Final Project: An Evaluation of the World Happiness Report

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INTRODUCTION

CodeStone chose to explore the data from the World Happiness Reports of 2018 and 2019, published by the Sustainable Development Network. According to the WHR, this data is derived from the Gallup World Poll, systematic telephone surveys and in person interviews in over 160 countries whose surveys claim to represent 80%+ of the population [1]. The calls are made via random phone number generation and randomly selecting households [2]. The data sets from each year include 312 cases, each representing the data for a particular country. The original variables in the data set included the overall rank according to happiness score, country name, happiness score, and then 6 variables that were used to calculate the happiness score in the WHR's analysis. These are GDP per capita, social support, healthy life expectancy, freedom to make life choices, generosity, and perceptions of corruption, all of which are expanded upon below. Additionally, we added variables for year as well as region to further our analysis.

Variable Sources and Definitions

Happiness Score: Happiness score is a self-reported measure of overall current life satisfaction. This was measured by asking respondents, "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?" The average of these values represents respective countries and regions [3][4].

GDP per capita: PPP (purchasing power parity) is a rate of conversion which attempts to equalize the purchasing power across all different currencies. The World Happiness Report sources its GDP per capita in PPP values from the 2017 and 2018 World Development Indicators respectively. This value is logged. [3][4].

Social Support: Social support is a self-reported measure of whether or not the respondent feels they can be helped. Specifically, respondents were asked, "If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?" and responded with 0 or 1 (no or yes). The average for each respective country or region creates this value [3][4].

Life Expectancy: Life expectancy data was extrapolated from the WHOs health observation data up to 2016. Where missing, life expectancy data for certain countries was found using research and government tools [3][4].

Perceptions of Corruption: Perception of Corruption is a self-reported measure of whether or not respondents feel there is active corruption within government and business. Specifically, respondents were asked, "Is corruption widespread throughout the government or not" and "Is corruption widespread within businesses or not?" and responded to both with 0 or 1 (no or yes). The average for each respective country or region creates this value [3][4]. Note: A higher value for this measure represents a lower perception of corruption.

Generally, we want to explore the following question: what factors contribute to the differences in happiness scores between countries in North America versus Western Europe? Both regions are relatively comparable in terms of financial and political structures, but Western Europe contains the Nordic countries which consistently score highest in the World Happiness reports. With this, questions are raised as to what contributes to such happiness in this region of the world.

The countries included in North America for the purposes of this study are the United States, Canada, and Mexico. We altered the original categorizations of regions, in which Mexico was not included but Australia and New Zealand were, to align with more common understandings of the region of North America. The countries included in Western Europe are much more extensive, and were not changed from the original categorization.

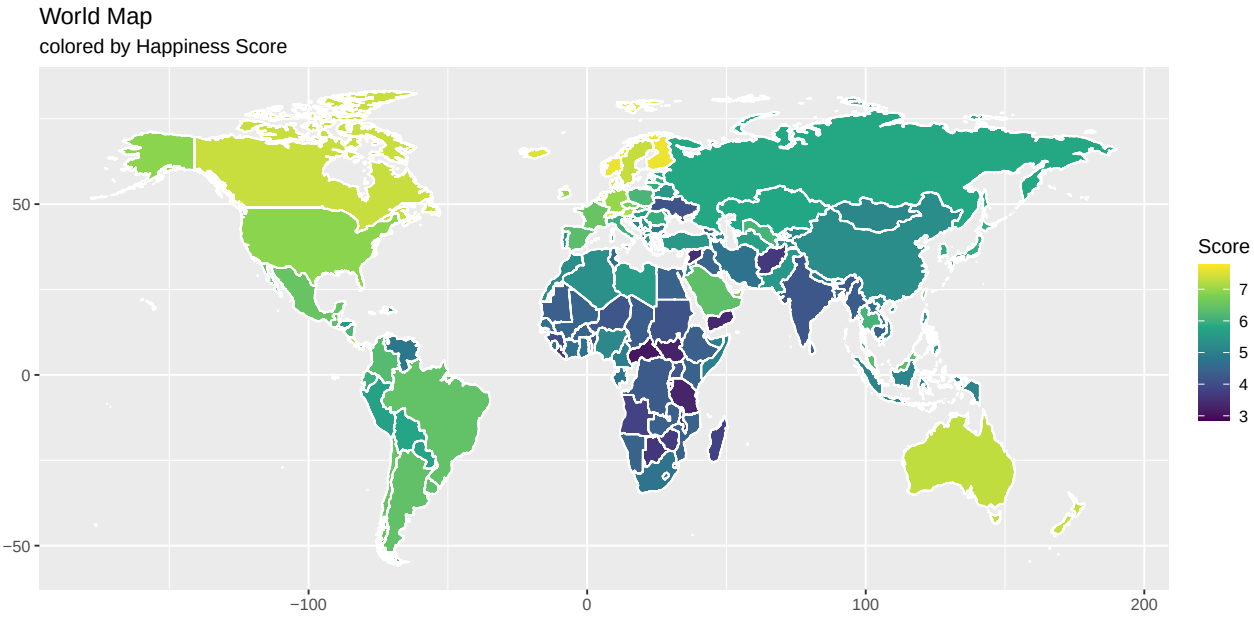
Considering the concerning state of our world in 2020, including the worsening effects of climate change, threats to democracy, and much more, we found it topical and insightful to evaluate what contributes to happiness within nations and between regions across the globe. The first World Happiness Report, published in 2012, presents the report as a means of grappling with the countless contradictions that exist in modern society such as the balance between pursuing economic success versus protecting the environment or the tradeoffs between personal profit and community trust [5]. Eight years later, these paradoxes persit, and the potential solutions are closely linked to definitions of morality, heightening their controversy. Considering the continued debate over such questions, we believe there are grounds for further investigation into trends of happiness over time and the factors that contribute to it.

METHODOLOGY

Chi-square test

Is there a relationship between region of the world and happiness score?

Description of chi square test for methodology



https://www.datanovia.com/en/blog/how-to-create-a-map-using-ggplot2/

H_0: There is no association between region of the world and happiness score. H_a: There is an association between region of the world and happiness score.

```
##
##  Pearson's Chi-squared test with simulated p-value (based on 2000
##  replicates)
##
## data:  worldhappiness$Score and worldhappiness$Region
## X-squared = 2562.2, df = NA, p-value = 0.1149
```

Table 1: Figure 1: Mean Scores for World Happiness Report Categories

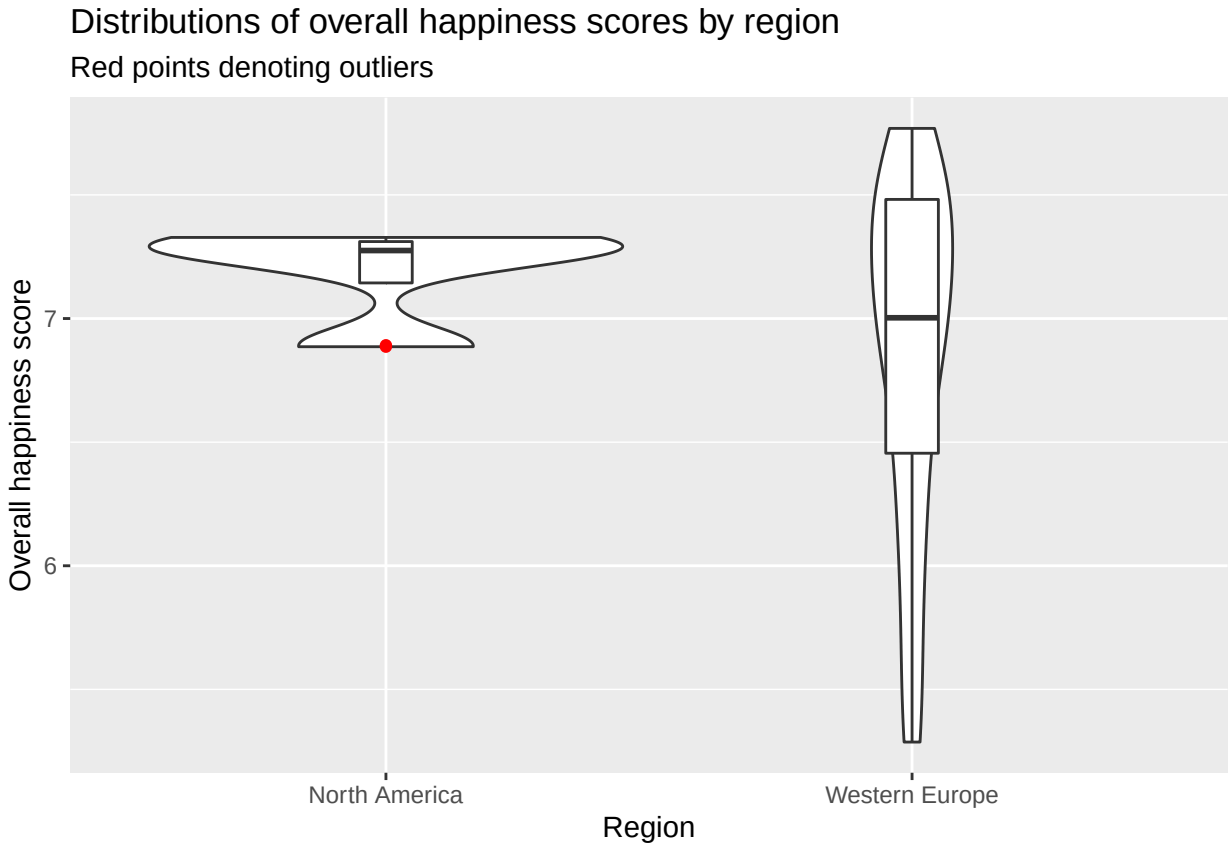
	Happiness Score	GDP	Social Support	Healthy Life Expectancy	Generosity	Corruption
Western Europe	6.863750	1.343850	1.486825	0.954825	0.22245	0.2176750
North America	6.911167	1.272333	1.423333	0.875000	0.22000	0.1713333

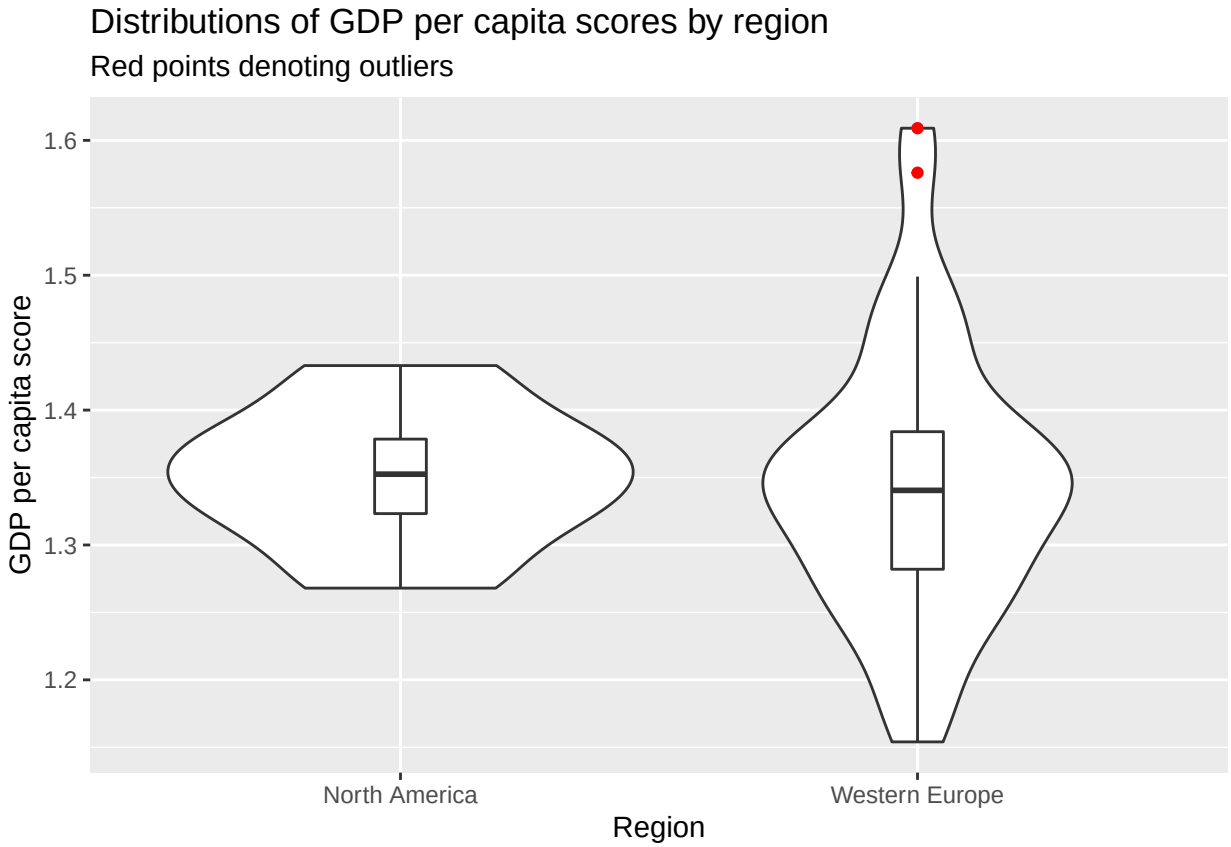
Summary Statistics

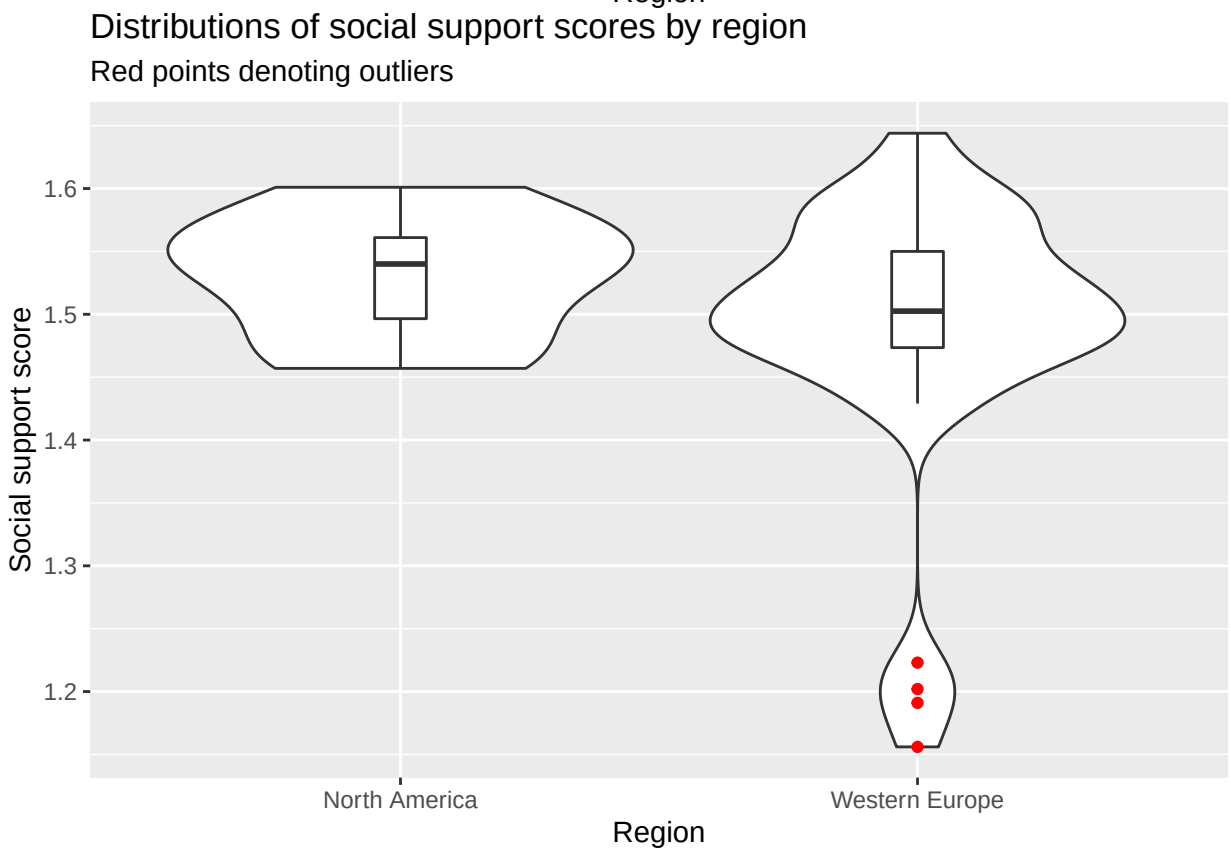
Description of summary statistics for methodology

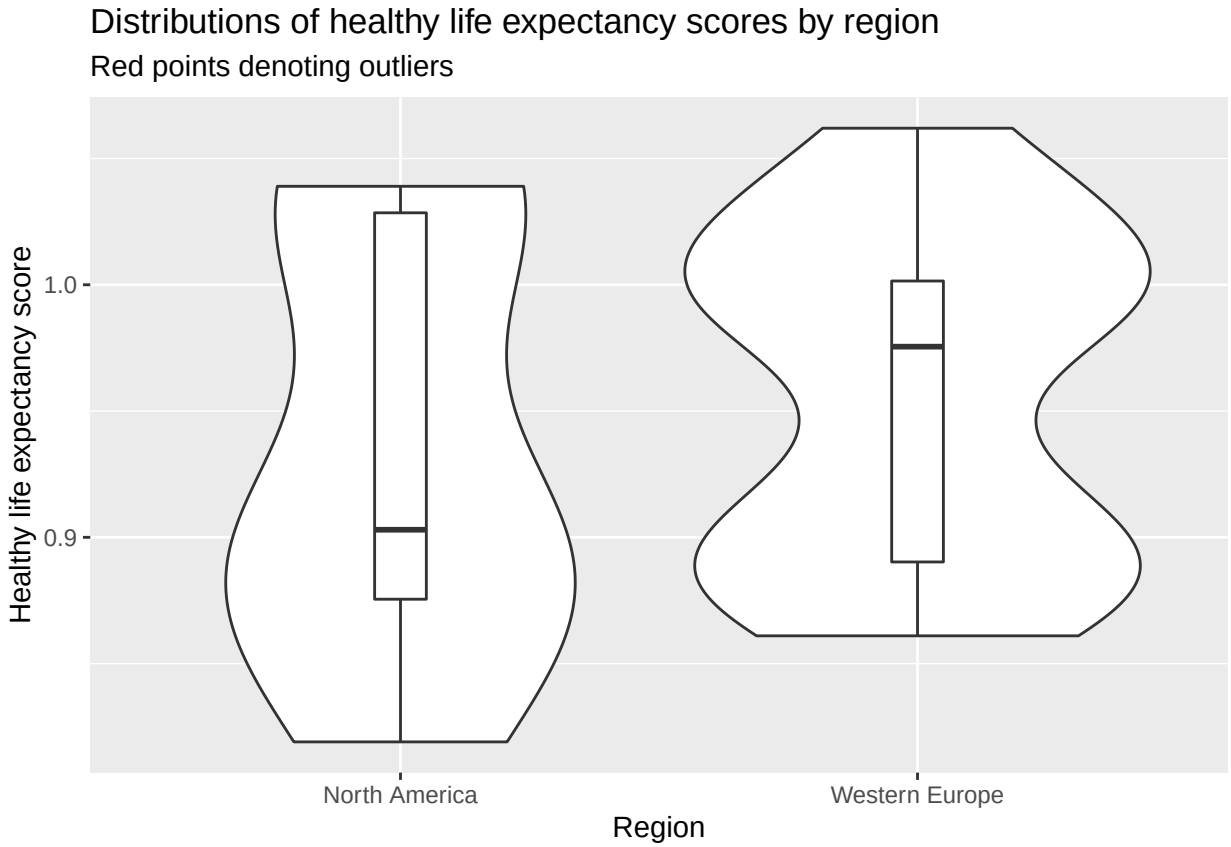
Violin Plot Visualizations

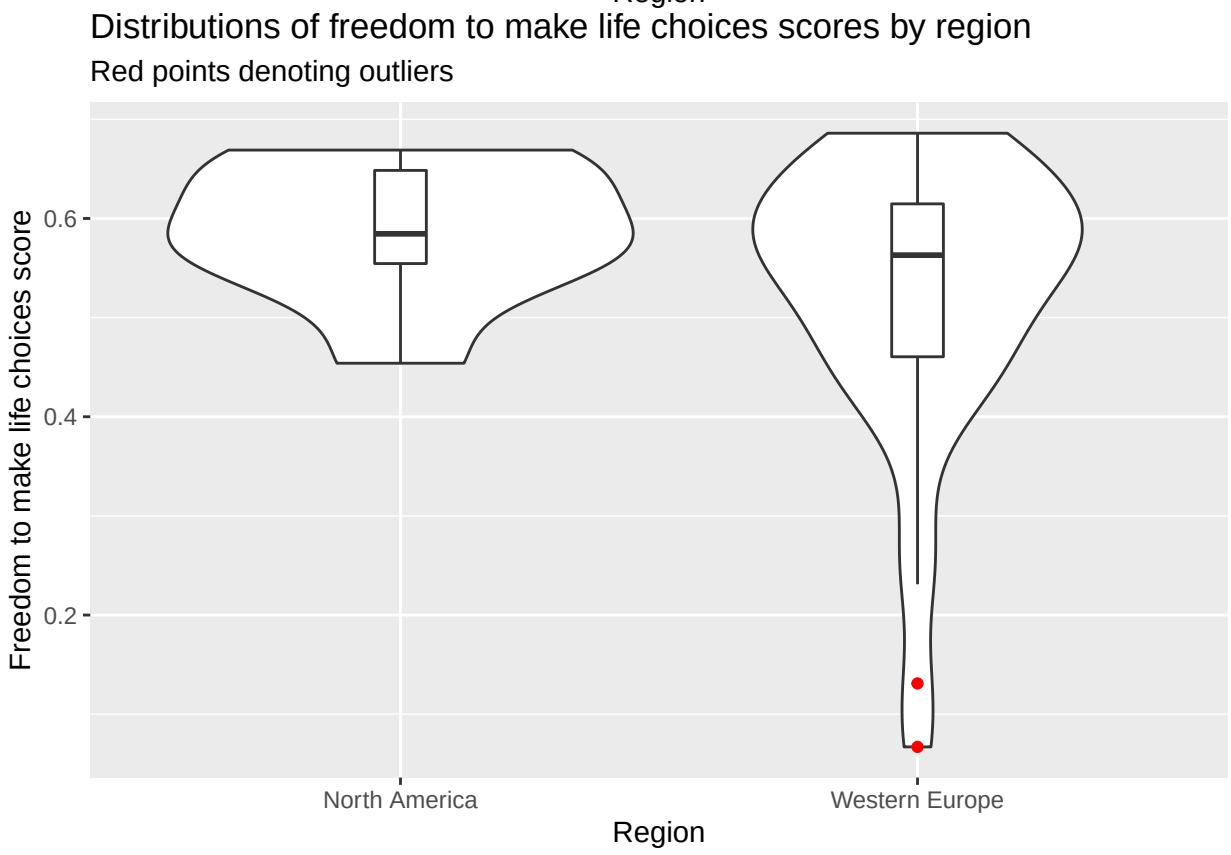
Description of visualizations for methodology.

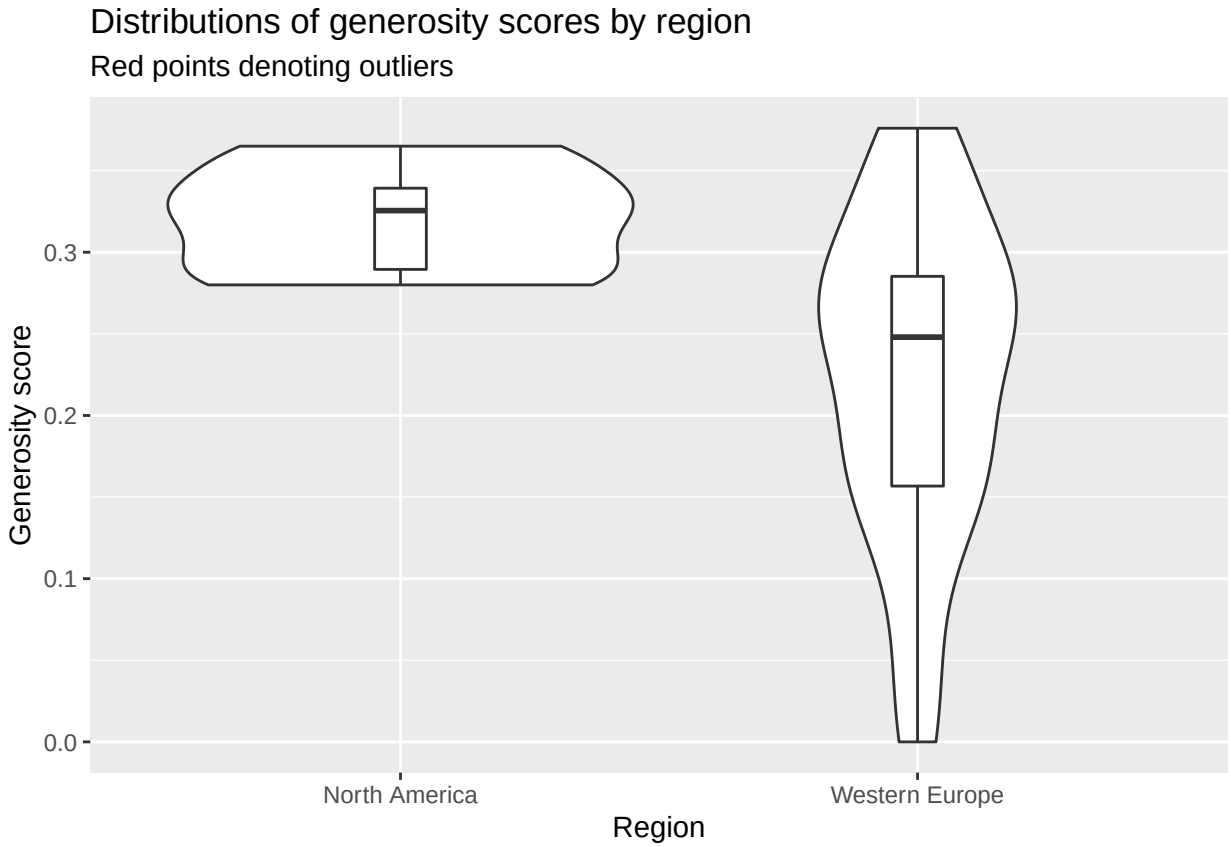


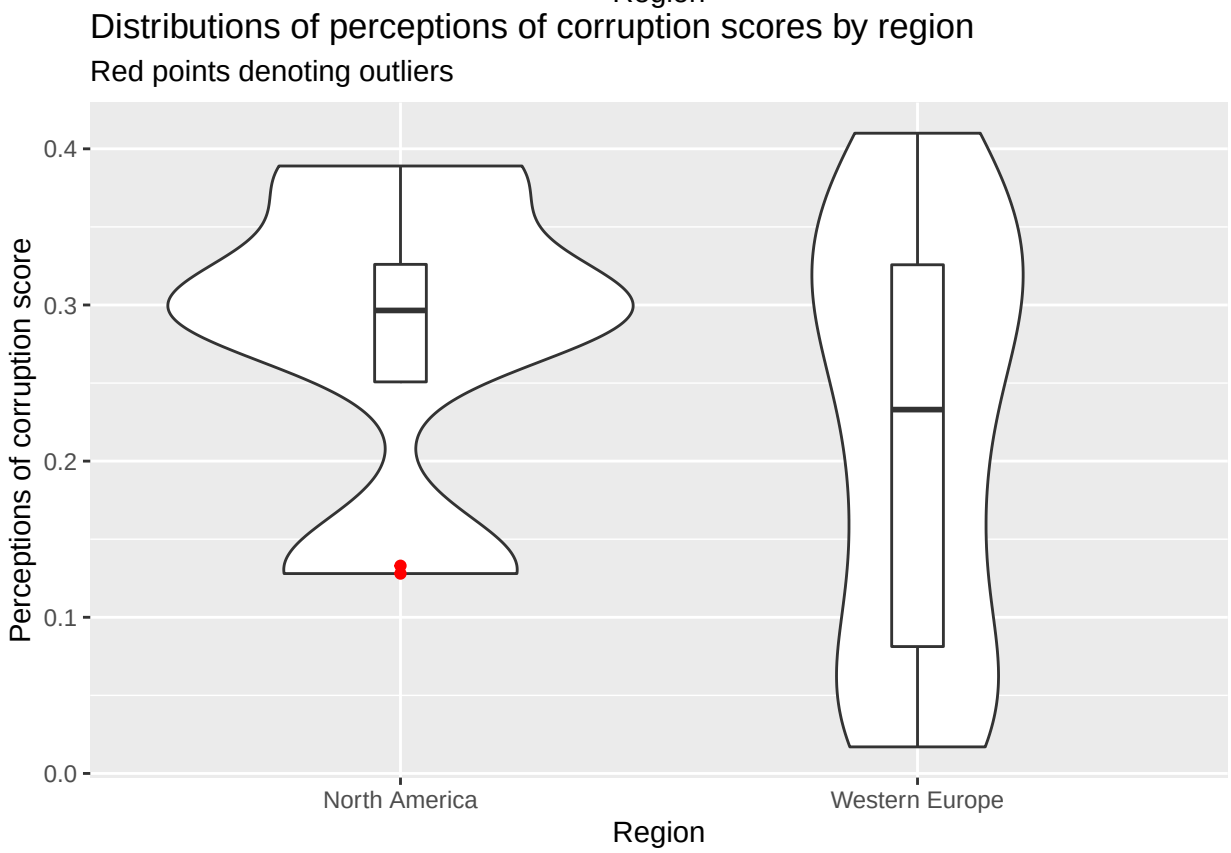

Distributions of GDP per capita scores by region
Red points denoting outliers
GDP per capita score
1.6
1.5
1.4
1.3
1.2
North America
Western Europe
Region


Distributions of social support scores by region
Red points denoting outliers
Social support score
1.6
1.5
1.4
1.3
1.2
North America
Western Europe
Region


Distributions of healthy life expectancy scores by region
Red points denoting outliers
Healthy life expectancy score
1.0
0.9
North America
Western Europe
Region


Distributions of freedom to make life choices scores by region
Red points denoting outliers
Freedom to make life choices score
0.6
0.4
0.2
North America
Western Europe
Region





Simulation based hypothesis testing

Next, we conducted simulation-based hypothesis tests for each of the variables contributing to overall happiness score to evaluate whether there is a statistically significant difference the regions of Western Europe and North America.

Each of the simulation-based hypothesis tests used to evaluate the variables contributing to overall happiness score will be evaluated at the $\alpha = 0.05$ level.

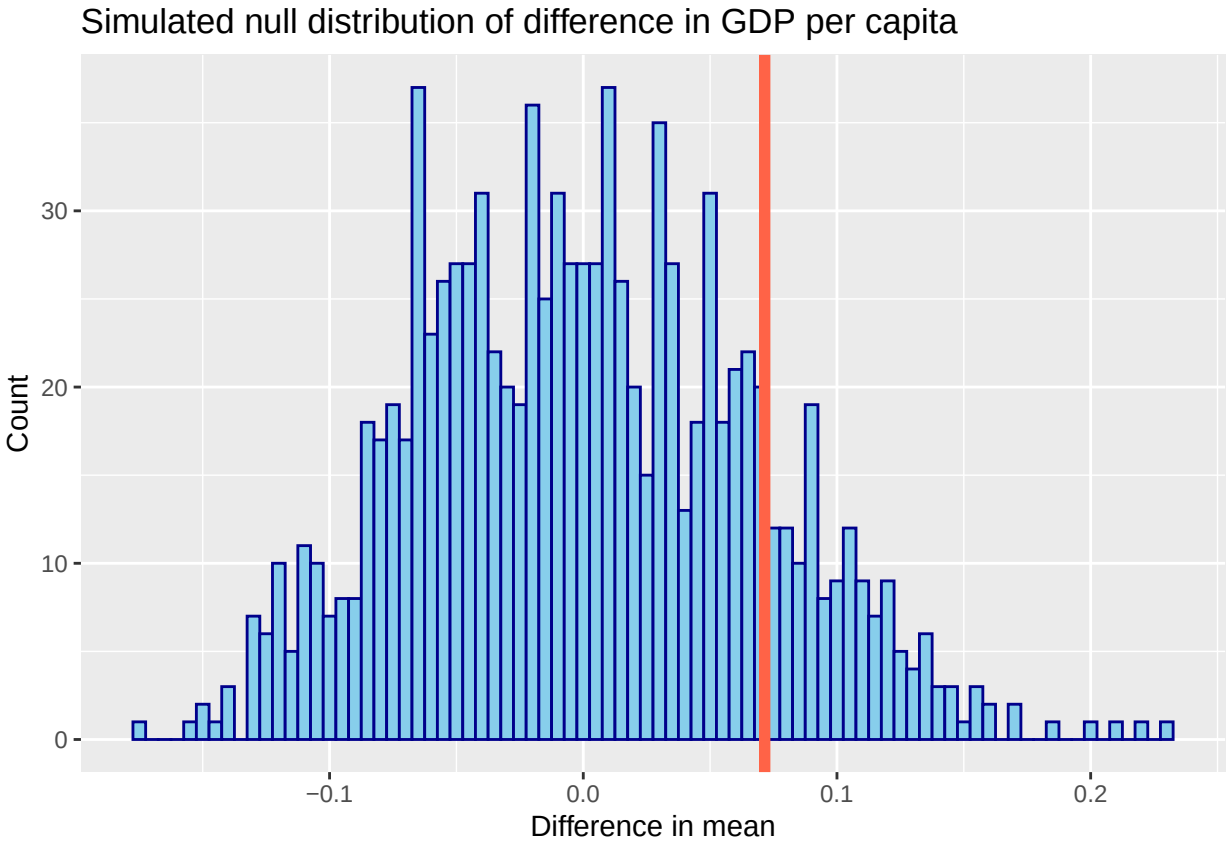
Generally, our null hypothesis states that the mean score for a particular variable in Western Europe equal to the mean score for that same variable in North America. Our alternative hypothesis therefore is that the mean score for a particular variable in Western Europe is not equal to that of the mean score for that variable in North America.

H_0: $\mu_{WE} = \mu_{NA}$

H_A: μ_{WE} != μ_{NA}

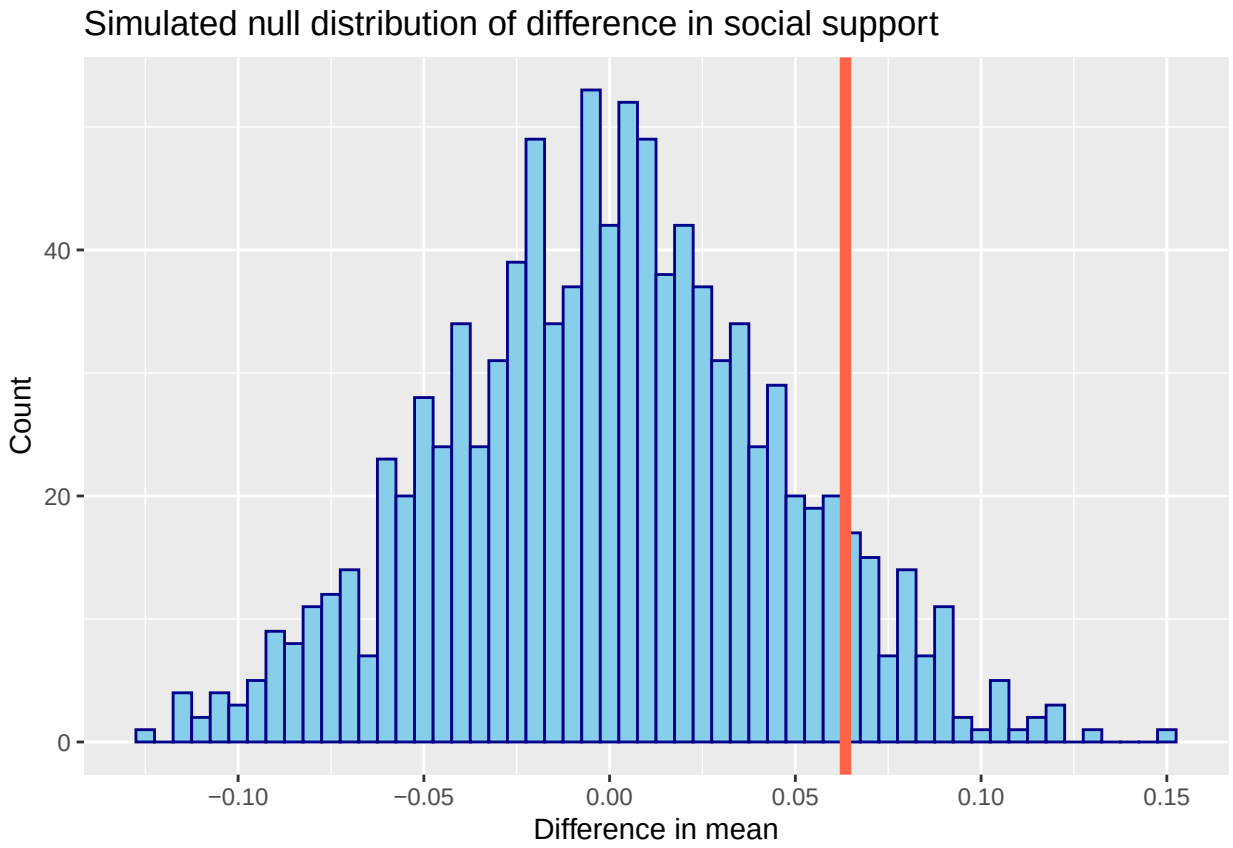
GDP per capita

```
##   p_val
## 1 0.145
```



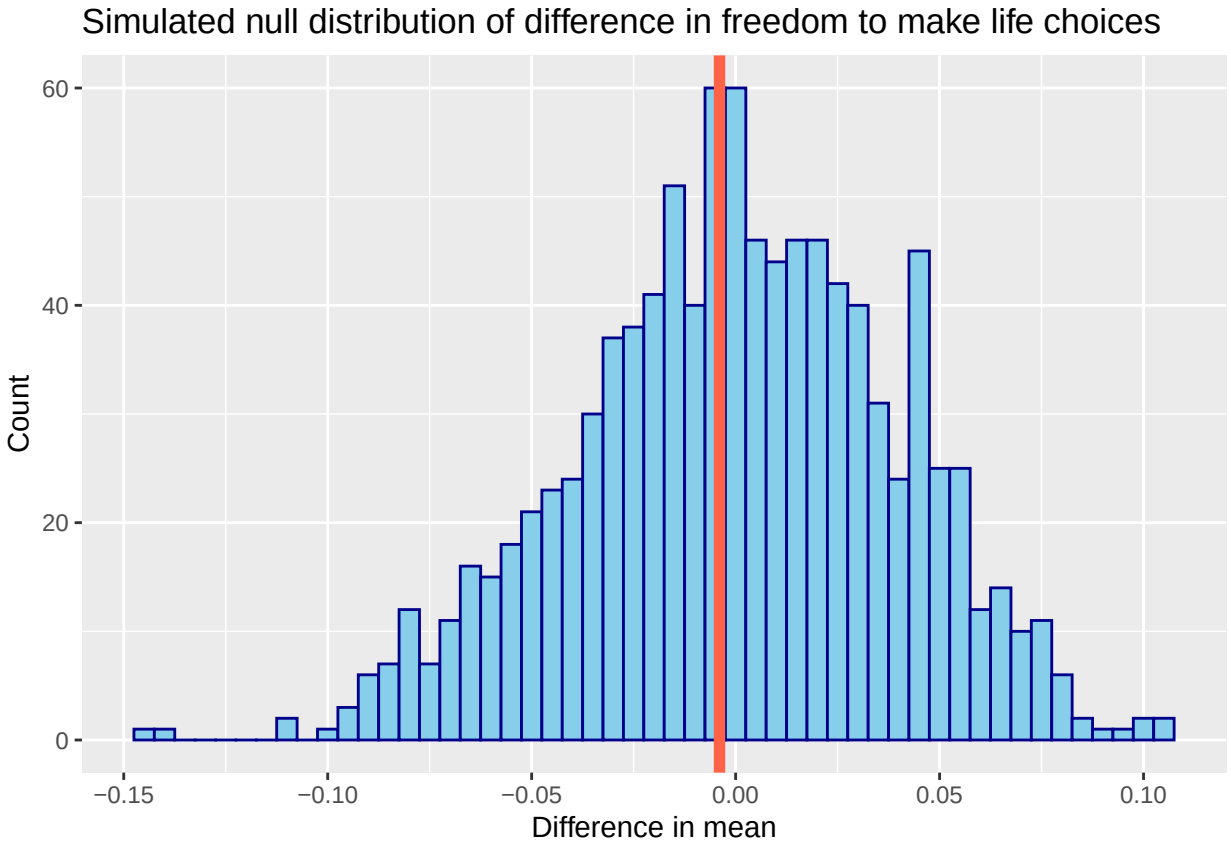
Social Support

```
##   p_val
## 1 0.083
```



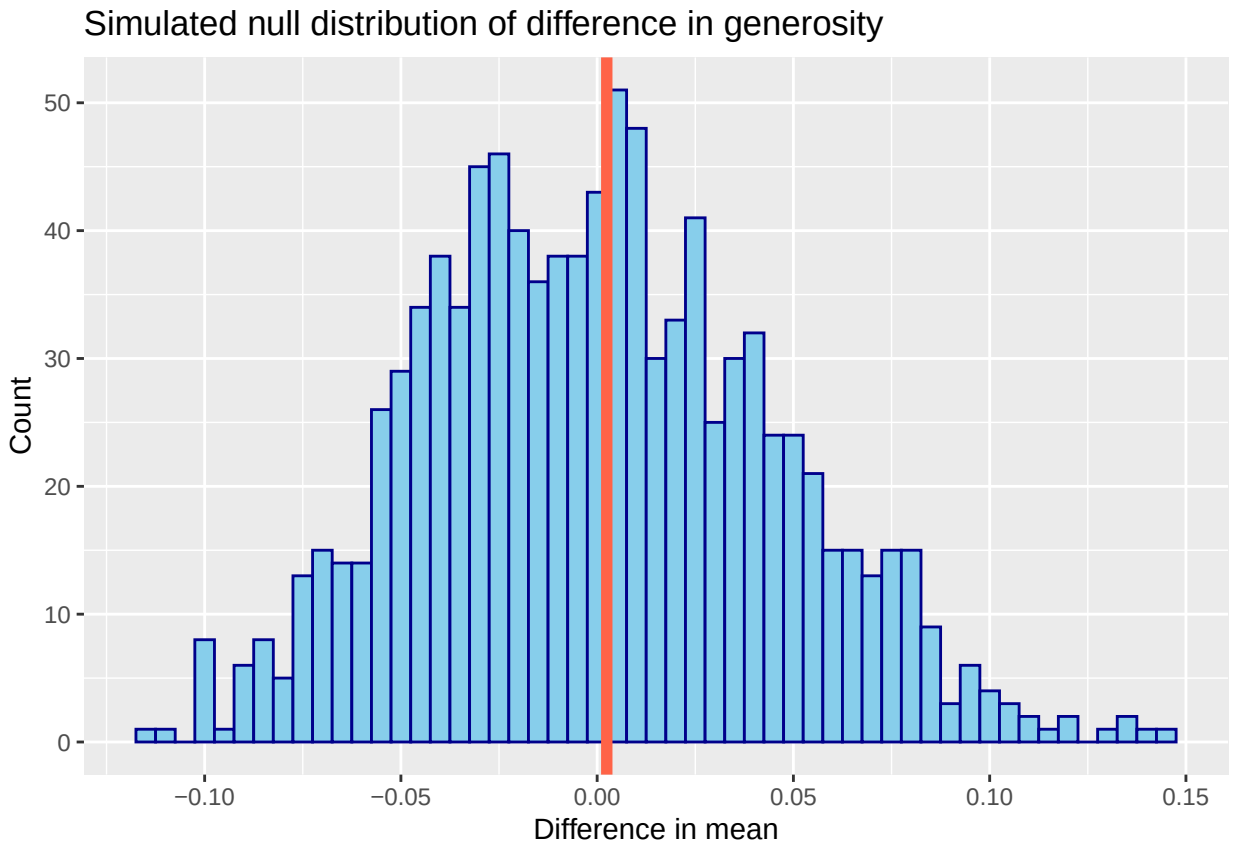
Freedom to make life choices

```
##   p_val
## 1 0.556
```



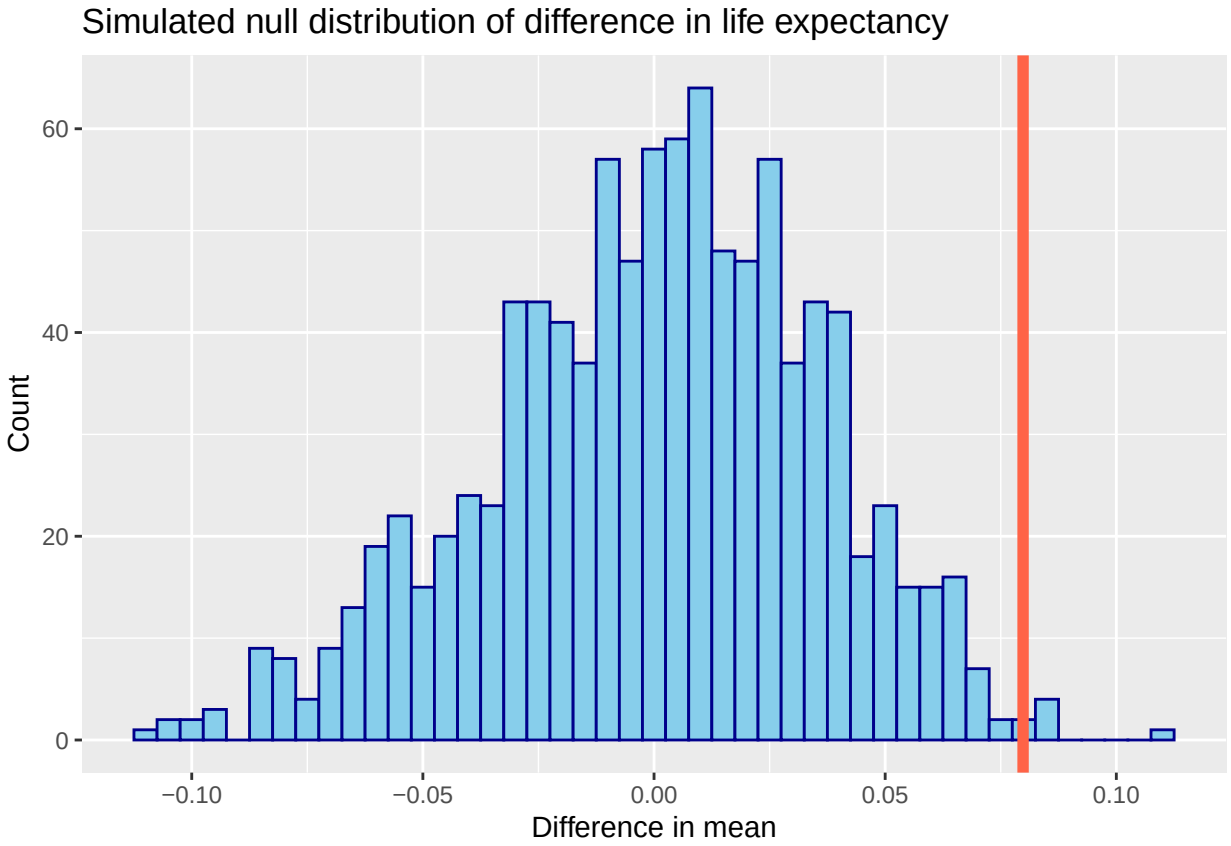
Generosity

```
##   p_val
## 1 0.468
```



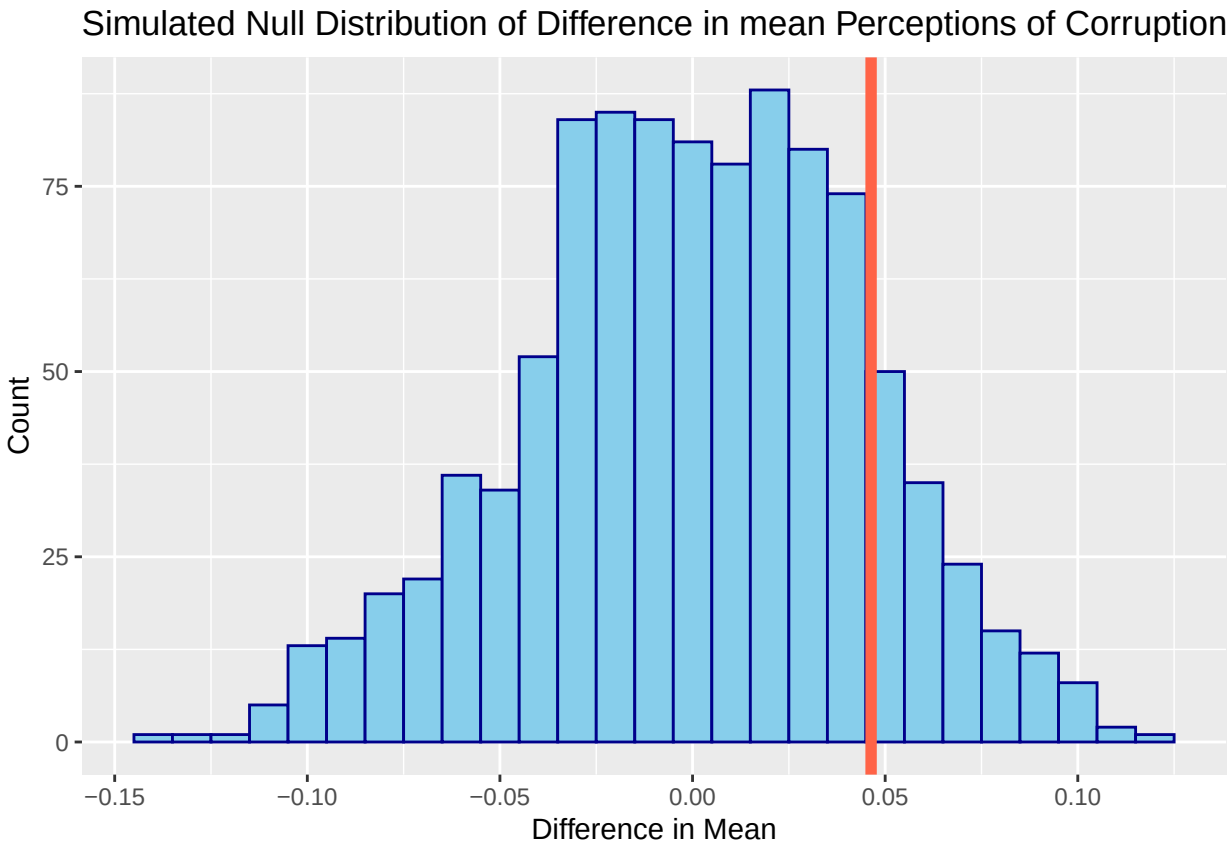
Life Expectancy

```
##   p_val
## 1 0.007
```



Perceptions of Corruption

```
##   p_val
## 1 0.142
```



RESULTS

Chi-square test

With a simulated p-value of 0.1124 which is less than our $\alpha = 0.05$, we have sufficient evidence to reject the null hypothesis in favor of the alternative hypothesis and conclude that there is an association between region of the world and happiness score.

Simulation-based hypothesis tests

GDP per capita: Since the calculated p-value of 0.145 is not significant at the $\alpha = 0.05$ level, we fail to reject the null hypothesis. Therefore, there is not statistically significant evidence to suggest that the mean GDP per capita score in Western Europe is greater than that of North America.

Social support: The calculated p-value of 0.083 is not significant at the $\alpha = 0.05$ level, so we fail to reject the null hypothesis. Therefore, there is not statistically significant evidence to suggest that the mean social support score in Western Europe is greater than that of North America.

Freedom to make life choices Since the calculated p-value of 0.556 is not significant at the $\alpha = 0.05$ level, we fail to reject the null hypothesis. Therefore, there is not statistically significant evidence to suggest that the mean freedom to make life choices score in Western Europe is greater than that of North America.

Generosity The calculated p-value of 0.468 is not significant at the $\alpha = 0.05$ level, so we fail to reject the null hypothesis. Therefore, there is not statistically significant evidence to suggest that the mean generosity score in Western Europe is greater than that of North America.

Life expectancy The calculated p-value of 0.007 is significant at the $\alpha = 0.05$ level, so we can reject the null hypothesis. Therefore, there is statistically significant evidence to suggest that the mean life expectancy score in Western Europe is greater than that of North America.

Perceptions of corruption Since the calculated p-value of 0.142 is not significant at the $\alpha = 0.05$ level, we fail to reject the null hypothesis. Therefore, there is not statistically significant evidence to suggest that the mean perceptions of corruption score in Western Europe is greater than that of North America.

DISCUSSION

Based on the data from the World Happiness Reports of 2018 and 2019, we aimed to explore the differences in the particular variables contributing to happiness score. Of the 5 variables evaluated, statistically significant results were found at the $\alpha = 0.05$ level only for life expectancy, supporting the claim that the mean life expectancy in Western Europe is not equal to that of North America. For all other variables, though, we failed to reject the null hypothesis, indicating that the mean scores for these variables in Western Europe were not statistically different than those of North America.

Initially we believed that there would be a difference in happiness for a number of reasons. First, Western Europe includes the Nordic countries, societies in which capitalist elements are combined with more socialist concepts such as a strong social safety net [5]. While not all of Western Europe follows the Nordic Model, it stands out as a notable ideological difference between the regions of the world being considered. We also believed that the United States' emphasis on individualism over collectivism would lead to differences in the main variables. Yet, for almost every variable, our results did not support the claim that the mean scores in Western Europe were statistically significantly different than those of North America.

Also, in our initial thoughts, we failed to take into account that Canada has very high scores across the board, bringing the North America average up by a lot. Furthermore, a decent amount of countries in Western Europe, like France, have medium levels of mean happiness scores, bringing the Western European average down. Interestingly, the mean scores for most variables ended up being quite similar between the two regions, revealing a level of comparability. Part of the reason for this might be because each region includes a heterogeneous group of countries with varying levels of happiness. For instance, North America includes Canada (high levels), the US (medium-high levels), and Mexico (medium levels). Western Europe similarly has an even distribution of countries in these three categories—the variety of social and political cultures across Western Europe might have offset the effects of the Nordic countries being in that pool. The one variable that did differ significantly, life expectancy, can be explained by the fact that Mexico has a very low score in that category. However, the failure to reject the null hypothesis for the vast majority of the variables points to similarities between the two regions which aligns with the understanding that both regions include relatively heterogeneous developed countries. Despite differences in political or economic structures both among and between the regions, the findings are not statistically significant, and therefore potentially suggest that these different models both can provide for national happiness.

Furthermore, we wanted to evaluate whether happiness was independent of region. Essentially, does the average individual's happiness depend on the region of the world that they live in? Based on an initial survey of the data, we found that happiness varies from country to country. On top of that, some regions have high concentrations of high-, mid-, and low-happiness, suggesting that region also plays a role. For example, while North America, Nordic countries, and Oceania have very high levels of overall happiness, regions like Central Africa and South Asia have lower levels of overall happiness. However, our chi-square test calculated a p-value of 0.11, meaning we don't have enough evidence to reject the null hypothesis that happiness is independent of region.

When understanding our findings, it's important to evaluate the integrity of the dataset. Considering that the data was collected through Gallup, a group well-respected for proper data collection, it can be deemed reliable. However, it should be noted that the translation of particular interviews and surveys into quantitative numbers leaves room for subjectivity to affect the data. While a variable such as GDP per capita is more concrete, something such as Perceptions of Corruption may be dependent on other factors such as access to

education or level of freedom of the media. Consequently, the results of data analysis should be interpreted with this in mind.

Considering that we were unable to reject the null hypothesis for our chi-square test for happiness and region, but there is a possibility that we made a type II error. In order to perform a Pearson's chi-squared test, four conditions have to be satisfied: simple random sample, sample size, expected cell count, and independence. Based on the description of the dataset, the survey was random, enough people were sampled, and the people sampled were independent of each other. Due to the nature of our data, however, expected counts for several cells were smaller than 5, and so the test loses a lot of accuracy. Our solution to this was to add the field simulate.p.value = TRUE to the chi-squared test, which uses the Monte Carlo method to obtain a p-value from random sampling from the original sample. However, we still did not have enough evidence to reject the null hypothesis.

After trying different analytical strategies, such as the linear model, we learned that the range of methods applicable to analyze this particular dataset is limited by the ways in which the raw data was manipulated in the creation of the report. While we originally started this project with an interest in looking at correlations between variables and the overall happiness score, we soon learned that this is impossible with this dataset considering how the overall happiness score is composed as the sums of the scores from the individual categories. So, we shifted our strategy to instead compare regions. However, a further step for this analysis would be to dive into the raw data from Gallup in order to look at some of the other potential patterns between these variables across the world. Furthermore, our insights into the comparison of regions is also relatively limited considering the small number of countries within each region, such as only having three countries within North America.

Furthermore, going forward, we would hope to study what specific factors lead to happiness among a general population within a country. In order to do this, we would need more variables that affect people's lives: e.g. level of infrastructure, quality of healthcare, quality of education, safety. We might also seek to answer questions like the following: do the factors that predict happiness vary by region? Why are some regions happier than others? What factor is the most important for happiness across the board?

Generally, quantifying happiness is a fascinating concept that takes into account a range of human experiences. However, we do want to note the potential for cultural biases in defining what makes one "happy," so it would be interesting to explore in more detail the ways in which this is evaluated. Regardless, however, the countless potential paths for further research reflect an opportunity to better understand the human condition, and could potentially inform legislation to better people's lives across the globe.

BIBLIOGRAPHY

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[3] Helliwell, J., Layard, R., & Sachs, J. (2019). World Happiness Report 2019, New York: Sustainable Development Solutions Network.

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[5] https://www.investopedia.com/terms/n/nordic-model.asp