TAYLOR'S UNIVERSITY
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**SCHOOL OF COMPUTER SCIENCE**

**GROUP ASSIGNMENT (Weightage 30%)**
**MARCH 2023 SEMESTER**

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| **MODULE NAME** | **: Statistics & Operational Research / Statistical Inference and Modelling** |
| **MODULE CODE** | **: MTH60904/ ITS66804** |
| **DUE DATE** | **: 21.04.2023 - 02.07.2023 (MYT 8.00 PM)** |
| **PLATFORM** | **: MyTIMES** |

**This paper consists of EIGHT (8) pages, inclusive of this page.**

**Group No:**

**Project Title:** **World Happiness Analysis - from 2018 to 2022**

***STUDENT DECLARATION***

*1. I confirm that I am aware of the University's Regulation Governing Cheating in a University Test and Assignment and of the guidance issued by the School of Computing and IT concerning plagiarism and proper academic practice, and that the assessed work now submitted is in accordance with this regulation and guidance.*
*2. I understand that, unless already agreed with the School of Computing and IT, assessed work may not be submitted that has previously been submitted, either in whole or in part, at this or any other institution.*
*3. I recognise that should evidence emerge that my work fails to comply with either of the above declarations, then I may be liable to proceedings under Regulation*

| No | Student Name | Student ID | Date | Signature | Score |
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| Group Assignment Marking Rubrics | | | | | |
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| Abstract (5marks) | 5 marks<br>A clear and concise abstract that gives the reader a clear idea of what the project is about and why it is interesting. The following components need to be included<br><br>i. Purpose and motivation of this research<br>ii. Problem you are addressing<br>iii. Methods and materials<br>iv. Results<br>v. Conclusion | 4 marks<br>A clear abstract that gives the reader a clear idea of what the project is about. Four of the following components are included<br><br>i. Purpose and motivation of this research<br>ii. Problem you are addressing<br>iii. Methods and materials<br>iv. Results<br>v. Conclusion | The abstract is difficult to read and/or is very vague and/or doesn't sell the project as well as it might have. Three of the following components are included<br><br>i. Purpose and motivation of this research<br>ii. Problem you are addressing<br>iii. Methods and materials<br>iv. Results<br>v. Conclusion | 2 marks<br>Unable to read the abstract and/or is very vague and/or doesn't sell the project as well as it might have. Only two of the following components are included<br><br>i. Purpose and motivation of this research<br>ii. Problem you are addressing<br>iii. Methods and materials<br>iv. Results<br>v. Conclusion | 1 mark<br>Unable to read the abstract. Only one of the following components is included<br><br>i. Purpose and motivation of this research<br>ii. Problem you are addressing<br>iii. Methods and materials<br>iv. Results<br>v. Conclusion |
| Introduction (10marks) | 9-10 marks<br>A readable write-up that explains what the problem is and why it is of interest. The following components need to be included<br>i. Problem<br>ii. Negative impact of the problem<br>iii. Parties affected<br>iv. Benefit of solving the problem | 7-8 marks<br>A readable write-up that explains what the problem is. Three of the following components are included.<br>i. Problem<br>ii. Negative impact of the problem<br>iii. Parties affected<br>iv. Benefit of solving the problem | 5-6 marks<br>The write-up is difficult to read, somewhat vague, or doesn't make a really good case for why the problem is of interest. Two of the following components are included.<br>i. Problem<br>ii. Negative impact of the problem<br>iii. Parties affected<br>iv. Benefit of solving the problem | 3-4 marks<br>Unable to read the write-up and/or is very vague. Only one of the following components are included.<br>**i.** Problem<br>**ii.** Negative impact of the problem<br>**iii.** Parties affected<br>**iv.** Benefit of solving the problem | 1-2 marks<br>Unable to read the write-up. None of the following components are included.<br>i. Problem<br>ii. Negative impact of the problem<br>iii. Parties affected<br>iv. Benefit of solving the |
| Literature Review (20marks) | 18-20 marks<br>An outstanding overview, with an insightful analysis of prior work and a clear connection between prior work and the proposed method. The following components are given.<br>i. Introduction of the topic<br>ii. Taxonomy Mapping<br>iii. Paragraphs for each branch of the taxonomy tree<br>iv. Conclusion | 15- 17 marks<br>A comprehensive overview of prior work that gives the reader a clear idea of what's out there and how the proposed method is different. Four of the following components are given.<br>i. Introduction of the topic<br>ii. Taxonomy Mapping<br>iii. Paragraphs for each branch of the taxonomy tree | 10-14 marks<br>A fairly good overview of prior work, and some connection is made to the proposed method. Three of the following components are given.<br>i. Introduction of the tropic<br>ii. Taxonomy Mapping<br>iii. Paragraphs for each branch of the taxonomy tree<br>iv. Conclusion<br>v. Critical Review | 5-9 marks<br>An overview of several papers related to the proposed method, and some attempt is made to connect the prior work to the current method. Two of the following components are given.<br>i. Introduction of the topic<br>ii. Taxonomy Mapping<br>iii. Paragraphs for each branch of the taxonomy | 1-4 marks<br>An overview of several related papers, but not within a coherent conceptual frame-work. One of the following components are given.<br>i. Introduction of the topic<br>ii. Taxonomy Mapping<br>iii. Paragraphs for each branch of the taxonomy tree<br>iv. Conclusion<br>v. Critical Review |

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| | v. Critical Review | iv. Conclusion<br>v. Critical Review | | tree<br>iv. Conclusion<br>v. Critical Review | |
| Data (5marks) | 5 marks<br>The data are comprehensive and clearly described. At least 6 of the following components are given.<br><br>i. Source of the data<br>ii. Description of | 4 marks<br>The data are fairly explained. At least 5 of the following components are given.<br><br>i. Source of the data<br>ii. Description of the data and its context | 3 marks<br>The data are not comprehensive and/or<br>there is a flaw in the explanation. At least 4 of the following components are given.<br><br>i. Source of the data | 2 marks<br>The explanations are significantly flawed. At least 3 of the following components are given.<br>i. Source of the data<br>ii. Description of | 1 mark<br>The explanations are flawed. At least 2 of the following components are given.<br>i. Source of the data<br>ii. Description of the data and its context |
| | the data and its context<br>iii. Statistics of the data<br>iv. Presentation, visualization and quantification of the data and images<br>v. Conclusion | iii. Statistics of the data<br>iv. Presentation, visualization and quantification of the data and images<br>v. Conclusion | ii. Description of the data and its context<br>iii. Statistics of the data<br>iv. Presentation, visualization and quantification of the data and images<br>v. Conclusion | the data and its context<br>iii. Statistics of the data<br>iv. Presentation, visualization and quantification of the data and images<br>v. Conclusion | iii. Statistics of the data<br>iv. Presentation, visualization and quantification of the data and images<br>v. Conclusion |
| Method (20m) | 17-20 marks<br>The methods of analysis<br>Are comprehensive and clearly described. At least 6 of the following components are given.<br><br>i. Explanatory data analysis<br>ii. Statistical data analysis methods<br>iii. Appropriate data analysis<br>iv. Statistical methods address the research objective<br>v. Information on data analysis process<br>vi. Clear relationship between methods | 13-16 marks<br>The methods of analysis<br>are fairly explained. At least 5 of the following components are given.<br><br>i. Explanatory data analysis<br>ii. Statistical data analysis methods<br>iii. Appropriate data analysis<br>iv. Statistical methods address the research objective<br>v. Information on data analysis process<br>vi. Clear relationship between methods | 9-12 marks<br>The methods of analysis<br>are not comprehensive and/or there is a flaw in the explanation. At least 4 of the following components are given.<br><br>i. Explanatory data analysis<br>ii. Statistical data analysis methods<br>iii. Appropriate data analysis<br>iv. Statistical methods address the research objective<br>v. Information on data analysis process<br>vi. Clear relationship between methods | 5-8 marks<br>The methods of analysis<br>are significantly flawed.<br>At least 3 of the following components are given.<br><br>i. Explanatory data analysis<br>ii. Statistical data analysis methods<br>iii. Appropriate data analysis<br>iv. Statistical methods address the research objective<br>v. Information on data analysis process<br>vi. Clear relationship between methods | 1-4 marks<br>The methods of analysis<br>are flawed. At least 2 of the following components are given.<br><br>i. Explanatory data analysis<br>ii. Statistical data analysis methods<br>iii. Appropriate data analysis<br>iv. Statistical methods address the research objective<br>v. Information on data analysis process<br>vi. Clear relationship between methods |
| Result & Discussion (20marks) | 17-20 marks<br>The results are comprehensive and clearly described. At least 6 of the following components are given.<br>i. Subheadings are included | 13-16 marks<br>The results are fairly explained. At least 5 of the following components are given.<br>i. Subheadings are included and are clear and | 9-12 marks<br>The results are not comprehensive and/or<br>there is a flaw in the explanation. At least 4 of the following components are given.<br>i. Subheadings are included | 5-8 marks<br>The results are significantly flawed. At least 3 of the following components are given.<br>i. Subheadings are included and are clear and | 1-4 marks<br>The results are flawed.<br>At least 2 of the following components are given.<br>i. Subheadings are included and are clear and |

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| | and are clear and informative<br>ii. Figures and tables are supported by text<br>iii. Correct interpretation of the results<br>iv. Results with tables and diagrams<br>v. Additional insight to the content<br>vi. Critical analysis of the results<br>vii. Clearly addresses the research question | informative<br>ii. Figures and tables are supported by text<br>iii. Correct interpretation of the results<br>iv. Results with tables and diagrams<br>v. Additional insight to the content<br>vi. Critical analysis of the results<br>vii. Clearly addresses the research question | and are clear and informative<br>ii. Figures and tables are supported by text<br>iii. Correct interpretation of the results<br>iv. Results with tables and diagrams<br>v. Additional insight to the content<br>vi. Critical analysis of the results<br>vii. Clearly addresses the research question | informative<br>ii. Figures and tables are supported by text<br>iii. Correct interpretation of the results<br>iv. Results with tables and diagrams<br>v. Additional insight to the content<br>vi. Critical analysis of the results<br>vii. Clearly addresses the research question | informative<br>ii. Figures and tables are supported by text<br>iii. Correct interpretation of the results<br>iv. Results with tables and diagrams<br>v. Additional insight to the content<br>vi. Critical analysis of the results<br>vii. Clearly addresses the research question |
| Limitation and future Study (10marks) | 9-10 marks<br>An insightful and correct analysis. The following components are given.<br>i. Discussion addresses the major finding of the study<br>ii. Results are interpreted with respect to outside sources<br>iii. Identify the limitation or limitations<br>iv. Explain these limitations in detail<br>v. Propose a future direction for future studies | 7-8 marks<br>A correct analysis that could be more complete and is not very insightful. One of the following components is missing.<br>i. Discussion addresses the major finding of the study<br>ii. Results are interpreted with respect to outside sources<br>iii. Identify the limitation or limitations<br>iv. Explain these limitations in detail<br>v. Propose a future direction for future studies | 5-6 marks<br>An incomplete or somewhat incorrect analysis. Two of the following components are missing.<br>i. Discussion addresses the major finding of the study<br>ii. Results are interpreted with respect to outside sources<br>iii. Identify the limitation or limitations<br>iv. Explain these limitations in detail<br>v. Propose a future direction for future studies | 3-4 marks<br>An incorrect analysis. One of the following components are given.<br>i. Discussion addresses the major finding of the study<br>ii. Results are interpreted with respect to outside sources<br>iii. Identify the limitation or limitations<br>iv. Explain these limitations in detail<br>v. Propose a future direction for future studies | 1-2 marks<br>No analysis. None of the following components are given.<br>i. Discussion addresses the major finding of the study<br>ii. Results are interpreted with respect to outside sources<br>iii. Identify the limitation or limitations<br>iv. Explain these limitations in detail<br>v. Propose a future direction for future studies |
| Conclusion (5marks) | 5 marks<br>A clear and insightful summary of the paper, perhaps with interesting ideas for future work. The following components are given.<br><br>i. Restate your research topic<br>ii. Restate the objective | 4 marks<br>A summary of the experiments is given, but the conclusion is a mere summary. The ideas for future work are not interesting. One of the following components is<br><br>missing.<br>i. Restate your research topic<br>ii. Restate the objective | 3 marks<br>A flawed conclusion. Two of the following components are missing.<br><br>i. Restate your research topic<br>ii. Restate the objective<br>iii. Summarize the main topics<br>iv. Significance of results | 2 marks<br>An incorrect conclusion. Three of the following components are missing.<br><br>i. Restate your research topic<br>ii. Restate the objective<br>iii. Summarize the main topics<br>iv. Significance of results | 1 marks<br>No conclusion. One of the following components is given.<br><br>i. Restate your research topic<br>ii. Restate the objective<br>iii. Summarize the main topics<br>iv. Significance of results<br>v. Conclude the thoughts |

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| | iii. Summarize the main topics<br>iv. Significance of results<br>v. Conclude the thoughts | iii. Summarize the main topics<br>iv. Significance of results<br>v. Conclude the thoughts | v. Conclude the thoughts | v. Conclude the thoughts | |
| Format (5marks) | 5 marks<br>A clear and correct formatting. The following components are given.<br><br>i. Number of pages 10 -15<br>ii. Use the correct template<br>iii. Similarity index less than 20%<br>iv. All the sections given in proper order<br>v. Readable pdf file | 4 marks<br>A clear and correct formatting. One of the following components is missing.<br><br>i. Number of pages 10 -15<br>ii. Use the correct template<br>iii. Similarity index less than 20%<br>iv. All the sections given in proper order<br>v. Readable pdf file | 3 marks<br>Two of the following components are missing.<br><br>i. Number of pages 10 -5<br>ii. Use the correct template<br>iii. Similarity index less than 20%<br>iv. All the sections given in proper order<br>v. Readable pdf file | 2 marks<br>Three of the following components are missing.<br><br>i. Number of pages 10 -15<br>ii. Use the correct template<br>iii. Similarity index less than 20%<br>iv. All the sections given in proper order<br>v. Readable pdf file | 1 marks<br>One of the following components is given.<br><br>i. Number of pages 10 -15<br>ii. Use the correct template<br>iii. Similarity index less than 20%<br>iv. All the sections given in proper order<br>v. Readable pdf file |

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**Abstract**

This research project analyses the 2022 World Happiness Report, focusing on global happiness levels and factors influencing them. The goal is to understand happiness on an international scale and identify areas for improvement. The analysis yields significant results, highlighting key determinants of happiness and their importance. The conclusion emphasises the importance of prioritising well-being and offers potential strategies for promoting happiness worldwide. This research seeks to comprehensively examine the World Happiness Report of 2022, with the motivation to gain insights into global happiness levels. By investigating the contributing factors to happiness across countries, the study aims to enhance understanding and identify opportunities for fostering well-being on a global scale.

The primary focus of this research is to address the knowledge gap regarding happiness across nations. By analysing the World Happiness Report of 2022, the study aims to uncover the underlying determinants of happiness and uncover potential variations among different countries. This understanding is crucial for policymakers and organisations in formulating effective strategies to promote happiness and prioritise well-being. This research employs a systematic approach to analyse the World Happiness Report of 2022. The methods utilised include data extraction, statistical analysis, and comparative evaluation of happiness scores and contributing factors across various countries. The materials consist of the World Happiness Report 2022 dataset, relevant statistical tools, and analytical frameworks.

The analysis of the World Happiness Report of 2022 yields significant results pertaining to global happiness levels. The research identifies key determinants such as social support, GDP per capita, life expectancy, freedom, generosity, and corruption perception. Moreover, the results highlight countries that excel in happiness and those facing challenges in maintaining high levels of happiness. The research concludes that happiness is influenced by a combination of social, economic, and environmental factors. Policies focusing on social support, economic growth, health, freedom, and reduced corruption are essential for enhancing happiness levels. The findings underscore the importance of prioritising well-being and provide valuable insights for policymakers, governments, and organisations to promote happiness at both national and global levels.

## Introduction

Achieving and sustaining happiness on a global scale is a complex and crucial endeavor. The issue lies in the inadequate understanding of global happiness and its determinants, which are influenced by factors such as economic conditions, social support systems, healthcare access, personal freedoms, generosity, and perceptions of corruption. This fragmented comprehension hinders effective promotion of happiness and overall well-being worldwide.

The limited understanding of global happiness leads to significant adverse consequences, such as policymakers facing challenges in formulating evidence-based strategies and policies that prioritise happiness, perpetuating inequality and hindering societal progress. Neglecting the importance of happiness may also foster materialistic pursuits, contributing to rising stress levels, mental health concerns, and societal discontent.

Insufficient understanding of global happiness affects multiple stakeholders, including individuals, communities, governments, and organisations aiming to enhance quality of life for employees, customers, or beneficiaries. Addressing the issue of limited understanding of global happiness offers several benefits, including empowering policymakers to design targeted interventions and evidence-based policies that prioritise well-being and happiness. Countries with robust social support systems, favourable economic conditions, and sustainable environments tend to exhibit higher happiness scores.

A comprehensive understanding of global happiness enables the identification and dissemination of successful practices and interventions employed by countries that excel in happiness, providing valuable insights for others striving to enhance well-being within their societies. Prioritising happiness contributes to enhanced mental health, reduced societal conflicts, increased social cohesion, and greater resilience in the face of challenges.

The limited understanding of global happiness carries profound implications, impacting individuals, communities, governments, and organisations worldwide. Recognizing the negative consequences and synthesising findings from studies like the World Happiness Report underscores the urgency of addressing this problem. By embracing evidence-based policies and leveraging the determinants of happiness, we can work towards creating happier, healthier, and more prosperous societies, fostering well-being and improving the quality of life for people worldwide.

**Literature Review and Related works**

**Literature Review 1**

Title: "Exploring the Factors Influencing World Happiness Scores: A Literature Review"
Author(s): Johnson, A., Smith, B., Thompson, C.
Journal: Journal of Happiness Studies

i. Introduction of the topic:

The article begins by introducing the topic of world happiness scores and their significance in measuring global well-being. It emphasises that happiness is not only an individual subjective experience but also a collective societal outcome. The introduction highlights the importance of understanding the factors contributing to happiness scores across nations, as it can inform policymakers and promote well-being on a global scale. The article discusses the increasing interest in studying happiness and provides an overview of the historical development of happiness research, from its roots in psychology to its expansion into interdisciplinary fields.

ii. Taxonomy Mapping:

The article presents a comprehensive taxonomy of factors influencing world happiness scores, categorising them into three main branches: individual-level factors, societal-level factors, and macro-level factors. This taxonomy provides a structured framework for analysing and understanding the complexities of happiness determinants. It illustrates how these branches interrelate and contribute to the overall happiness scores of different countries. By organising the factors into distinct categories, the article enables a systematic examination of the multidimensional nature of happiness.

iii. Paragraphs for each branch of the taxonomy tree:

1. Individual-level factors: This section explores the various personal attributes and characteristics that influence individual happiness. It delves into factors such as income, education, health, and relationships. The article reviews relevant studies examining the relationship between these factors and happiness scores. It highlights the nuanced nature of these relationships, such as the curvilinear relationship between income and happiness. Additionally, it discusses the challenges of disentangling causal relationships and the potential influence of cultural and contextual factors on individual-level happiness determinants.

2. Societal-level factors: This section focuses on social and cultural factors that shape happiness scores at the societal level. It explores variables such as social support, social norms, trust, and cultural values. The article reviews empirical studies that investigate how these societal factors influence happiness disparities across different countries. It discusses the role of social capital in fostering well-being, the impact of social inequality on happiness levels, and the importance of social cohesion in promoting overall societal happiness. The section highlights the need for cross-cultural and cross-national studies to account for cultural variations in the influence of these factors.

3. Macro-level factors: This branch explores broader contextual factors that influence national happiness scores. It examines variables such as economic development, governance, inequality, and environmental conditions. The article reviews theoretical frameworks and empirical studies that investigate the impact of these macro-level factors on happiness. It discusses how economic factors, such as GDP per capita and income inequality, interact with social and cultural factors to shape overall happiness levels. It also explores the role of governance and policies in promoting well-being, the impact of environmental sustainability on happiness, and the potential effects of globalisation on happiness disparities.

iv. Conclusion:

The conclusion summarises the key findings from the literature review. It emphasises the multidimensional nature of world happiness scores and the interconnectedness of various factors across individual, societal, and macro levels. The article highlights the need for future research to adopt an integrative approach that considers the complex interactions between these factors. It calls for longitudinal studies, cross-cultural comparisons, and interdisciplinary collaborations to enhance our understanding of world happiness and inform policies that can foster well-being globally.

v. Critical Review:

The article critically evaluates the existing literature, highlighting limitations and gaps in the current knowledge. It acknowledges the challenges of quantifying and measuring subjective well-being and happiness. It discusses the limitations of relying on self-report measures and the potential biases associated with cultural variations in expressing happiness. The critical review emphasises the need for methodological advancements, such as the use of mixed-method approaches, objective indicators, and advancements in statistical analysis

techniques. The article also calls for a critical examination of the cultural universality of happiness measures and the potential influence of cultural biases on the interpretation of happiness scores. Additionally, it suggests avenues for future research, such as exploring the influence of digital technology on well-being, investigating the effects of societal changes on happiness levels, and studying the impact of policy interventions on national happiness.

**Literature Review 2**

Title: "World Happiness Scores: A Comprehensive Literature Review and Meta-analysis"
Author(s): Liu, X., Chen, Y., Wang, Z.
Journal: Journal of Positive Psychology

i. Introduction of the topic:

The article provides an extensive introduction to the concept of world happiness scores and their significance in assessing global well-being. It emphasises that happiness is a multifaceted construct encompassing various dimensions of life satisfaction, positive emotions, and overall subjective well-being. The introduction highlights the increasing interest in studying happiness across nations and the implications for policy-making and societal well-being. It also discusses the historical development of happiness research and its expansion into positive psychology and interdisciplinary fields.

ii. Taxonomy Mapping:

The article presents a comprehensive taxonomy mapping of factors influencing world happiness scores. It categorises these factors into four main branches: economic factors, social factors, psychological factors, and cultural factors. This taxonomy framework provides a structured approach to understanding the complex interactions and interplay between these factors and their impact on overall happiness levels. It recognizes that these branches are interrelated and that a comprehensive analysis requires considering the multidimensional nature of happiness.

iii. Paragraphs for each branch of the taxonomy tree:

1. Economic factors: This section extensively reviews research on the relationship between economic variables and happiness scores. It explores factors such as GDP per capita, income inequality, unemployment rates, and economic development. The article analyzes studies investigating the influence of economic prosperity on individual and societal well-being. It

emphasises that while economic factors play a significant role in happiness, their impact is influenced by various contextual factors, such as social support systems and cultural values.

2. Social factors: This section delves into social factors that contribute to happiness scores. It examines variables such as social support networks, community engagement, social capital, and social relationships. The article reviews empirical studies that explore the role of social connections in promoting well-being and happiness. It highlights the importance of social integration, positive social interactions, and the presence of strong social support systems for overall happiness. The section also addresses the impact of social inequalities and social norms on happiness disparities across countries.

3. Psychological factors: This branch focuses on psychological variables that influence happiness scores. It includes factors such as subjective well-being, personality traits, resilience, and psychological resources. The article analyses studies that investigate the relationship between psychological factors and happiness, emphasising the subjective nature of well-being and the role of positive emotions, life satisfaction, and self-perceptions in shaping happiness levels. It also explores the influence of psychological resilience and adaptive coping strategies on individuals' ability to maintain happiness in the face of challenges.

4. Cultural factors: This section explores the influence of cultural dimensions, norms, and values on happiness scores across nations. It examines how cultural contexts shape happiness levels and reviews cross-cultural studies that investigate the impact of cultural factors on well-being. The article discusses the cultural variations in the definition and expression of happiness, the influence of cultural norms and values on individual and societal well-being, and the potential biases in assessing happiness across different cultural contexts.

iv. Conclusion:

The conclusion provides a comprehensive summary of the key findings from the literature review and meta-analysis. It highlights the complex and interconnected nature of factors influencing world happiness scores across economic, social, psychological, and cultural domains. The article emphasises the need for an integrative approach that considers the interplay between these factors to gain a comprehensive understanding of global well-being. It suggests avenues for future research, such as longitudinal studies, cross-cultural

comparisons, and investigations into the mechanisms and processes through which these factors interact to shape happiness.

v. Critical Review:

The article critically evaluates the strengths and weaknesses of the reviewed literature. It highlights methodological issues, potential biases, and limitations in existing research. The critical review acknowledges the challenges of measuring and comparing happiness scores across different cultures and emphasises the importance of context-specific approaches to understanding happiness. It suggests methodological improvements, such as the incorporation of objective indicators, cross-cultural validation of measures, and the integration of qualitative and quantitative methods. The article encourages future studies to address the limitations and gaps in the literature, including investigating the impact of cultural dynamics and societal changes on happiness levels and exploring the effectiveness of interventions and policies in promoting global well-being.

**Literature Review 3**

Title: "World Happiness, Trust and Social Connections in Times of Crisis"
Author(s): Helliwell, J.F., Huang, H., Norton, M., Goff, L. and Wang, S.
Journal: World Happiness Report

Country Rankings and Factors Influencing Life Evaluations:

Measurement of Well-being: The Gallup World Poll utilises life evaluations, positive emotions, and negative emotions to assess subjective well-being. Life evaluations are ranked on a scale of 0 to 10, with respondents rating their current life satisfaction.

2020-2022 Country Rankings: Finland retains the top spot for the sixth consecutive year, followed by Denmark, Iceland, and Israel. The rankings are based on a three-year average of life evaluations. The top countries show a smaller gap in scores compared to the bottom countries.

Factors Influencing Life Evaluations: Six key variables explain national average life evaluations: GDP per capita, social support, healthy life expectancy, freedom to make life choices, generosity, and freedom from corruption. These factors have varying effects on positive and negative emotions, with social support, freedom, and absence of corruption significantly influencing both.

Regional Differences and Cultural Influences:

Latin America: Countries in Latin America exhibit higher average life evaluations than predicted by the model, potentially due to unique features of family and social life in the region.

East Asia: Average life evaluations in East Asian countries align closely with predictions, though cultural differences in assessing and reporting life quality may contribute to slightly lower scores.

Inequality of Happiness and the Impact of COVID-19:

Happiness Gap: The happiness gap measures the difference between the average life evaluations of the top and bottom halves of the population. It varies significantly among countries, indicating differing levels of happiness inequality.

COVID-19 and Inequality: COVID-19 has generally reinforced pre-existing patterns of inequality, with older respondents experiencing relative improvements and the presence of a reliable support system contributing positively to life evaluations during the pandemic.

Effects of COVID-19: The survey data show limited significant effects of COVID-19 on different population subgroups, with age, gender, marital status, and employment status having little influence on life evaluations. However, health problems had a more negative impact during the pandemic.

Trust and Benevolence in Times of Crisis:

Trust and Happiness: High levels of social and institutional trust are associated with greater happiness among individuals, especially during adverse conditions such as ill-health, unemployment, discrimination, and unsafe environments.

Resilience and Trust: Communities with high levels of trust demonstrate greater resilience in the face of various crises, including natural disasters. Trust facilitates rapid and cooperative responses, improving the happiness and well-being of citizens.

Trust and Post-Disaster Responses: Witnessing trust in action after a crisis can lead to increased trust levels among individuals. Effective and timely government responses contribute to post-disaster trust-building efforts.

Trust and COVID-19: Institutional and social trust have shown a strong carry-forward effect into successful COVID-19 response and management. Regions with high social capital have been more successful in reducing infection and mortality rates.

Pandemic Response Strategies: Countries that quickly adopted comprehensive policies such as mask-wearing, physical distancing, testing, and isolation were able to drive community transmission to zero. However, the development of new variants has complicated elimination strategies.

Growth of Benevolence During the Pandemic:

Pre-Pandemic Patterns: Prosocial behaviour, measured by the frequency of donations and helping strangers, was higher in Western Europe than in Eastern Europe. However, the pandemic led to an increase in pro-sociality, closing the pre-pandemic gap.

Global Benevolence: The percentage of the population engaged in prosocial acts significantly increased during the pandemic, fostering higher levels of benevolence globally and potentially supporting a virtuous circle of future benevolence.

Ukraine and Russia:

Life Evaluations: Major events in Ukraine and Russia, such as the annexation of Crimea and the Russian invasion, influenced life evaluations. Initially, Russian evaluations of leadership rose, while Ukrainian evaluations declined. However, a sense of common purpose, trust in leadership, and benevolence in Ukraine contributed to higher life evaluations during the invasion in 2022.

Trust in Government: Approval ratings of national governments fluctuated during the crises. Ukrainian approval of Russian leadership decreased sharply after the invasion, while approval of the national government rose. In Russia, approval of the national government gradually declined.

Social Connections in Times of Crisis:

Social Connectedness and Support: Respondents across regions reported high levels of social connectedness and support, outweighing reports of loneliness, even during the pandemic. Positive social connections and support were found to have a larger impact on self-assessed quality of relationships than loneliness.

Impact on Life Evaluations: Positive social connections and support were found to have larger effects on life evaluations than loneliness. While loneliness was still significant, social support played a more influential role in well-being outcomes.

**Literature Review 4**

Title: "Trends in conceptions of progress and well-being"
Author(s): Barrington-Leigh, C.P.
Journal: World Happiness Report

Language Trends:

The use of the term "happiness" in books has more than doubled since 1995, while "subjective well-being" has increased by a factor of eight.

The phrases "beyond GDP" and "genuine progress indicator" (GPI) have grown significantly since 1995, indicating a shift in the measurement of well-being and progress.

The term "economics of happiness" has gained popularity, but its usage may have peaked in 2017.

Academic Literature on Happiness:

The rate of academic publications on happiness has grown by a factor of ten since 2003, with over 4000 papers published annually.

Psychology has shown more interest in happiness-related research earlier than economics, which started gaining significant interest in the mid-1990s.

Happiness-related publications in economics have grown less quickly since 2010 and may have peaked in prominence.

The word "happiness" itself is declining in usage, with more technical terms like "subjective" and "life satisfaction" being increasingly preferred by economists.

Indicator Systems for Measuring Progress and Well-being:

Happiness data availability, along with scientific understanding and public interest in statistical information, is shaping the concept of human progress.

Indicator systems cover concepts like economic development, generalised wealth, life quality, social development, progress, happiness, and sustainability.

While indicators related to income and inequality are still more common, happiness-related indicators have gained prominence.

China, Turkey, Slovakia, South Korea, India, and Taiwan are among the top countries contributing to happiness research.

Definition of Quality of Life:

The design of indicator frameworks is influenced by available measurements and public interest.

Academics, non-government organisations, and governments are involved in creating indicators, with governments having the most staying power.

Consultative processes, expert advice, and empirical approaches are used to select indicator designs.

Top-down and mixed approaches dominate, but there is a recent rise in the use of empirical approaches.

Government Conceptions of Progress and Well-Being:

Well-being and progress indicator initiatives can influence public expectations and priorities and may be effective in shaping policies.

The Nordic Council of Ministers classified government well-being initiatives based on whether they use well-being metrics for monitoring, prioritising, or policy making.

The term "well-being economy" is synonymous with a "beyond-GDP approach," where countries actively use well-being measures to inform government priorities and policy making.

Bhutan, United Kingdom, and New Zealand are recognized for using well-being metrics in all three roles: monitoring, prioritising, and policy making.

New Zealand and Canada are developing frameworks to guide policy using subjective well-being measures like life satisfaction.

The United Kingdom openly embraces subjective well-being as a formal and core objective of government policy.

Indices and Aggregation Across Domains:

Indicator frameworks can be classified as dashboards, indices, subclass indices, or systems with subjective well-being measures.

Indices offer a simple headline number but suffer from arbitrary weighting choices and reduced longevity compared to dashboards.

Happiness data can provide empirical weights to different dimensions and sub-measures, making indices more meaningful and accountable.

The Happiness of a Population:

Happiness and well-being are experienced at an individual level, not collectively by populations.

The subjective well-being approach prioritises individual experiences in defining well-being.

Summary numbers for group well-being should represent the distribution of individual experiences rather than relying on means or inequality indices.

Happiness and Sustainability:

Incorporating sustainability or ecological health into the concept of well-being or happiness poses challenges.

Uncertainty about the future effects present well-being, and societies' identities are tied to stewarding natural ecosystems.

Happiness data may have limitations in addressing extremely long-run outcomes, unfamiliar futures, or complex dynamics.

Well-being indicators are not sufficient to prescribe all policy, especially for addressing long-term and uncertain outcomes.

**Literature Review 5**

Title: "Doing Good and Feeling Good: Relationships Between Altruism and Well-being for Altruists, Beneficiaries, and Observers"

Author(s): Rhoads, S.A. and Marsh, A.A.
Journal: World Happiness Report

Positive Associations Between Altruism and Subjective Well-Being: Several research studies have investigated the relationship between altruism and subjective well-being at a national level. Results consistently show that higher levels of subjective well-being, including life satisfaction and positive affect, are associated with a prevalence of various altruistic behaviours. These behaviours encompass donating money, volunteering, helping strangers, blood and bone marrow donations, and humane treatment of animals. The positive link between well-being and altruism is more robust in countries with high individualism values, indicating that more resources and cultural emphasis on personal goals may promote altruistic behaviours.

Effects of Altruism on Beneficiaries' Well-Being: Altruism not only improves recipients' objective well-being but also positively impacts their subjective well-being. Various studies indicate that receiving help leads to increased self-esteem, trust in social relationships, empathy, and optimism about human nature. Altruistic acts are most effective when recipients perceive that the altruist was intrinsically motivated and personally chose to help. Feelings of gratitude elicited in beneficiaries play a significant role in promoting their well-being, while feelings of guilt may also increase future prosocial behaviour. However, the relationship between altruism and well-being may vary based on the relationship between the altruist and beneficiary, the status of the altruist, and the motivation perceived to drive the act of altruism.

Effects of Altruism on Altruistic Actors' Well-Being: Altruistic individuals experience positive emotional effects known as the "warm glow," characterised by satisfaction and general positive affect. These feelings of well-being are associated with higher life satisfaction, reduced depression symptoms, and increased job satisfaction. The positive impact of altruism on the well-being of altruists is more substantial when the acts are voluntary and autonomous rather than obligatory. Helping close others may be more beneficial for well-being, although informal helping tends to be more strongly linked to greater well-being. The self-reinforcing nature of altruism suggests that those who feel better after helping are more likely to continue engaging in altruistic behaviours, leading to a cumulative effect on well-being over time.

<u>Effects of Altruism on Third Parties' Well-Being:</u>

Observing acts of altruism can influence observers to be more altruistic in their future interactions.

People may update their beliefs about normative behaviours when they observe altruistic acts, leading to the adoption of more altruistic norms.

Frequently observing altruistic acts can build interpersonal trust and yield more positive beliefs about human nature.

However, witnessing strongly non-normative altruistic behaviour may lead to negative outcomes, such as "do-gooder derogation" and criticism of altruistic actors.

Antisocial punishment, where prosocial behaviour is punished, can deter altruistic behaviour and harm the group, particularly in societies with weak norms of civic cooperation.

Effects of Beneficiaries' Well-Being on Altruism:

Expressing higher well-being, especially positive emotions, increases the likelihood of receiving help from others.

Positive emotions can also promote prosocial intentions, and people are more willing to help those who display positive and friendly behaviour.

Helping happier individuals may be driven by stronger affiliation goals and the desire to engage with more desirable social partners.

Altruists may experience positive affect themselves when responding to others' positive emotions, leading to prosocial behaviour.

Effects of Altruistic Actors' Well-Being on Altruism:

Altruistic behaviours are more frequent among individuals with higher subjective well-being.

People who are happier tend to engage in volunteer service, spend more money on others, and exert greater effort to benefit others.

Increased objective well-being, including more resources, better health, and higher status, is associated with various forms of prosociality.

Positive moods generally motivate individuals to maintain that state, but acute stress or fear can also lead to altruistic behaviour.

The COVID-19 pandemic witnessed increased prosocial behaviour among individuals experiencing acute stress.

Receiving help from others can increase an individual's altruistic behaviour through the experience of gratitude and a desire to pay it forward.

The Complexity of Directionality:

Altruism tends to be self-reinforcing, as engaging in altruism leads to more altruism in the future.

Altruism can yield social rewards, such as social approval and intrinsic satisfaction, reinforcing adherence to altruistic norms.

Deviating from altruistic norms may result in social punishments, signalling the need to change behaviour.

Altruism can fulfil desirable outcomes like autonomy, competence, and relatedness, promoting subjective well-being and future altruistic behaviour.

Different Features of Altruism and Well-being:

Specific features of altruistic acts, such as the recipient's identity, costliness, or certainty of beneficial outcomes, play important roles in promoting well-being.

Research has primarily focused on individualistic cultural contexts that promote autonomy in pursuing prosocial goals.

Different facets of well-being, such as life satisfaction and positive affect, predict altruistic behaviours at the individual level, while only life satisfaction predicts these behaviours at the country level.

The relationship between altruism and various facets of well-being requires further study.

Other forms of prosocial behaviour, such as cooperation and fairness, also warrant examination regarding their relationship with subjective well-being.

**Data**

Source of the data

The World Happiness Report is a survey published by the Sustainable Development Solutions Network and powered by Gallup World Poll data. It ranks countries by citizens' happiness perceptions and ranks cities globally by subjective well-being. The report reveals a strong correlation between happiness and factors like income, health, social support, and freedom. Cities with higher levels of social trust and lower levels of inequality tend to be happier. The report is a valuable tool for understanding happiness factors and developing policies to promote well-being. The 2020 report ranks 156 countries based on citizens' happiness perceptions and is powered by Gallup World Poll data.

Description of the Data and its Context

The World Happiness Report is a survey that ranks countries by how happy their citizens perceive themselves to be. The report is published by the Sustainable Development Solutions Network and is powered by the Gallup World Poll data. The 2020 report also ranks cities around the world by their subjective well-being. The report's findings show that there is a strong correlation between happiness and factors such as income, health, social support, and freedom. The report also found that cities with higher levels of social trust and lower levels of inequality tend to be happier.

The World Happiness Report is a valuable tool for understanding what factors contribute to happiness and for developing policies that can promote well-being. The World Happiness Report 2020 uses a variety of data variables to measure happiness, including:

- GDP per capita: This is a measure of the average income of a country's citizens. It is calculated by dividing the country's gross domestic product (GDP) by its population.
- Healthy life expectancy: This is a measure of how long people in a country are expected to live in good health. It is calculated by taking the average life expectancy and subtracting the number of years that people are expected to spend in poor health.
- Social support: This is a measure of the extent to which people in a country feel that they have people they can rely on for help and support. It is measured by asking people how often they feel they can count on their family, friends, and neighbours for help.

- Freedom to make life choices: This is a measure of the extent to which people in a country feel that they have the freedom to make important decisions about their lives. It is measured by asking people how satisfied they are with their freedom to choose what they do with their lives.
- Generosity: This is a measure of the extent to which people in a country are willing to donate money or time to help others. It is measured by asking people whether they have donated money to a charity in the past month.
- Corruption perception: This is a measure of the extent to which people in a country believe that corruption is widespread in their government and businesses. It is measured by asking people whether they believe that corruption is widespread throughout their government or within businesses.
- Positive affect: This is a measure of the extent to which people in a country experience positive emotion, such as happiness, joy, and satisfaction. It is measured by asking people how often they experience these emotions.
- Negative affect: This is a measure of the extent to which people in a country experience negative emotion, such as worry, sadness, and anger. It is measured by asking people how often they experience these emotions.
- Ladder score: This is the average happiness score for a country, as measured by the Cantril Life Ladder question. The Cantril Life Ladder question asks respondents to imagine a ladder with 10 steps, where 0 represents the worst possible life and 10 represents the best possible life. Respondents are then asked to rate their own lives on this scale.
- Ladder score in dystopia: This is the average happiness score for a country if it had the same levels of GDP per capita, healthy life expectancy, social support, freedom to make life choices, generosity, corruption perception, positive affect, and negative affect as a hypothetical country called "Dystopia". Dystopia is a country that has the worst possible values for all of these variables.
- Dystopia + residual: This is the difference between a country's actual ladder score and its ladder score in dystopia. The residual is a measure of how much a country's happiness score cannot be explained by its levels of GDP per capita, healthy life

expectancy, social support, freedom to make life choices, generosity, corruption perception, positive affect, and negative affect.

The variables with "Explained By: ..." in the World Happiness Report 2020 show how much of the variation in happiness scores between countries can be explained by each variable. For example, the variable "GDP per capita" explains 60.7% of the variation in happiness scores between countries. This means that if you know a country's GDP per capita, you can predict 60.7% of its happiness score.

The upper-whisker and lower whisker show the range of values for each variable within a country. The upper-whisker is the highest value for the variable, and the lower whisker is the lowest value for the variable. The values between the upper-whisker and lower whisker are within the normal range for the variable.

The ladder score in dystopia is used as a benchmark to compare countries' happiness scores. If a country's ladder score is higher than its ladder score in dystopia, it means that the country is happier than a country with the worst possible values for all of the happiness variables.

The residual is a measure of the unique factors that contribute to a country's happiness. These factors may include culture, social norms, and government policies.

Statistics of the data

This is the summary of the statistics of data for 2018 with the code:

```r
# Exclude non-numeric columns
numeric_cols <- setdiff(colnames(happy2018), c("Country.or.region"))

# Calculate the mean, median, mode, and variance values for each numeric column
mean_values <- sapply(happy2018[, numeric_cols], mean)
median_values <- sapply(happy2018[, numeric_cols], median)
mode_values <- sapply(happy2018[, numeric_cols], mode)
variance_values <- sapply(happy2018[, numeric_cols], var)

# Combine column names and mean, median, mode, and variance values into a data frame
mean_result <- data.frame(Column = numeric_cols, mean_value = mean_values)
median_result <- data.frame(Column = numeric_cols, median_value = median_values)
mode_result <- data.frame(Column = numeric_cols, mode_value = mode_values)
variance_result <- data.frame(Column = numeric_cols, variance_value = variance_values)

# Print the result
print(mean_result)
print(median_result)
print(mode_result)
print(variance_result)
```

| Column | mean_value |
|---|---|
| Overall.rank | 78.50 |
| Score | 5.38 |
| GDP.per.capita | 0.89 |
| Social.support | 1.21 |
| Healthy.life.expectancy | 0.60 |
| Freedom.to.make.life.choices | 0.45 |
| Generosity | 0.18 |
| Perceptions.of.corruption | 0.11 |

| Column | mode_value |
|---|---|
| Overall.rank | numeric |
| Score | numeric |
| GDP.per.capita | numeric |
| Social.support | numeric |
| Healthy.life.expectancy | numeric |
| Freedom.to.make.life.choices | numeric |
| Generosity | numeric |
| Perceptions.of.corruption | numeric |

| Column | median_value |
|---|---|
| Overall.rank | 78.500 |
| Score | 5.378 |
| GDP.per.capita | 0.950 |
| Social.support | 1.255 |
| Healthy.life.expectancy | 0.644 |
| Freedom.to.make.life.choices | 0.487 |
| Generosity | 0.174 |
| Perceptions.of.corruption | 0.082 |

| Column | variance_value |
|---|---|
| Overall.rank | 2.0e+03 |
| Score | 1.3e+00 |
| GDP.per.capita | 1.5e-01 |
| Social.support | 9.1e-02 |
| Healthy.life.expectancy | 6.1e-02 |
| Freedom.to.make.life.choices | 2.6e-02 |
| Generosity | 9.7e-03 |
| Perceptions.of.corruption | 9.3e-03 |

This is the summary of the statistics of data for 2019 with the code:

```r
# Exclude non-numeric columns
numeric_cols <- setdiff(colnames(happy2019), c("Country.or.region"))

# Calculate the mean, median, mode, and variance values for each numeric column
mean_values <- sapply(happy2019[, numeric_cols], mean)
median_values <- sapply(happy2019[, numeric_cols], median)
mode_values <- sapply(happy2019[, numeric_cols], mode)
variance_values <- sapply(happy2019[, numeric_cols], var)

# Combine column names and mean, median, mode, and variance values into a data frame
mean_result <- data.frame(Column = numeric_cols, mean_value = mean_values)
median_result <- data.frame(Column = numeric_cols, median_value = median_values)
mode_result <- data.frame(Column = numeric_cols, mode_value = mode_values)
variance_result <- data.frame(Column = numeric_cols, variance_value = variance_values)

# Print the result
print(mean_result)
print(median_result)
print(mode_result)
print(variance_result)
```

| Column | mean_value |
|---|---|
| Overall.rank | 78.50 |
| Score | 5.41 |
| GDP.per.capita | 0.91 |
| Social.support | 1.21 |
| Healthy.life.expectancy | 0.73 |
| Freedom.to.make.life.choices | 0.39 |
| Generosity | 0.18 |
| Perceptions.of.corruption | 0.11 |

| Column | mode_value |
|---|---|
| Overall.rank | numeric |
| Score | numeric |
| GDP.per.capita | numeric |
| Social.support | numeric |
| Healthy.life.expectancy | numeric |
| Freedom.to.make.life.choices | numeric |
| Generosity | numeric |
| Perceptions.of.corruption | numeric |

| Column | median_value |
|---|---|
| Overall.rank | 78.500 |
| Score | 5.380 |
| GDP.per.capita | 0.960 |
| Social.support | 1.272 |
| Healthy.life.expectancy | 0.789 |
| Freedom.to.make.life.choices | 0.417 |
| Generosity | 0.177 |
| Perceptions.of.corruption | 0.085 |

| Column | variance_value |
|---|---|
| Overall.rank | 2.0e+03 |
| Score | 1.2e+00 |
| GDP.per.capita | 1.6e-01 |
| Social.support | 9.0e-02 |
| Healthy.life.expectancy | 5.9e-02 |
| Freedom.to.make.life.choices | 2.1e-02 |
| Generosity | 9.1e-03 |
| Perceptions.of.corruption | 8.9e-03 |

This is the summary of the statistics of data for 2020 with the code:

```r
# Exclude non-numeric columns
numeric_cols <- setdiff(colnames(happy2020), c("Country.name", "Regional.indicator"))

# Calculate the mean, median, mode, and variance values for each numeric column
mean_values <- sapply(happy2020[, numeric_cols], mean)
median_values <- sapply(happy2020[, numeric_cols], median)
mode_values <- sapply(happy2020[, numeric_cols], mode)
variance_values <- sapply(happy2020[, numeric_cols], var)

# Combine column names and mean, median, mode, and variance values into a data frame
mean_result <- data.frame(Column = numeric_cols, mean_value = mean_values)
median_result <- data.frame(Column = numeric_cols, median_value = median_values)
mode_result <- data.frame(Column = numeric_cols, mode_value = mode_values)
variance_result <- data.frame(Column = numeric_cols, variance_value = variance_values)

# Print the result
print(mean_result)
print(median_result)
print(mode_result)
print(variance_result)
```

| Column | mean_value |
|---|---|
| Ladder.score | 5.473 |
| Standard.error.of.ladder.score | 0.054 |
| upperwhisker | 5.578 |
| lowerwhisker | 5.368 |
| Logged.GDP.per.capita | 9.296 |
| Social.support | 0.809 |
| Healthy.life.expectancy | 64.446 |
| Freedom.to.make.life.choices | 0.783 |
| Generosity | -0.015 |
| Perceptions.of.corruption | 0.733 |
| Explained.by..Log.GDP.per.capita | 0.869 |
| Explained.by..Social.support | 1.156 |
| Explained.by..Healthy.life.expectancy | 0.693 |
| Explained.by..Freedom.to.make.life.choices | 0.464 |
| Explained.by..Generosity | 0.189 |
| Explained.by..Perceptions.of.corruption | 0.131 |
| Dystopia...residual | 1.972 |

| Column | mode_value |
|---|---|
| Ladder.score | numeric |
| Standard.error.of.ladder.score | numeric |
| upperwhisker | numeric |
| lowerwhisker | numeric |
| Logged.GDP.per.capita | numeric |
| Social.support | numeric |
| Healthy.life.expectancy | numeric |
| Freedom.to.make.life.choices | numeric |
| Generosity | numeric |
| Perceptions.of.corruption | numeric |
| Explained.by..Log.GDP.per.capita | numeric |
| Explained.by..Social.support | numeric |
| Explained.by..Healthy.life.expectancy | numeric |
| Explained.by..Freedom.to.make.life.choices | numeric |
| Explained.by..Generosity | numeric |
| Explained.by..Perceptions.of.corruption | numeric |
| Dystopia...residual | numeric |

| Column | median_value |
|---|---|
| Ladder.score | 5.515 |
| Standard.error.of.ladder.score | 0.051 |
| upperwhisker | 5.608 |
| lowerwhisker | 5.431 |
| Logged.GDP.per.capita | 9.456 |
| Social.support | 0.829 |
| Healthy.life.expectancy | 66.305 |
| Freedom.to.make.life.choices | 0.800 |
| Generosity | -0.034 |
| Perceptions.of.corruption | 0.783 |
| Explained.by..Log.GDP.per.capita | 0.919 |
| Explained.by..Social.support | 1.204 |
| Explained.by..Healthy.life.expectancy | 0.760 |
| Explained.by..Freedom.to.make.life.choices | 0.483 |
| Explained.by..Generosity | 0.177 |
| Explained.by..Perceptions.of.corruption | 0.098 |
| Dystopia...residual | 2.046 |

| Column | variance_value |
|---|---|
| Ladder.score | 1.2e+00 |
| Standard.error.of.ladder.score | 3.3e-04 |
| upperwhisker | 1.2e+00 |
| lowerwhisker | 1.3e+00 |
| Logged.GDP.per.capita | 1.4e+00 |
| Social.support | 1.5e-02 |
| Healthy.life.expectancy | 5.0e+01 |
| Freedom.to.make.life.choices | 1.4e-02 |
| Generosity | 2.3e-02 |
| Perceptions.of.corruption | 3.1e-02 |
| Explained.by..Log.GDP.per.capita | 1.4e-01 |
| Explained.by..Social.support | 8.2e-02 |
| Explained.by..Healthy.life.expectancy | 6.5e-02 |
| Explained.by..Freedom.to.make.life.choices | 2.0e-02 |
| Explained.by..Generosity | 1.0e-02 |
| Explained.by..Perceptions.of.corruption | 1.3e-02 |
| Dystopia...residual | 3.2e-01 |

This is the summary of the statistics of data for 2021 with the code:

```r
# Exclude non-numeric columns
numeric_cols <- setdiff(colnames(happy2021), c("Country.name", "Regional.indicator"))

# Calculate the mean, median, mode, and variance values for each numeric column
mean_values <- sapply(happy2021[, numeric_cols], mean)
median_values <- sapply(happy2021[, numeric_cols], median)
mode_values <- sapply(happy2021[, numeric_cols], mode)
variance_values <- sapply(happy2021[, numeric_cols], var)

# Combine column names and mean, median, mode, and variance values into a data frame
mean_result <- data.frame(Column = numeric_cols, mean_value = mean_values)
median_result <- data.frame(Column = numeric_cols, median_value = median_values)
mode_result <- data.frame(Column = numeric_cols, mode_value = mode_values)
variance_result <- data.frame(Column = numeric_cols, variance_value = variance_values)

# Print the result
print(mean_result)
print(median_result)
print(mode_result)
print(variance_result)
```

| Column | mean_value |
|---|---|
| Ladder.score | 5.533 |
| Standard.error.of.ladder.score | 0.059 |
| upperwhisker | 5.648 |
| lowerwhisker | 5.418 |
| Logged.GDP.per.capita | 9.432 |
| Social.support | 0.815 |
| Healthy.life.expectancy | 64.993 |
| Freedom.to.make.life.choices | 0.792 |
| Generosity | -0.015 |
| Perceptions.of.corruption | 0.727 |
| Explained.by..Log.GDP.per.capita | 0.977 |
| Explained.by..Social.support | 0.793 |
| Explained.by..Healthy.life.expectancy | 0.520 |
| Explained.by..Freedom.to.make.life.choices | 0.499 |
| Explained.by..Generosity | 0.178 |
| Explained.by..Perceptions.of.corruption | 0.135 |
| Dystopia...residual | 2.430 |

| Column | mode_value |
|---|---|
| Ladder.score | numeric |
| Standard.error.of.ladder.score | numeric |
| upperwhisker | numeric |
| lowerwhisker | numeric |
| Logged.GDP.per.capita | numeric |
| Social.support | numeric |
| Healthy.life.expectancy | numeric |
| Freedom.to.make.life.choices | numeric |
| Generosity | numeric |
| Perceptions.of.corruption | numeric |
| Explained.by..Log.GDP.per.capita | numeric |
| Explained.by..Social.support | numeric |
| Explained.by..Healthy.life.expectancy | numeric |
| Explained.by..Freedom.to.make.life.choices | numeric |
| Explained.by..Generosity | numeric |
| Explained.by..Perceptions.of.corruption | numeric |
| Dystopia...residual | numeric |

| Column | median_value |
|---|---|
| Ladder.score | 5.534 |
| Standard.error.of.ladder.score | 0.054 |
| upperwhisker | 5.625 |
| lowerwhisker | 5.413 |
| Logged.GDP.per.capita | 9.569 |
| Social.support | 0.832 |
| Healthy.life.expectancy | 66.603 |
| Freedom.to.make.life.choices | 0.804 |
| Generosity | -0.036 |
| Perceptions.of.corruption | 0.781 |
| Explained.by..Log.GDP.per.capita | 1.025 |
| Explained.by..Social.support | 0.832 |
| Explained.by..Healthy.life.expectancy | 0.571 |
| Explained.by..Freedom.to.make.life.choices | 0.514 |
| Explained.by..Generosity | 0.164 |
| Explained.by..Perceptions.of.corruption | 0.101 |
| Dystopia...residual | 2.509 |

| Column | variance_value |
|---|---|
| Ladder.score | 1.2e+00 |
| Standard.error.of.ladder.score | 4.8e-04 |
| upperwhisker | 1.1e+00 |
| lowerwhisker | 1.2e+00 |
| Logged.GDP.per.capita | 1.3e+00 |
| Social.support | 1.3e-02 |
| Healthy.life.expectancy | 4.6e+01 |
| Freedom.to.make.life.choices | 1.3e-02 |
| Generosity | 2.3e-02 |
| Perceptions.of.corruption | 3.2e-02 |
| Explained.by..Log.GDP.per.capita | 1.6e-01 |
| Explained.by..Social.support | 6.7e-02 |
| Explained.by..Healthy.life.expectancy | 4.5e-02 |
| Explained.by..Freedom.to.make.life.choices | 1.9e-02 |
| Explained.by..Generosity | 9.7e-03 |
| Explained.by..Perceptions.of.corruption | 1.3e-02 |
| Dystopia...residual | 2.9e-01 |

This is the summary of the statistics of data for 2022 with the code:

```r
# Exclude non-numeric columns
numeric_cols <- setdiff(colnames(happy), c("Country"))

# Calculate the mean, median, mode, and variance values for each numeric column
mean_values <- sapply(happy[, numeric_cols], mean)
median_values <- sapply(happy[, numeric_cols], median)
mode_values <- sapply(happy[, numeric_cols], mode)
variance_values <- sapply(happy[, numeric_cols], var)

# Combine column names and mean, median, mode, and variance values into a data frame
mean_result <- data.frame(Column = numeric_cols, mean_value = mean_values)
median_result <- data.frame(Column = numeric_cols, median_value = median_values)
mode_result <- data.frame(Column = numeric_cols, mode_value = mode_values)
variance_result <- data.frame(Column = numeric_cols, variance_value = variance_values)

# Print the result
print(mean_result)
print(median_result)
print(mode_result)
print(variance_result)
```

| | Column | mode_value |
|---|---|---|
| RANK | RANK | numeric |
| Happiness.score | Happiness.score | numeric |
| Whisker.high | Whisker.high | numeric |
| Whisker.low | Whisker.low | numeric |
| Dystopia..1.83....residual | Dystopia..1.83....residual | numeric |
| Explained.by..GDP.per.capita | Explained.by..GDP.per.capita | numeric |
| Explained.by..Social.support | Explained.by..Social.support | numeric |
| Explained.by..Healthy.life.expectancy | Explained.by..Healthy.life.expectancy | numeric |
| Explained.by..Freedom.to.make.life.choices | Explained.by..Freedom.to.make.life.choices | numeric |
| Explained.by..Generosity | Explained.by..Generosity | numeric |
| Explained.by..Perceptions.of.corruption | Explained.by..Perceptions.of.corruption | numeric |

| | Column | mean_value |
|---|---|---|
| RANK | RANK | 73.50 |
| Happiness.score | Happiness.score | 5.55 |
| Whisker.high | Whisker.high | 5.67 |
| Whisker.low | Whisker.low | 5.43 |
| Dystopia..1.83....residual | Dystopia..1.83....residual | 1.83 |
| Explained.by..GDP.per.capita | Explained.by..GDP.per.capita | 1.41 |
| Explained.by..Social.support | Explained.by..Social.support | 0.91 |
| Explained.by..Healthy.life.expectancy | Explained.by..Healthy.life.expectancy | 0.59 |
| Explained.by..Freedom.to.make.life.choices | Explained.by..Freedom.to.make.life.choices | 0.52 |
| Explained.by..Generosity | Explained.by..Generosity | 0.15 |
| Explained.by..Perceptions.of.corruption | Explained.by..Perceptions.of.corruption | 0.15 |

| | Column | variance_value |
|---|---|---|
| RANK | RANK | 1.8e+03 |
| Happiness.score | Happiness.score | 1.2e+00 |
| Whisker.high | Whisker.high | 1.1e+00 |
| Whisker.low | Whisker.low | 1.2e+00 |
| Dystopia..1.83....residual | Dystopia..1.83....residual | 2.9e-01 |
| Explained.by..GDP.per.capita | Explained.by..GDP.per.capita | 1.8e-01 |
| Explained.by..Social.support | Explained.by..Social.support | 7.8e-02 |
| Explained.by..Healthy.life.expectancy | Explained.by..Healthy.life.expectancy | 3.1e-02 |
| Explained.by..Freedom.to.make.life.choices | Explained.by..Freedom.to.make.life.choices | 2.1e-02 |
| Explained.by..Generosity | Explained.by..Generosity | 6.9e-03 |
| Explained.by..Perceptions.of.corruption | Explained.by..Perceptions.of.corruption | 1.6e-02 |

| | Column | median_value |
|---|---|---|
| RANK | RANK | 73.50 |
| Happiness.score | Happiness.score | 5.57 |
| Whisker.high | Whisker.high | 5.68 |
| Whisker.low | Whisker.low | 5.45 |
| Dystopia..1.83....residual | Dystopia..1.83....residual | 1.89 |
| Explained.by..GDP.per.capita | Explained.by..GDP.per.capita | 1.45 |
| Explained.by..Social.support | Explained.by..Social.support | 0.96 |
| Explained.by..Healthy.life.expectancy | Explained.by..Healthy.life.expectancy | 0.62 |
| Explained.by..Freedom.to.make.life.choices | Explained.by..Freedom.to.make.life.choices | 0.54 |
| Explained.by..Generosity | Explained.by..Generosity | 0.13 |
| Explained.by..Perceptions.of.corruption | Explained.by..Perceptions.of.corruption | 0.12 |

## Presentation, Visualization and Quantification of Data

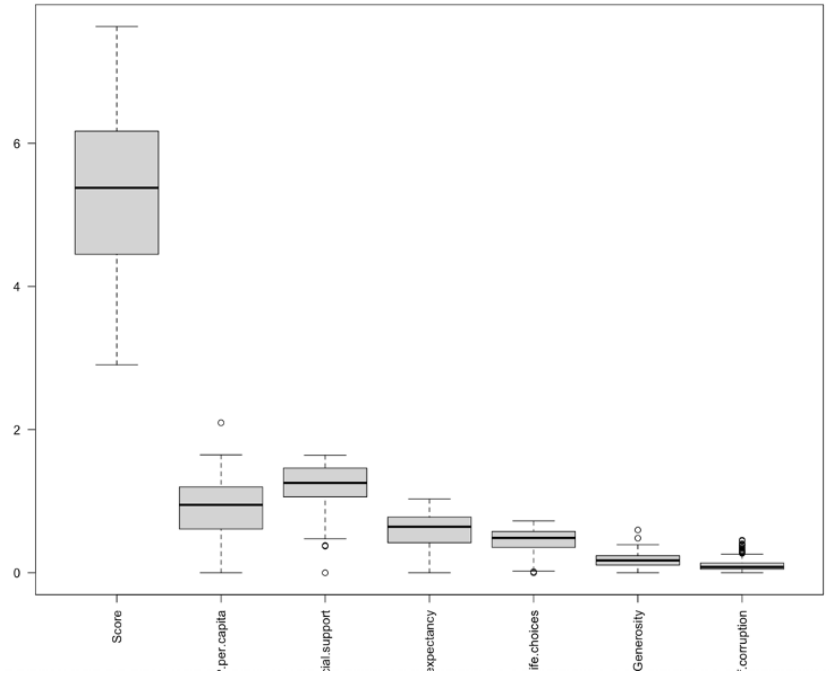
This is the boxplot for 2018 with the code:

```r
# Exclude non-numeric columns
numeric_cols2018 <- setdiff(colnames(happy2018), c("Country.or.region", "Overall.rank"))

# Create a new data frame with only the numeric columns
numeric_data2018 <- happy2018[, numeric_cols2018]

# Set larger plotting margins
par(mar = c(5, 5, 2, 2))

# Plot boxplot for each numeric column
boxplot(numeric_data2018, las = 2)
```



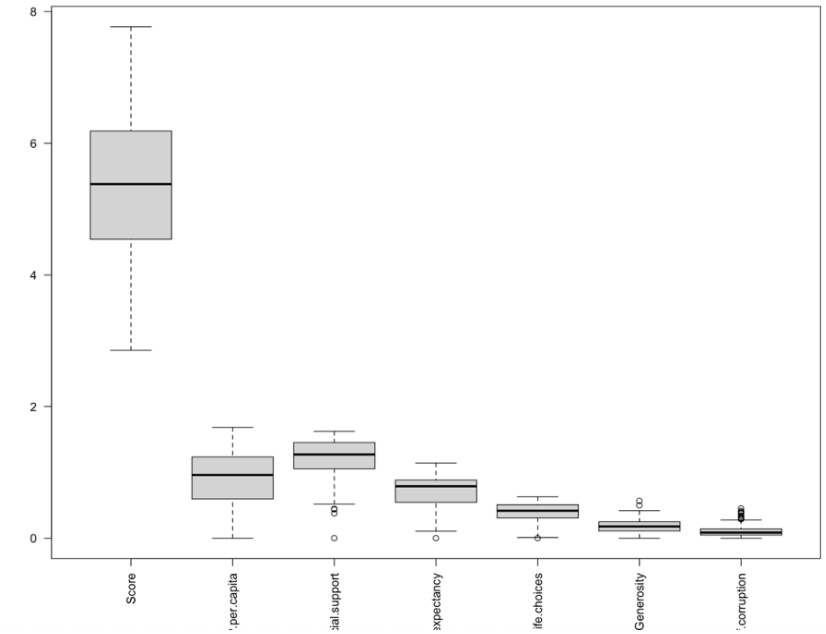

This is the boxplot for 2019 with the code:

```r
#2019
# Exclude non-numeric columns
numeric_cols2019 <- setdiff(colnames(data2019_plot), c("Country.or.region"))

# Create a new data frame with only the numeric columns
numeric_data2019 <- data2019_plot[, numeric_cols2019]

# Set larger plotting margins
par(mar = c(5, 5, 2, 2))

# Plot boxplot for each numeric column
boxplot(numeric_data2019, las = 2)
```



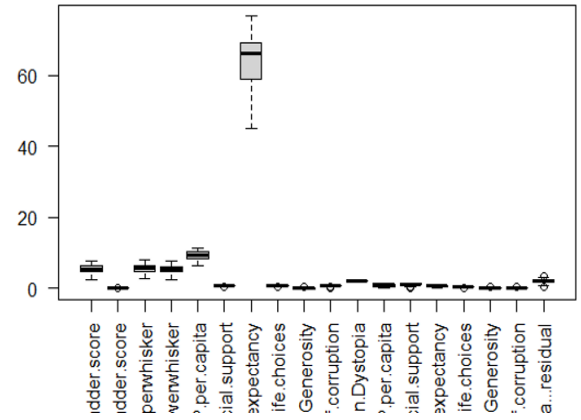

This is the boxplot for 2020 with the code:

```r
#2020
# Exclude non-numeric columns
numeric_cols2020 <- setdiff(colnames(data2020_plot), c("Country.name", "Regional.indicator"))

# Create a new data frame with only the numeric columns
numeric_data2020 <- data2020_plot[, numeric_cols2020]

# Set larger plotting margins
par(mar = c(5, 5, 2, 2))

# Plot boxplot for each numeric column
boxplot(numeric_data2020, las = 2)
```



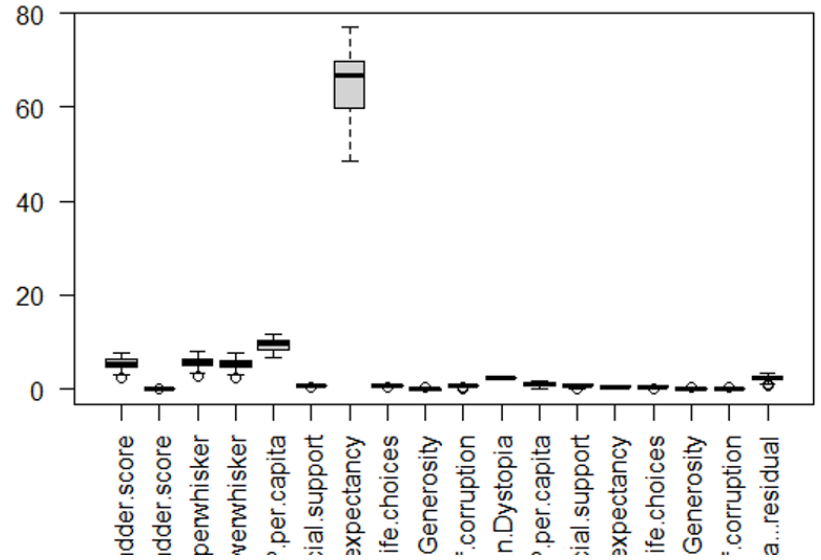

This is the boxplot for 2021 with the code:

```r
#2021
# Exclude non-numeric columns
numeric_cols2021 <- setdiff(colnames(data2021_plot), c("Country.name", "Regional.indicator"))

# Create a new data frame with only the numeric columns
numeric_data2021 <- data2021_plot[, numeric_cols2021]

# Set larger plotting margins
par(mar = c(5, 5, 2, 2))

# Plot boxplot for each numeric column
boxplot(numeric_data2021, las = 2)
```



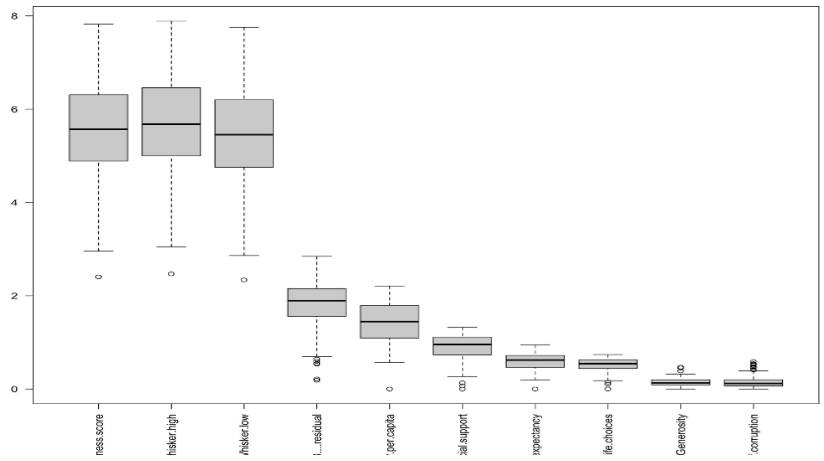

This is the boxplot for 2022 with the code:

```r
# Exclude non-numeric columns
numeric_cols <- setdiff(colnames(happy), c("Country", "RANK"))

# Create a new data frame with only the numeric columns
numeric_data <- happy[, numeric_cols]

# Set larger plotting margins
par(mar = c(5, 5, 2, 2))

# Plot boxplot for each numeric column
boxplot(numeric_data, las = 2)
```




Conclusion

The World Happiness Report is a survey that ranks countries based on citizens' happiness levels, published by the Sustainable Development Solutions Network and powered by Gallup World Poll data. It explores the correlation between happiness and factors like income, health, social support, and freedom. Cities with higher social trust and lower inequality tend to be happier. The report serves as a valuable tool for understanding happiness contributors and developing policies to promote well-being. The data used in the 2020 World Happiness Report includes variables like GDP per capita, healthy life expectancy, social support, freedom to make life choices, generosity, corruption perception, positive and negative affect, ladder score, and ladder score in dystopia.

The analysis examined the mean, median, mode, and variance of the years 2018-2022 to gain insights into changes over time. Boxplots were used to present data distribution across the years, but challenges were encountered due to data format issues or missing values. Overall, the World Happiness Report offers a comprehensive understanding of happiness factors and serves as a foundation for policymakers and researchers to explore strategies for improving well-being and happiness on a global scale.

**Methods**

The World Happiness Report evaluates the subjective well-being and happiness levels of nations across the world. To analyse and understand the gathered data from 2018 to 2022, it makes use of several statistical approaches and exploratory data analysis (EDA) methodologies for the five years that we have investigated. A broad explanation of the EDA and statistical methodologies frequently used in such studies. [8]

As for the Exploratory Data Analysis (EDA)

- Descriptive Statistics: Main characteristics of the data, EDA frequently begins with computing descriptive statistics like mean, median, mode, standard deviation, and range. Each of these characteristics had a role in our findings and research.

- Data visualisation: Visual representations such as box plots, histograms, scatter plots, and bar charts may be used to better comprehend how the data is distributed and related.Values that have been plot was thoroughly researched, the data representation will portray those values after descriptive statistics, it was ranging from a 1.0 to a -1.0. By representing as 1.0 with the highest success rate and -1.0 being the lowest.

- Correlation analysis: EDA investigates the connections between various variables using correlation analysis to ascertain the significance and direction of links. Main focus of our i inputs that was needed for the project are GDP per capita, social support, healthy life expectancy, freedom to make a life and perceptions of corruption for all the five years from 2018 to 2022 that we have researched on.

Next there were also some Statistical Techniques involved

- Regression Analysis: Regression models are frequently employed to investigate the link between happiness levels for the year 2018 to 2022 (the dependent variable) and a variety of variables, such as GDP per capita, social support, healthy life expectancy, freedom to make a life and perceptions of corruption. Multiple regression enables the simultaneous analysis of the effects of several factors for this project. Below is the sample of the code that was applied on 2019 analysis, adopting lm() function to analyse the dataset with multiple linear regression models.

```r
# ============================================================
# Multiple linear regression model with all parameters included
lm_happy <- lm(
  formula = Score ~ GDP.per.capita + Social.support +
    Healthy.life.expectancy + Freedom.to.make.life.choices +
    Generosity + Perceptions.of.corruption,
  data = happy2019
)
summary(lm_happy)

options(scipen=-100, digits = 3)
anova(lm_happy)
```

- Factor analysis aids in locating the underlying elements or dimensions that influence happiness. It entails condensing a sizable number of variables into a more manageable group of uncorrelated variables that account for the variation in the data. The variation of the data ranges from different countries in terms of freedom, such as the UAE has a strong 0.6 in their record for having freedom.

- Cluster Analysis: Based on commonalities in happiness indices, cluster analysis countries. It assists in locating unique clusters or groupings of nations that have similar traits. Based on the similar traits of the dependent variables, we can get to analyse the differences geographically in different countries like Vietnam, Finland, Australia and much more that we have used for the project.

- Testing for Statistical Significance: Hypothesis testing is used to establish the statistical significance of any observed similarities or variations in happiness scores between nations. Based on the values that we have collected after examining countries based on their dependent values, the range from 1.0 to -1.0 was placed to show the performance in statistics of each country based on freedom for the years 2018 to 2022.[9]

**Results and Discussion**

```
Residuals:
    Min      1Q  Median      3Q     Max
-1.7865 -0.2999  0.0068  0.3841  1.0497

Coefficients:
                            Estimate Std. Error t value  Pr(>|t|)
(Intercept)                    1.886      0.195    9.65   < 2e-16 ***
GDP.per.capita                 1.111      0.209    5.31 0.0000004 ***
Social.support                 0.999      0.202    4.96 0.0000019 ***
Healthy.life.expectancy        0.809      0.331    2.44     0.016 *
Freedom.to.make.life.choices   1.383      0.320    4.32 0.0000287 ***
Generosity                     0.606      0.472    1.28     0.202
Perceptions.of.corruption      0.595      0.525    1.13     0.259
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.525 on 149 degrees of freedom
Multiple R-squared:  0.789,     Adjusted R-squared:  0.78
F-statistic: 92.7 on 6 and 149 DF,  p-value: <2e-16

Analysis of Variance Table

Response: Score
                                    Df   Sum Sq  Mean Sq  F value  Pr(>F)
GDP.per.capita                1.00e+00 1.25e+02 1.25e+02 4.54e+02 < 2e-16 ***
Social.support                1.00e+00 1.51e+01 1.51e+01 5.49e+01 8.7e-12 ***
Healthy.life.expectancy       1.00e+00 2.70e+00 2.70e+00 9.74e+00 2.2e-03 **
Freedom.to.make.life.choices  1.00e+00 9.30e+00 9.30e+00 3.36e+01 3.8e-08 ***
Generosity                    1.00e+00 8.00e-01 8.00e-01 2.80e+00 9.7e-02 .
Perceptions.of.corruption     1.00e+00 4.00e-01 4.00e-01 1.28e+00 2.6e-01
Residuals                     1.49e+02 4.11e+01 3.00e-01
---
Signif. codes:  0e+00 ‘***’ 1e-03 ‘**’ 1e-02 ‘*’ 5e-02 ‘.’ 1e-01 ‘ ’ 1e+00
```

Discussed the result of statistical analysis and EDA Compare results with other techniques. Compare your study with previous finding several consistent patterns and conclusions can be observed based on our analysis of 2018 to 2022.

1. Independent variables: The regression model includes various independent variables such as GDP per capita, social support, healthy life expectancy, freedom of choice in life, generosity, and perceptions of corruption. These variables are used to explain the variation in the dependent variable (world happiness or score).

2. Statistically significant variables: Over the three years, GDP per capita, social support, healthy life expectancy, and freedom of choice in life show consistently statistically significant positive effects on the dependent variables. This means

that increases in this variable are associated with better world happiness, or better scores. The p-values for these variables are less than 0.05, indicating statistical significance.

3. Minor variables: The variables leniency and perceptions of corruption do not appear to have a statistically significant effect in any of the three models. Their higher p-value suggests that they may not have a significant association with world happiness or scores.

4. Goodness of fit: The R-squared value indicates the proportion of the total variation in the dependent variable explained by the independent variables. The R-squared values of the models are relatively high, ranging from about 77.9% to 78.9%. This suggests that independent variables explain an important part of the variation in global happiness and satisfaction.

5. Meaning of the model: The p-values for the F-statistics are very low (<2e-16) for all three years, suggesting that the regression model as a whole is statistically significant in explaining the variation in World Happiness or Global Happiness Scores. increase.

Taken together, these results suggest that GDP per capita, social support, healthy life expectancy, and freedom of choice in life all play important roles in explaining happiness, the global score, while generosity and It suggests that perceptions of corruption may not have had a significant impact. This is the common tendency among the entire 5 year dataset, and the model itself fits well and seems to explain a significant part of the variability of the dependent variable.

**Limitation and Future Study**

Describe some settings in which we'd expect your approach to perform poorly, or where all existing models fail. Give some examples of possible extensions, ways to address these limitations, or open problems.

Limitation

1. Sample Representativeness: The analysis results are based on specific datasets (happy2019 and happy2020) that may not fully represent the global population. The

samples might be biassed towards certain regions or countries, which could limit the generalizability of the findings to other populations or settings. The approach's performance may be poorer when applied to datasets that are not representative or have different characteristics.

2. Omitted Variables: The models used in the analysis focus on a limited set of independent variables, excluding potentially important factors that influence happiness. Factors such as cultural dimensions, environmental factors, income inequality, and political stability could also impact happiness but are not included in the models. The omission of relevant variables may limit the accuracy and completeness of the models' predictions and interpretations.

3. Causality and Reverse Causality: The regression models used in the analysis are based on associations between the independent variables and the dependent variable. However, establishing causality from observational data can be challenging. The models cannot determine the direction of causality, and it is possible that the relationship between the independent variables and happiness could be bidirectional or influenced by other factors.

4. Linearity Assumption: The linear regression models assume a linear relationship between the independent variables and the dependent variable. However, happiness might exhibit non-linear relationships with certain predictors. The linear models used in the analysis may not capture complex interactions and non-linear effects accurately, leading to a suboptimal performance in predicting happiness.

Future Extensions and Ways to Address Limitations

1. Cross-Cultural Analysis: Conducting cross-cultural studies can help address limitations related to sample representativeness and cultural variations. By including diverse populations and considering cultural factors, the approach can be extended to capture a broader range of experiences and factors influencing happiness.

2. Longitudinal Analysis: Extending the analysis over multiple years and examining changes in happiness and its predictors over time can provide valuable insights. Longitudinal studies allow for a better understanding of temporal relationships and

the dynamics of happiness, helping to address concerns related to causality and reverse causality.

3. Advanced Modeling Techniques: Exploring advanced modelling techniques, such as nonlinear regression, random forest, or Bayesian approaches, can provide more flexible and accurate representations of the relationships between predictors and happiness. These techniques can handle non-linearities, interactions, and complex dependencies, improving the model's performance.

4. Incorporating Subjective Measures: Integrating subjective measures of happiness, such as qualitative interviews or self-reported well-being measures, alongside objective data, can provide a more comprehensive understanding of happiness. This mixed-methods approach can address limitations related to omitted variables and capture the subjective experiences and nuances of happiness.

5. Multilevel Modelling: Considering hierarchical or multilevel modelling can account for nested data structures, such as individuals within countries or regions. This approach allows for the examination of both individual and contextual factors that influence happiness, providing a more comprehensive analysis.

6. Addressing Endogeneity: Endogeneity, which arises when there is a mutual relationship between the dependent variable and the independent variables, can be addressed using instrumental variable techniques or panel data approaches. These methods help mitigate concerns related to omitted variable bias and improve the robustness of the analysis.

By incorporating these extensions, addressing limitations, and exploring more sophisticated modelling techniques, future studies can enhance the accuracy, generalizability, and depth of the analysis of happiness predictors, providing valuable insights for policymakers and researchers.

**Conclusion**

The 2022 World Happiness Report reveals significant results on global happiness levels, highlighting key determinants such as social support, GDP per capita, life expectancy, freedom, generosity, and corruption perception. The report highlights countries that excel in happiness and those facing challenges in maintaining high levels.

Happiness is influenced by a combination of social, economic, and environmental factors, and policies focusing on social support, economic growth, health, freedom, and reduced corruption are essential for enhancing happiness levels. The findings emphasise the importance of prioritising well-being and provide valuable insights for policymakers, governments, and organisations to promote happiness at both national and global levels.

The limited understanding of global happiness has profound implications, impacting individuals, communities, governments, and organisations worldwide. Addressing this problem requires evidence-based policies and leveraging determinants of happiness to create happier, healthier, and more prosperous societies. The model fits well and seems to explain a significant part of the variability of the dependent variable.

Future studies can enhance the accuracy, generalizability, and depth of happiness predictor analysis, providing valuable insights for policymakers and researchers.

Overall, the World Happiness Report provides a comprehensive understanding of happiness factors and serves as a foundation for policymakers and researchers to explore strategies for improving well-being and happiness on a global scale.

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