

# PSTAT 100 Course Project: World Happiness Report 2023

## Background

World Happiness Report aims to analyze and understand the factors influencing happiness and well-being worldwide. The project utilizes a dataset containing information from the World Happiness Report spanning the years 2008 to 2023. The project starts by examining the overall happiness trend over time for different countries, utilizing data analysis to gain insights into the factors that influence happiness and well-being across countries. The findings helps us understand global happiness trends and can provide valuable insights for policymakers and researchers seeking to enhance societal well-being.

## Dataset Description

The dataset provided contains information from the World Happiness Report spanning the years 2008 to the present. It consists of several variables related to happiness and well-being in different countries. The variables include the country name, year, Life Ladder (a measure of overall happiness), Log GDP per capita, Social support, Healthy life expectancy at birth, Freedom to make life choices, Generosity, Perceptions of corruption, Positive affect, and Negative affect.

By utilizing this dataset, we can gain valuable insights into the specific factors that influence happiness, including economic prosperity measured by Log GDP per capita, social support, indicators of health such as Healthy life expectancy at birth, freedom of choice, generosity, and perceptions of corruption. With this detailed information at our disposal, we can thoroughly analyze the interplay between these factors and overall happiness levels. Besides, by examining the data, we can investigate trends and patterns in happiness levels across countries and identify potential correlations between these variables. Additionally, we can analyze how different countries perform in terms of social support, freedom, generosity, and corruption perception, shedding light on the overall well-being of their populations.

The dataset offers the opportunity for exploratory and descriptive analyses, allowing us to gain a deeper understanding of the factors influencing happiness and well-being worldwide. Furthermore, it presents the potential for statistical modeling to predict happiness levels based on the provided variables, which could offer valuable insights for policymakers and researchers seeking to enhance societal well-being.

| Variable                         | Description   |
|----------------------------------|---|
| Country name                     | Name of country analyzed  |
| year                             | Year in which the data was collected                            |
| Life Ladder                      | Measure of well-being from a scale of 0-10                      |
| Log GDP per capita               | Economic output per person in a country                         |
| Social support                   | National binary responses on having someone to count on         |
| Healthy life expectancy at birth | Average years of good health for newborns                       |
| Freedom to make life choices     | National average of satisfaction with personal freedom          |
| Generosity                       | Residual from regressing charitable donations on GDP per capita |
| Perceptions of curruption        | National average of survey responses on corruption              |
| Positive affect                  | Average of positive emotions in Gallup World Poll               |
| Negative affect                  | Average of negative emotions in Gallup World Poll               |

```
In [1]: import numpy as np
import pandas as pd
import altair as alt
import matplotlib.pyplot as plt

whr = pd.read_csv('data/whr-2023.csv')
```

```
In [2]: whr.head()
```

Out[2]:

|   | Country name | year | Life Ladder | Log GDP per capita | Social support | Healthy life expectancy at birth | Freedom to make life choices | Generosity | Perceptions of corruption | Positive affect | Negative affect |
|---|--------------|------|-------------|--------------------|----------------|----------------------------------|------------------------------|------------|---------------------------|-----------------|-----------------|
| 0 | Afghanistan  | 2008 | 3.724       | 7.350              | 0.451          | 50.5                             | 0.718                        | 0.168      | 0.882                     | 0.414           | 0.258           |
| 1 | Afghanistan  | 2009 | 4.402       | 7.509              | 0.552          | 50.8                             | 0.679                        | 0.191      | 0.850                     | 0.481           | 0.237           |
| 2 | Afghanistan  | 2010 | 4.758       | 7.614              | 0.539          | 51.1                             | 0.600                        | 0.121      | 0.707                     | 0.517           | 0.275           |
| 3 | Afghanistan  | 2011 | 3.832       | 7.581              | 0.521          | 51.4                             | 0.496                        | 0.164      | 0.731                     | 0.480           | 0.267           |
| 4 | Afghanistan  | 2012 | 3.783       | 7.661              | 0.521          | 51.7                             | 0.531                        | 0.238      | 0.776                     | 0.614           | 0.268           |

How has the overall happiness (Life Ladder) changed over time for different countries?

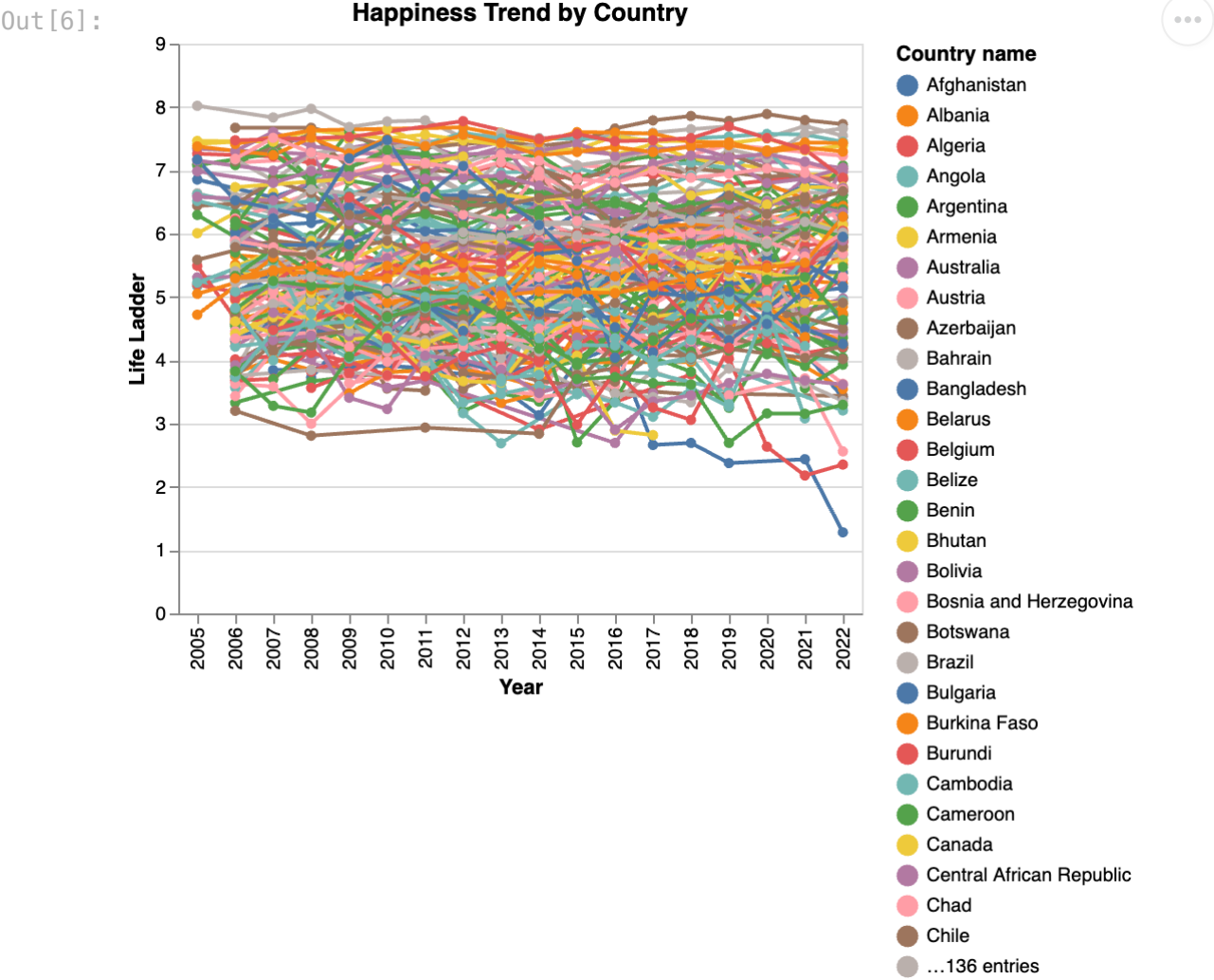
This graph obtains a line chart depicting the overall happiness trend over time. Each point on the line represents the average Life Ladder score for a specific year. We can observe the general pattern of happiness levels changing over time, identifying any significant fluctuations or trends.

However, we can clearly see that, regarding Afghanistan in 2022 having a Life Ladder score of approximately 1.3, it is important to ensure the accuracy of the data and perform further analysis to understand the reasons behind such a low value. By investigation, Afghanistan's humanitarian crisis worsened in 2022, largely because of the country's enduring economic collapse in the wake of the Taliban takeover. Over 90 percent of the population remained food insecure throughout the year, including tens of millions forced to skip meals daily or endure whole days without eating, that is the reason why they have had extremely low happiness scores in recent years.

```
In [6]: average_happiness_by_year = whr.groupby(['Country name', 'year'])['Life Ladder'].mean().reset_index()

fig1 = alt.Chart(average_happiness_by_year.reset_index()).mark_line(point=True).encode(
    x=alt.X('year:N', title='Year'),
    y=alt.Y('Life Ladder:Q', title='Life Ladder'),
    color='Country name:N'
).properties(title='Happiness Trend by Country')

fig1
```



Is there a correlation between a country's GDP per capita and its happiness level (Life Ladder)?

Based on the graph, we can observe that there is a strong positive correlation of approximately 0.78 between a country's GDP per capita and its happiness level (Life Ladder). That suggests that as a country's GDP per capita increases, its happiness level tends to increase as well. This finding aligns with the intuition that higher economic prosperity is often associated with greater well-being and life satisfaction. However, it is important to note that correlation does not imply causation, and other factors may also contribute to a country's happiness level.

```
In [7]: # Calculate the correlation between GDP per capita and Life Ladder
correlation = whr['Log GDP per capita'].corr(whr['Life Ladder'])

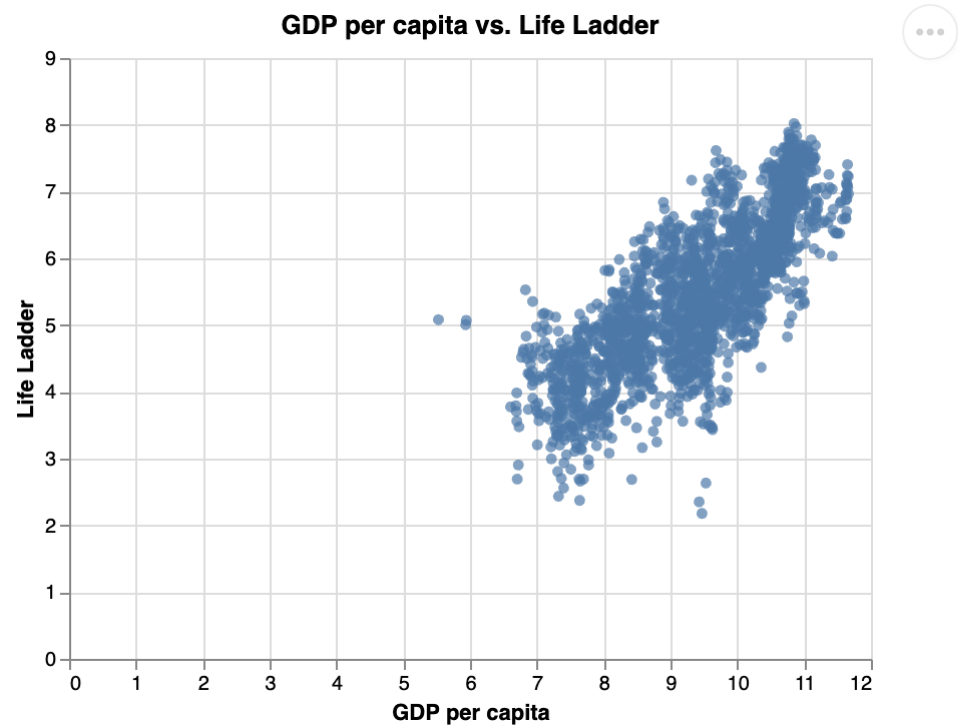
# Print the correlation coefficient
print("Correlation between GDP per capita and Life Ladder:", correlation)
```

Correlation between GDP per capita and Life Ladder: 0.7848684422556059

```
In [8]: fig2 = alt.Chart(whr).mark_circle().encode(
    x=alt.X('Log GDP per capita:Q', title='GDP per capita'),
    y=alt.Y('Life Ladder:Q', title='Life Ladder'),
    tooltip=['Country name', 'Log GDP per capita', 'Life Ladder']
).properties(
    title='GDP per capita vs. Life Ladder'
).interactive()

fig2
```

Out [8]:



## How does social support contribute to the overall happiness of individuals across different countries?

Observing the trend of the data points, we can discern a general pattern of upward movement from left to right, indicating that countries with greater social support tend to exhibit higher happiness levels. Among all the countries, the graph depicting the relationship between social support and happiness level reveals a positive correlation. The visualization illustrates that as individuals receive higher levels of social support, their reported happiness levels tend to increase. It's not hard to understand that, when individuals receive emotional, tangible, and informational assistance from their social circles, they often experience increased life satisfaction and a greater sense of belonging.

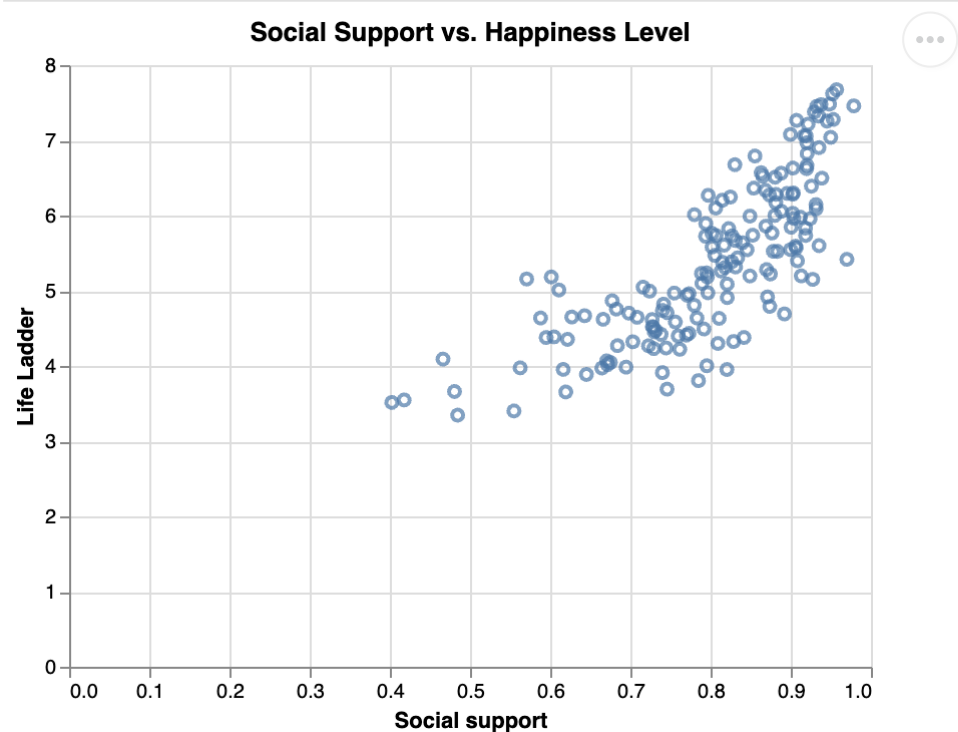
```
In [10]: # Group the data by country name and calculate average social support and happiness level
avg_social_support_by_country = whr.groupby('Country name')['Social support'].mean().reset_index()
avg_happiness_by_country = whr.groupby('Country name')['Life Ladder'].mean().reset_index()

# Merge the average social support and happiness level dataframes
merged_data = pd.merge(avg_social_support_by_country, avg_happiness_by_country, on='Country name')

# Create an Altair chart to visualize the relationship between social support and happiness level
fig3 = alt.Chart(merged_data).mark_point().encode(
    x='Social support:Q', y='Life Ladder:Q',
    tooltip=['Country name', 'Social support', 'Life Ladder']
).properties(
    title='Social Support vs. Happiness Level'
)

fig3
```

Out [10]:



## Are countries with longer healthy life expectancy at birth more likely to have higher happiness levels?

The distribution of healthy life expectancy at birth exhibits a left-skewed pattern, indicating that the majority of countries have relatively higher life expectancies. However, there are a few countries with notably low health life expectancies, indicating significant health challenges.

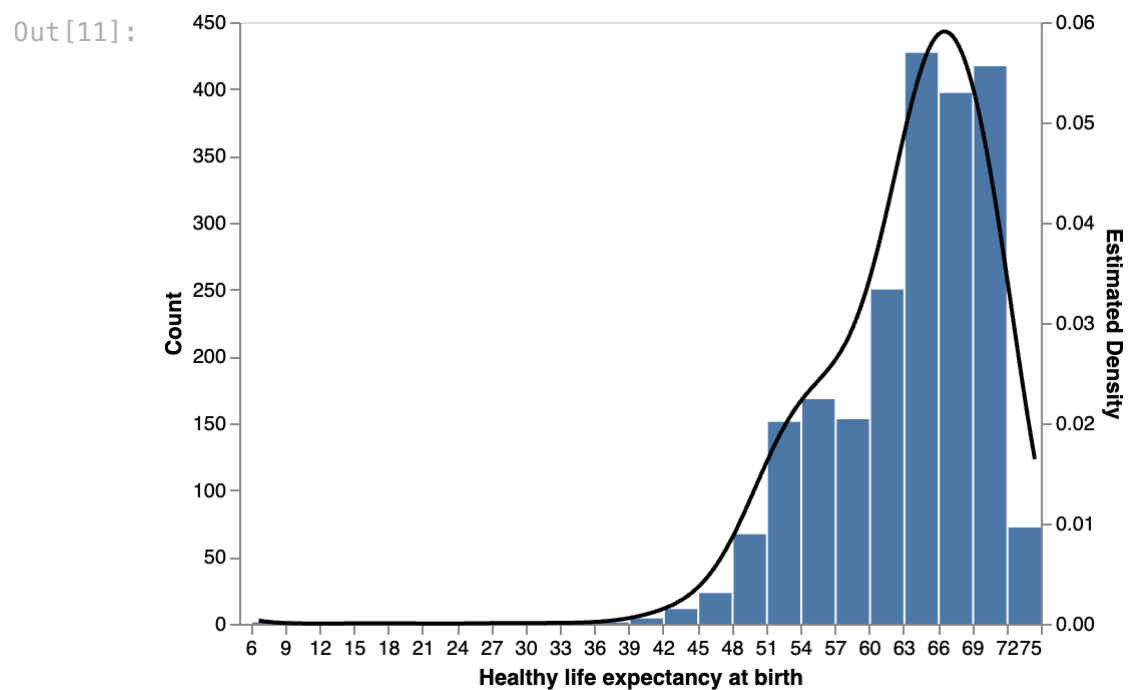
When examining the relationship between life ladder and health life expectancy at birth through a scatter plot, a clear trend emerges. Countries with longer life expectancies tend to exhibit higher levels of happiness. This suggests that there is a positive association between longer life expectancy and overall well-being.

Interestingly, there are a few outliers in the plot that deviate from this general trend. These outliers represent countries with exceptionally low life expectancies but relatively higher life ladder scores. This suggests that despite facing health challenges, these countries may possess other factors or circumstances that contribute to higher levels of life satisfaction.

```
In [11]: fig_3 = alt.Chart(whr).mark_bar().encode(
    x=alt.X('Healthy life expectancy at birth:Q',
        bin=alt.Bin(step=3),
        title='Healthy life expectancy at birth'),
    y=alt.Y("count()", title="Count"))

# plot kernel density estimate of life expectancies in 2010
life_smooth = alt.Chart(whr).transform_density(
    density = 'Healthy life expectancy at birth', # variable to smooth
    as_ = ['Life Expectancy at Birth', 'Estimated Density'], # names of outputs
    bandwidth = 3, # how smooth?
    #extent = [30, 85], # domain on which the smooth is defined
    steps = 1000 # for plotting: number of points to generate for plotting line
).mark_line(color = 'black').encode(
    x = 'Life Expectancy at Birth:Q',
    y = 'Estimated Density:Q')

alt.layer(fig_3, life_smooth).resolve_scale(y = 'independent')
```



```
In [13]: life_and_happy = alt.Chart(whr).mark_point(opacity=0.5).encode(
    y = alt.Y("Life Ladder", scale = alt.Scale(type = 'linear', zero = False)),
    x = alt.X("Healthy life expectancy at birth", scale=alt.Scale(type = 'linear', zero = False)))

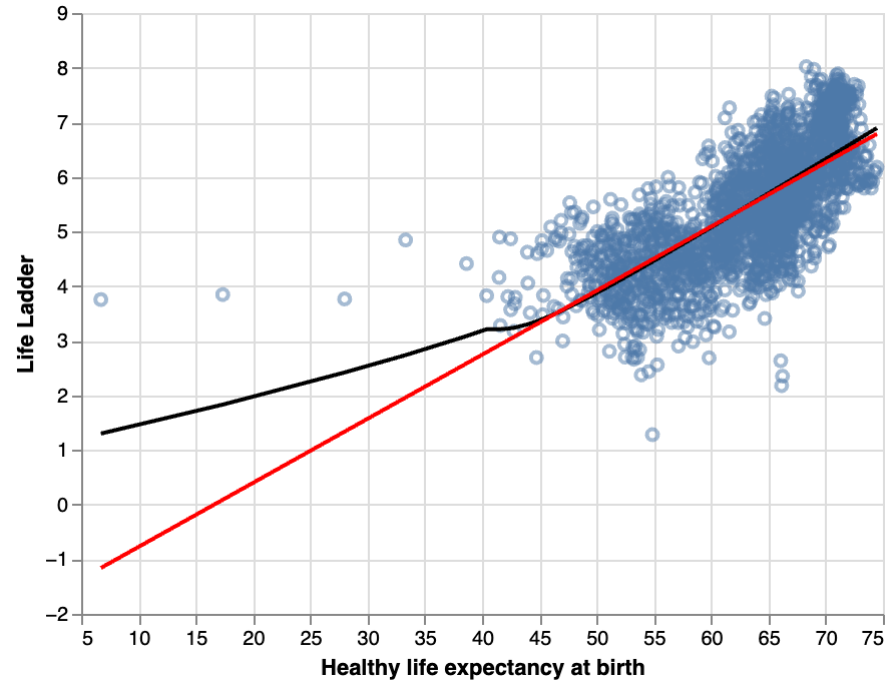
LH_reg = life_and_happy.transform_regression(
    'Healthy life expectancy at birth',
    regression = 'Life Ladder').mark_line(color = 'red')#.facet(column = "year")

LH_smooth = life_and_happy.transform_loess(
    on = 'Healthy life expectancy at birth', # x variable
    loess = 'Life Ladder', # y variable
    bandwidth = 1 # how smooth?
).mark_line(color = 'black')#.facet(column = "year")

fig_4 = alt.layer(life_and_happy, LH_smooth, LH_reg)#.resolve_scale(domain = [40,85])
fig_4
```



Out [13]:



## Has there been any significant change in the freedom to make life choices over the years in the world?

The freedom to make life choices has undergone significant changes over the years. Analyzing the mean and median freedom of life choice from 2005 to the present, we observe a fluctuating trend. From 2005 to 2008, there was a decline in the freedom of life choice. However, since then, there has been a general upward trend with some exceptions.

One notable exception occurred in 2012 when there was a decrease in the freedom of life choice. This change may have been influenced by various factors specific to that year. However, it is essential to consider the broader context and factors that could impact freedom of choice, such as social, political, and economic developments.

Moreover, the COVID-19 pandemic brought about significant changes in the freedom to make life choices. The measures implemented to control the spread of the virus, including quarantines, travel restrictions, and government regulations, had a profound impact on personal freedoms. These interventions temporarily limited individuals' ability to freely choose their lifestyles, work arrangements, and engage in social activities.

```
In [14]: choice_by_year_median = whr.loc[:,["year","Freedom to make life choices"]].groupby("year").median("Freedom to make
choice_by_year_median = choice_by_year_median.rename(
    columns = {"Freedom to make life choices": "Median Life Choices"})

choice_year_mean = whr.loc[:,["year","Freedom to make life choices"]].groupby("year").mean("Freedom to make life ch
choice_year_mean = choice_year_mean.rename(
    columns = {"Freedom to make life choices": "Mean Life Choices"})

tbl_5 = pd.concat([choice_by_year_median,choice_year_mean], axis = 1).sort_values(by = ["year"]).reset_index()
tbl_5
```

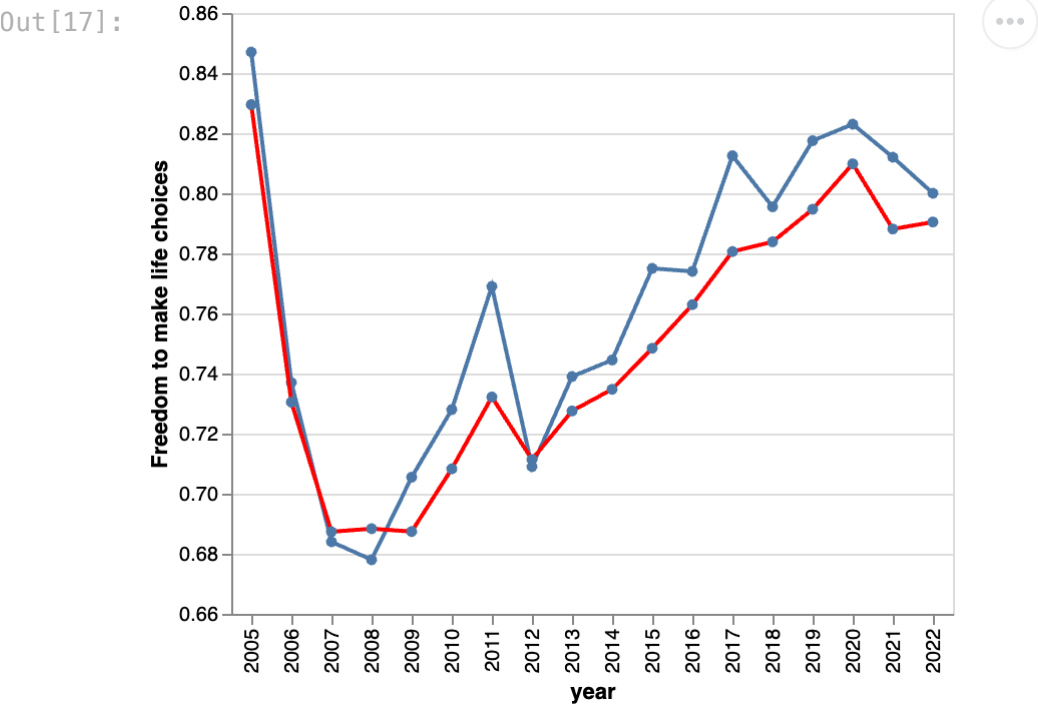
Out [14]:

|    | year | Median Life Choices | Mean Life Choices |
|----|------|---------------------|-------------------|
| 0  | 2005 | 0.8470              | 0.829520          |
| 1  | 2006 | 0.7370              | 0.730477          |
| 2  | 2007 | 0.6840              | 0.687337          |
| 3  | 2008 | 0.6780              | 0.688355          |
| 4  | 2009 | 0.7055              | 0.687402          |
| 5  | 2010 | 0.7280              | 0.708262          |
| 6  | 2011 | 0.7690              | 0.732186          |
| 7  | 2012 | 0.7090              | 0.711371          |
| 8  | 2013 | 0.7390              | 0.727548          |
| 9  | 2014 | 0.7445              | 0.734746          |
| 10 | 2015 | 0.7750              | 0.748417          |
| 11 | 2016 | 0.7740              | 0.762921          |
| 12 | 2017 | 0.8125              | 0.780603          |
| 13 | 2018 | 0.7955              | 0.783843          |
| 14 | 2019 | 0.8175              | 0.794683          |
| 15 | 2020 | 0.8230              | 0.809800          |
| 16 | 2021 | 0.8120              | 0.788099          |
| 17 | 2022 | 0.8000              | 0.790434          |

```
In [17]: q5_layer_1 = alt.Chart(tbl_5).mark_line(point = True).encode(
          x=alt.X("year:0"),
          y=alt.Y("Median Life Choices", title="Freedom to make life choices", scale=alt.Scale(zero=False)))

q5_layer_2 = alt.Chart(tbl_5).mark_line(point = True, color = "Red").encode(
          x=alt.X("year:0"),
          y=alt.Y("Mean Life Choices", title="Freedom to make life choices", scale=alt.Scale(zero=False)))

q5_layer_1+q5_layer_2
```



### How does the level of generosity in a country relate to its happiness level?

The level of generosity in a country is an important factor to consider when examining its happiness level. Analyzing the data, we observe that the distribution of generosity is right-skewed, indicating that there are relatively fewer countries with high levels of generosity compared to those with lower levels.

The histogram reveals a peak slightly below zero, suggesting that the overall trend leans towards a less generous disposition. However, it is important to note that generosity is a complex and multi-dimensional concept that cannot be solely determined by a single measure. Other factors, such as cultural norms, socio-economic conditions, and individual beliefs, may also influence the perception and practice of generosity within a country.

By examining the regression line and loess curve, we can identify a positive relationship between generosity and the happiness level, as represented by the life ladder. Countries with higher levels of generosity tend to exhibit higher life ladder scores, indicating greater overall happiness.

It is essential to delve deeper into the specific dynamics and factors that contribute to this relationship. Factors such as social cohesion, community engagement, and the availability of resources for charitable initiatives may play a role in fostering a culture of generosity and positively influencing overall happiness.

Overall, the level of generosity in a country can be seen as a contributing factor to its happiness level. Promoting and nurturing a culture of generosity may have a positive impact on the well-being and happiness of individuals and communities.

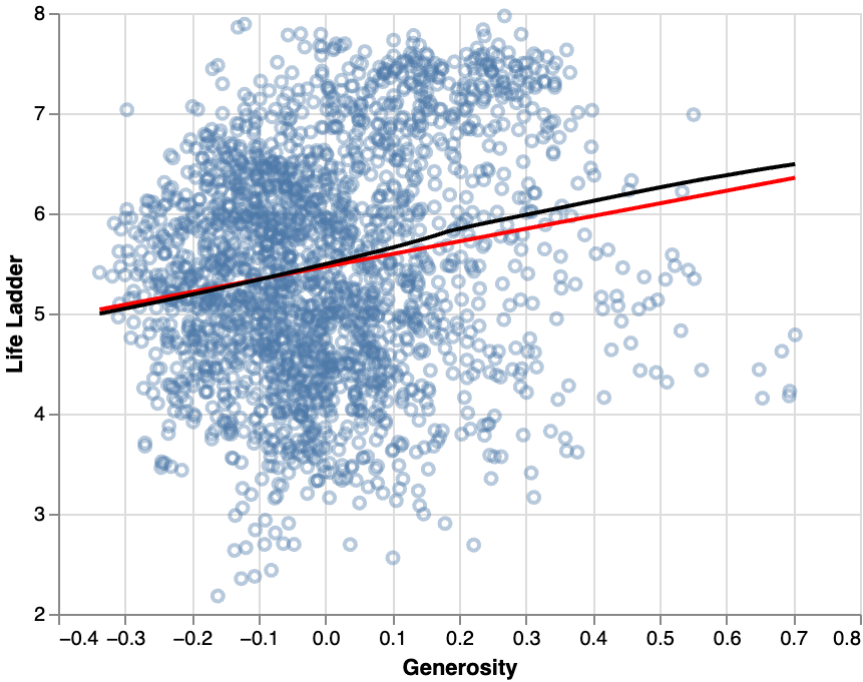
```
In [18]: generosity_and_happy = alt.Chart(whr).mark_point(opacity=0.4).encode(
          x = alt.X("Generosity", scale=alt.Scale(type = 'linear',zero = False)),
          y = alt.Y("Life Ladder", scale = alt.Scale(type = 'linear', zero = False)))

GH_reg = generosity_and_happy.transform_regression(
          'Generosity', regression = 'Life Ladder'
        ).mark_line(color = 'red')#.facet(column = "year")

GH_smooth = generosity_and_happy.transform_loess(
          on = 'Generosity', # x variable
          loess = 'Life Ladder', # y variable
          bandwidth = 1 # how smooth?
        ).mark_line(color = 'black')#.facet(column = "year")

fig_6 = alt.layer(generosity_and_happy, GH_reg, GH_smooth)#.resolve_scale(domain = [40,85])
fig_6
```

Out [18]:



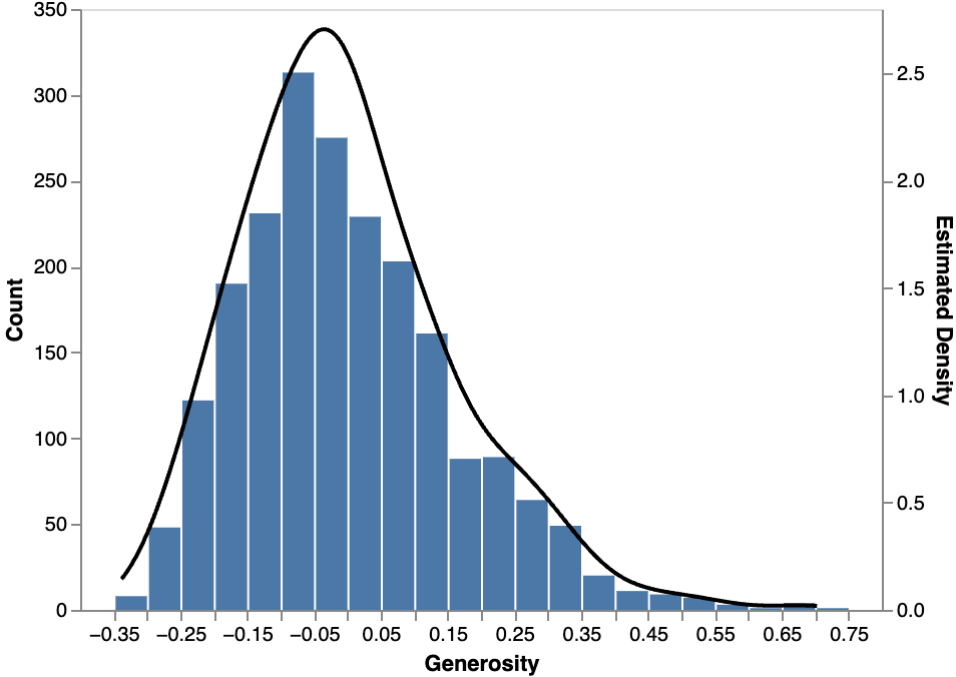
In [19]:

```
fig_6_2 = alt.Chart(whr).mark_bar().encode(
    x=alt.X('Generosity:Q',
            bin=alt.Bin(step=0.05),
            title='Generosity'),
    y=alt.Y("count()", title="Count"))

# plot kernel density estimate of life expectancies in 2010
generosity_smooth = alt.Chart(whr).transform_density(
    density = 'Generosity', # variable to smooth
    as_ = ['Generosity Yearly', 'Estimated Density'], # names of outputs
    bandwidth = 0.05, # how smooth?
    #extent = [30, 85], # domain on which the smooth is defined
    steps = 1000 # for plotting: number of points to generate for plotting line
).mark_line(color = 'black').encode(
    x = 'Generosity Yearly:Q',
    y = 'Estimated Density:Q')

alt.layer(fig_6_2, generosity_smooth).resolve_scale(y = 'independent')
```

Out [19]:



## Is there a relationship between the perceptions of corruption in a country and its happiness level?

Analyzing the data, we observe that the histogram for the perception of corruption is left-skewed, indicating that most countries tend to have perceptions of corruption in the range of 80% to 90%. This suggests that the majority of countries face some level of perceived corruption, although the extent may vary.

By examining the regression line and loess curve, we can identify a negative relationship between the perception of corruption and the happiness level, as measured by the life ladder. Countries with higher perceptions of corruption tend to exhibit lower life ladder scores, indicating lower levels of happiness.

This finding aligns with the common understanding that corruption can undermine social trust, economic stability, and overall well-being. When citizens perceive their government or public institutions as corrupt, it can erode their confidence, hinder social cohesion, and impact their overall happiness and quality of life.

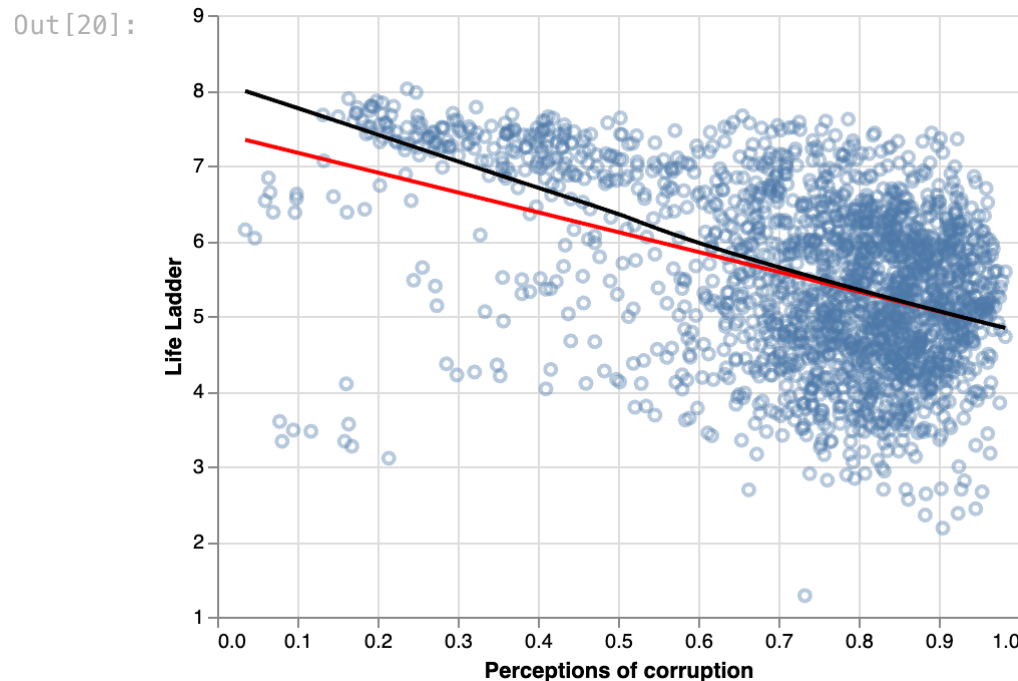
In addition, it is worth noting that there is a positive development over the years regarding the trend of corruption. There has been a decrease in the perception of corruption in many countries. This is an encouraging sign, suggesting that efforts to combat corruption, strengthen governance, and promote transparency have been effective in certain regions.

```
In [20]: corruption_and_happy = alt.Chart(whr).mark_point(opacity=0.4).encode(
    x = alt.X("Perceptions of corruption", scale=alt.Scale(type = 'linear', zero = False)),
    y = alt.Y("Life Ladder", scale = alt.Scale(type = 'linear', zero = False)))

CH_reg = corruption_and_happy.transform_regression(
    'Perceptions of corruption', regression = 'Life Ladder'
).mark_line(color = 'red')#.facet(column = "year")

CH_smooth = corruption_and_happy.transform_loess(
    on = 'Perceptions of corruption', # x variable
    loess = 'Life Ladder', # y variable
    bandwidth = 1 # how smooth?
).mark_line(color = 'black')#.facet(column = "year")

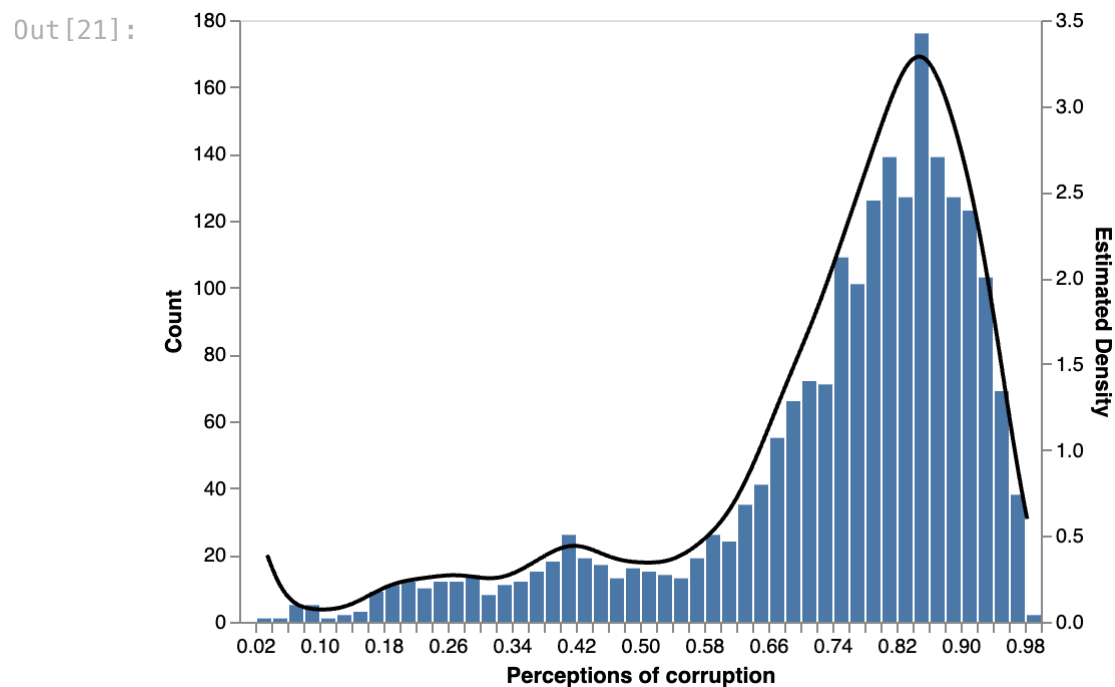
fig_7 = alt.layer(corruption_and_happy, CH_reg, CH_smooth)#.resolve_scale(domain = [40,85])
fig_7
```



```
In [21]: fig_7_2 = alt.Chart(whr).mark_bar().encode(
    x=alt.X('Perceptions of corruption:Q',
        bin=alt.Bin(step=0.02),
        title='Perceptions of corruption'),
    y=alt.Y("count()", title="Count"))

# plot kernel density estimate of life expectancies in 2010
corruption_smooth = alt.Chart(whr).transform_density(
    density = 'Perceptions of corruption', # variable to smooth
    as_ = ['Corruption', 'Estimated Density'], # names of outputs
    bandwidth = 0.03, # how smooth?
    #extent = [30, 85], # domain on which the smooth is defined
    steps = 1000 # for plotting: number of points to generate for plotting line
).mark_line(color = 'black').encode(
    x = 'Corruption:Q', y = 'Estimated Density:Q')

alt.layer(fig_7_2, corruption_smooth).resolve_scale(y = 'independent')
```



```
In [22]: # compute median expenditures
corruption_year_median = whr.loc[:,["year","Perceptions of corruption"]].groupby("year").median("Perceptions of cor
corruption_year_median = corruption_year_median.rename(columns = {"Perceptions of corruption": "Median Perceptions

corruption_by_year_mean = whr.loc[:,["year","Perceptions of corruption"]].groupby("year").mean("Perceptions of corr
corruption_by_year_mean = corruption_by_year_mean.rename(columns = {"Perceptions of corruption": "Mean Perceptions
```



```
tbl_7 = pd.concat([corruption_year_median,corruption_by_year_mean], axis = 1).sort_values(by = ["year"]).reset_index()
tbl_7
```

Out [22]:

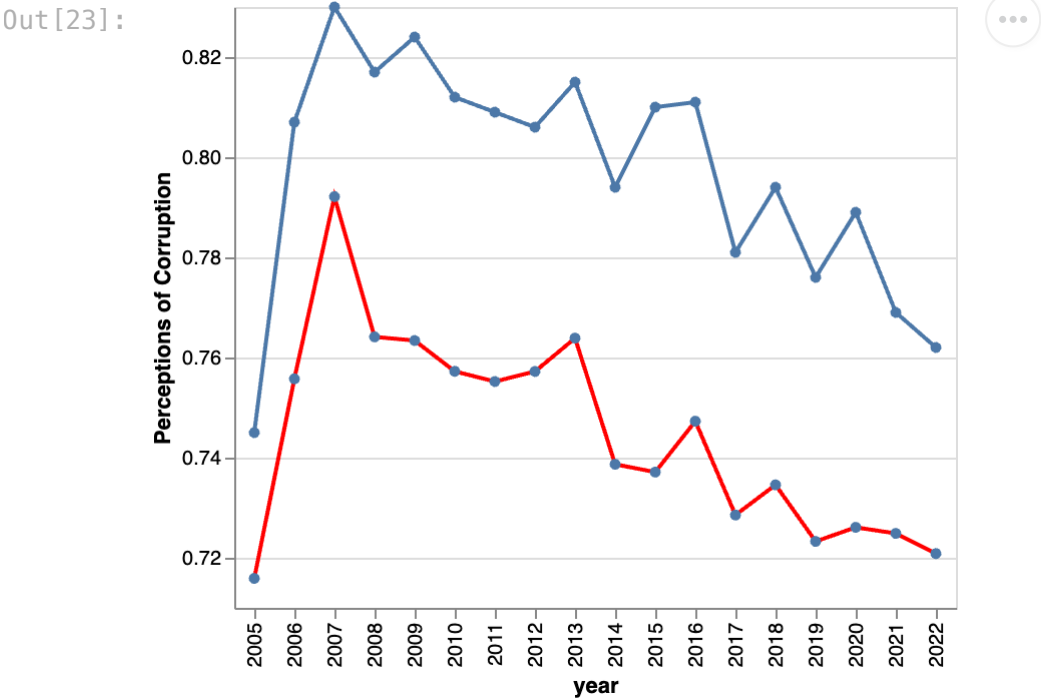
|    | year | Median Perceptions of Corruption | Mean Perceptions of Corruption |
|----|------|----------------------------------|--------------------------------|
| 0  | 2005 | 0.745                            | 0.715880                       |
| 1  | 2006 | 0.807                            | 0.755747                       |
| 2  | 2007 | 0.830                            | 0.792133                       |
| 3  | 2008 | 0.817                            | 0.764121                       |
| 4  | 2009 | 0.824                            | 0.763387                       |
| 5  | 2010 | 0.812                            | 0.757235                       |
| 6  | 2011 | 0.809                            | 0.755203                       |
| 7  | 2012 | 0.806                            | 0.757214                       |
| 8  | 2013 | 0.815                            | 0.763868                       |
| 9  | 2014 | 0.794                            | 0.738674                       |
| 10 | 2015 | 0.810                            | 0.737114                       |
| 11 | 2016 | 0.811                            | 0.747277                       |
| 12 | 2017 | 0.781                            | 0.728540                       |
| 13 | 2018 | 0.794                            | 0.734571                       |
| 14 | 2019 | 0.776                            | 0.723267                       |
| 15 | 2020 | 0.789                            | 0.726082                       |
| 16 | 2021 | 0.769                            | 0.724866                       |
| 17 | 2022 | 0.762                            | 0.720838                       |

In [23]:

```
q7_layer_1 = alt.Chart(tbl_7).mark_line(point = True).encode(
    x=alt.X("year:0"),
    y=alt.Y("Median Perceptions of Corruption:Q", title="Perceptions of Corruption", scale=alt.Scale(zero=False)),)

q7_layer_2 = alt.Chart(tbl_7).mark_line(point=True,stroke = 'Red').encode(
    x=alt.X("year:0"), y=alt.Y("Mean Perceptions of Corruption:Q", scale=alt.Scale(zero=False)),)

fig_7_3 = alt.layer(q7_layer_1, q7_layer_2)#.resolve_scale(y = 'independent')
fig_7_3
```



## How does the average generosity in the world change over time?

To understand the correlation between the average global generosity and world events, I created a line graph to see how it fluctuates over time. As one can see, the generosity levels drop below zero at at years 2008-2013 and 2016-2020. This can be inferred that world events can cause the average generosity to fall. For example, the coronavirus becoming a threat to human health allowed many people to take on the 'every man for themselves' mentality, focusing on spending their resources to keep themselves healthy or not wanting to wear a mask because of its uncomfortable nature. In addition, financial crises like the 2008 recession in the US can also be an explanation for people to not donate to charities.

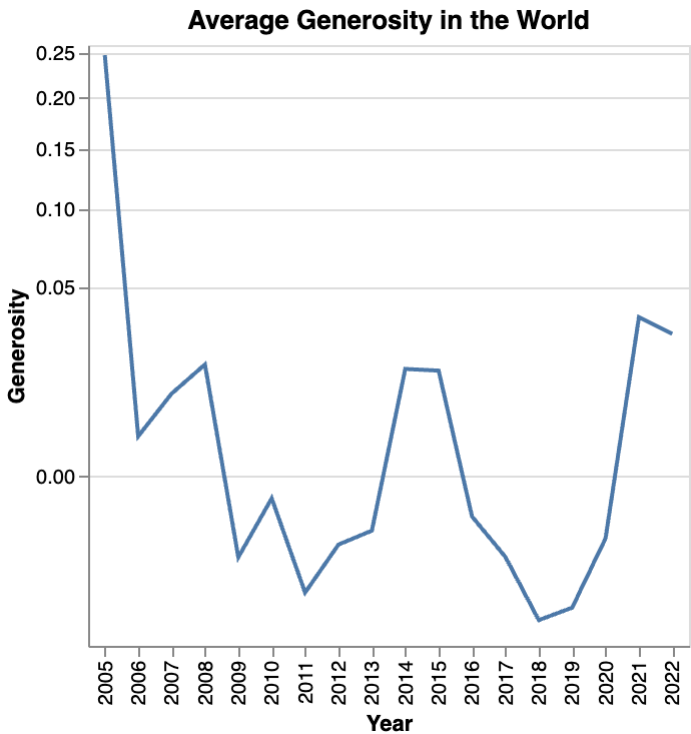
In [3]:

```
year = whr.drop(columns = 'Country name').groupby('year').mean().reset_index()

generosity = alt.Chart(year).mark_line().encode(
    x = alt.X('year:N', title = 'Year'),
    y = alt.Y('Generosity', scale = alt.Scale(type = 'sqrt'))
).properties(title = 'Average Generosity in the World', width = 300, height = 300)
```

generosity

Out [3]:



### How do the countries with the most and least happiness compare?

By sorting the data by the highest average of the 'Life Ladder' values, we can observe that the happiest country is Denmark while the least happiest is Afghanistan from years 2008 to 2023. Once the countries are isolated into their own datasets, I created graphs to show the differences in values in other variables over time. In the Denmark line graph, the variables `Social support` and `Freedom to make life choices` are closely related and near the value 1, while the `Perceptions of corruption` is close to 0. On the other hand, we can see that this is not the case for Afghanistan. The `Perceptions of corruption` is near 1 and the `Generosity` values go below zero after 2016. In addition, the average Log GDP per capita differs between the two countries by 2.

```
In [4]: happiness = whr.groupby('Country name').mean().sort_values(by='Life Ladder', ascending=True).drop(columns = 'year')
countries = whr.groupby(['Country name', 'year']).mean().reset_index()

low = countries.loc[countries['Country name'] == 'Afghanistan']
high = countries.loc[countries['Country name'] == 'Denmark']
```

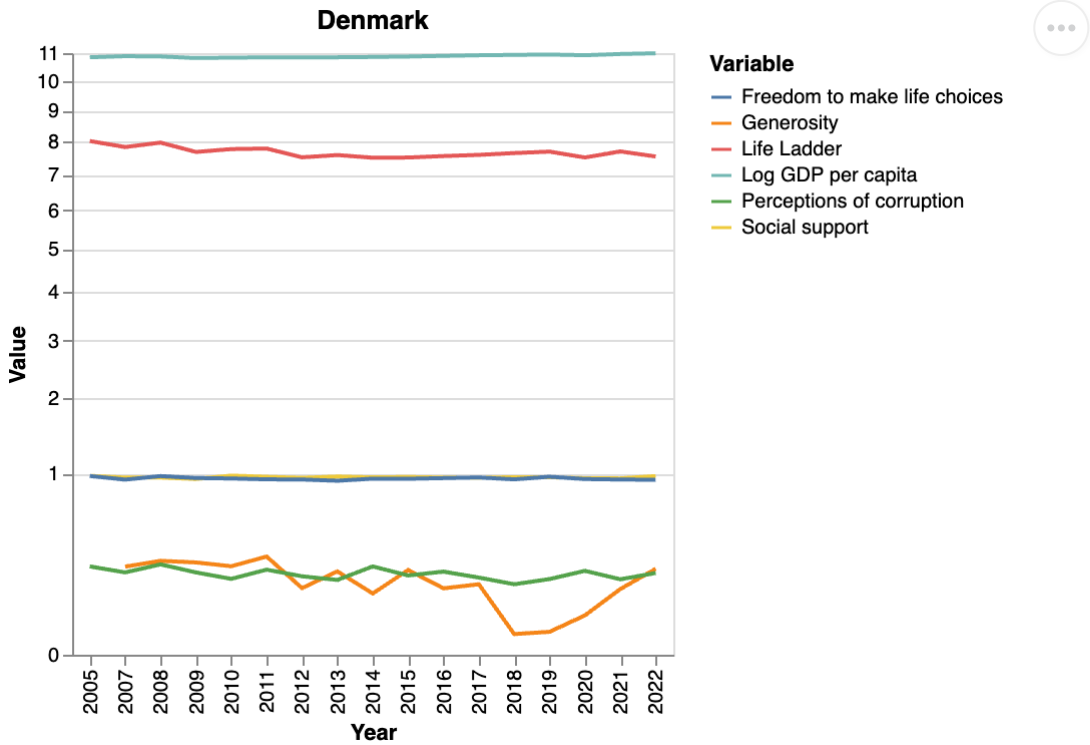
```
In [5]: a_melt = low.melt(
    id_vars = 'year',
    value_vars = ['Life Ladder', 'Log GDP per capita', 'Social support',
                  'Freedom to make life choices', 'Generosity', 'Perceptions of corruption'],
    var_name = 'Variable', value_name = 'Value')

d_melt = high.melt(
    id_vars = 'year',
    value_vars = ['Life Ladder', 'Log GDP per capita', 'Social support',
                  'Freedom to make life choices', 'Generosity', 'Perceptions of corruption'],
    var_name = 'Variable', value_name = 'Value')
```

```
In [7]: denmark = alt.Chart(d_melt).mark_line().encode(
    x = alt.X('year:N', title = 'Year'),
    y = alt.Y('Value', scale = alt.Scale(type = 'sqrt')),
    color = alt.Color('Variable').properties(title = 'Denmark', width = 300, height = 300))

denmark
```

Out [7]:



```
In [8]: afghanistan = alt.Chart(a_melt).mark_line().encode(
        x = alt.X('year:N', title = 'Year'),
        y = alt.Y('Value', scale = alt.Scale(type = 'sqrt')),
        color = alt.Color('Variable')).properties(title = 'Afghanistan', width = 300, height = 300)

afghanistan
```

Out [8]:

