction." *Our World in Data*, 14 May 2013, <https://ourworldindata.org/happiness-and-life-satisfaction>.
- Rufus, Anneli. "Happiness by Age, Location, and Political Affiliation." *The Daily Beast*, The Daily Beast Company, 14 July 2017, <https://www.thedailybeast.com/happiness-by-age-location-and-political-affiliation>.
- Senik, Claudia. "Wealth and Happiness." *Oxford Review of Economic Policy*, vol. 30, no. 1, Oxford University Press, 2014, pp. 92–108
- Tsutsui, Yoshiro. "Weather and Individual Happiness." *AMETSOC*, American Meteorological Society, 1 Jan. 2013, https://journals.ametsoc.org/view/journals/wcas/5/1/wcas-d-11-00052_1.xml.