IMPACT OF SOCIAL REASONS ON MENTAL HEALTH: A STATISTICAL ANALYTIC STUDY USING PYTHON AND R SOFTWARE OF THE DATA SET FROM "MENTAL HEALTH MILLION PROJECT 2021", "UNDP'S HDI 2021", "GLOBAL HEALTH SECURITY INDEX 2021", "UNDP'S GLOBAL MULTIDIMENSIONAL POVERTY INDEX 2021" AND "CLIMATE CHANGE PERFORMANCE INDEX 2021".

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CERTIFICATE

This is to certify that the project entitled: "**IMPACT OF SOCIAL REASONS ON MENTAL HEALTH: A STATISTICAL ANALYTIC STUDY USING PYTHON AND R SOFTWARE OF THE DATA SET FROM "MENTAL HEALTH MILLION PROJECT 2021", "UNDP'S HDI 2021", "GLOBAL HEALTH SECURITY INDEX 2021", "UNDP'S GLOBAL MULTIDIMENSIONAL POVERTY INDEX 2021" AND "CLIMATE CHANGE PERFORMANCE INDEX 2021""**, has been carried out by the following group of students of

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INTRODUCTION

CHAPTER 1 [1]

1.1 WHAT IS MENTAL HEALTH?

"Mental health is a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community."

The World Health Organization (WHO) states that mental health is "more than just the absence of mental disorders or disabilities." Peak mental health is not only about managing active conditions but also looking after ongoing wellness and happiness. It also emphasizes that preserving and restoring mental health is crucial individually and at a community and society level.

Mental Health encompasses emotional, psychological, and social well-being, influencing cognition, perception, and behavior. It likewise determines how an individual handles stress, interpersonal relationships, and decision-making.

Mental health includes subjective well-being, perceived self-efficacy, autonomy, competence, intergenerational dependence, and self-actualization of one's intellectual and emotional potential, among others. From the perspectives of positive psychology or holism, mental health may include an individual's ability to enjoy life and to create a balance between life activities and efforts to achieve psychological resilience.

Cultural differences, subjective assessments, and competing professional theories all affect how one defines "mental health". Some early signs related to mental health problems are sleep irritation, lack of energy, lack of appetite and thinking of harming yourself or others.

"If we start being honest about our pain, our anger, and our shortcomings instead of pretending they don't exist, then maybe we'll leave the world a better place than we found it."

-Russell Wilson

"The most beautiful people we have known are those who have known defeat, known suffering, known struggle, known loss, and have found their way out of the depths. These persons have an appreciation, sensitivity, and an understanding of life that fills them with compassion, gentleness, and a deep loving concern.

[1] The contents of this Chapter have been taken from the websites and reports mentioned in References.

Beautiful people do not just happen."

-Elisabeth Kubler-Ross

History of Mental Health Services:

History is a screen through which the past lightens the present and the present brightens the future. The ancient Indian thought emphasized the theory of unity of body and soul and also explained how to deal with health and mental health problems in a psychosomatic way. A concern with mental health has long been a part of Indian culture, which has evolved in a variety of ways, attempting to understand and negotiate psychological disorder.

Pioneers like Al-Razi (865–925) and Ibn-Sina (Avicenna, 980–1037) established the first mental hospitals and applied humane treatments. Indeed, the first mental hospital in the world was built in Baghdad in 705. The region then entered the dark ages and it was not until **the middle of the 20th century that modern psychiatric services appeared in Iraq.**

Modern psychiatry in the Indian subcontinent dates back to the factories of the East India Company in the 17th century. **The first asylum was established in Bombay in 1745 and the second at Calcutta in 1784. Dr LP Varma, First Assistant Superintendent, Indian Mental Hospital, Ranchi observed in 1953,** "The history of Psychiatry in this country is the history of establishment of mental hospitals and then increasing its accommodation from time to time as the exigencies of the time demand".

In the early 1950s, Dr Jack Aboud and Dr Ali Kamal led in establishing Al-Rashid and Al-Rashad mental hospitals (the former was later replaced by Ibn Rushid State Hospital). The 1960s and 1970s saw the development of mental health centers and units in general hospitals, school mental health programmes and public awareness campaigns.

1.2 TYPES OF MENTAL HEALTH DISORDER

1.2.1 DEPRESSION:

"Depression is a mood disorder that causes persistent feelings of sadness, emptiness, and loss of joy. It is different from the mood fluctuations that people regularly experience as a part of life."

Depression is a mental state of low mood and aversion to activity, which affects more than 280 million people of all, ages (about 3.5% of the global population). Classified medically as a mental and behavioral disorder, the experience of depression affects a person's thoughts, behavior, motivation, feelings, and sense of well-being. The core symptom of depression is said to be anhedonia, which refers to loss of interest or a loss of feeling of pleasure in certain activities that usually bring joy to people.

Depressed mood is a symptom of some mood disorders such as major depressive disorder or dysthymia. It may feature sadness, difficulty in thinking and concentration and a significant increase or decrease in appetite and time spent sleeping. People experiencing depression may have feelings of dejection, hopelessness, and suicidal thoughts. It can either be short term or long term.

1.2.2 ANXIETY:

"The American Psychological Association (APA) defines anxiety as "an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure."

Anxiety is an emotion which is characterized by an unpleasant state of inner turmoil and includes feelings of dread over anticipated events. It is often accompanied by nervous behavior such as pacing back and forth, somatic complaints, and rumination.

Anxiety is a feeling of uneasiness and worry, usually generalized and unfocused as an overreaction to a situation that is only subjectively seen as menacing. It is often accompanied by muscular tension, restlessness, fatigue, inability to catch one's breath, tightness in the abdominal region, nausea, and problems in concentration. Anxiety is closely related to fear, which is a response to a real or perceived immediate threat (fight or flight response); anxiety involves the expectation of future threat including dread. People facing anxiety may withdraw from situations which have provoked anxiety in the past.

Though anxiety is a typical human response, when excessive or persisting beyond developmentally appropriate periods it may be diagnosed as an anxiety disorder. There are multiple forms of anxiety disorder (such as generalized anxiety disorder and obsessive-compulsive disorder) with specific clinical definitions.

1.2.3 BIPOLAR DISORDER:

Bipolar disorder, previously known as manic depression, is a mental disorder characterized by periods of depression and periods of abnormally elevated mood that last from days to weeks each.

If the elevated mood is severe or associated with psychosis, it is called mania; if it is less severe, it is called hypomania. During mania, an individual behaves or feels abnormally energetic, happy or irritable, and they often make impulsive decisions with little regard for the consequences. There is usually also a reduced need for sleep during manic phases. During periods of depression, the individual may experience crying and have a negative outlook on life and poor eye contact with others.

The risk of suicide is high; over a period of 20 years, 6% of those with bipolar disorder died by suicide, while 30–40% engaged in self-harm. Other mental health issues, such as anxiety disorders and substance use disorders, are commonly associated with bipolar disorder.

While the causes of this mood disorder are not clearly understood, both genetic and environmental factors are thought to play a role. Many genes, each with small effects, may contribute to the development of the disorder. Genetic factors account for about 70–90% of the risk of developing bipolar disorder. Environmental risk factors include a history of childhood abuse and long-term stress. Bipolar disorder occurs in approximately 1% of the global population.

1.2.4 ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopment disorder characterized by excessive amounts of in attention, hyperactivity, and impulsivity that are pervasive, impairing in multiple contexts, and otherwise age-inappropriate.

ADHD symptoms arise from executive dysfunction, and emotional dysregulation is often considered a core symptom. ADHD is associated with other neurodevelopment and mental disorders as well as some non-psychiatric disorders, which can cause additional impairment, especially in modern society. Although people with ADHD struggle to focus on tasks they are not particularly interested in completing, they are often able to maintain an unusually prolonged and intense level of attention for tasks they do find interesting or rewarding; this is known as hyper focus.

The precise causes of ADHD are unknown in the majority of cases. Genetic factors play an important role; ADHD tends to run in families and has a heritability rate of 74%. Toxins and infections during pregnancy and brain damage may be environmental risks.

The precise causes of ADHD are unknown in the majority of cases. Genetic factors play an important role; ADHD tends to run in families and has a heritability rate of 74%. Toxins and infections during pregnancy and brain damage may be environmental risks.

ADHD was officially known as attention deficit disorder (ADD) from 1980 to 1987; prior to the 1980s, it was known as hyperkinetic reaction of childhood. Symptoms similar to those of ADHD have been described in medical literature dating back to the 18th century.

ADHD is generally claimed to be the result of neurological dysfunction in processes associated with the production or use of dopamine and nor epinephrine in various brain structures, but there are no confirmed causes. It may involve interactions between genetics and the environment.

1.2.5 POST-TRAUMATIC STRESS DISORDER (PTSD)

“Post-traumatic stress disorder (PTSD) is a mental and behavioral disorder that can develop because of exposure to a traumatic event, such as sexual assault, warfare, traffic collisions, child abuse, domestic violence, or other threats on a person's life.”

Symptoms may include disturbing thoughts, feelings, or dreams related to the events, mental or physical distress to trauma-related cues, attempts to avoid trauma-related cues, alterations in the way a person thinks and feels, and an increase in the fight-or-flight response. These symptoms last for more than a month after the event. A person with PTSD is at a higher risk of suicide and intentional self-harm.

Most people who experience traumatic events do not develop PTSD. People who experience interpersonal violence such as rape, other sexual assaults, being kidnapped, stalking, physical abuse by an intimate partner, and incest or other forms of childhood sexual abuse are more likely to develop PTSD than those who experience non-assault-based trauma, such as accidents and natural disasters.

Those who experience prolonged trauma, such as slavery, concentration camps, or chronic domestic abuse, may develop complex post-traumatic stress disorder (C-PTSD). C-PTSD is similar to PTSD but has a distinct effect on a person's emotional regulation and core identity.

Symptoms of PTSD generally begin within the first three months after the inciting traumatic event, but may not begin until years later. In the typical case, the individual with PTSD persistently avoids either trauma-related thoughts and emotions or discussion of the traumatic event and may even have amnesia of the event.

The term "post-traumatic stress disorder" came into use in the 1970s in large part due to the diagnoses of U.S. military veterans of the Vietnam War. It was officially recognized by the American Psychiatric Association in 1980 in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III).

1.2.6 OBSESSIVE–COMPULSIVE DISORDER (OCD)

“Obsessive–compulsive disorder (OCD) is a mental and behavioral disorder in which an individual has intrusive thoughts and/or feels the need to perform certain routines repeatedly to the extent where it induces distress or impairs general function.”

As indicated by the disorder's name, the primary symptoms of OCD are obsessions and compulsions. Obsessions are persistent unwanted thoughts, mental images, or urges that generate feelings of anxiety, disgust, or discomfort. Common obsessions include fear of contamination, obsession with symmetry, and intrusive thoughts about religion, sex, and harm. Compulsions are repeated actions or routines that occur in response to obsessions.

Common compulsions include excessive hand washing, cleaning, counting, ordering, hoarding, neutralizing, seeking assurance, and checking things. Washing is in response to the

fear of contamination. People with OCD tend to be overly cleanly, repeatedly count objects, and seek reassurance to avoid making a mistake. Many adults with OCD are aware that their compulsions do not make sense, but they perform them anyway to relieve the distress caused by obsessions.

The cause of OCD is unknown. There appear to be some genetic components, and it is more likely for both identical twins to be affected than both fraternal twins. Risk factors include a history of child abuse or other stress-inducing events; some cases have occurred after streptococcal infections.

1.2.7 ADDICTION:

"Addiction is a neuropsychological disorder characterized by a persistent and intense urge to engage in certain behaviors, often usage of a drug, despite substantial harm and other negative consequences. Repetitive drug use often alters brain function in ways that perpetuate craving, and weakens (but does not completely negate) self-control."

This phenomenon – drugs reshaping brain function – has led to an understanding of addiction as a brain disorder with a complex variety of psychosocial as well as neurobiological (and thus involuntary) factors that are implicated in addiction's development. Classic signs of addiction include compulsive engagement in rewarding stimuli, preoccupation with substances or behavior, and continued use despite negative consequences. Habits and patterns associated with addiction are typically characterized by immediate gratification (short-term reward), coupled with delayed deleterious effects (long-term costs).

The term "addiction" is frequently misused when referring to other compulsive behaviors or disorders, particularly dependence, in news media. Addiction is the compulsive use of a substance or performance of a behavior that is independent of withdrawal. Addiction can occur in the absence of dependence, and dependence can occur in the absence of addiction, although the two often occur together.

Personality theories of addiction are psychological models that associate personality traits or modes of thinking (i.e., affective states) with an individual's proclivity for developing an addiction.

1.2.8 EATING DISORDER:

"An eating disorder is a mental disorder defined by abnormal eating behaviors that negatively affect a person's physical or mental health. Only one eating disorder can be diagnosed at a given time."

Types of eating disorders include binge eating disorder, where the patient eats a large amount in a short period of time; anorexia nervosa, where the person has an intense fear of gaining weight and restricts food or over exercises to manage this fear; bulimia nervosa, where individuals eat a large quantity (binging) then try to rid themselves of the food (purging); pica, where the patient eats non-food items; rumination syndrome, where the patient regurgitates undigested or minimally digested food; avoidant/restrictive food intake disorder (ARFID), where people have a reduced or selective food intake due to some psychological reasons and a group of other specified feeding or eating disorders.

Anxiety disorders, depression and substance abuse are common among people with eating disorders. These disorders do not include obesity. People often experience co morbidity between an eating disorder and OCD. It is estimated 20-60% of patients with an ED have a history of OCD.

The causes of eating disorders are not clear; although both biological and environmental factors appear to play a role. Cultural idealization of thinness is believed to contribute to some eating disorders.

1.3 SOME CAUSES OF MENTAL HEALTH

1.3.1 MENTAL HEALTH AND GENDER DISPARITY:

"Gender equality is more than a goal in itself. It is a precondition for meeting the challenge of reducing poverty, promoting sustainable development, and building good governance."

-Kofi Annan

The World Health Organization (WHO) recognizes that health outcomes are unequal for people, both across and within countries, with inequity especially disadvantageous for women across their lifespan. The overt social and economic inequalities more commonly experienced by women, such as lower rates of schoolings and employment, less pay for similar jobs, under representation in leadership positions, and the higher level of psychosocial stressors and problems, from care giving burden to intimate partner violence, all contribute to these disparities. In recent years, these overt examples of gender inequality have rightly been the focus of many programs to improve health. What has been less studied is the impact of a more pervasive - although often less overt and quantifiable – form of gender discrimination.

Women have a significantly higher frequency of depression and anxiety in adulthood, while men have a larger prevalence of substance use disorders and antisocial behaviors. Women also have a higher prevalence of depression and anxiety disorders due to genetic and biological factors. Some studies have found that mood swings are linked to hormonal changes

during the menstrual cycle. The interplay of psychosocial and hormonal factors resulted in an increased risk of prenatal and postnatal depression. Infertility and hysterectomy have been linked to an increased risk of affective/neurotic disorders in women.

According to the social constructionist perspectives, gender differences do not reside in the individual but are actively (re)produced in social interactions. Men and women think and act the way they do due to cultural ideas of femininity and masculinity, not because of role identities or psychological qualities.

1.3.2 MENTAL HEALTH AND CLIMATE CHANGE:

"We are in danger of destroying ourselves by our greed and stupidity. We cannot remain looking inwards at ourselves on a small and increasingly polluted and overcrowded planet."

- Stephen Hawking

The expanding research literature on climate change and mental health includes increasing evidence that extreme weather events—which are more frequent, intense, and complex under a changing climate—can trigger post-traumatic stress disorder (PTSD), major depressive disorder (MDD), anxiety, depression, complicated grief, survivor guilt, vicarious trauma, recovery fatigue, substance abuse, and suicidal ideation.

Incremental climate changes, such as rising temperatures, rising sea levels, and episodic drought, can change natural landscapes, disrupt food, and water resources, change agricultural conditions, change land use and habitation, weaken infrastructure, and give rise to financial and relationship stress, increase risks of violence and aggression, and displacement of entire communities.

The overarching threats of a changing climate can also incite despair and hopelessness as actions to address the 'wicked problem' of climate change seem intangible or insignificant in comparison to the scale and magnitude of the threats. Paradoxically, these same disastrous circumstances may also inspire altruism, compassion, optimism, and foster a sense of meaning and personal growth (otherwise referred to as post-traumatic growth) as people band together to salvage, rebuild, and console amongst the chaos and loss of a changing climate.

1.3.3 MENTAL HEALTH AND ECONOMY

“The economy is the start and end of everything. You can't have successful education reform or any other reform if you don't have a strong economy.”

-David Cameron

Mental health not only has an impact at the individual level but at the economic level. A Penn State research study found that poor mental health can result in billions of dollars of less total income for the economy. Stephan Goetz, professor of agricultural and regional economics, Penn State, and director of the Northeast Regional Center for Rural Development, says a single day of poor mental health can result in 1.84 percent drop in the per capita real income growth rate, which adds up to $53 billion less of total income, according to Science Daily.

The Penn State researchers estimate that, over the next 20 years, the global impact of mental illness could be more than $16 trillion. WHO estimates that $1 trillion is lost every year due to decreased productivity as a result of mental health issues. Tending to mental health can have a major impact for employers and the economy. A 2016 WHO study found that for every dollar investing in treatment for depression and anxiety resulted in a return of $4, as well as better health and productivity.

Mental health needs to be a global humanitarian and development priority — and a priority in every country,” said Arthur Klein man, Professor of Medical Anthropology and Psychiatry at Harvard University and an expert on global mental health. “We need to provide treatment, now, to those who need it most, and in the communities where they live. Until we do, mental illness will continue to eclipse the potential of people and economies.”

1.3.4 PHYSICAL AND MENTAL HEALTH

“When mental health is ultimately recognized as essential to physical health, not an extraneous element of it, then we will have access to true, complete, modern medicine.”

-John Campo

Mental and physical health is fundamentally linked. There are multiple associations between mental health and chronic physical conditions that significantly impact people’s quality of life, demands on health care and other publicly funded services, and generate consequences to society. The World Health Organization (WHO) defines: health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The WHO states that **“there is no health without mental health.”**

Understanding the links between mind and body is the first step in developing strategies to reduce the incidence of co-existing conditions and support those already living with mental illnesses and chronic physical conditions. People with serious mental health conditions are at high risk of experiencing chronic physical conditions and vice versa.

Your mental health plays a huge role in your general well-being. Being in a good mental state can keep you healthy and help prevent serious health conditions. A study found that positive psychological well-being can reduce the risks of heart attacks and strokes.

On the other hand, poor mental health can lead to poor physical health or harmful behaviors.

Chronic diseases: Depression has been linked to many chronic illnesses. These illnesses include diabetes, asthma, cancer, cardiovascular disease, and arthritis.

Mental health conditions can also make dealing with a chronic illness more difficult. The mortality rate from cancer and heart disease is higher among people with depression or other mental health conditions.

Sleep problems: People with mental health conditions are more likely to suffer from sleep disorders, like insomnia or sleep apnea. Insomnia can make it hard to fall asleep or stay asleep. Sleep apnea leads to breathing problems, which can cause you to wake up frequently.

Smoking: People with mental health conditions are more likely to smoke than those who do not have mental health conditions. Among smokers, people with mental health conditions are more likely to smoke a greater number of cigarettes.

People with depression have lower levels of the chemical dopamine. Dopamine influences positive feelings in your brain. The nicotine in cigarettes triggers the production of the chemical dopamine, so smoking may be used as a way to relieve symptoms of depression.

***"*So many spend their health gaining wealth, and then have to spend their wealth to regain their health."**

– A.J. Materi

“Give yourself a break. Stop beating yourself up! Everyone makes mistakes, has setbacks and failures. You don’t come with a book on how to get it right all the time. You will fail sometimes, not because you planned to, but simply because you’re human. Failure is a part of creating a great life.”

-Les Brown

“Although the general perception of mental illness has improved over the past decades, studies show that stigma against mental illness is still powerful, largely due to media stereotypes and lack of education, and that people tend to attach negative stigmas to

mental health conditions at a far higher rate than to other diseases and disabilities, such as cancer, diabetes or heart disease."

-Jean Holthauss

1.4 MENTAL HEALTH QUOTIENT:

1.4.1 INTRODUCTION:

The Mental Health Quotient (MHQ) is an anonymous web-based assessment of mental health and well-being that comprehensively covers symptoms across 10 major psychiatric disorders, as well as positive elements of mental function. It uses a novel life impact scale and provides a score to the individual that places them on a spectrum from Distressed to Thriving along with a personal report that offers self-care. Since April 2020, the MHQ has been freely deployed as part of the Mental Health Million Project. The objective of the Mental Health Million Project is to provide an evolving global map of mental wellbeing, and enable deep insights into its drivers that can be used for more effective management of population mental wellbeing through evidence-based social policy and interventions.

To address these challenges, as describe below, we have developed a new web-based assessment tool called the Mental Health Quotient (MHQ), which is designed for the general population and covers the complete breadth of clinical mental health symptoms as well as positive mental assets. It has been developed based on an extensive review of the way mental health is assessed in clinical and research fields, and its purpose is to provide a comprehensive assessment of an individual's mental health profile ranging from clinical to thriving, which is suitable for both clinical and population-based assessments. Here, we describe the development of the MHQ and provide preliminary data from a cross-section of the population to illustrate its output.

1.4.2 CHALLENGES IN MENTAL HEALTH ASSESSMENT:

One major challenge is that the clinical heritage of mental health assessment means that most tools are not designed for the general population but are instead built around specific psychiatric disorder categories based on the clinical classification systems of the Diagnostic and Statistical Manual of Mental Disorders (DSM) or the International Classification of Diseases (ICD). In this way, an assessment can identify whether an individual exhibits symptoms pertaining to a specific mental health disorder such as depression, attention-deficit/hyperactivity disorder (ADHD), or alcohol addiction but does not readily provide a perspective of their overall mental health. In contrast, the general population falls along a continuum ranging from disordered to thriving and therefore having a system that is predominantly focused on disorders and dysfunction, without an equivalent understanding of well-being, presents a challenge to advancing the understanding of the borders between

normal mental health and clinical disorder , especially because many mental health symptoms such as sadness, anxiety, and risk-taking also fall within the spectrum of normal mental functioning in the general population. Understanding when such normal mental functions cross the boundary to become symptoms requires an assessment approach that is designed for the general population and that encompasses the range from clinical dysfunction to positive mental assets.

A second challenge is that existing mental health assessment tools, despite being broadly based on symptom criteria defined by DSM or ICD classification systems, are highly heterogeneous. Our recent analysis of 126 commonly used mental health screening assessments revealed considerable inconsistency in symptom assessment across different tools focusing on the same disorder and substantial overlap between disorders. Consequently, two assessments that target the same population group, but which used different tools to assess their experience of mental health problems, may deliver different results because they are assessing a different set of symptoms (see also the study by Fried). This creates ambiguity, bias, and inconsistency in mental health determination and confuses the development of effective treatments and interventions to promote well-being within the general population. Moreover, when examining assessment tools that span multiple disorders and therefore aim to provide a broader perspective on mental health, Newson et al found that none of the 16 cross-disorder assessment tools that were analyzed covered the complete breadth of mental health symptoms and few considered positive mental assets (see also the study by Allsopp et al). This suggests that existing cross-disorder tools fail to provide a complete picture of mental health symptoms and positive assets that would apply to both clinical and normal healthy populations.

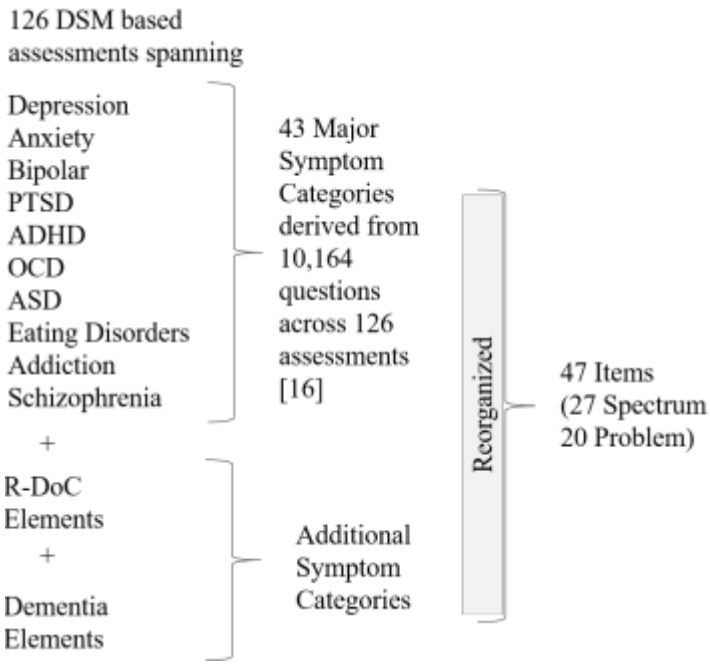
1.5 DESIGN AND DEVELOPMENT OF THE MHQ

The key design criteria of the MHQ were that it had to be fast and easy to complete by the general population (take ≤15 min) and administered such that respondents felt confident in providing honest responses that were reflective of the current perception of the respondent's mental health. The MHQ was therefore designed to provide a view of respondent perception within their individual life context, which is not absolute, that is, what one person means by a severity rating of 8 could be different from what someone else means in actual life outcomes and can change over time. This is in line with how the majority of mental health symptoms are typically assessed. In addition, as an output, it would have to provide an overall score of mental health as well as scores along key macro dimensions. Taking these requirements into consideration, the standard version of the MHQ was developed to be taken on the web anonymously and provide a score and full individual report that encourages honest self-report.

1.6 DEVELOPING A COMPLETE INVENTORY OF MENTAL HEALTH AND WELL-BEING ELEMENTS

The MHQ was developed based on a comprehensive review of symptoms assessed across 126 commonly used psychiatric assessment tools, spanning disorders of depression, anxiety, bipolar disorder, ADHD, post-traumatic stress disorder (PTSD), obsessive-compulsive disorder (OCD), addiction, schizophrenia, eating disorder, and autism spectrum disorder (ASD), and cross-disorder tools (see the study by Newson Etalfor a complete list of assessment tools).

Diagram illustrating the method of development of the MHQ



1.6.1 MHQ QUESTIONS:

Questions designed to collect demographic, experience and momentary information are also included to provide insights into the life context and situation of the respondent.

Questions were answered based on the current perception of the respondent (“Please choose your answers based on your current perception of yourself”) and were formulated on a 9-point scale reflecting the consequence on one’s life functioning and performance. Figure A shows an example of a spectrum question from the MHQ and figure B shows an example of a

problem question. Each question included a broad category label, as well as a one sentence description of the item for clarity.

1.6.2 MHQ SCALE:

The MHQ positions individuals on the spectrum from *Distressed* to *Thriving*, spanning a possible range of scores from −100 to +200 where negative scores indicate a mental wellbeing status that has significant negative impact on the ability to function. Importantly the MHQ score is not based on a simple averaging of question ratings but rather each individual rating is thresholder along the functional scale between positive and negative impact to function and nonlinearly transformed based on a ranked severity of implications. The positive range of the scale is modelled on the IQ scale. Positive scores, which are largely normally distributed, are calibrated to a mean of 100 based on our original 2019 sample and can range from 1 to 200. Negative scores, on the other hand, have a long-tailed distribution. In order to ensure that overall average scores are not inordinately determined by the small number of individuals in the long tail, the negative scale was compressed to a smaller scale of 0 to -100 in order to mitigate the impact of negative scores on the population average. More details of this methodology are provided in (Newson and Thiagarajan, 2020).

MHQ SCORE	INTERPRETATION
-100 to -50	Distressed
-50 to 0	Struggling
0 to 50	Enduring
50 to 100	Managing
100 to 150	Succeeding
150 to 200	Thriving

1.6.3 THE SIX DIMENSIONS OF MENTAL HEALTH IN THE MHQ:

1. **Mood and Outlook:** The ability to manage and regulate emotions effectively and encompasses feelings of distress like fear, anxiety, anger, irritability, guilt, and sadness. It also includes the ability to have a constructive or optimistic outlook for the future. Abnormal forms of emotional functioning include uncontrollable crying, night terrors, severe temper outbursts, extreme phobias, uncontrollable panic attacks, highly traumatic flashbacks, intense mania, or suicidal intentions.

2. **Social self**: The ability to interact with, relate to, and see oneself with respect to others. It includes factors like confidence, communication skills, self-worth, body image, empathy, and relationship building. Abnormal forms of social functioning include excessive unprovoked aggression, a strong sense of being detached from reality, or suicidal intentions

3. **Drive and motivation:** The ability to work toward desired goals and to initiate, perseveres, and completes activities in daily life. It is associated with interest, curiosity, and motivation and is also related to overall energy levels. Abnormal forms of drive and motivation include severe addictions that cause harm or extreme withdrawal from activities or social interaction.

4. **Cognition**:

(i) **Core cognition:** The ability to function effectively and independently on a moment-to-moment basis. It includes brain functions such as attention, memory, learning, and self-control. Abnormal aspects of core cognition include severe or extreme forms of mental confusion, obsessive thoughts, sensory sensitivity, compulsive behaviors, psychosis, and hallucinations.

(ii) **Complex cognition:** The ability to synthesize and make sense of complex sets of events and situations and display a longer-term perspective in thoughts and behavior. It includes brain functions such as decision making, creativity, problem solving, planning, and adaptability to change. Abnormal forms of complex cognition are associated with extreme risk-taking and severe intolerance to change.

5. **Adaptability & Resilience:** Your ability to shift your behavior and outlook in response to changing circumstances and cope with the challenges and setbacks that you encounter.

6. **Mind-body**: The regulation of the balance between mind and body to ensure that any mental concerns do not manifest themselves as physical symptoms in the body in a chronic or severe way. It includes functions like sleep, appetite, coordination, physical intimacy, and fatigue. Abnormal forms of mind-body balance can include insomnia or chronic and severe pain, as well as a propensity for infection or frequent physical symptoms (e.g., digestive issues) with no obvious physical cause.

1.7 SAPIENS LABS:

Sapiens Labs is developing an open data platform that strives to enable the understanding of the spectrum of dynamical properties of the human brain across diverse global populations. Using EEG readings from new consumer-facing hardware like OpenBCI or Emotive EPOC, Sapiens Labs hopes to inspire a global data collaboration that will advance our understanding of factors that drive human brain dynamics and how this in turn drives human behavior.

1.8 GENDER GAP:

The gender gap is the difference between women and men as reflected in social, political, intellectual, cultural, or economic attainments or attitudes.

The Global Gender Gap Index benchmarks the evolution of gender-based gaps among four key dimensions:

- Economic Participation and Opportunity,
- Educational Attainment,
- Health and Survival, and
- Political Empowerment

tracks progress towards closing these gaps over time.

1.8.1 ECONOMIC PARTICIPATION AND OPPORTUNITY

Economic participation refers to an individual's engagement in work and/or education, and their access to economic resources that results from such participation. Since economic participation provides financial, health and social benefits, it is central to the wellbeing of a population. Economic opportunity means young people can access the education, training, guidance, and connections required to successfully achieve economic security and independence.

The gender gap in Economic Participation and Opportunity remains the second-largest of the four key gaps tracked by the index. According to this year's index results 58% of this gap has been closed so far. The gap has seen marginal improvement since the 2020 edition of the report and as a result we estimate that it will take another 267.6 years to close. The slow progress seen in closing the Economic Participation and Opportunity gap is the result of two opposing trends. On one hand, the proportion of women among skilled professionals continues to increase, as does progress towards wage equality, albeit at a slower pace. On the other hand, overall income disparities are still only part-way towards being bridged and there is a persistent lack of women in leadership positions, with women representing just 27% of all manager positions. Additionally, the data available for the 2021 edition of the report does not yet fully reflect the impact of the pandemic. Projections for a select number of countries show that gender gaps in labour force participation are wider since the outbreak of the pandemic. Globally, the economic gender gap may thus be between 1% and 4% wider than reported. The second-largest gender gap among the four components of the index is for the Economic Participation and Opportunity sub index. Only 58.3% of this gap has been closed so far, virtually unchanged since last year. The difference in performance between the best-positioned countries and those at the bottom of the ranking is significant: 41.6 percentage points separate the top 5th percentile from the bottom 5^{th}. One of the most important sources of inequality between men and women is women's underrepresentation in the labor market. Participating in labour markets has been an important channel for economic empowerment of women and for building diverse, inclusive and innovative organizations. Globally, considering population-weighted averages, almost 80% of men aged 15–64 are in the labor

force versus only 52.6% of women of the same age group, explaining in part why the gender gap in labour force participation remains above 35%. Therefore, addressing normative and legal barriers for women to work and advance remains a priority area for policymakers and businesses in all countries.

This sub index contains three concepts: the participation gap, the remuneration gap and the advancement gap. The participation gap is captured using the difference between women and men in labour force participation rates. The remuneration gap is captured through a hard data indicator and a qualitative indicator gathered through the World Economic Forum's annual Executive Opinion Survey. Finally, the gap between the advancement of women and men is captured through two hard data statistics.

1.8.2 EDUCATION ATTAINMENT

Educational Attainment is the sub index with the smallest global gender gap and relatively low variation: 121 countries have closed at least 95% of their educational gender gaps and 64 countries (more than one-third of the sample) have already achieved at least 99.5% gender parity. Among them are 28 advanced economies and 36 emerging and developing economies from all regions. Nineteen are located in the Eastern Europe and Central Asia region; sixteen are in Latin America, seventeen in Western Europe, three in Sub-Saharan Africa, four in East Asia and the Pacific, two in North America, two in the Middle East and North Africa and one in South Asia. However, in Sub-Saharan Africa and the Middle East there are countries with educational gender gaps as large as 10% or more. In fact, 21 countries in these two regions have closed below 89% of their gender gaps in education, and eight countries rank below the fifth percentile on the index, with scores below 76%. These are Mali (75.7%), Benin, where only 73.3% of the educational gender gap has been bridged, Niger (72.6%), Yemen (71.7%), Guinea (68.0%), Congo, Dem. Rep. (65.8%), Chad (58.9%) and the newly assessed Afghanistan (51.4%).

On Educational Attainment, gender gaps can be fully closed in just 14.2 years. Global performance is unchanged at 96.1%, marking a progress of 4.9% since 2006, or 0.33 percentage points per year. The sub index has improved steadily towards parity, with step-changes in 2008 and 2015. However, between 2021 and 2022, the distance between the highest and lowest gender gap score increased, reflecting widening disparities within this sub index.

Regional variations on the Educational Attainment sub-indexes are narrower.

This indicator is calculated by dividing the number of adult's age 25 years and above who completed the specified level of education as the highest level of educational attainment by the total population of the same age group and multiplying the result by 100.

It refers to the highest level of education that a person has successfully completed. Successful completion of a level of education refers to the achievement of the learning objectives of that level, typically validated through the assessment of acquired knowledge, skills and

competencies. It is usually measured with respect to the highest education program successfully completed, which is typically certified by a recognized qualification.

Educational attainment can be collected or derived from any of the following:

1. a single question referring specifically to the highest certificate, diploma or degree obtained by the person.
2. a single question which asks for all certificates, diplomas, or degrees the person has obtained.
3. responses to a set of questions, each of which ask whether the person has obtained a specific certificate, diploma, or degree.

This sub index captures the gap between women's and men's current access to education through ratios of women to men in primary-, secondary- and tertiary-level education. A longer-term view of the country's ability to educate women and men in equal numbers is captured through the ratio of the female literacy rate to the male literacy rate.

1.8.3 HEALTH AND SURVIVAL

Health and Survival is the sub index in terms of progress towards gender parity globally.

The male-female health-survival paradox—the phenomenon observed in modern human societies in which women experience greater longevity and yet higher rates of disability and poor health than men—has far-reaching economic, sociological, and medical implications.

Health and Survival is the second-best sub index in terms of progress towards gender parity globally. Here, compared to the results on the Educational Attainment sub index, the progress is more uniform across countries. All countries have closed at least 93% of their health gender gaps so far, including 56 countries that have already achieved full gender parity to date. However, populous countries such as China, India, Azerbaijan, and Pakistan have achieved scores that are lower than 94%, with China slightly progressing since the last edition. The main driver of cross-country variation is the skewed sex ratio at birth. In China, there are 0.88 female births for every male birth.

Health and Survival gender gap remains undefined. There has been a very slight decline in the global score this year (from 95.7% to 95.6%). In Health and Survival, only East Asia and the Pacific has shown performance improvements over the previous year. In all other regions, gender gaps are either stagnant or slightly wider than one year ago.

This sub index provides an overview of the differences between women's and men's health through the use of two indicators. The first is the sex ratio at birth, which aims specifically to capture the phenomenon of "missing women," prevalent in many countries with a strong son preference. Second, we use the gap between women's and men's healthy life expectancy. This measure provides an estimate of the number of years that women and men can expect to live in good health by taking into account the years lost to violence, disease, malnutrition, and other relevant factors.

1.8.4 POLITICAL EMPOWERMENT

Political Empowerment sub index shows no overall progress against last year, with virtually no change in the three indicators that constitute it. This sub index also manifests the largest remaining gender gap of all sub-indexes with a global average score of 0.22, as well as the widest range of dispersion among countries. The lowest measure of progress on this sub index is 0%, Vanuatu, and the highest is 87%, Iceland. The global Political Empowerment gender gap this year is still 77.6% – about 8.1 percentage points smaller than the first measure reported in 2006, but not the lowest in the history of the index. The Political Empowerment sub index registered significant advance towards parity between 2006 and 2016, fluctuating until 2021, after which it stalled below its 2019 peak. At this rate, it will take 155 years to close the Political Empowerment gap.

The area where gender gaps remain the widest is Political Empowerment, which also registers the most important regression compared to last year (-2.4 percentage points). Although Political Empowerment improves by at least 0.1 percentage points in 92 countries, only 22.3% of this gap has been closed so far, and even the best performer, Iceland, has yet to close 24% of this gap. Iceland's score is 23.2 percentage points above the 95th percentile and 56.5 percentage points higher than the median global performance. It highlights just how exceptional the performance of Iceland is, but also how much remains to be done to achieve gender parity in politics in most countries. Of some 35,500 parliament seats across the 156 countries covered by the index, only 26.1% of them are held by women. In 52 countries women represent less than 20% of the lower-chamber seats and in two countries (Vanuatu and Papua New Guinea), as reported in the previous edition of the report, there are no women in the entire parliament. Women are similarly under-represented in ministerial positions. Only 22.6% of the over 3,400 ministers worldwide are women. The median country performance on this aspect is 21.5%, and only in the top 5th percentile of the index are there are at least as many women ministers as there are men. In nine countries (Armenia, Azerbaijan, Brunei Darussalam, Papua New Guinea, Saudi Arabia, Thailand, Viet Nam and Yemen) there are no female ministers at all. Examining the highest political position in a country, very few women have served as head of state in the past 50 years. In 81 (over one-half) of the 156 countries assessed this year, there has never been a woman in this position, including countries considered relatively progressive with respect to gender parity such as Sweden, Spain, the Netherlands, and the United States. In an additional 17 countries, women have been in power collectively for less than one year in the last 50 years. There are, however, some countries where women have been in leadership roles for several years or have increased their presence at the highest institutional levels in the past few years. For instance, in Switzerland, a woman has been in head-of-state positions for almost eight of the past 50 years and the Presidency of the Swiss Confederation has been held by a woman in six of the past 10 years. Countries where women are found in the head-of state position more frequently than the norm include Finland (13 years out of 50), New Zealand (14 years), the United Kingdom (14.6 years), India (15.5 years), Germany (15.6 years), the Philippines (15.8 years), Norway (17.4 years), Ireland (20.8 years), Iceland (23.5 years) and Bangladesh, which

is the only country where more women have held head-of-state positions (27 years) than men in the past 50 years.

Political Empowerment has consistently been the area with the largest remaining gender gaps across all regions and has in fact further widened in some regions this year. Performance remains poor in the Middle East and North Africa, where only 12.1% of the gap has been closed, as well as in Eastern Europe and Central Asia (14.2%), and East Asia and the Pacific (13.5%).

This sub index measures the gap between men and women at the highest level of political decision-making through the ratio of women to men in ministerial positions and the ratio of women to men in parliamentary positions. In addition, we have included the ratio of women to men in terms of years in executive office (prime minister or president) for the last 50 years. A clear drawback in this category is the absence of any indicators capturing differences between the participation of women and men at local levels of government. Should such data become available at a globally comparative level in future years, it will be considered for inclusion in the index.

1.9 MULTIDIMENSIONAL POVERTY INDEX:

Multidimensional Poverty Indices use a range of indicators to calculate a summary poverty figure for a given population, in which a larger figure indicates a higher level of poverty. It reflects the deprivations that a poor person faces simultaneously concerning education, health, and living standards

The key findings of MPI 2021 are:

a) 1.3 billion people across 109 countries live in acute multidimensional poverty.

b) Out of 1.3 billion people, 644 million are children (below the age of 18); whereas 105 million people are old (above the age of 60).

c) Nearly, 85 percent of multidimensionally poor people live in Saharan Africa or South Asia.

d) 84 percent of these poor people live in rural areas.

e) 67 percent and more of the total multidimensionally poor population, live in middle-income countries.

The global Multidimensional Poverty Index (MPI) measures acute multidimensional poverty across more than 100 developing countries. It does so by measuring each person's deprivations across 10 indicators in three equally weighted dimensions: health, education and standard of living. By identifying both who is poor and how they are poor, the global MPI complements the international $1.90 a day poverty rate. The global MPI is updated annually to incorporate newly released surveys and share fresh analyses. In the global MPI, people are counted as multidimensionally poor if they are deprived in one-third or more of 10 indicators, where each indicator is equally weighted within its dimension, so the health and education indicators are weighted 1/6 each, and the standard of living indicators are weighted 1/18 each.

The MPI is the product of the incidence of multidimensional poverty (proportion of multidimensionally poor people) and the intensity of multidimensional poverty (average share of weighted deprivations, or average deprivation score, 1 among multidimensionally poor people) and is therefore sensitive to changes in both components. The MPI ranges from 0 to 1, and higher values imply higher multidimensional poverty. To ensure transparency, the detailed definition of each indicator is published online, together with country-specific adjustments and the computer code used to calculate the global MPI value for each country. For the first time the global MPI is disaggregated by ethnicity or race (for 40 countries with available information), by caste (for India) and by gender of the household head (for 108 countries). Of the 20 countries that reduced their MPI value the fastest, 14 were in Sub-Saharan Africa, 3 were in South Asia, 2 were in East Asia and the Pacific and 1 was in Latin America and the Caribbean. For all available indicators 23 countries experienced a statistically significant reduction in the percentage of people who were multidimensionally poor and deprived in a given indicator for at least one period.

Households in high-MPI countries were unlikely to be covered by emergency social protection that could alleviate their insecurity. Of the 109 countries covered by the 2021 global Multidimensional Poverty Index, 108 (all but China) have estimates disaggregated by gender of the household head.1 Across all surveys, gender is a binary variable (male or female), and household head is a self-reported category. Household members typically acknowledge the household head on the basis of age (older), gender (male) or economic status (main provider; ICF 2020; UNICEF 2019). The analysis provides a global account of multidimensional poverty by headship but is constrained by the mixed definition of headship used in the surveys

Each person is assigned a deprivation score according to his or her household's deprivations in each of the 10 component indicators.

1.10 GROSS DOMESTIC PRODUCT (GDP)

Gross Domestic Product gives information about the size of the economy and how an economy is performing. It measures the monetary value of final goods and services, i.e., those that are bought by the final user produced in a country in a given period of time (say a quarter or a year). It counts all of the output generated within the borders of a country. GDP is composed of goods and services produced for sale in the market and also include some nonmarket production, such as defense or education services provided by the government. An alternative concept, gross national product, or GNP, counts all the output of the residents of a country.

Not all productive activity is included in GDP. For example, unpaid work and black-market activities are not included because they are difficult to measure and value accurately. That means, for example, that a baker who produces a loaf of bread for a customer would contribute to GDP, but would not contribute to GDP if he baked the same loaf for his family.

GDP is collected at current, or nominal, prices, one cannot compare two periods without making adjustments for inflation. To determine real GDP, its nominal value must be adjusted

to take into account price changes to allow us to see whether the value of output has gone up because more is being produced or simply because prices have increased. A statistical tool called the price deflator is used to adjust GDP from nominal to constant prices. The growth rate of real GDP is often used as an indicator of the general health of the economy.

The GDP of a nation is an estimate of the total value of all the goods and services it produced during a specific period, usually a quarter or a year.

When GDP is shrinking, as it did in many countries during the recent global economic crisis, employment often declines. In some cases, GDP may be growing, but not fast enough to create a sufficient number of jobs for those seeking them. It is measured in the currency of the country in question. That requires adjustment when trying to compare the value of output in two countries using different currencies. The usual method is to convert the value of GDP of each country into U.S. dollars and then compare them.

Real gross domestic product (GDP) increased at an annual rate of 6.9 percent in the fourth quarter of 2021, according to the advance estimate released by the Bureau of Economic Analysis. In the third quarter, real GDP increased 2.3 percent.

As of 2021, the United States and China would occupy the first two places in both methods' GDP ranking. The US and China's margin is coming down in nominal ranking as China's GDP growth rate of 2021 (8.02%) is higher than the US's 5.97%. On a nominal basis, the US is ahead of China by $6 trillion in 2021.

1.11 HUMAN DEVELOPMENT INDEX (HDI)

The HDI was created to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone. It is a summary measure of average achievement in key dimensions of human development - a long and healthy life: measured by life expectancy., being knowledgeable: measured by expected years of schooling of children at school-entry age and mean years of schooling of the adult population., and having a decent standard of living: measured by Gross National Income per capita adjusted for the price level of the country.. The HDI is the geometric mean of normalized indices for each of the three dimensions. The health dimension is evaluate by life expectancy at birth, the education dimension is measured by the mean of years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering the age. The standard of living dimension is measured by gross national income per capita. The HDI uses the logarithm of income, to reflect the diminishing importance of income with increasing GNI. The scores for the three HDI dimension indices are then aggregated into a composite index using geometric mean. Refer to technical notes for more details.

It can be used to question national policy choices, asking how two countries with the same level of GNI per capita can end up with different human development outcomes. These contrasts can stimulate debate about government policy priorities. It also simplifies and

captures only part of what human development entails. It does not reflect on inequalities, poverty, human security, empowerment, etc.

The HDI data is regularly published by the United Nations Development Programme. The differences across the world are very large, ranging from the highest values in North America, Europe, Japan, and Oceania to the lowest in central Africa.

Democratic institutions are means to deliver on collective choices. Uncertainty can affect this role, through polarization, which in turn can affect beliefs about democratic institutions. Overall, support for democracy is high globally. But the share of people considering democracy very important is sensitive to the perceptions of human insecurity, particularly in very high Human Development Index (HDI) countries and among high-income groups. People near the top of the HDI generally enjoy greater human security than those living in lower HDI settings. And because people near the top of the HDI have known greater human security, they are likely to feel entitled to it and therefore perceive insecurity as a loss. This may be a reason why people in higher HDI countries derive more distress from human insecurity.

The feeling of uncertainty across HDI categories can also be affected by the mismatch between expectations and reality: people suffering insecurity in very high HDI countries and high-income countries are more likely to experience the cognitive dissonance of development-with-insecurity: income, a measure of worth and success that often guides people's behavior and incentives, cannot in these extreme cases protect against threats, as could be typically expected. As market-based mechanisms of security and regular state-based policies struggle to deliver, authoritarian approaches might become attractive, consistent with the earlier discussion on the appeal of dominant-type leaders

HDI classifications are based on HDI fixed cutoff points, which are derived from the quartiles of distributions of the component indicators. The cutoff points are HDI of less than 0.550 for low human development, 0.550–0.699 for medium human development, 0.700–0.799 for high human development and 0.800 or greater for very high human development.

1.12 GLOBAL HEALTH SECURITY INDEX (GHS)

The Global Health Security (GHS) Index is an assessment and benchmarking of health security and related capabilities across 195 countries. The GHS Index, which is developed in partnership by the Nuclear Threat Initiative (NTI) and the Johns Hopkins Center for Health Security at the Bloomberg School of Public Health, working with Economist Impact, was first launched in October 2019. The 2021 Global Health Security Index assesses countries across 6 categories, 37 indicators, and 171 questions using publicly available information. The GHS Index benchmarks health security in the context of other factors critical to fighting outbreaks, such as political and security risks, the broader strength of the health system, and country adherence to global norms.

The GHS Index cannot predict how well available resources will be deployed when a crisis occurs. Instead, it is designed to inform leaders of the foundational elements that are

necessary to prepare their countries for future outbreaks and where they should prioritize planning and invest durable funding. By assessing these capacities every 2-3 years, the GHS Index stimulates political will and action to prioritize addressing these gaps.

The GHS Index is built upon three fundamental principles:

• Rewarding transparency: The GHS Index can assess only transparent and available data.

• Recognizing that many factors contribute to preparedness: From core public health and healthcare preparedness capacities, the GHS Index also measures cross-cutting factors related to effective biological threat mitigation, socioeconomic resilience, and societal vulnerabilities.

• Expanding accountability and responsibility: The GHS Index is prepared with the understanding that measuring countries' capacities and risks will increase accountability and motivate countries, inter-governmental organizations, donors, and the private sector to work together to ensure that countries are prepared for health security threats.

The GHS Index plays an important role within the global health security field by providing baseline data related to country preparedness capacities and risks. Countries can use these data to inform preparedness efforts, and international governmental and other global organizations can use country-level data to monitor and advocate for better preparedness for health emergencies. It provides a data driven foundation for reinvigorated national and global conversations about how to develop needed capacities and support the political, financial, and social environments needed to improve global preparedness for infectious disease threat. It also provides data-driven support for the recommendations from the GPMB and other international panels, including the G20 High Level Independent Panel on Financing the Global Commons for Pandemic Preparedness and Response and the Independent Panel for Pandemic Preparedness and Response.

The 2021 GHS Index continues to show that all countries still lack some critical capacities, which hinders their ability to respond effectively to COVID-19 and reduces their preparedness for future epidemic and pandemic threats. The average country score in 2021 was 38.9 out of 100, which is essentially unchanged from 2019. Looking at overall index scores, no country placed in the top tier of the GHS Index, signaling that significant gaps exist for all countries and across all GHS Index categories and reinforcing that preparedness remains fundamentally weak at all country income levels.

The GHS Index includes five additional high-level findings:

- Most countries, including high-income nations, have not made dedicated financial investments in strengthening epidemic or pandemic preparedness.
- Most countries saw little or no improvement in maintaining a robust, capable, and accessible health system for outbreak detection and response.

- Political and security risks have increased in nearly all countries, and those with the fewest resources have the highest risk and greatest preparedness gaps.
- Political and security risks have increased in nearly all countries, and those with the fewest resources have the highest risk and greatest preparedness gaps.
- Countries are not prepared to prevent globally catastrophic biological events that could cause damage on a larger scale than COVID-19.

1.13 CLIMATE CHANGE PERFORMANCE INDEX

The Climate Change Performance Index (CCPI) is an instrument to enable transparency in national and international climate politics. The CCPI uses a standardized framework to compare the climate performance of 57 countries and the EU, which together account for 90% of global greenhouse gas emissions. The climate protection performance is assessed in four categories: GHG Emissions, Renewable Energy, Energy Use and Climate Policy.

The climate crisis is an existential threat to life on Earth. To reduce the magnitude of the crisis' impacts, we must limit global warming to 1.5°C, as decided in the Paris Agreement. Only decisive action will reduce greenhouse gas emissions, which are responsible for climate change. As an independent monitoring tool, the CCPI has a leading role in informing on the Paris Agreement's implementation phase. Since 2005, the CCPI has provided analysis of countries' climate protection performance**.** It creates transparency in climate policy, makes it possible to compare climate protection efforts, and lets you see progress and setbacks.

The CCPI evaluates 59 countries and the European Union, which together generate 90%+ of global greenhouse gas emissions.
Using standardized criteria, the CCPI looks at four categories, with 14 indicators: Greenhouse Gas Emissions (40% of the overall score), Renewable Energy (20%), Energy Use (20%), and Climate Policy (20%).
The CCPI's unique climate policy section evaluates countries' progress in implementing policies working towards achieving the Paris Agreement goals. The indicators the CCPI provides, as well as the textual analysis and inclusion of climate policy, make it a very useful and accessible tool for climate and environmental actors. Its data helps inform policy, advocacy and legal strategy.

The CCPI aims to deliver a comprehensive and balanced evaluation of the diverse countries evaluated. It uses 14 indicators (outer circle) and the following four categories:

1. GHG Emissions (40% of overall score)
2. Renewable Energy (20% of overall score)
3. Energy Use (20% of overall score)
4. Climate Policy (20% of overall score)

The Climate Change Performance Index (CCPI) 2021 paints a mixed picture of the European Union (EU) climate action. Scandinavian EU countries, Portugal and the EU, as a whole, rank high on the index with relatively good indicators. However, Hungary, Poland and the Czech Republic stand out as laggards on climate progress within the bloc. In the overall

ranking, the EU has improved from the 22nd place last year to the 16th place this year, almost exclusively thanks to a much better rated climate policy. The latest Climate Change Performance Index clearly shows that the EU stands at a crossroads. The EU can become a role model in climate protection with green recovery measures after the coronavirus crisis, by setting an ambitious climate target for 2030 in line with the 1.5°C-limit and a good implementation and further development of its Green Deal. But it can also stumble badly if it pursues green washing instead of green recovery and implements inadequate targets and instruments in the European Green Deal.

CHAPTER 2

RESEARCH METHODOLOGY

CHAPTER 2[2]

RESEARCH METHODOLOGY

2.1 TOPIC OF STUDY

Impact of Social Reasons on Mental Health: A Stastical Analytic Study Using Python and R Software of the data set from Mental Health Million Project 2021, UNDP's HDI 2021, Global Health Security Index 2021, UNDP's Global Multidimensional Poverty Index 2021 and Climate Change Performance Index 2021.

2.2 OBJECTIVE OF THE STUDY

The Objectives of the Study are: -

1) To examine the effects of various social reasons on Mental Health Quotient.
2) To find the correlation between MHQ Score and various social reasons.
3) To identify which continent, have high variation in MHQ Score and various social reasons.
4) To make recommendations for increasing the MHQ Score.

2.3 DATA

2.3.1 DEFINITION: -Data is the raw information from which statistics are created. It can be numbers, measurements, observations or even just descriptions of things.

2.3.2 TYPES OF DATA: There are mainly four types of statistical data:

i) Primary Statistical Data
ii) Secondary Statistical Data
iii) Qualitative Statistical Data
iv) Quantitative Statistical Data

i) PRIMARY STATISTICAL DATA

The Primary data is the data that is collected directly and is not taken from a source. This data includes the data collected through direct interviews, surveys and experiments. Basically, this data comprises of results obtained through surveys on which the statistical operations have not been applied.

[2] The contents of this Chapter are taken from the sources as listed in the Websites and References

ii) SECONDARY STATISTICAL DATA

The Secondary Statistical data is the data that is obtained by the researcher from another source. This data may be collected from various sources. Many important and current data which was initially a primary data can be published in books, research papers, journals or can be kept in record books to be used as the secondary data for another researcher. The primary data on which the statistical operations have been applied is also defined as the secondary data. The secondary data can be official i.e., obtained from a ministry or a department.

iii) QUALITATIVE STATISTICAL DATA

The qualitative statistical data is the data which is expressed in words rather than in numbers. In other words, the qualitative data is the data in which the measurement of a category is expressed in words.

iv) QUANTITATIVE STATISTICAL DATA

The quantitative statistical data is the data in which the measurements are numerically expressed. The quantitative data represents measurements taken with a scale includes the variables such as temperature, weight and size that can be measured in a precise scale are expressed in their actual measurements in quantitative data.

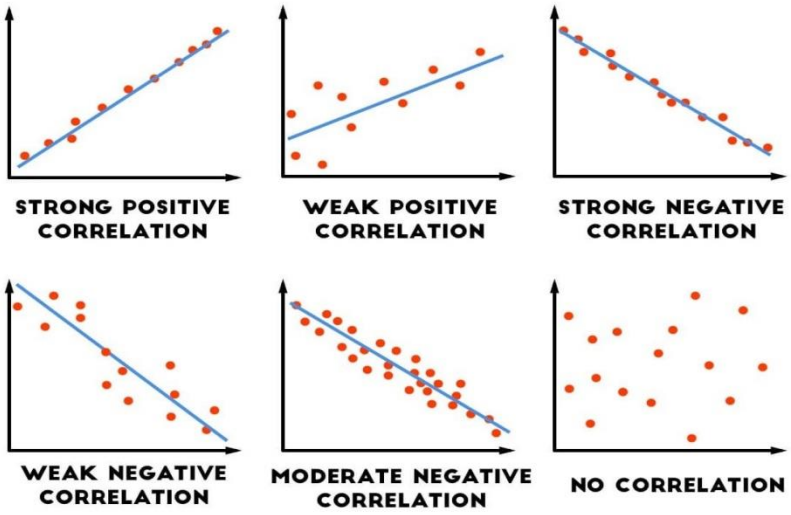
2.4 CORRELATION:

Correlation analysis is the process of studying the strength of the relationship between two related variables. If the change in one variable affects a change in the other variable, the variables are said to be correlated. The measure of correlation is the correlation coefficient or correlation index .it is an absolute measure.

2.4.1 TYPES OF CORRELATION

The scatter plot explains the correlation between the two attributes or variables. It represents how closely the two variables are connected. There can be three such situations to see the relation between the two variables –

- **Positive Correlation -** When the values of the two variables move in the same direction so that an increase/decrease in the value of one variable is followed by an increase/decrease in the value of the other variable.
- **Negative Correlation -** When the values of the two variables move in the opposite direction so that an increase/decrease in the value of one variable is followed by decrease/increase in the value of the other variable.
- **No Correlation** - When there is no linear dependence or no relation between the variables.



2.4.2 COEFFICIENT OF CORRELATION

A coefficient of correlation is generally applied in statistics to calculate a relationship between two variables. The correlation shows a specific value of the degree of a linear relationship between the X and Y variables, say X and Y. There are various types of correlation coefficients. However, Pearson's correlation (also known as Pearson's R) is the correlation coefficient that is frequently used in linear regression.

2.4.3 PEARSON'S COEFFICIENT CORRELATION

Karl Pearson's coefficient of correlation is an extensively used mathematical method in which the numerical representation is applied to measure the level of relation between linearly related variables. The coefficient of correlation is expressed by **"r".**

$$r = \frac{\sum(X-\overline{X})(Y-\overline{Y})}{\sqrt{\sum(X-\overline{X})^2}\sqrt{(Y-\overline{Y})^2}}$$

Where, $\overline{X}$ = mean of X variable

$\overline{Y}$ = mean of Y variable

INTERPRETATION

The correlation coefficient lies between -1 to +1, that is $-1 < r < 1$

- A positive value of 'r' indicates positive correlation
- A negative value of 'r' indicates negative correlation
- If r =+1, then the correlation is perfect positive.
- If r =-1, then the correlation is perfect negative.
- If r=0, then the variables are uncorrelated.
- If | r|=0.7, then the correlation will be of higher degree in interpretation we use the adjective 'highly'.
- If X and Y are independent, then r_{xy} =0. However, the converse need not be true.

2.5 SCATTER DIAGRAM

A scatter diagram is the simplest way of the diagrammatic representation of bivariate data. One variable is represented along the X axis and the other variable is represented along the Y axis. The pair of points are plotted on the two dimensional graph .The diagram of points so obtained is known as scatter diagram.

2.6 SIMPLE LINEAR REGRESSION

The simple linear regression model, that is, a model with a single regressor x, that has a relationship with a response y, that is a straight line. This simple linear regression model is

$$Y=\beta_0+\beta_1 X+ e_i \quad i=1,2,\ldots\ldots\ldots n.$$

2.6.1 ASSUMPTIONS OF SIPLE LINEAR REGRESSION:

- The regression model is linear in the parameters, though it may or may not be linear in the variables.
- X values should be independent of the error term.
- Zero mean value of error e, i.e. E (e_i) = 0.
- Homoscedasticity or constant variance of e. The variance of the error term is the same regardless of the value of X. Symbolically, var(e_i)=σ^2 .
- No autocorrelation between the errors. The observations are sampled independently. Symbolically, cov(e_i,e_j)=0 , if X is nonstochastic.

2.7 MULTIPLE LINEAR REGRESSION

Multiple linear regressions are a regression model that estimates the relationship between a dependent variable and two or more independent variables using a straight line.

Multiple linear regression (MLR), is a statistical technique that uses several explanatory variables to predict the outcome of a response variable.

Generalizing multiple two-variable regression function is:

$$Y_i=\beta_0+\beta_1X_{1i}+--------+\beta_nX_{ni}+e_i \quad i=1,2,\ldots.n.$$

Where Y is the dependent variable, $X_1,X_2,\ldots X_n$ are the explanatory variables, e_i is the error term.

2.8 NORMALITY ASSUMPTION

The classical linear regression model assumes that each e_i is distribution normally with

Mean: $E(e_i) = 0$

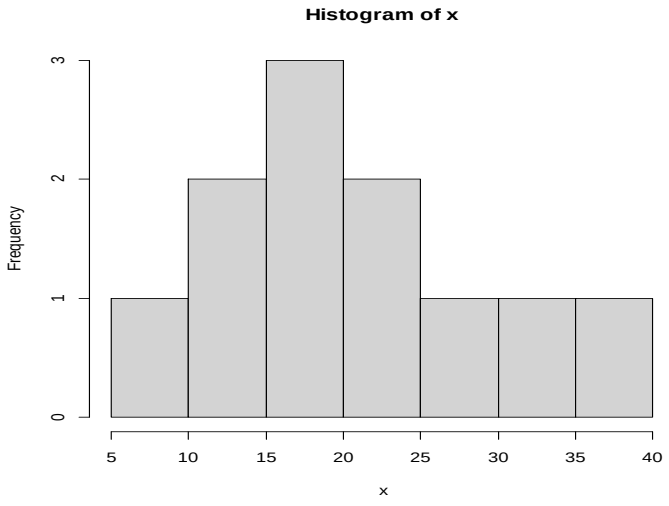
Variance: $E[e_i - E(e_i)]^2 = \sigma^2$

Cov(e_i,e_j): : $E[e_i\text{-}E(e_i)][e_j - E(e_j)]=E(e_i,e_j)=0 \quad i\neq j$

The assumption given above can be more compactly stated as

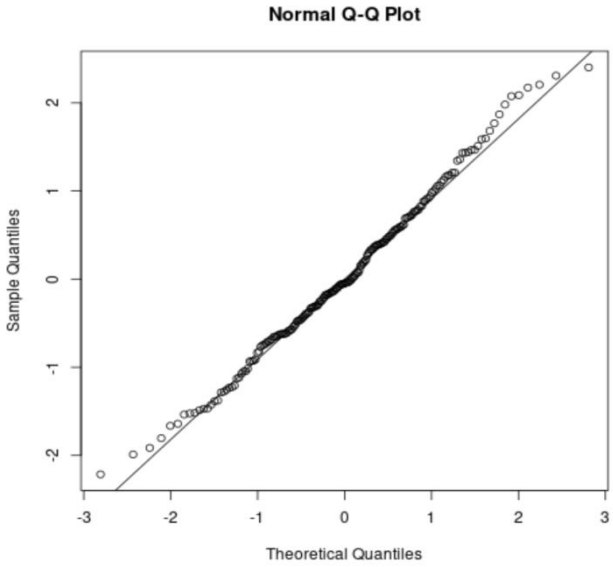
$e_i \sim N(0,\sigma^2)$

2.8.1 HISTOGRAM



A normally distributed variable has a bell-shaped histogram, with only one peak, and is symmetric around the mean. The terms kurtosis ("peakedness" or heaviness of tails") and skewness (asymmetry around the mean) are often used to describe departures from normality.

2.8.2 Q-Q Plot



In this plot, the observed data is plotted against the expected quantiles of a normal distribution. If the data is normally distributed, the points in a Q-Q plot will lie on a straight diagonal line.

2.8.3 KOLMOGOROV-SMIRNOV TEST

The Kolmogorov-Smirnov test is used to test the null hypothesis that a set of data comes from a normal distribution. The Kolmogorov-Smirnov test produces test statistics that are used (along with a degree of freedom parameter) to test for normality.

2.8.4 ANDERSON-DARLING TEST

The Anderson-Darling Test is used to test if a sample of data comes from a population with a specific distribution. It is used for testing whether your data comes from a normal distribution.

The two hypotheses for the Anderson-Darling test for the normal distribution are given below:

H_0: The data follows the normal distribution

H_1: The data do not follow the normal distribution

2.8.5 SHAPIRO-WILK TEST

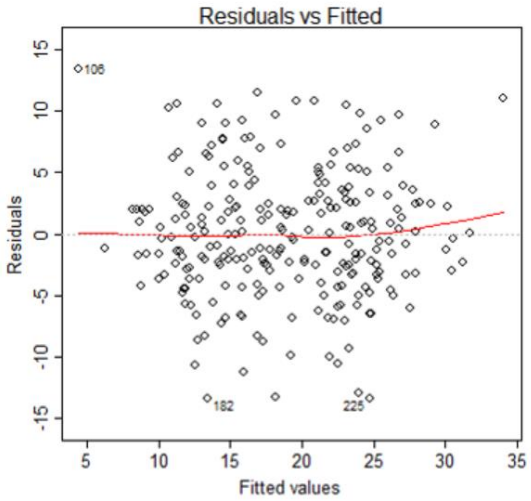
The Shapiro-Wilk test is a statistical test of the hypothesis that the distribution of the data as a whole deviate from a comparable normal distribution. If the test is non-significant ($p>.05$) it tells us that the distribution of the sample is not significantly different from a normal distribution. If, however, the test is significant ($p < .05$) then the distribution in question is significantly different from a normal distribution.

2.9 HOMOSCEDASTICITY

Homoscedasticity describes a situation in which the error term is the same across all values of the independent variables. Heteroscedasticity (the violation of homoscedasticity) is present when the size of the error term differs across values of an independent variable.

2.9.1 FITTED VS RESIDUAL

It is a scatter plot of residuals on the y axis and fitted values (estimated responses) on the x axis. When homoscedasticity holds, the spread of residuals should be approximately the same across the x-axis. If the model does not meet the linear model assumption, we would expect to see residuals that are very large (big positive value or big negative value). To assess if the homoscedasticity assumption is met, we look to make sure that there is no pattern in the residuals and that they are equally spread around the y = 0 line.



2.9.2 BREUSCH-PAGAN TEST

The Breusch-Pagan test is used to determine whether or not heteroscedasticity is present in a regression model.

The test uses the following null and alternative hypotheses:

Null Hypothesis (H_0): Homoscedasticity is present (the residuals are distributed with equal variance)

Alternative Hypothesis (H_A): Heteroscedasticity is present (the residuals are not distributed with equal variance)

If the p-value of the test is less than some significance level (i.e. $\alpha = .05$) then we reject the null hypothesis and conclude that heteroscedasticity is present in the regression model.

2.10 MULTICOLLINEARITY

Multicollinearity is a statistical concept where several independent variables in a model are correlated. Two variables are considered to be perfectly collinear if their correlation coefficient is +/- 1.

2.10.1 VARIANCE INFLATION FACTOR

A variance inflation factor (VIF) is a measure of the amount of multicollinearity in regression analysis. It measures how much the behavior (variance) of an independent variable is influenced, or inflated, by its interaction/correlation with the other independent variables.

A large VIF on an independent variable indicates a highly collinear relationship to the other variables that should be considered or adjusted for in the structure of the model and selection of independent variables.

- VIF equal to 1 = variables are not correlated
- VIF between 1 and 5 = variables are moderately correlated
- VIF greater than 5 = variables are highly correlated

The higher the VIF, the higher the possibility that multicollinearity exists, and further research is required. When VIF is higher than 10, there is significant multicollinearity that needs to be corrected.

2.11 LOGISTIC REGRESSION

Logistic regression estimates the probability of an event occurring, such as voted or didn't vote, based on a given dataset of independent variables. Since the outcome is a probability, the dependent variable is bounded between 0 and 1. In logistic regression, a logit transformation is applied on the odds, that is, the probability of success divided by the probability of failure.

For estimation purpose we write L_i as

$$L_i = \ln(P_i /(1 – P_i)) = \beta_1 + \beta_2 X_i + e_i$$

Where L_i is the dependent variable, P_i is the probability of success.

If we take the above dependent variable and add a regression equation for the independent variables, we get a logistic regression:

$$\text{logit}(P)=a+b_1x_1+b_2x_2+b_3x_3+\ldots$$

As in least-squares regression, the relationship between the logit(P) and X is assumed to be linear.

And standard logistic equation = exp(y)/(1+exp(y)).

CHAPTER 3

STATISTICAL ANALYSIS

CHAPTER 3

STATISTICAL ANALYSIS

3.1 DATA UNDER STUDY:

Here we have secondary real data for analysis. We have used the data from Report on Mental State of the 2021 by Sapien Labs, Report on Global Gender Gap Report 2021 by the World Economic Forum, Report on Global Multidimensional Poverty Index 2021 by the United Nations Development Program and Oxford Poverty Human Development Initiative, Report on Human Development 2021/2022 by the United Nations Development Program and Report on Gross Domestic Product. The study aimed at finding the correlation between MHQ Score and various social factors affecting it. The study also aims at finding the relationship between MHQ Score and various social reasons affecting it.

3.2 EXPLORATORY DATA ANALYSIS:

The data under study is given in appendix. The data is from 33 countries. The variable under study are given below:

- Mental Health Quotient (MHQ)
- Economic Participation and opportunity (EPP)
- Education Attainment
- Political Empowerment
- Health and Survival
- Multidimensional Poverty Index
- Gross Domestic Product
- Human Development Index (HDI)
- Global Health Security Index
- Climate Change Performance Index

The basic statistical constants are obtained using R software and are given below:

```
## Country             MHQ.SCORE       EPP
##  Length:33          Min.   :46.00   Min.   :0.2280
##  Class :character   1st Qu.:63.00   1st Qu.:0.5100
##  Mode  :character   Median :71.00   Median :0.6580
##                     Mean   :68.55   Mean   :0.5999
##                     3rd Qu.:74.00   3rd Qu.:0.7090
##                     Max.   :91.00   Max.   :0.7630
##
## Education.Attnmnt     Health.and.Survival Political.Empowerement Poverty.Index
##  Min.   :0.6580       Min.   :0.9370      Min.   :0.0010         Min.   :0.00300
##  1st Qu.:0.9660       1st Qu.:0.9640      1st Qu.:0.1510         1st Qu.:0.02000
##  Median :0.9920       Median :0.9680      Median :0.2760         Median :0.03300
##  Mean   :0.9518       Mean   :0.9682      Mean   :0.2864         Mean   :0.09431
##  3rd Qu.:1.0000       3rd Qu.:0.9730      3rd Qu.:0.4190         3rd Qu.:0.13400
##  Max.   :1.0000       Max.   :0.9800      Max.   :0.6300         Max.   :0.25400
##                                                                  NA's   :20
##  Gross.Domestic.Product Human.Development  Global.Health.Index
##  Min.   :  106166       Min.   :0.4550    Min.   :16.10
##  1st Qu.:  315006       1st Qu.:0.6860    1st Qu.:31.20
##  Median :  466135       Median :0.7580    Median :50.80
##  Mean   : 1750866       Mean   :0.7756    Mean   :46.45
##  3rd Qu.: 1392592       3rd Qu.:0.9210    3rd Qu.:58.80
##  Max.   :22996100       Max.   :0.9620    Max.   :75.90
##  NA's   :7
##  Climate.Change.Performance.Index Continent
##  Min.   :19.75                    Length:33
##  1st Qu.:41.88                    Class :character
##  Median :46.13                    Mode  :character
##  Mean   :47.14
##  3rd Qu.:57.59
##  Max.   :69.66
##  NA's   :14
```

INTERPRETAION

1. **MENTAL HEALTH QUOTIENT**: - Among 33 countries, Venezuela is reported to have best mental health condition as it has the maximum Mental Health Quotient, 91. While, United Kingdom and South Africa have minimum Mental Health Quotient of 46. Average Mental Health Quotient for the 33 countries is 68.5. First and third Quartiles are 63.00 and 74.00 respectively. The median Mental Health Quotient is 71. Chile, Nigeria, Cameroon, and Mexico have Mental Health Quotient as 71. Mental Health Quotient for India is below average, 56.
2. **ECONOMIC PARTICIPATION AND OPPORTUNITY (EPP): -** Among 33 countries, New Zealand has the maximum EPP for females. It has the score of 0.7630. However, Iraq has minimum EPP Score as 0.2280. Average score is 0.5999 and first quartile, median and third quartiles are 0.5100, 0.6580 and 0.7090 respectively. EPP for India is far below the average, 0.326.
3. **EDUCATION ATTAINMENT: -** Among 33 countries maximum Education Attainment of female is 1.00. Argentina, Belgium, France, Chile, Columbia, United States, Canada, New Zealand, and Australia have scored of 1.00. While Democratic country of Congo has minimum score of 0.6580. Average score is 0.9518 and first quartile, median and last quartile are 0.9660, 0.9920 and 1.000 respectively. Education Attainment of females for India is above average, 0.962.
4. **HEALTH AND SURVIVAL: -** Among 33 countries, Venezuela has maximum Health and Survival score for females is 0.9800. However, India has minimum score of 0.9370. Average score is 0.9680. And first quartile, median and last quartiles are 0.9640, 0.9680 and 0.9730 respectively.
5. **POLITICAL EMPOWERMENT: -** Among 33 countries, New Zealand has the maximum Political Empowerment for females their score as 0.6580. While, Yemen has minimum score of 0.0010. Average score is 0.2864 and first quartile, median and last quartile are 0.1510, 0.2760 and 0.6300 respectively. Political Empowerment of females in India is below average, 0.276.
6. **MULTIDIMENSIONAL POVERTY INDEX: -** Since the Multidimensional Poverty Index is not available for few countries, among 13 available countries, Nigeria has maximum Multidimensional Poverty Index of 0.25400. However, Tunisia has minimum Multidimensional Poverty Index of 0.00300. And average Multidimensional Poverty Index is 0.09431. The first quartile, median and third quartile have Multidimensional Poverty Index are 0.02000, 0.03300 and 0.13400 respectively. Multidimensional Poverty Index for India is above average, 0.123.
7. **GROSS DOMESTIC PRODUCT: -** Gross Domestic Product of few countries is not available, hence among 26 countries, United States is reported to have maximum Gross Domestic Product of $22,996,100 and Ecuador has minimum Gross Domestic Product of $106,166. Average Gross Domestic Product is $1,750,866. First quartile, median and third quartiles are $315,006, $466,136 and $1,392,592. Gross Domestic Product for India is above average and below the median, $3,173,398.
8. **HUMAN DEVELOPMENT INDEX (HDI): -** Among 33 countries, Switzerland possesses a maximum Human Development Index of 0.9620 and Yemen possesses a

minimum Human Development Index of 0.4550. Average Human Development Index is 0.7756. First quartile, median, and third quartile, for Human Development Index (HDI) are 0.6860, 0.7580 and 0.9210. Human Development Index for India is below average, 0.633.

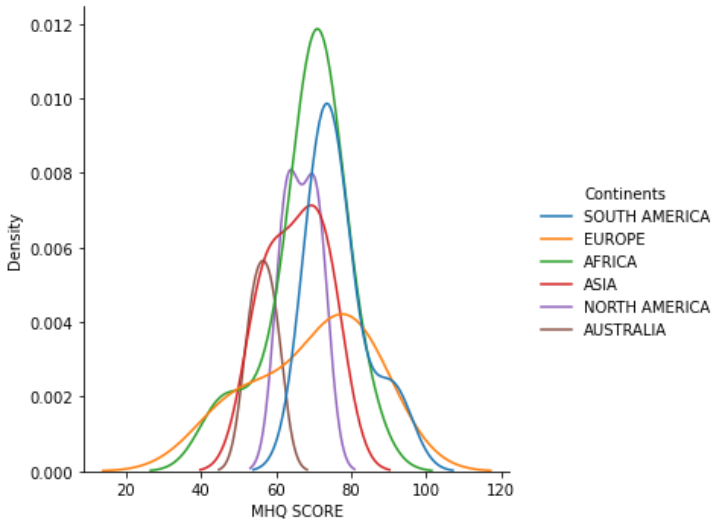
9. **GLOBAL HEALTH SECURITY INDEX: -** Among 33 countries, United States has maximum Global Health Index of 75.90 and Yemen has minimum Global Health Index of 16.10. Mean Global Health Index is 50.80. First quartile, median and third quartile Global Health Index are 31.20, 50.80 and 58.80. Global Health Security Index for India is below average, 42.8.
10. **CLIMATE CHANGE PERFORMANCE INDEX: -** Climate Change Performance Index was available for only 19 countries. Among those 19 countries, United Kingdom has maximum Climate Change Performance Index of 69.66 and United States has minimum Climate Change Performance Index of 19.75. Mean Climate Change Performance Index is 47.14. First quartile, median and third quartile Climate Change Performance Index are 41.88, 46.13 and 57.59.Climate Change Performance Index for India is fairly above average, 63.98.

3.3 CONTINENT-WISE ANALYSIS:

Using Python ten Kernel Density (KD) plots are drawn as follows.

We have used the data from 33 countries and divided them into continent wise to show their variability with the help of kernel density plot (kd plot).

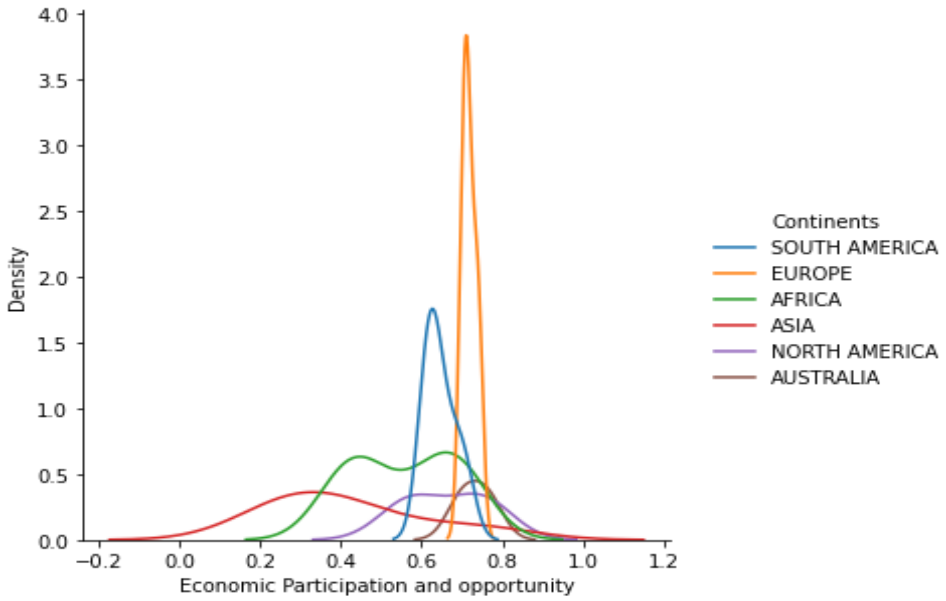
KD PLOT FOR MHQ SCORE



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in MHQ SCORE of European Countries is highest followed by Africa and Asia whereas Australia has the lowest MHQ SCORE.

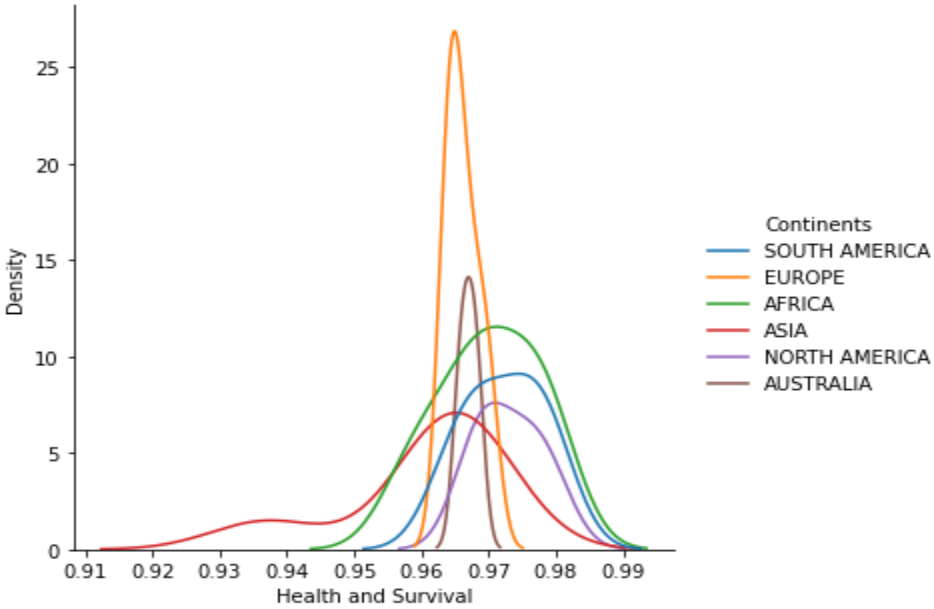
KD PLOT FOR ECONOMIC PARTICIPATION AND OPPORTUNITY



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in EPP is highest in Asia whereas it is lowest in Australia. Therefore Australia has lowest MHQ Score.

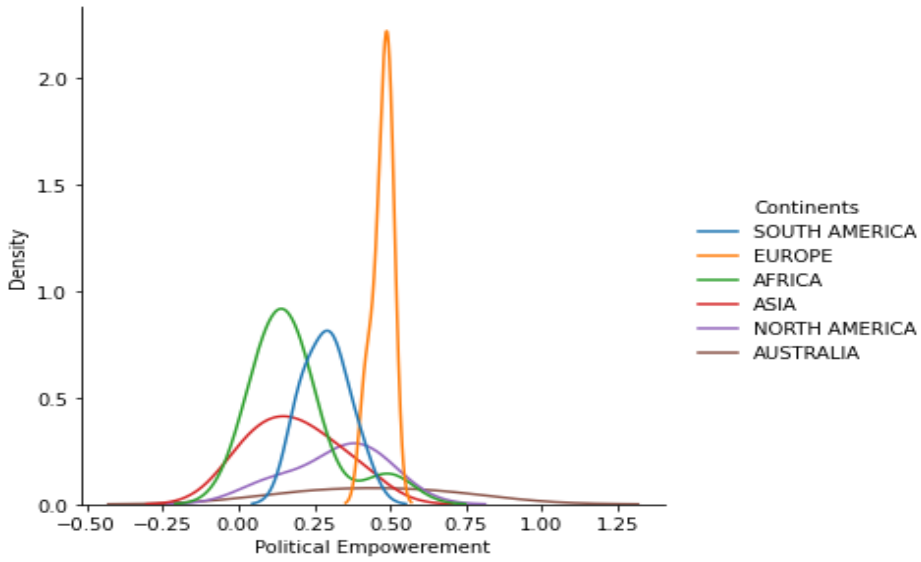
KD PLOT FOR HEALTH AND SURVIVAL



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Health and Survival is highest in Asia whereas it is lowest in Australia.

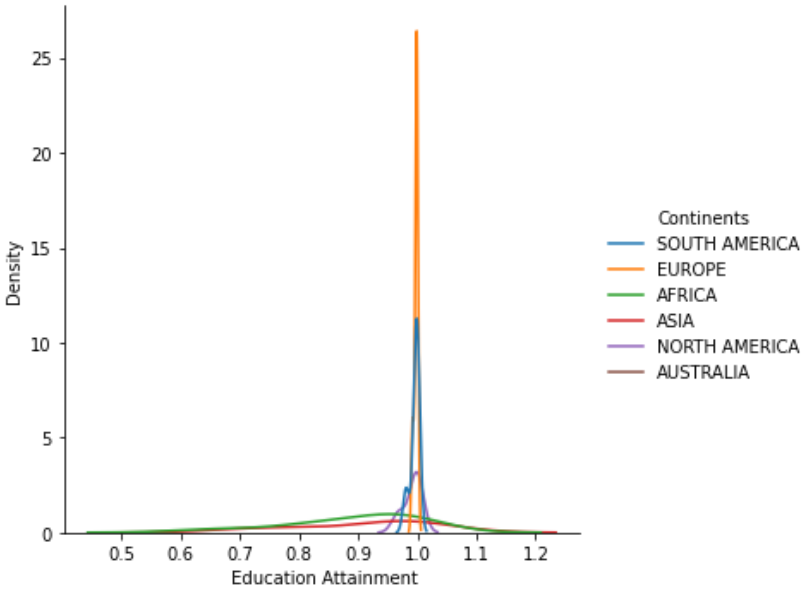
KD PLOT FOR POLITICAL EMPOWEREMENT



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Political Empowerment is highest in Australia followed by North America and Asia whereas it is lowest in Europe.

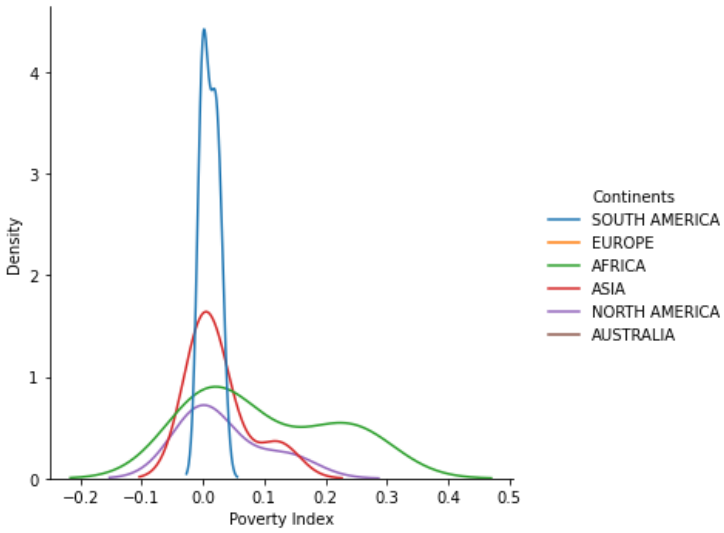
KD PLOT FOR EDUCATION ATTAINMENT



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Education Attainment is highest in Africa and Asia whereas it is lowest in Europe followed by Australia, South America and North America.

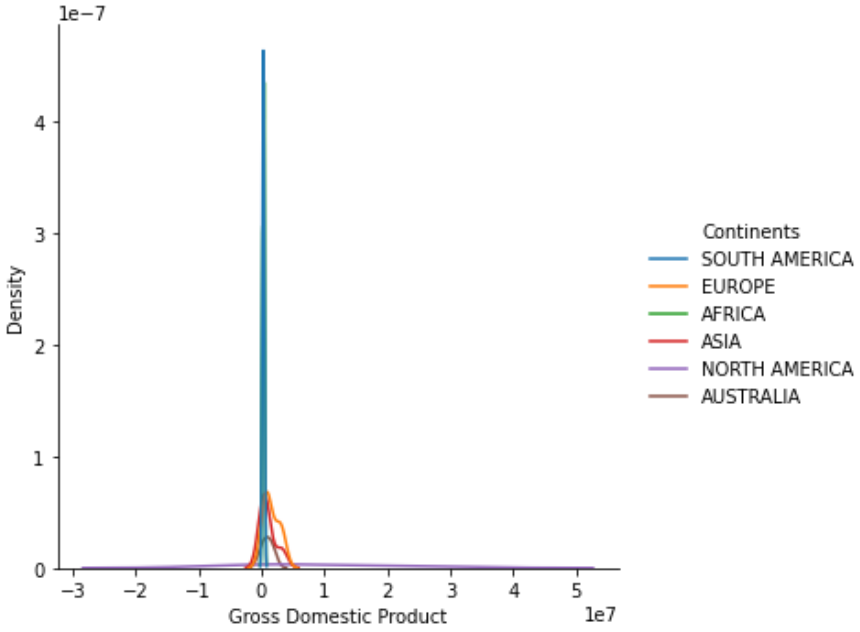
KD PLOT FOR POVERTY INDEX



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Poverty Index is highest in Africa followed by North America and Asia while it is lowest in South America.

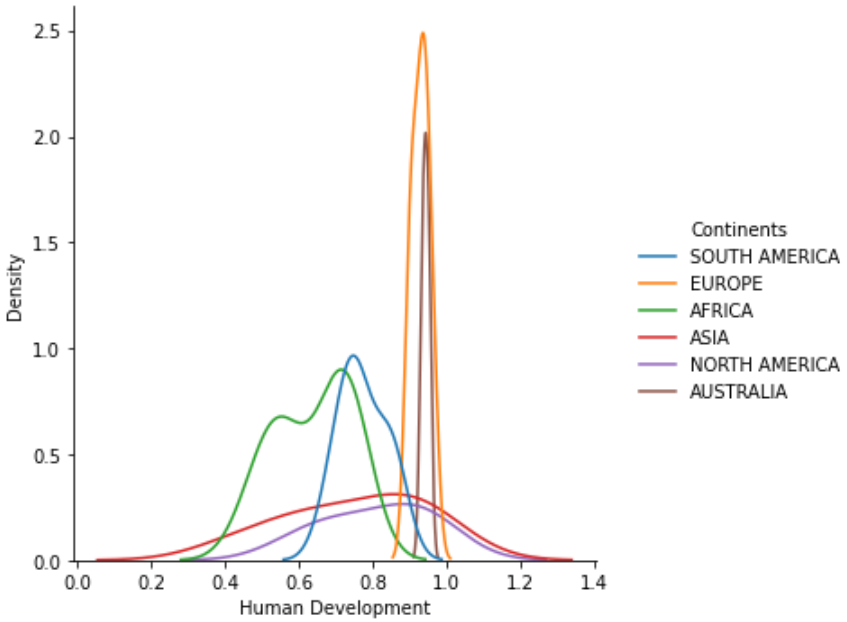
KD PLOT FOR GROSS DOMESTIC PRODUCT



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Gross Domestic Product is highest in North America whereas it is lowest in South America followed by Australia and it is moderate in Asia.

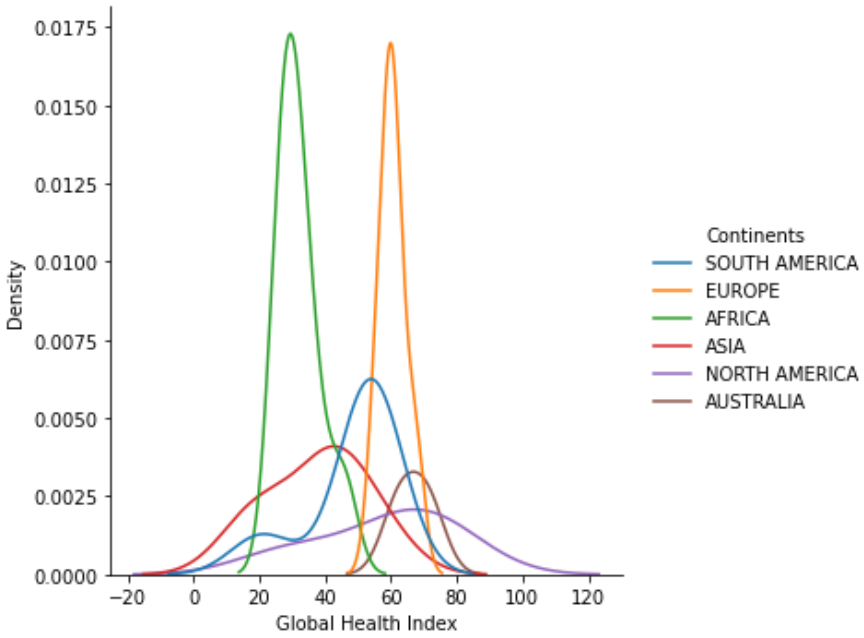
KD PLOT FOR HUMAN DEVELOPMENT INDEX



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Human Development is highest in Asia followed by North America whereas it is lowest in Australia followed by Europe.

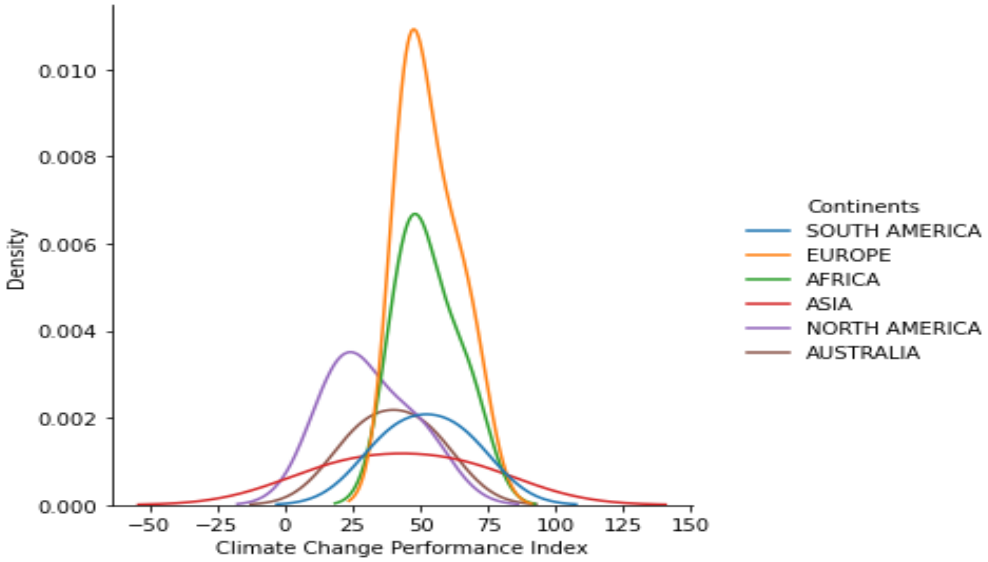
KD PLOT FOR GLOBAL HEALTH INDEX



INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Global Health Index is highest in North America followed by Asia and South America whereas it is lowest in Europe followed by Australia.

KD PLOT FOR CLIMATE CHANGE PERFORMANCE INDEX



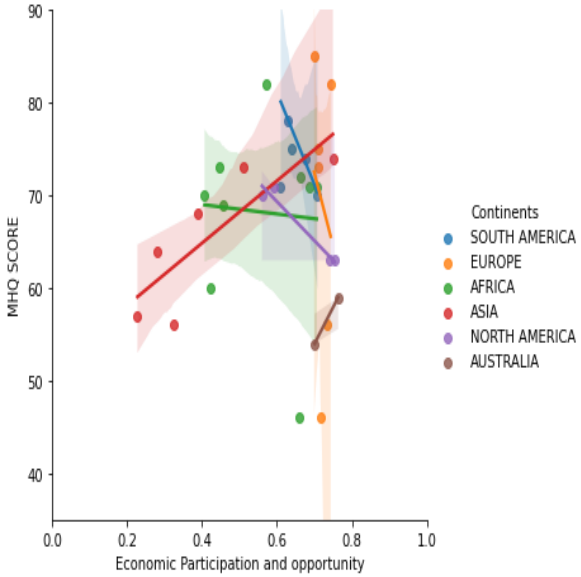
INTERPRETATION:

From the spread of the curves in the above plot, we conclude that variation in Climate Change Performance Index is highest in Asia whereas it is lowest in Africa and Europe.

Scatter Plots

Using Python nine scatter plots are drawn and given below,

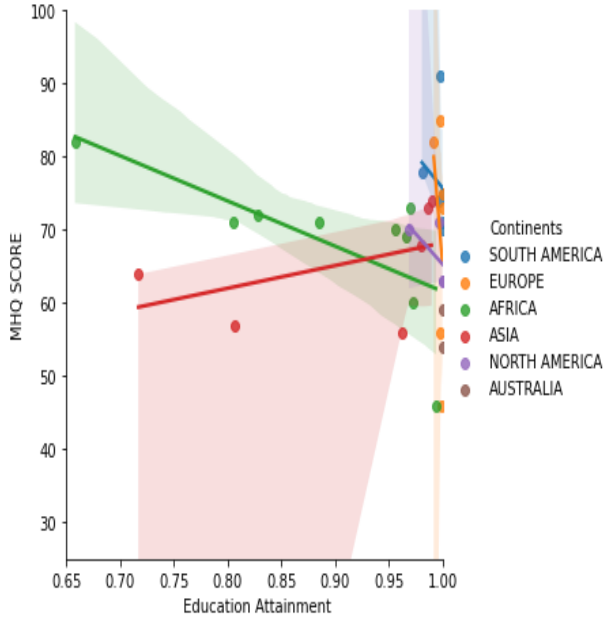
SCATTER PLOT BETWEEN MHQ AND EPP



INTERPRETATION:

The scatter plot indicates that the EPP has positive, linear relationship for Asia, and Australia and negative, linear relationship for South America, Europe, Africa, North America with Mental Health Quotient.

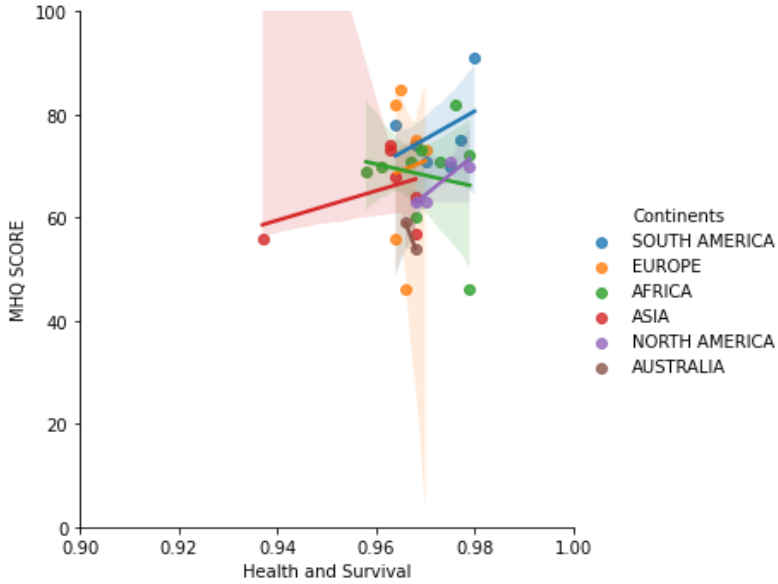
SCATTER PLOT BETWEEN MHQ AND EDUCATION ATTAINMENT



INTERPRETATION:

The scatter plot indicates that the Education attainment has positive, linear relationship for Asia and negative, linear relationship for South America, Europe, Africa, North America, Australia with Mental Health Quotient.

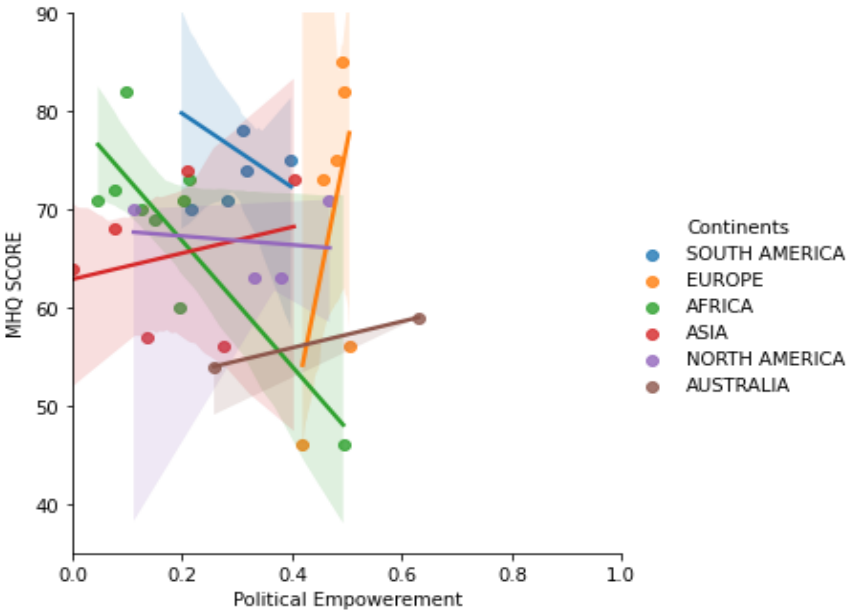
SCATTER PLOT BETWEEN MHQ AND HEALTH AND SURVIVAL



INTERPRETATION:

The scatter plot indicates that the Health and Survival has positive, linear relationship for South America, Europe, Asia, North America and negative, linear relationship for Africa and Australia with Mental Health Quotient.

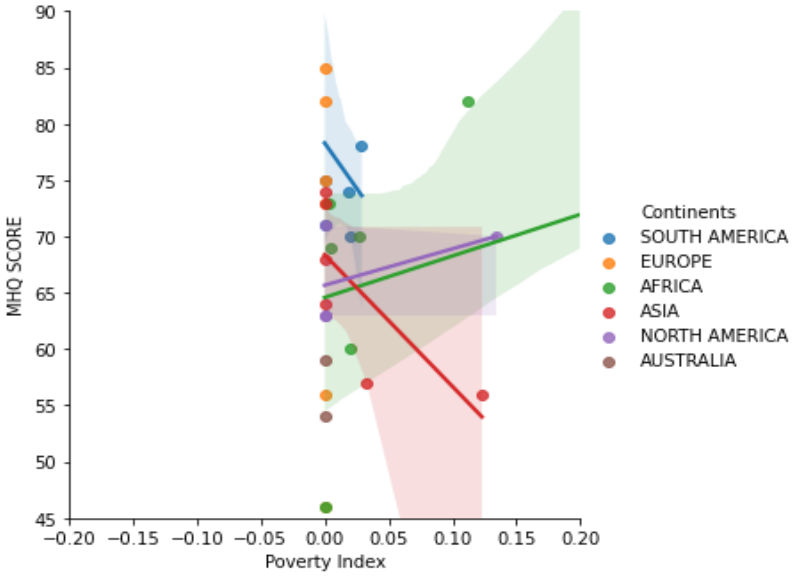
SCATTER PLOT BETWEEN MHQ AND POLITICAL EMPOWERMENT



INTERPRETATION:

The scatter plot indicates that the Political Empowerment of women has positive, linear relationship for Asia and Australia and negative, linear relationship for South America, Europe, Africa, North America with Mental Health Quotient.

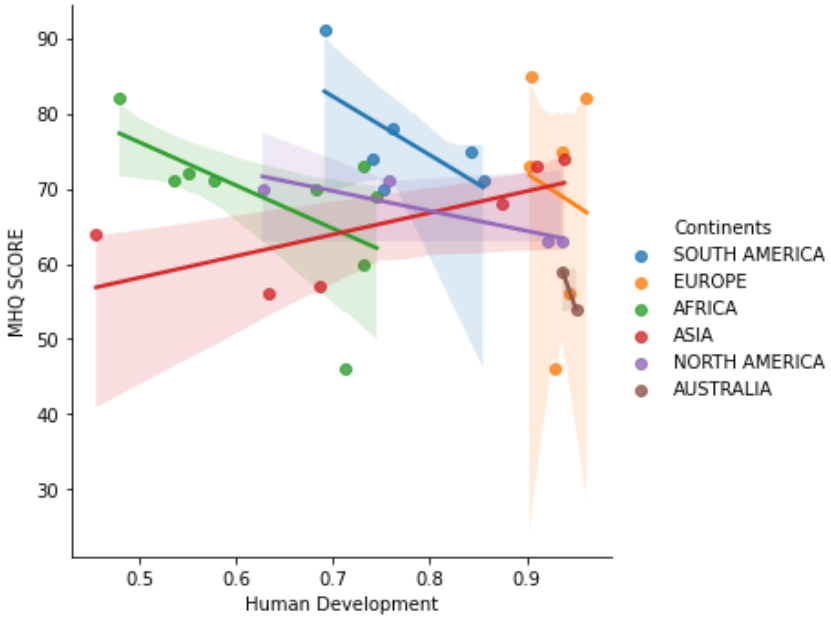
SCATTER PLOT MHQ AND MULTIDIMENSIONAL POVERTY INDEX



INTERPRETATION:

The scatter plot indicates that the Poverty Index has positive, linear relationship Africa and North America and negative, linear relationship for South America and Asia with Mental Health Quotient.

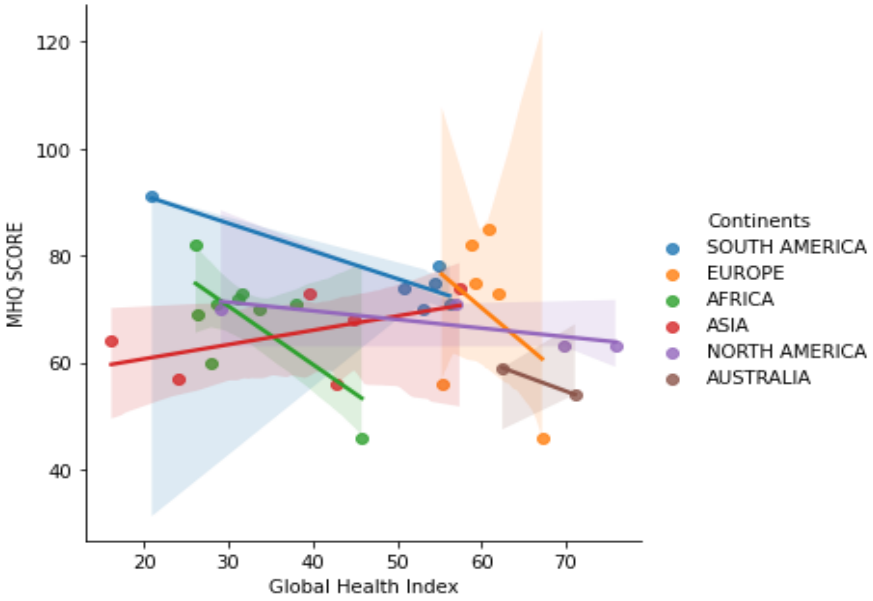
SCATTER PLOT BETWEEN MHQ AND HUMAN DEVELOPMENT INDEX(HDI)



INTERPRETATION:

The scatter plot indicates that the Human Development has positive, linear relationship for Asia and negative, linear relationship for South America, Europe, Africa, North America, Australia with Mental Health Quotient.

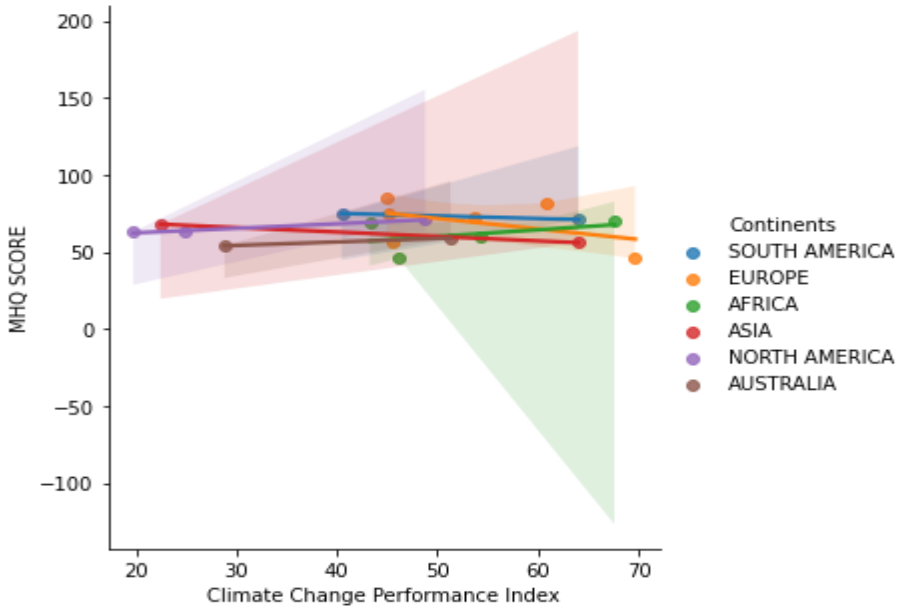
SCATTER PLOT BETWEEN MHQ AND GLOBAL HEALTH SECURITY INDEX



INTERPRETATION:

The scatter plot indicates that the Global Health Index has positive, linear relationship for Asia and negative, linear relationship for South America, Europe, Africa, North America, Australia with Mental Health Quotient.

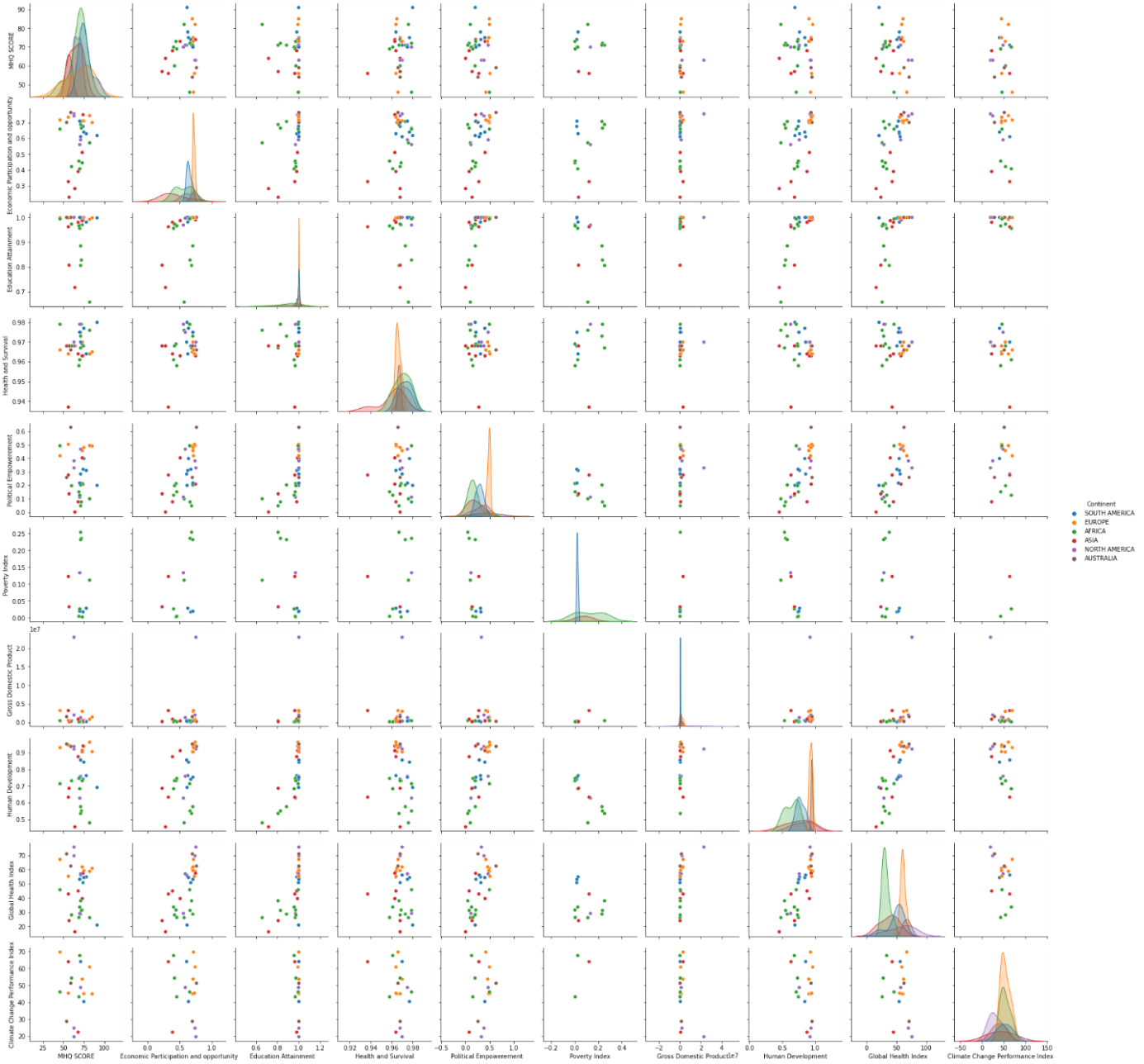
SCATTER PLOT BETWEEN MHQ AND CLIMATE CHANGE PERFORMANCE INDEX



INTERPRETATION:

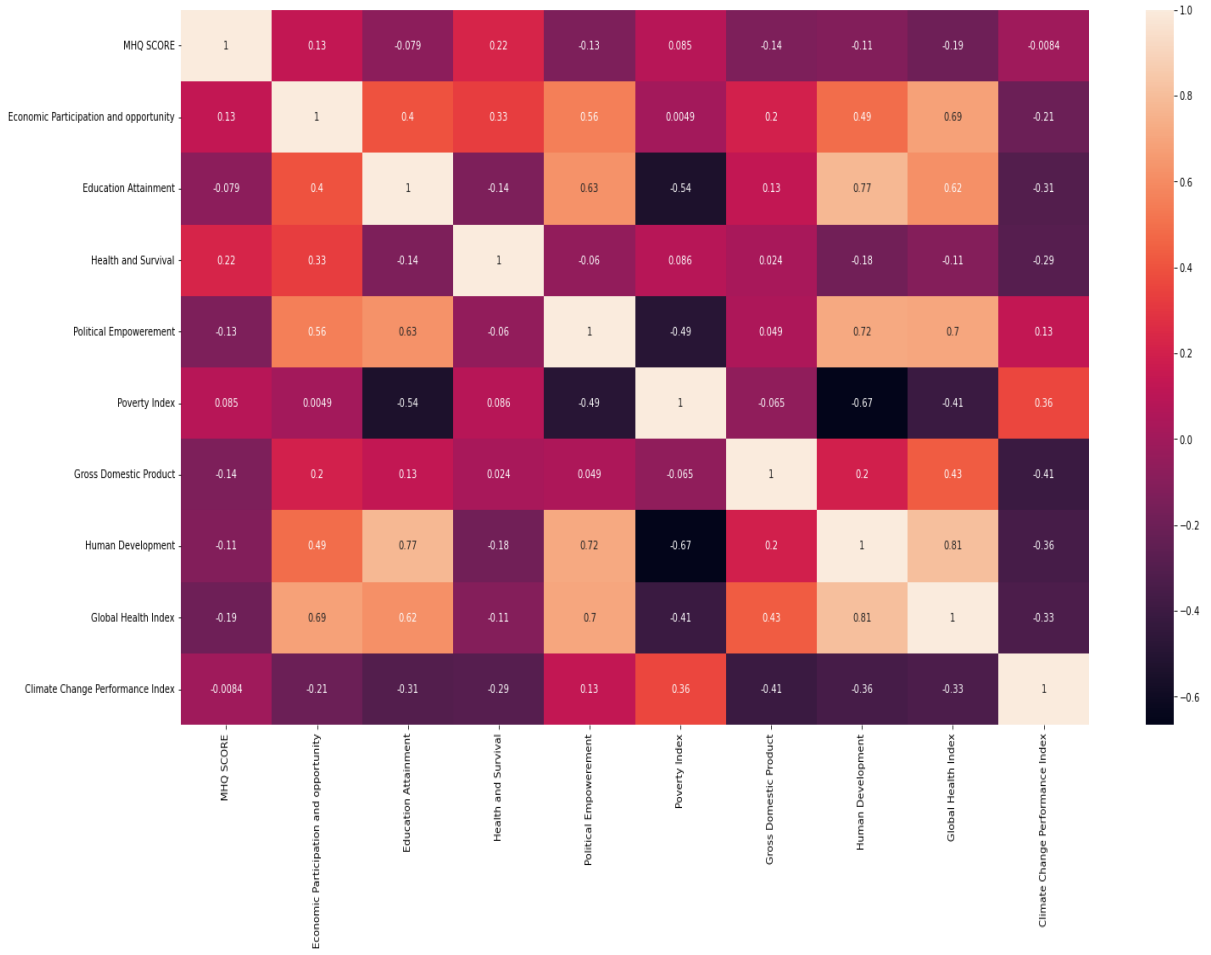
The scatter plot indicates that the Climate Change Performance Index has positive, linear relationship for Africa, North America, Australia and negative, linear relationship for South America, Europe, Asia with Mental Health Quotient.

For a collective look of the above ten scatter plots, these have been shown as a scatter plot matrix below.



3.4 Heat Map Graph between MHQ Score and Variables

Using Python following Heat map graph is drawn to show the correlation coefficients of MHQ with the other variables in a comparative manner.



Interpretations from the Heat Map:

Correlation between MHQ Score and EPP: -

The correlation between MHQ Score and EPP is 0.13 which shows that as economic participation of women in country increases, its MHQ Score also increases which shows that EPP has a positive impact on MHQ Score.

Correlation between MHQ Score and Education Attainment: -

The correlation between MHQ Score and Education Attainment is -0.079 which shows that as the education attainment of women increases, while MHQ score decreases. Therefore, from the above, education attainment is negatively correlated with MHQ Score.

Correlation between MHQ Score and Health and Survival: -

The correlation between Health and MHQ Score is 0.22, which shows that Health and Survival has positive impact on MHQ. As status of health of a woman in a country improves its MHQ score also increases.

Correlation between MHQ Score and Political Empowerment: -

The correlation between Political Empowerment and MHQ score is -0.13 which is negatively correlated with the MHQ Score. As the status of Political Empowerment of women in a country improves in a country its MHQ score decreases. This is evident from the current situation in the developed countries such as New Zealand.

Correlation between MHQ Score and Multidimensional Poverty Index: -

From the above graph we observe that the correlation between MHQ score and Poverty Index is 0.085 which shows positive correlation. As the Poverty Index of a country increases, its MHQ score also increases.

Correlation between MHQ Score and Gross Domestic Product: -

The correlation between MHQ Score and Gross Domestic Product is -0.14 which is negatively correlated to the MHQ Score which shows that as the GDP of a country increases, its MHQ Score decreases. This is evident from the current situation in the developed countries such as USA.

Correlation between MHQ Score and Human Development Index (HDI): -

The correlation between Human development and MHQ score is -0.11 which is negatively correlated to the MHQ Score.

Correlation between MHQ Score and Global Health Index: -

The correlation between Global Health Index and MHQ Score is -0.19 which also has negative impact on MHQ.

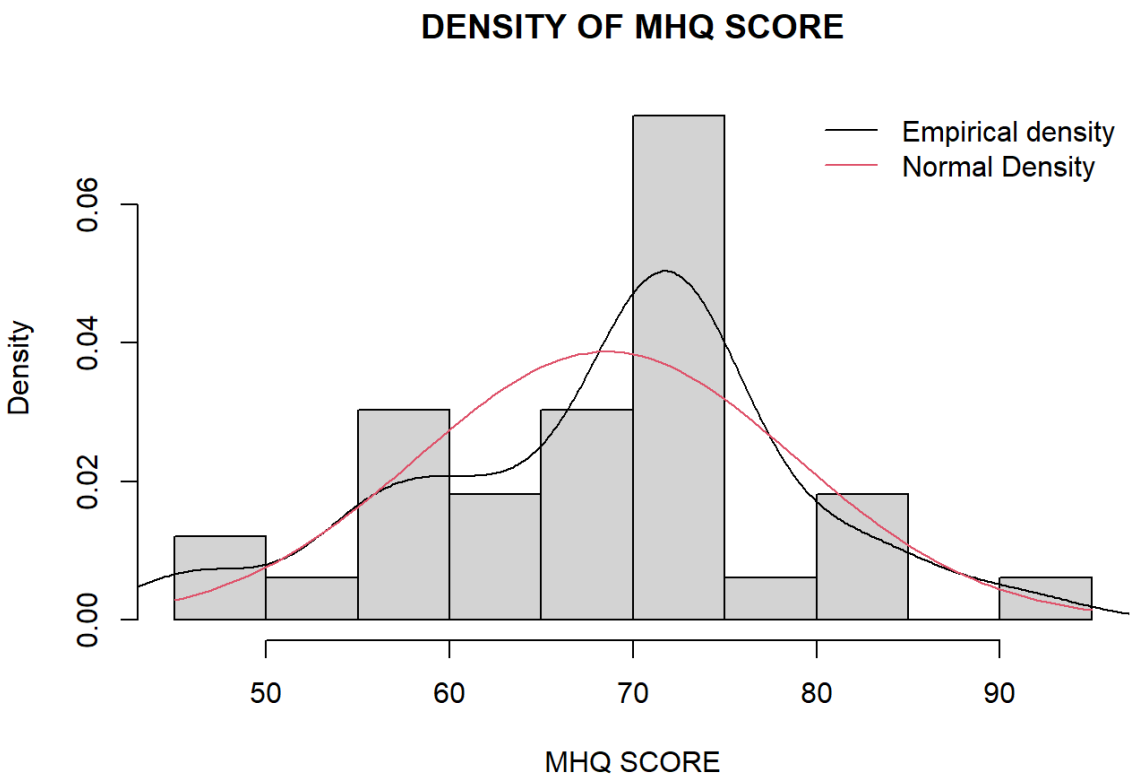
Correlation between MHQ Score and Climate Change Performance Index:

From the above data we conclude that the correlation between MHQ Score and Climate Change is -0.008 which shows negative impact on MHQ Score. Thus, Climate Change Performance Index is negatively correlated to MHQ Score.

3.5 NORMALITY ASSUMPTION

The normality assumption is tested by using R software and different approaches, for the sake of exercise.

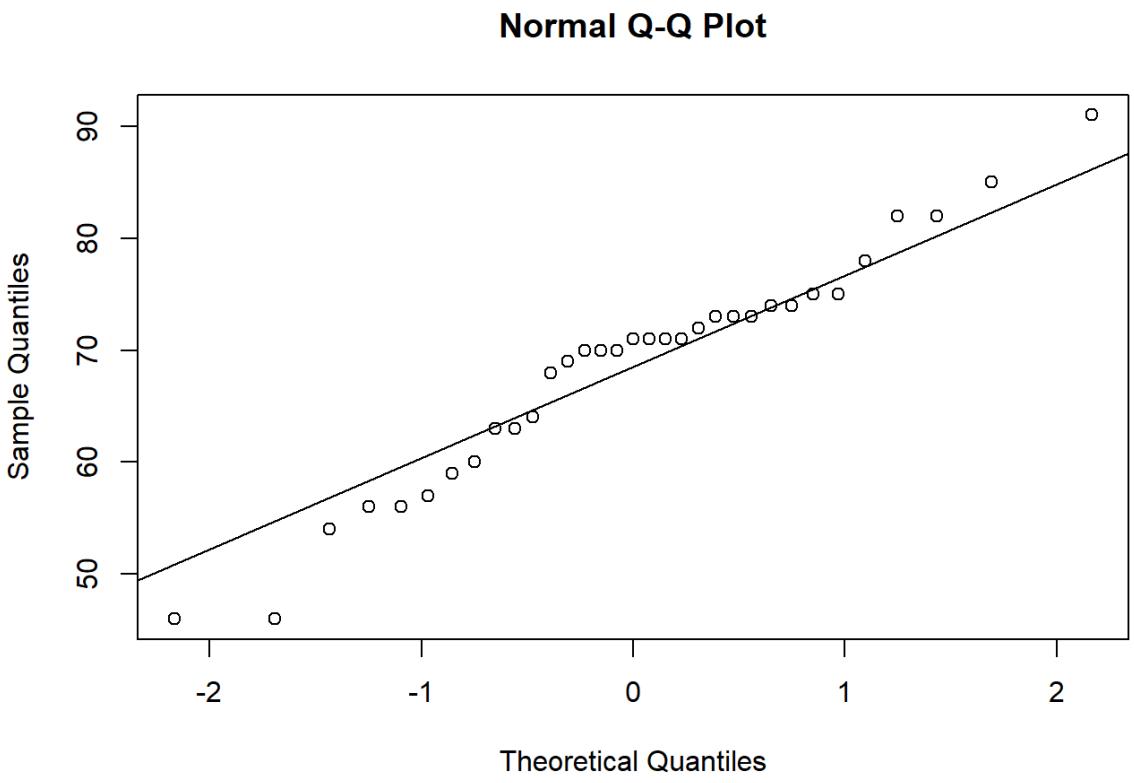
3.5.1 HISTOGRAM



INTERPRETATION

It can be observed from the above histogram that Mental Health Quotient follows normal distribution. Hence, normality assumption is satisfied. However, empirical density function deviates from normal density function at certain points. This deviation is further tested by using the following Q-Q plot.

3.5.2 QQ-PLOT



INTERPRETATION

From above QQ-Plot it is observed that MHQ Score follows normality.

3.5.3 KOLMOGOROV-SMIRNOV-TEST

```
##  Asymptotic one-sample Kolmogorov-Smirnov test
##
## data:  data$MHQ.SCORE
## D = 0.16222, p-value = 0.3503
## alternative hypothesis: two-sided
```

INTERPRETATION:

From K-S test, we have obtained p-value = 0.3503 > 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., Mental Health Quotient follows Normal distribution.

3.5.4 ANDERSON-DARLING TEST

```
##  Anderson-Darling normality test
## data:  data$MHQ.SCORE
## A = 0.62741, p-value = 0.09355
```

INTERPRETATION

According to Anderson-Darling normality test, p-value = 0.09355 > 0.05 = α.

Hence, we fail. to reject our. null hypothesis i.e., Mental Health Quotient follows normal distribution.

3.5.5 SHAPIRO TEST

```
##  Shapiro-Wilk normality test
##
## data:  data$MHQ.SCORE
## W = 0.96198, p-value = 0.2938
```

INTERPRETATION

According to Shapiro Test, we have obtained p-value=0.2938 > 0.05 = α.

We fail to reject our null hypothesis i.e.; Mental Health Quotient follows normal distribution.

3.6 SIMPLE LINEAR REGRESSION MODEL

Using R software, the nine linear regression models are fitted between MHQ as a dependent variable and each of the nine variables as independent variable in the respective model.

MODEL 1:

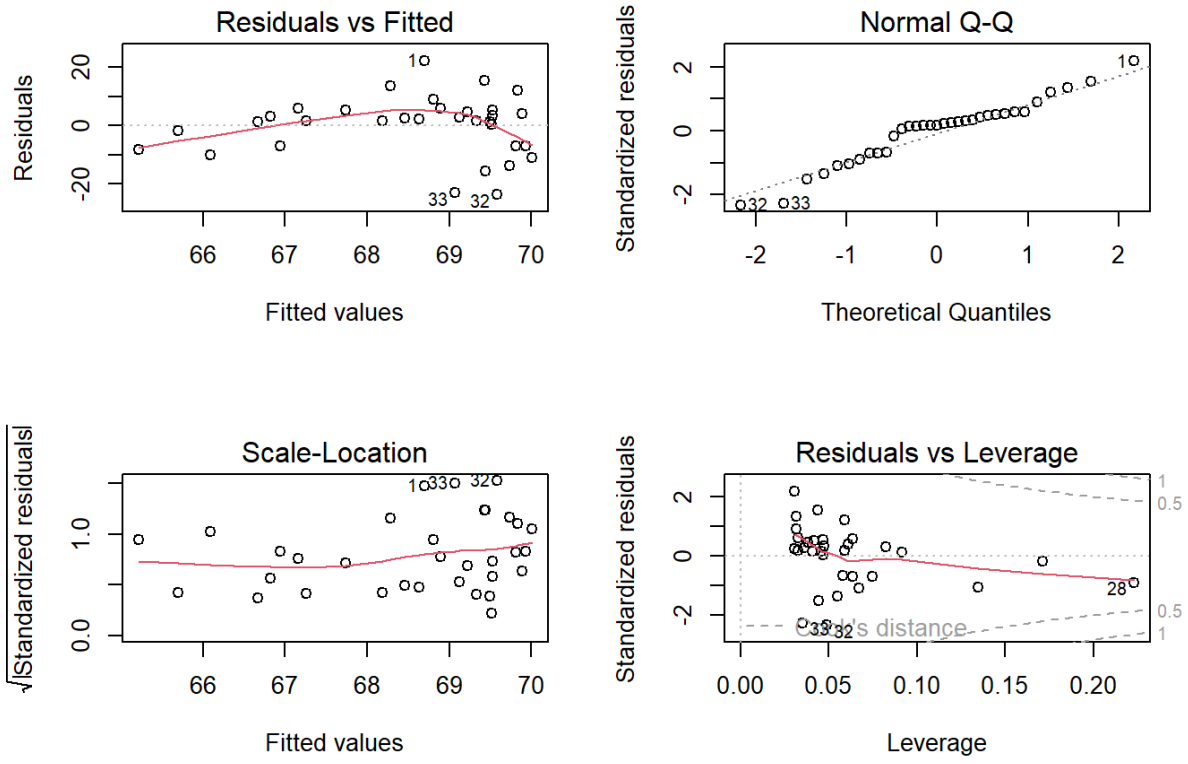
Model 1 is between MHQ and EPP:

For linear regression model 1,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 EPP + \epsilon$$

For fitting of regression model 1, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted graph, we observe that there might be the possibility of heteroscedasticity. To further investigate this heteroscedasticity, we use Breusch-Pagan test.

BREUSCH-PAGAN TEST

```
##  studentized Breusch-Pagan test
## data:  fit1
## BP = 1.6905, df = 1, p-value = 0.1935
```

From Studentized Breusch-Pagan test, we have obtained p-value = 0.1935 > 0.05 =α.

Hence, we fail to reject our null hypothesis i.e., there is homoscedasticity which mean it has constant variance.

Now, we can fit the Simple linear regression for model 1

Fitting of Model 1:

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Economic.Participation.and.opportunity,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -23.586  -6.926   1.812   5.260  22.301
## Coefficients:
##                                     Estimate Std. Error t value
Pr(>|t|)
## (Intercept)                           63.172      7.566   8.349
1.98e-09 ***
## Economic.Participation.and.opportunity    8.957     12.249   0.731
0.47
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 10.37 on 31 degrees of freedom
## Multiple R-squared:  0.01696,    Adjusted R-squared:  -0.01475
## F-statistic: 0.5348 on 1 and 31 DF,  p-value: 0.4701
```

INTERPRETATION

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 EPP + \epsilon$$

We get regression coefficients as $\beta_0 = 63.172$ and $\beta_1 = 8.957$.

As we can see that the value of intercept is 63.172 and value of slope is 8.957 i.e., if there is a unit change in EPP then there will be a change of 8.957 in the value of MHQ. This shows that it is positively correlated which means if EPP of a woman in a country increase, its MHQ also increases.

Residual Standard Error = 10.37 on 31 degrees of freedom

Multiple R-Squared = 0.01696

That implies that the average Mental Health Quotient will deviate from true regression line by 10.37 and approximately 1.69% of the variance found in Mental Health Quotient can be explained by EPP of female.

MODEL 2:

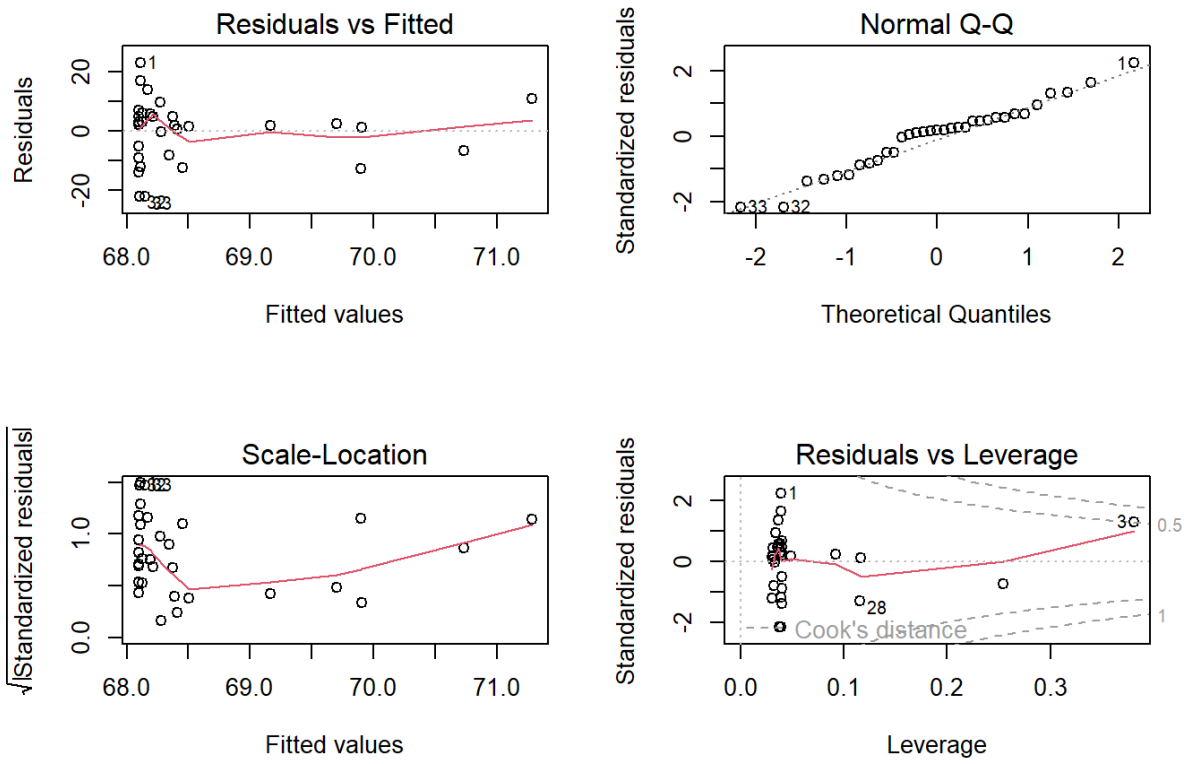
Model 2 is between MHQ and Education Attainment:

For linear regression model 2,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Education\ Attainment + \epsilon$$

For fitting of regression model 2, first we check for homoscedasticity.

Testing for Homoscedasticity:



From the Residual vs Fitted plot we can say that there is heteroscedasticity present in our data. To check its significance, we use Breusch-Pagan Test.

BREUSCH-PAGAN TEST

```
##
##  studentized Breusch-Pagan test
## data:  fit2
## BP = 0.67925, df = 1, p-value = 0.4098
```

From Studentized Breusch-Pagan test, we have obtained p-value=0.4098 >0.05 = α.

Hence, we fail to reject our null hypothesis i.e. homoscedasticity is present which mean it has a constant variance.

Now, we can fit the Simple linear regression for model 2.

Fitting of Model 2:

```
## Call:
## lm(formula = MHQ.SCORE ~ Education.Attainment, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -22.151  -6.736   1.832   5.811  22.886
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)             77.426     20.088   3.854 0.000547 ***
## Education.Attainment    -9.331     21.020  -0.444 0.660188
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 10.43 on 31 degrees of freedom
## Multiple R-squared:  0.006317,   Adjusted R-squared:  -0.02574
## F-statistic: 0.1971 on 1 and 31 DF,  p-value: 0.660
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Education\ Attainment + \epsilon$$

We get regression coefficients as $\beta_0 = 77.426$ and $\beta_1 = -9.331$.

As we can see that the value of intercept is 77.426 and value of slope is -9.331 i.e., if there is a unit change in Education Attainment then there will be a change of -9.331 in the value of MHQ. This shows that it is negatively correlated which means if Education Attainment of a women in a country increase, its MHQ decreases.

Residual standard error = 10.43 on 31 degrees of freedom.

Multiple R-Squared = 0.006317.

Hence, average amount that the Mental Health Quotient will deviate from the true regression line is 10.43 and approximately 0.63% of the variation in Mental Health Quotient can be explained by Education Attainment of female.

MODEL 3:

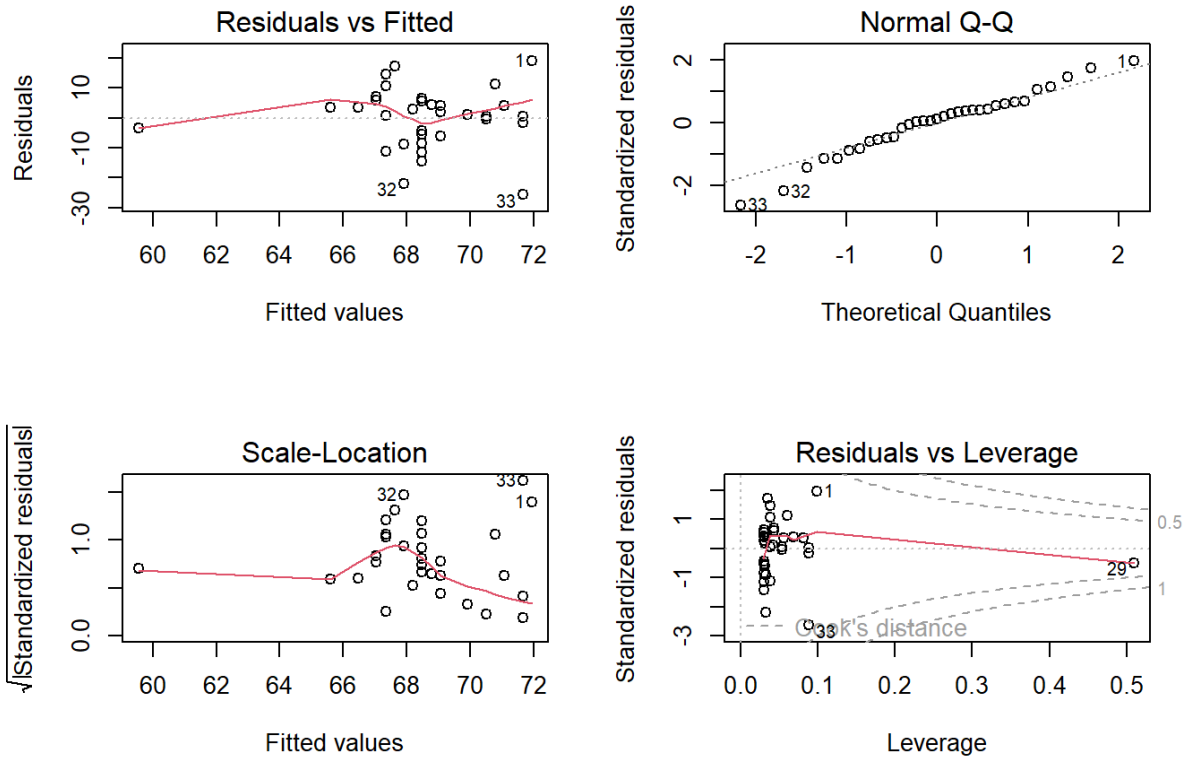
Model 3 is between MHQ and Health and Survival:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Health\ and\ Survival + \epsilon$$

For fitting of regression model 2, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there is heteroscedasticity present. To check its significance, we will use Breusch-Pagan test.

BREUSCH-PAGAN TEST

```
##  studentized Breusch-Pagan test
## data:  fit3
## BP = 1.2087, df = 1, p-value = 0.2716
```

From studentized Breusch-Pagan test, we have obtained p-value = 0.2716 > 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., homoscedasticity is present.

Now, we can fit the Simple linear regression for model 3.

Fitting of Model 3:

```
## Call:
## lm(formula = MHQ.SCORE ~ Health.and.Survival, data = data)
## Residuals:
##     Min      1Q  Median      3Q     Max
## -25.669  -5.493   1.064   5.507  19.043
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -211.0      219.2  -0.962    0.343
## Health.and.Survival    288.7      226.4   1.275    0.212
## Residual standard error: 10.2 on 31 degrees of freedom
## Multiple R-squared:  0.04982,    Adjusted R-squared:  0.01917
## F-statistic: 1.625 on 1 and 31 DF,  p-value: 0.2118
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Health\ and\ Survival + \epsilon$$

We get regression coefficients as $\beta_0 = -211.0$ and $\beta_1 = 288.7$

As we can see that the value of intercept is -211.0 and value of slope is 288.7 i.e., if there is a unit change in Health and Survival then there will be a change of 288.7 in the value of MHQ. This shows that it is negatively correlated which means if Health and Survival of a women in a country increase, its MHQ decreases.

Residual Standard Error = 10.2 on 31 degrees of freedom

Multiple R-Squared = 0.04982

Hence, average amount that the Mental Health Quotient will deviate from true regression line is 10.2 and 4.98% of the variance found in the Mental Health Quotient can be explained by Health and Survival of female.

MODEL 4:

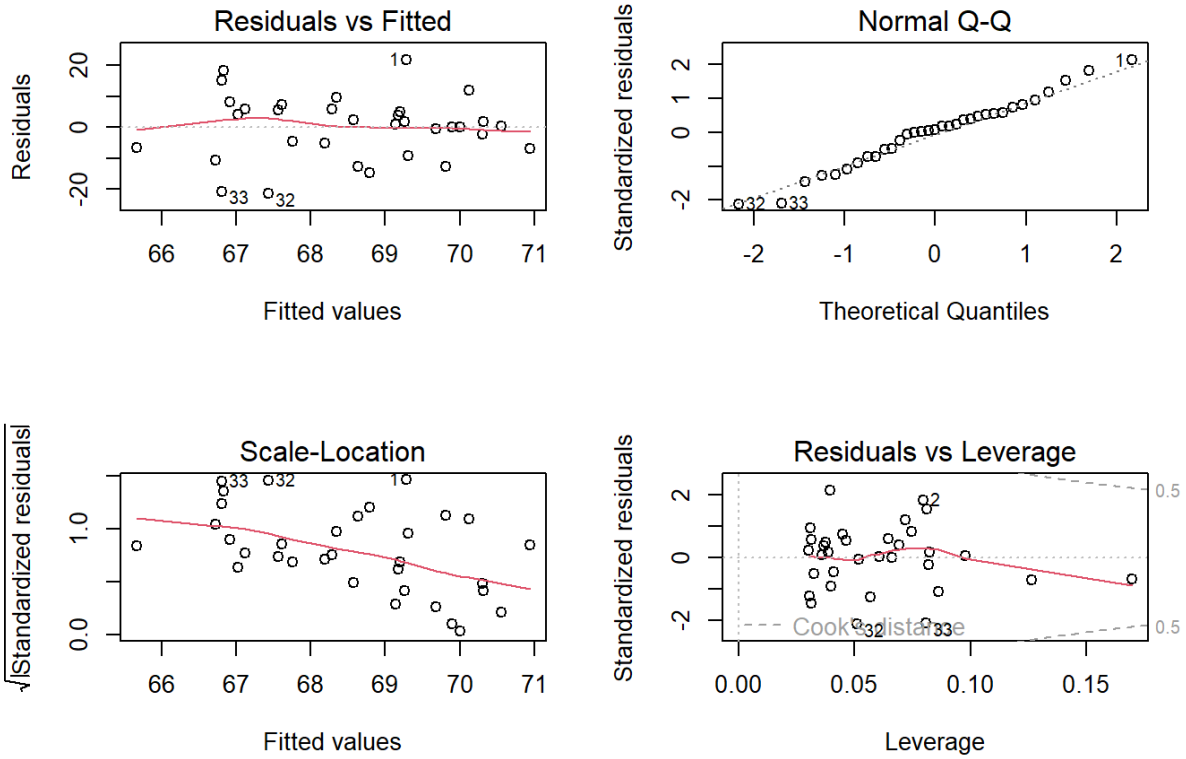
Model 4 is between MHQ and Political Empowerment:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Political\ Empowerement + \epsilon$$

For fitting of regression model 4, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there may be a slight heteroscedasticity present. To further investigate it, we use Breusch-Pagan Test.

BREUSCH-PAGAN TEST

```
##  studentized Breusch-Pagan test
## data:  fit4
## BP = 2.9853, df = 1, p-value = 0.08402
```

From the Studentized Breusch-Pagan Test, we have obtained p-value = 0.08402 > 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., homoscedasticity is present, which mean it has a constant variance.

Now, we can fit the Simple linear regression for Model 4.

Fitting of Model 4:

```
## Call:
## lm(formula = MHQ.SCORE ~ Political.Empowerement, data = data)
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.4308  -6.6577   0.8632   5.7204  21.7204
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)               70.952      3.696  19.198   <2e-16 ***
## Political.Empowerement   -8.403     11.261  -0.746    0.461
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 10.37 on 31 degrees of freedom
## Multiple R-squared:  0.01765,    Adjusted R-squared:  -0.01404
## F-statistic: 0.5569 on 1 and 31 DF,  p-value: 0.4611
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Political\ Empowerement + \epsilon$$

We get regression coefficients as $\beta_0 = 70.952$ and $\beta_1 = -8.403$.

As we can see that the value of intercept is 70.952 and value of slope is -8.403 i.e., if there is a unit change in Political Empowerment then there will be a change of -8.403 in the value of MHQ. This shows that it is negatively correlated which means if Political Empowerment of a women in a country increases, its MHQ decreases.

Residual Standard Error = 10.37 on 31 degrees of freedom

Multiple R-squared = 0.01765

Hence, average amount that the Mental Health Quotient deviates from the true line of regression is 10.37 and 1.7% of the variance found in the Mental Health Quotient can be explained by the Political Empowerment of females.

Model 5:

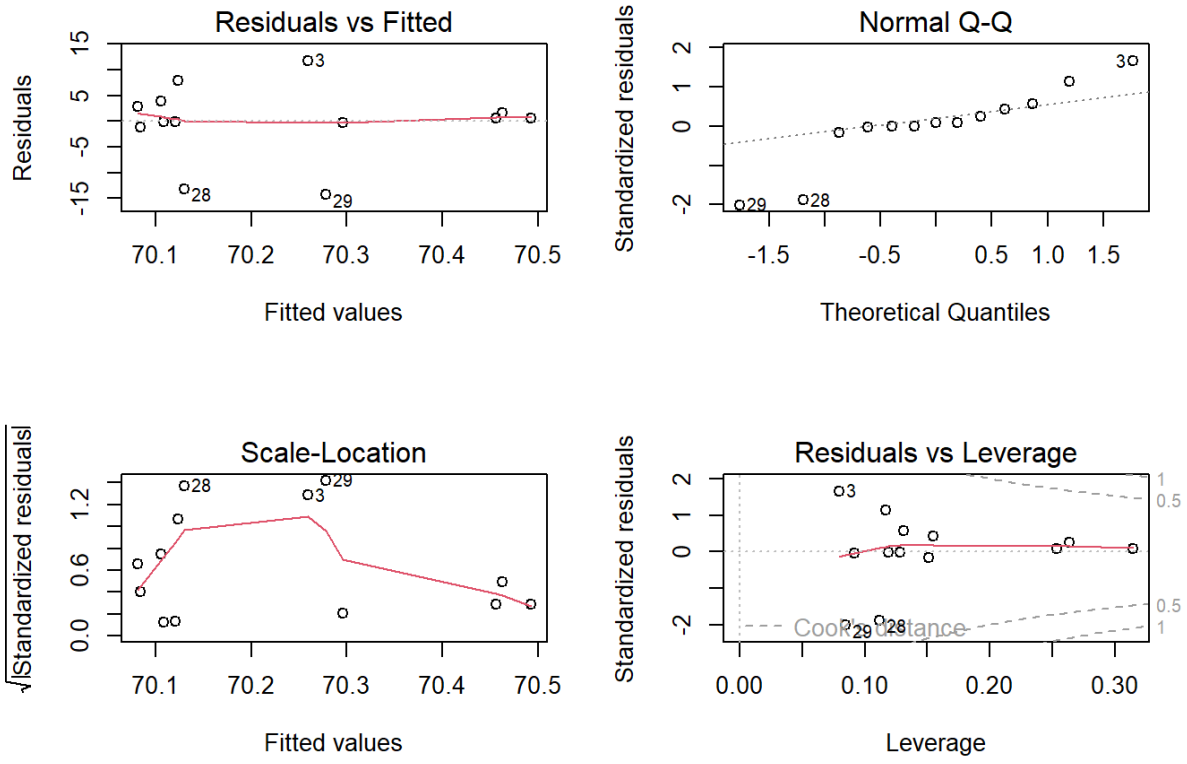
Model 5 is between MHQ and Multidimensional Poverty Index:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 MultiDimensional\ Poverty\ Index + \epsilon$$

For fitting of regression model 5, first we check for homoscedasticity

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there may be a heteroscedasticity present. To further investigate it, we use Breusch-Pagan Test.

BREUSCH-PAGAN TEST:

```
##  studentized Breusch-Pagan test
## data:  fit5
## BP = 0.11536, df = 1, p-value = 0.7341
```

From the Studentized Breusch-Pagan Test, we have obtained p-value = 0.7341> 0.05 = α.

Hence, we fail to reject the null hypothesis i.e., homoscedasticity is present which mean it has constant variance.

Now, we can fit Simple linear regression for model 5.

Fitting of Model 5:

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Poverty.Index, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.2778  -0.2958   0.5076   2.9188  11.7402
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)     70.076      2.961  23.665 8.73e-11 ***
## Poverty.Index    1.639     22.605   0.072    0.944
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.41 on 11 degrees of freedom
##   (20 observations deleted due to missingness)
## Multiple R-squared:  0.0004774,  Adjusted R-squared:  -0.09039
## F-statistic: 0.005254 on 1 and 11 DF,  p-value: 0.9435
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 MultiDimensional\ Poverty\ Index + \epsilon$$

We get regression coefficients as $\beta_0 = 70.076$and $\beta_1 = 1.639$

As we can see that the value of intercept is 70.076 and the value of slope is 1.639 i.e., if there is a unit change in Multidimensional Poverty Index then there will be a change of 1.639 in the value of MHQ. This shows that it is positively correlated which means if Multidimensional Poverty Index of a country increases, its MHQ also increases.

Residual Standard Error = 7.41 on 11 degrees of freedom

Multiple R-squared = 0.0004774

Hence, average amount that the Mental Health Quotient deviates from the true line of regression is 7.41 and 0.04774% of the variance found in the Mental Health Quotient can be explained by the Multidimensional Poverty Index.

Model 6:

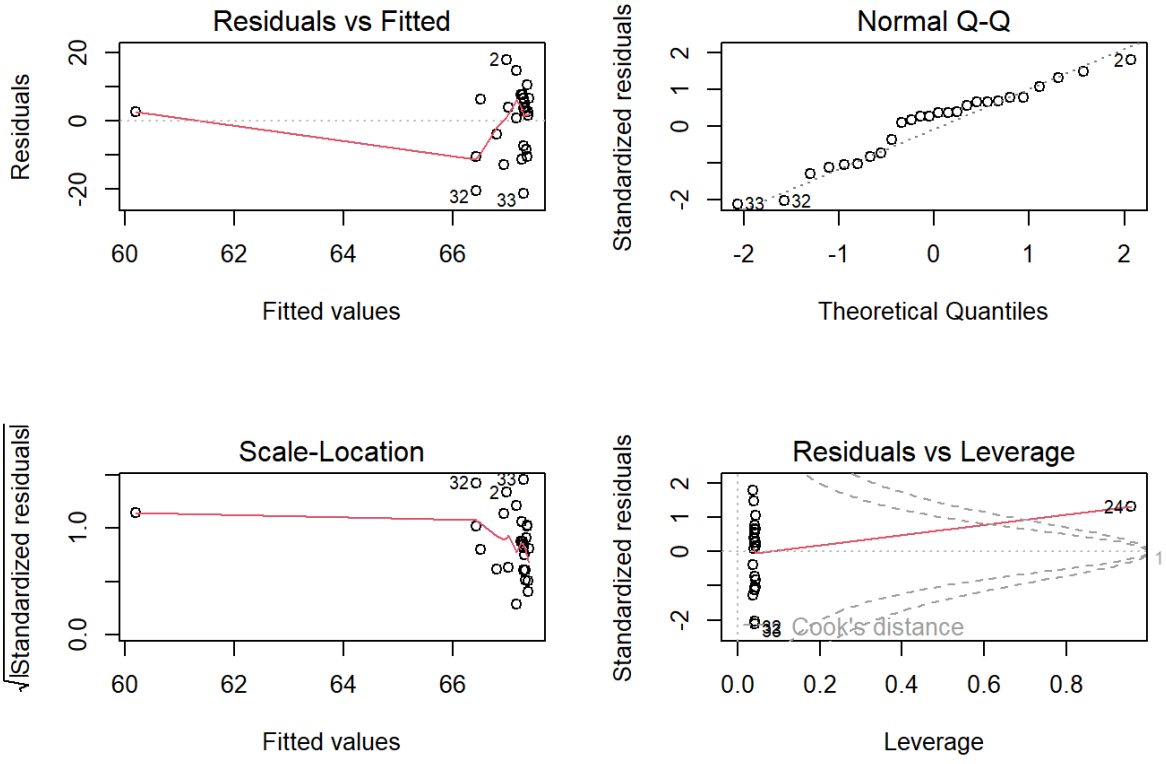
Model 6 is between MHQ and Gross Domestic Product:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Gross\ Domestic\ Product + \epsilon$$

For fitting of regression model 6, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there may be a heteroscedasticity present. To further investigate it, we use Breusch-Pagan Test.

BREUSCH-PAGAN TEST:

```
##  studentized Breusch-Pagan test
## data:  fit6
## BP = 0.14682, df = 1, p-value = 0.7016
```

From the Studentized Breusch-Pagan Test, we have obtained p-value = 0.7016> 0.05 = α.

Hence, we fail to reject the null hypothesis i.e., homoscedasticity is present

Now, we can fit the Simple linear regression for Model 6.

Fitting of Model 6:

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Gross.Domestic.Product, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -21.304  -8.095   2.734   6.570  18.013
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)              6.744e+01  2.170e+00   31.08   <2e-16 ***
## Gross.Domestic.Product -3.148e-07  4.630e-07   -0.68    0.503
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.26 on 24 degrees of freedom
##   (7 observations deleted due to missingness)
## Multip07le R-squared:  0.01891,    Adjusted R-squared:  -0.02197
## F-statistic: 0.4625 on 1 and 24 DF,  p-value: 0.503
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Gross\ Domestic\ Product + \epsilon$$

We get regression coefficients as β_0=6.744e^{01} and β_1=–3.148e^{-07}

As we can see that the value of intercept is 6.744e^{01} and the value of slope is –3.148e^{-07}

i.e., if there is a unit change in Gross Domestic Product then there will be a change of

–3.148e^{-07} in the value of MHQ. This shows that it is negatively correlated which means if Gross Domestic Product of a country increases, its MHQ decreases.

Residual Standard Error = 10.26 on 24 degrees of freedom

Multiple R-squared = 0.01891

Hence, average amount that the Mental Health Quotient deviates from the true line of regression is10.26 and 1.891% of the variance found in the Mental Health Quotient can be explained by the Gross Domestic Index.

MODEL 7:

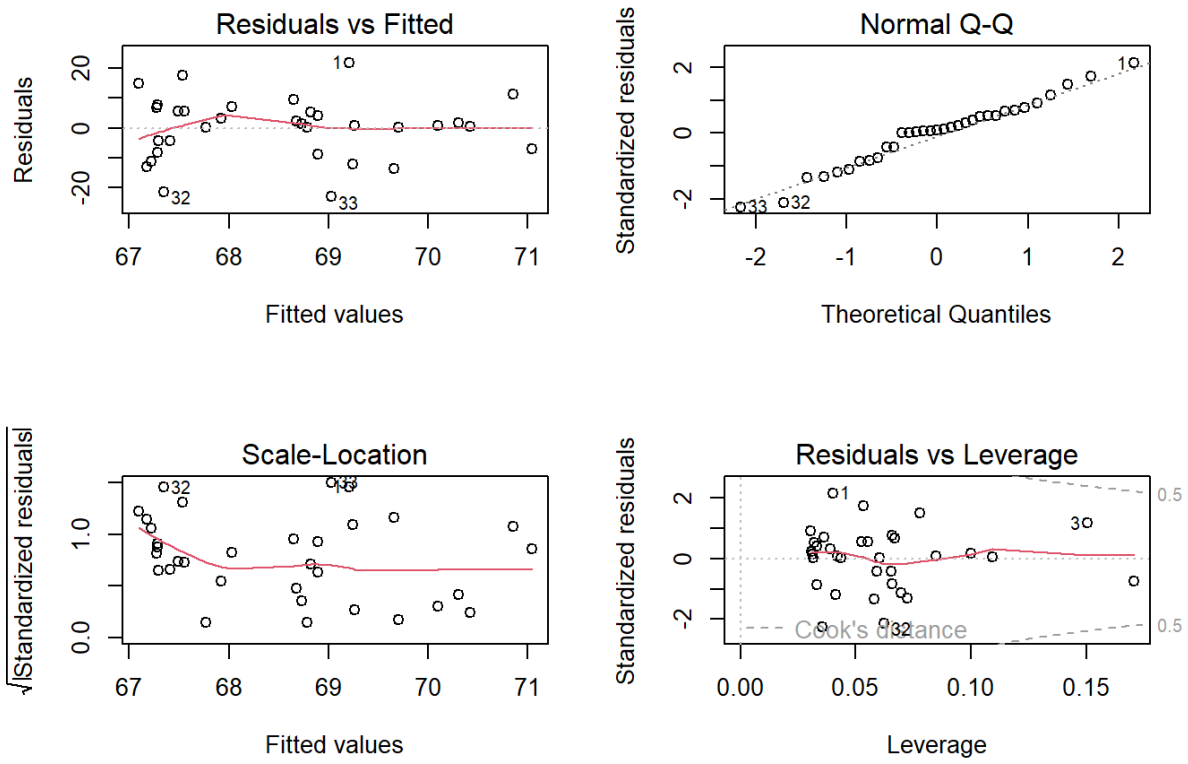
Model 7 is between MHQ and Human Development Index (HDI):

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Human\ Development + \epsilon$$

For fitting of regression model 7, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there may be a slight heteroscedasticity present. To further investigate it, we use Breusch-Pagan Test

BREUSCH-PAGAN TEST:

```
##
##  studentized Breusch-Pagan test
## data:  fit7
## BP = 0.3759, df = 1, p-value = 0.5398
```

From the Studentized Breusch-Pagan Test, we have obtained p-value = 0.5398> 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., homoscedasticity is present.

Now, we can fit the Simple linear regression for Model 7.

Fitting of Model 7:

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Human.Development, data = data)
## Residuals:
##      Min       1Q   Median       3Q      Max
## -23.0331  -7.0428   0.8998   5.5092  21.7955
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)         74.587      9.596   7.773 9.04e-09 ***
## Human.Development   -7.789     12.150  -0.641    0.526
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 10.4 on 31 degrees of freedom
## Multiple R-squared:  0.01309,    Adjusted R-squared:  -0.01875
## F-statistic: 0.411 on 1 and 31 DF,  p-value: 0.5262
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Human\ Development + \epsilon$$

We get regression coefficients as $\beta_0 = 74.587$ and $\beta_1 = -7.789$

As we can see that the value of intercept is 74.587 and value of slope is -7.789 i.e., if there is a unit change in Human Development Index (HDI) then there will be a change of -7.789 in the value of MHQ. This shows that it is negatively correlated which means if Human Development Index of a country increases, its MHQ decreases.

Residual Standard Error = 10.4 on 31 degrees of freedom

Multiple R-squared = 0.01309

Hence, average amount that the Mental Health Quotient deviates from the true line of regression is 10.4 and 1.309% of the variance found in the Mental Health Quotient can be explained by the Human Development Index.

MODEL 8:

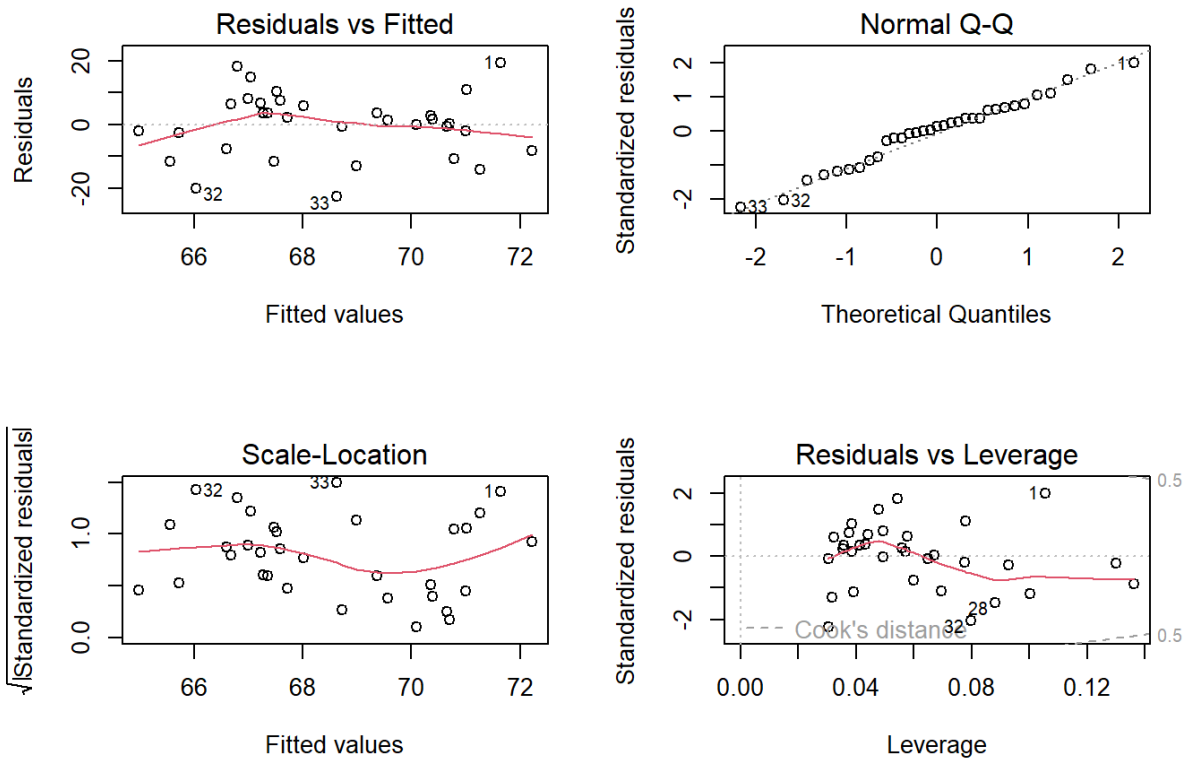
Model 8 is between MHQ and Global Health Security Index:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Global\ Health\ Index + \epsilon$$

For fitting of regression model 8, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there may be a slight heteroscedasticity present. To further investigate it, we use Breusch-Pagan Test

BREUSCH-PAGAN TEST:

```
##
##  studentized Breusch-Pagan test
##
## data:  fit8
## BP = 0.069852, df = 1, p-value = 0.7916
```

From the Studentized Breusch-Pagan Test, we have obtained p-value = 0.7916> 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., homoscedasticity is present.

Now, we can fit Simple linear regression for model 8.

Fitting of Model 8:

```
## Call:
## lm(formula = MHQ.SCORE ~ Global.Health.Index, data = data)
## Residuals:
##     Min      1Q  Median      3Q     Max
## -22.625  -7.604   1.431   6.324  19.362
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          74.1675     5.4174  13.691  1.1e-14 ***
## Global.Health.Index  -0.1210     0.1101  -1.099     0.28
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 10.27 on 31 degrees of freedom
## Multiple R-squared:  0.03752,    Adjusted R-squared:  0.006472
## F-statistic: 1.208 on 1 and 31 DF,  p-value: 0.2801
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Global\ Health\ Index + \epsilon$$

We get regression coefficients as $\beta_0 = 74.167$ and $\beta_1 = -0.121$.

As we can see that the value of intercept is 74.167 and value of slope is -0.121 i.e., if there is a unit change in Global Health Security Index then there will be a change of -0.121 in the value of MHQ. This shows that it is negatively correlated which means if Global Health Security Index of a country increases, its MHQ decreases.

Residual Standard Error = 10.27 on 31 degrees of freedom

Multiple R-squared = 0.03752

Hence, average amount that the Mental Health Quotient deviates from the true line of regression is 10.27 and 3.752% of the variance found in the Mental Health Quotient can be explained by the Global Health Index.

Model 9:

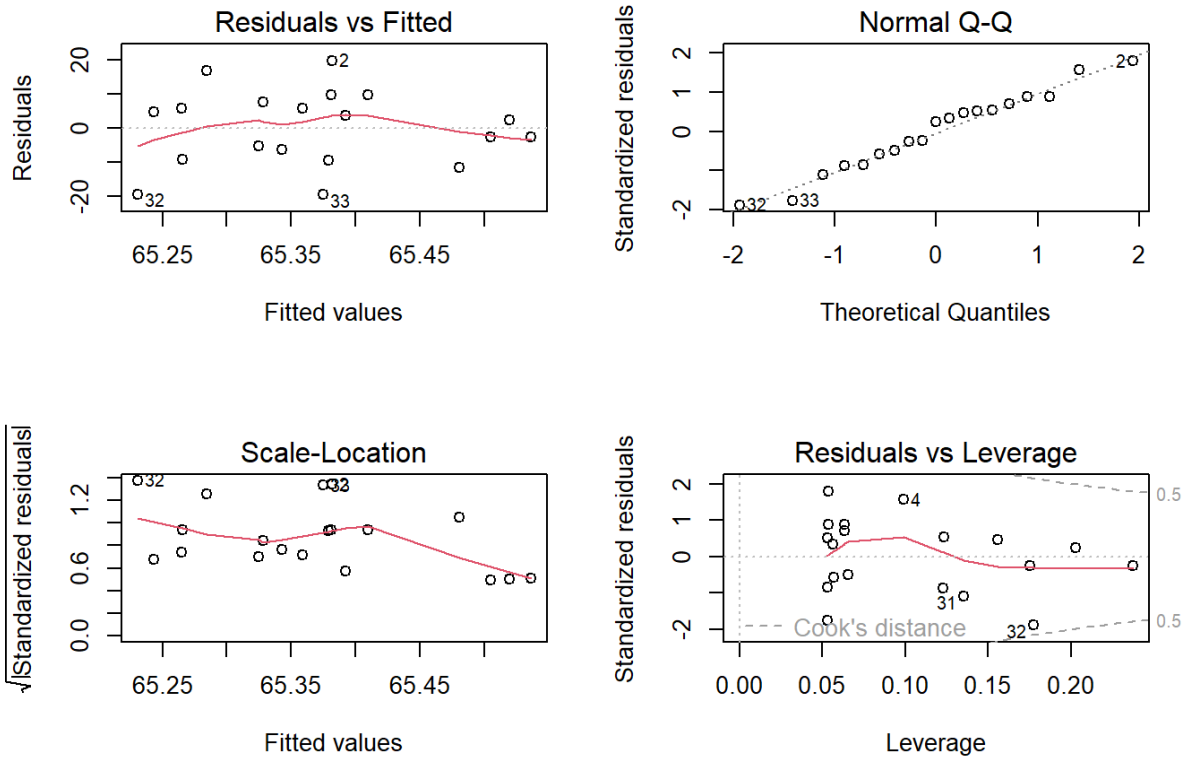
Model 9 is between MHQ and Climate Change Performance Index:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Climate\ Change\ Performance\ Index + \epsilon$$

For fitting of regression model 9, first we check for homoscedasticity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we can observe that there may be a heteroscedasticity present. To further investigate it, we use Breusch-Pagan Test

BREUSCH-PAGAN TEST:

```
bptest(fit9)
```

```
##  studentized Breusch-Pagan test
## data:  fit9
## BP = 1.5725, df = 1, p-value = 0.2098
```

From the Studentized Breusch-Pagan Test, we have obtained p-value = 0.2098> 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., homoscedasticity is present.

Now, we can fit the Simple linear regression for Model 9.

Fitting of Model 9:

```
summary(fit9)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Climate.Change.Performance.Index, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -19.375  -7.804   2.481   6.703  19.619
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     65.656581   8.699857   7.547    8e-07
***
## Climate.Change.Performance.Index -0.006113   0.176284  -0.035    0.973
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.24 on 17 degrees of freedom
##   (14 observations deleted due to missingness)
## Multiple R-squared:  7.074e-05,  Adjusted R-squared:  -0.05875
## F-statistic: 0.001203 on 1 and 17 DF,  p-value: 0.9727
```

INTERPRETATION:

For linear regression model,

$$Mental\ Health\ Quotient = \beta_0 + \beta_1 Climate\ Change\ Performance\ Index + \epsilon$$

We get regression coefficients as $\beta_0 = 65.656581$nd $\beta_1 = -0.006113$

As we can see that the value of intercept is 65.656581 and the value of slope is -0.006113 i.e. if there is a unit change in Climate Change Performance Index then there will be a change of -0.006113 in the value of MHQ. This shows that it is negatively correlated which means if a Climate Change Performance Index of a country increases, its MHQ decreases.

Residual Standard Error = 11.24 on 17 degrees of freedom

Multiple R-squared =$7.074e^{-05}$

Hence, average amount that the Mental Health Quotient deviates from the true line of regression is 11.24 and $7.074e^{-05}$%of the variance found in the Mental Health Quotient can be explained by the Climate Change Performance Index.

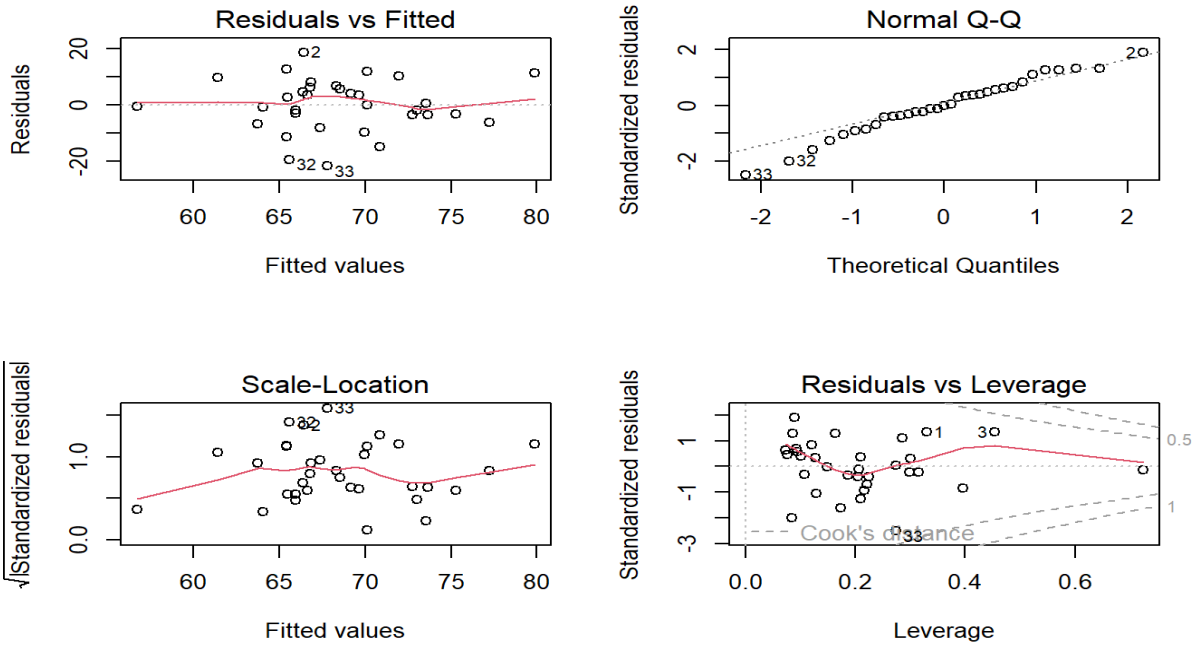
3.7 MULTIPLE LINEAR REGRESSION MODEL

Using R software multiple linear regression model is fitted with MHQ as dependent variable and six independent
variables
Education Attainment, Health and Survival, Political Empowerment, Global Health Index, Human Development Index (HDI)

$$\text{Mental Health Quotient} = \beta_0 + \beta_1 \text{EPP} + \beta_2 \text{Education Attainment} + \beta_3 \text{Health and Survival} + \beta_4 \text{Political Empowerment} + \beta_5 \text{Global Health Index} + \beta_6 \text{Human Development}$$

For fitting of Multiple linear regression model, first we check for homoscedasticity and multicollinearity.

Testing for Homoscedasticity:



From Residual vs Fitted plot, we observe that there might be a possibility of heteroscedasticity. To further investigate it, we use Breusch-Pagan test.

BREUSCH-PAGAN TEST

```
##  studentized Breusch-Pagan test
##
## data:  mlr
## BP = 10.089, df = 6, p-value = 0.121
```

From studentized Breusch-Pagan test, we have obtained p-value = 0.121 > 0.05 = α.

Hence, we fail to reject our null hypothesis i.e., homoscedasticity is present.

Testing for Multicollinearity:

```
#                                 Variables Tolerance      VIF
## 1 Economic.Participation.and.opportunity 0.3446882 2.901173
## 2                   Education.Attainment 0.3866133 2.586564
## 3                    Health.and.Survival 0.6720344 1.488019
## 4                  Political.Empowerement 0.4103390 2.437010
## 5                     Global.Health.Index 0.2073789 4.822090
## 6                       Human.Development 0.2060704 4.852710
```

We can observe that the Variance Inflation Factors for our model lie between 1 to 5. Hence, there is moderate correlation, but it is not severe enough to warrant corrective measures,

Now all the assumption has satisfied. Now, we can fit the Multiple Linear Regression Model.

Fitting of Multiple Linear Regression Model:

```
## Call:
## lm(formula = MHQ.SCORE ~ Economic.Participation.and.opportunity +
##     Education.Attainment + Health.and.Survival + Political.Empowerement +
##     Global.Health.Index + Human.Development, data = data)
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.7755  -3.7336  -0.1393   6.2049  18.5564
## Coefficients:
                                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)                          42.9908   267.6892   0.161   0.8736
## Economic.Participation.and.opportunity  38.1356    20.5825   1.853   0.0753 .
## Education.Attainment                  2.0117    33.1733   0.061   0.9521
## Health.and.Survival                   9.0148   277.1868   0.033   0.9743
## Political.Empowerement               -10.6671    17.3495  -0.615   0.5440
## Global.Health.Index                   -0.4397     0.2410  -1.824   0.0796 .
## Human.Development                     20.0070    26.3531   0.759   0.4546
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 10.24 on 26 degrees of freedom
## Multiple R-squared:  0.1975, Adjusted R-squared:  0.01232
## F-statistic: 1.067 on 6 and 26 DF,  p-value: 0.4074
```

INTERPRETATION:

For multiple linear regression model,

$$\begin{aligned}\text{Mental Health Quotient} &= \beta_0 + \beta_1 \text{EPP} + \beta_2 \text{Education Attainment} + \beta_3 \text{Health and Survival} \\ &+ \beta_4 \text{Political Empowerment} + \beta_5 \text{Global Health Index} \\ &+ \beta_6 \text{Human Development}\end{aligned}$$

We have obtained regression coefficients as $\beta_0 = 42.9908$, $\beta_1 = 38.1356$,$\beta_2 = 2.0117$, $\beta_3 = 9.0148$, $\beta_4 = -10.6671$, $\beta_5 = -0.4397$ and $\beta_6 = 20.007$

Residual Standard Error = 10.24 on 26 degrees of freedom

Multiple R-Squared = 0.1975

Hence, average amount that the Mental Health Quotient will deviate from the true regression line is 10.24 and 19.75% of the variance found in Mental Health Quotient can be explained by predictor variables.

3.8 LOGISTIC MODEL

We have transformed our dependent variable (Mental Health Quotient) to categorical variable (0 and 1). If Mental Health Quotient is greater than 68.55 (average MHQ) we assign the value of the variable as 1 and if Mental Health Quotient is less than 68.55 then we assign the value of variable as 0. Using R software, the logistic models are fitted to the categorical variable MHQ as dependent variable and other nine variables each as independent variable in the respective nine logistic models.

LOGISTIC MODEL-1:

Logistic Model 1 is between MHQ and EPP:

```
## Call:
## glm(formula = data$BINARY.FORM ~ data$EPP,
##     family = binomial, data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6432  -1.1658   0.8292   0.9247   1.1682
##
## Coefficients:
##                                        Estimate Std. Error z value
## (Intercept)                              -1.154      1.500  -0.769
## EPP                                  2.888      2.470   1.169
##                                        Pr(>|z|)
## (Intercept)                               0.442
## EPP                                   0.242
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 41.860  on 31  degrees of freedom
## AIC: 45.86
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION

- We have obtained regression coefficients as $\beta_0 = -1.154$ and $\beta_1 = 2.88$.
- We have obtained standard logistic regression function as,

$$\mathrm{p} = \frac{\exp(-1.154 + 2.88x)}{1 + \exp(-1.154 + 2.88x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = 2.88$, which is positive. This means that an increase in Economic Participation of Women is associated with increase in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in EPP will increase the odds of Mental Health Quotient being greater than 68.55 by exp (2.88).

LOGISTIC MODEL 2

Logistic Model 2 is between MHQ and Educational Attainment:

```
## Call:
## glm(formula = data$BINARY.FORM ~ data$Education.Attainment, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.4389  -1.4190   0.9510   0.9535   0.9537
## Coefficients:
##                            Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   0.709      4.021   0.176     0.86
## data$Education.Attainment    -0.157      4.206  -0.037     0.97
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 43.260  on 31  degrees of freedom
## AIC: 47.26
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = 0.709$ and $\beta_1 = -0.157$.
- We have obtained standard logistic regression function as,

$$\mathrm{p} = \frac{\exp\,(0.709 - 0.157x)}{1 + \exp\,(0.709 - 0.157x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = -0.157$, which is negative. This means that an increase in Education Attainment of Women is associated with decrease in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in EPP will decrease the odds of Mental Health Quotient being greater than 68.55 by exp (-0.157).

LOGISTIC MODEL 3

Logistic Model 3 is between MHQ and Health and Survival:

```
## Call:
## glm(formula = data$BINARY.FORM ~ data$Health.and.Survival, family = binomial,
##     data = data)
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7967  -1.3594   0.7361   0.9475   1.2552
## Coefficients:
##                           Estimate Std. Error z value Pr(>|z|)
## (Intercept)                -71.94      53.94  -1.334    0.182
## data$Health.and.Survival    74.91      55.73   1.344    0.179
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 41.006  on 31  degrees of freedom
## AIC: 45.006
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = -71.94$ and $\beta_1 = 74.91$.
- We have obtained standard logistic regression function as,

$$p = \frac{\exp(-71.94 + 74.91x)}{1 + \exp(-71.94 + 74.91x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = 74.91$, which is positive. This means that an increase in Health and Survival of Women is associated with increase in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Health and Survival will increase the odds of Mental Health Quotient being greater than 68.55 by exp (74.91).

LOGISTIC MODEL 4

Logistic Model 4 is between MHQ and Political Empowerment:

```
## call:
## glm(formula = data$BINARY.FORM ~ data$Political.Empowerement,
##     family = binomial, data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.5983  -1.3456   0.8680   0.9606   1.0586
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   0.9517     0.7640   1.246    0.213
## data$Political.Empowerement  -1.3475     2.2732  -0.593    0.553
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 42.907  on 31  degrees of freedom
## AIC: 46.907
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = 0.9517$ and $\beta_1 = -1.3475$.
- We have obtained standard logistic regression function as,

$$p = \frac{\exp(0.9517 - 1.3475x)}{1 + \exp(0.9517 - 1.3475x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = -1.3475$, which is negative. This means that an increase in Political Empowerment of Women is associated with decrease in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Political Empowerment will decrease the odds of Mental Health Quotient being greater than 68.55 by exp (-1.3475).

LOGISTIC MODEL 5

Logistic Model 5 is between MHQ and Multidimensional Poverty Index:

```
## Call:
## glm(formula = data$BINARY.FORM ~ Multidimensional.Poverty.Index,
##     family = binomial, data = data)
##
## Deviance Residuals:
##    Min      1Q  Median      3Q     Max
## -1.935  -1.177   0.578   1.177   1.177
##
## Coefficients:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                         1.7047     0.7687   2.218   0.0266
*
## Multidimensional.Poverty.IndexTRUE  -1.7047     0.8893  -1.917   0.0552
.
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 38.888  on 31  degrees of freedom
## AIC: 42.888
## Number of Fisher Scoring iterations:
```

INTERPRETATION:-

- We have obtained regression coefficients as $\beta_0 = 1.7047$ and $\beta_1 = -1.7047$.
- We have obtained standard logistic regression function as,

$$p = \frac{\exp(1.7047 - 1.7047x)}{1 + \exp(1.7047 - 1.7047x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = -1.7047$, which is negative. This means that an increase in Multidimensional Poverty Index is associated with decrease in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Multidimensional Poverty Index will decrease the odds of Mental Health Quotient being greater than 68.55 by exp (2.88).

LOGISTIC MODEL 6

Logistic Model 6 is between MHQ and Gross Domestic Product:

```
## Call:
## glm(formula = data$BINARY.FORM ~ Gross.Domestic.Product, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.5706  -1.1365   0.8161   0.8842   1.6090
##
## Coefficients:
##                           Estimate Std. Error z value Pr(>|z|)
## (Intercept)             1.031e+00  6.036e-01   1.708   0.0876 .
## Gross.Domestic.Product -6.826e-07  4.778e-07  -1.429   0.1531
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 35.426  on 25  degrees of freedom
## Residual deviance: 31.338  on 24  degrees of freedom
##   (7 observations deleted due to missingness)
## AIC: 35.338
## Number of Fisher Scoring iterations: 6
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = 1.031e^{+00}$ and $\beta_1 = -6.826e^{-07}$.
- We have obtained standard logistic regression function as,

$$p = \frac{\exp(.031e^{+00} - 6.826e^{-07}x)}{1 + \exp(.031e^{+00} - 6.826e^{-07}x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = -6.826e^{-07}$, which is negative. This means that an increase in Gross Domestic Product is associated with decrease in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Gross Domestic Product will decrease the odds of Mental Health Quotient being greater than 68.55 by exp $(-6.826e^{-07})$.

LOGISTIC MODEL 7

Logistic Model 7 is between Human Development Index (HDI):

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Human.Development, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7928  -1.2539   0.8079   0.9301   1.1299
## Coefficients:
##                         Estimate Std. Error z value Pr(>|z|)
## (Intercept)                2.523      2.075   1.216    0.224
## data$Human.Development    -2.506      2.578  -0.972    0.331
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 42.268  on 31  degrees of freedom
## AIC: 46.268
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = 2.523$and $\beta_1 = -2.506$.
- We have obtained standard logistic regression function as,

$$\mathrm{p} = \frac{\exp\,(2.523 - 2.506x)}{1 + \exp\,(2.523 - 2.506x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = -2.506$, which is negative. This means that an increase in Human Development Index is associated with decrease in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Human Development Index will decrease the odds of Mental Health Quotient being greater than 68.55 by exp (-2.506).

LOGISTIC MODEL 8

Logistic Model 8 is between MHQ and Global Health Security Index:

```
## Call:
## glm(formula = data$BINARY.FORM ~ data$Global.Health.Index, family = binomial,
##     data = data)
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7525  -1.2168   0.7958   1.0157   1.0869
## Coefficients:
##                           Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 1.6714     1.1767   1.420    0.155
## data$Global.Health.Index  -0.0235     0.0232  -1.013    0.311
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 42.196  on 31  degrees of freedom
## AIC: 46.196
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = 1.6714$ and $\beta_1 = -0.0235$.
- We have obtained standard logistic regression function as,

$$p = \frac{\exp(1.6714 - 0.0235x)}{1 + \exp(1.6714 - 0.0235x)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = -0.0235$, which is negative. This means that an increase in Global Health Security Index is associated with decrease in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Global Health Security Index will decrease the odds of Mental Health Quotient being greater than 68.55 by $\exp(-0.0235)$.

LOGISTIC MODEL 9

Logistic Model 9 is between MHQ and Climate Change Performance Index:

```
## glm(formula = data$BINARY.FORM ~ data$Climate.Change.Performance.Index,
##     family = binomial, data = data)
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6032  -1.0974  -0.6493   1.1476   1.3727
## Coefficients:
##                                     Estimate Std. Error z value Pr(>|z|)
## (Intercept)                          -2.4034     1.7995  -1.336    0.182
## data$Climate.Change.Performance.Index   0.0483     0.0360   1.342    0.180
## (Dispersion parameter for binomial family taken to be 1)
##     Null deviance: 26.287  on 18  degrees of freedom
## Residual deviance: 24.228  on 17  degrees of freedom
##   (14 observations deleted due to missingness)
## AIC: 28.228
## Number of Fisher Scoring iterations: 4
```

INTERPRETATION: -

- We have obtained regression coefficients as $\beta_0 = -2.4034$ and $\beta_1 = 0.0483$.
- We have obtained standard logistic regression function as,

$$\mathrm{p} = \frac{\exp\left(-2.4034 + 0.0483x\right)}{1 + \exp\left(-2.4034 + 0.0483x\right)}$$

- We observe that the coefficient estimate of EPP is $\beta_1 = 0.0483$, which is positive. This means that an increase in Global Health Security Index is associated with increase in the probability that MHQ is greater than 68.55. Hence, this indicates that one unit increase in Global Health Security Index will increase the odds of Mental Health Quotient being greater than 68.55 by $\exp(0.0483)$.

CHAPTER 4
RESULTS AND CONCLUSIONS

CHAPTER 4

RESULTS AND CONCLUSIONS:

INTERPRETATION:

- The correlation between Mental Health Quotient (MHQ) and Economic Participation and Opportunity for female is found to be positive. This indicates that mental health of a country will improve if females are given more opportunities to participate at the levels of legislators, senior officials, managers, technical and professional worker.
- A negative correlation between Mental Health Quotient (MHQ) and Education Attainment is observed. This implies that as the ratio of women to men in primary, secondary and tertiary level of education increases, the Mental Health of that country decreases. It can be due to increase level of stress, anxiety of academic pressure, unemployment etc.
- The positive correlation between MHQ and 'Health and survival' indicates that as the gap between women's and men's healthy life expectancy decreases the Mental Health of that country increases. Note that a Health and Survival provides an estimate of the number of years that women and men can expect to live in good health by taking into account the years lost to violence, diseases, malnutrition and other relevant factors.
- The correlation between MHQ and Political Empowerment of women is found to be negative; this implies that the participation of women at highest level of political decision-making negatively affects the Mental Health of a country.
- Correlation between MHQ and Multidimensional Poverty Index is observed to be positive. This indicates that economic adversity of the country does not imply less Mental Health Quotient. This is evident from the MHQ and poverty index of Nigeria.
- Correlation between MHQ and Gross Domestic Product is found to be negative. Hence, as the GDP of a country increases then the MHQ decreases. The USA is an obvious example of it.
- The negative correlation between MHQ and Human Development Index indicates that MHQ increases as the longevity of life, education and income per capita decreases. This phenomenon is visible in the case of New Zealand that has below average MHQ and above average HDI.

- Global Health Security Index does not imply a good MHQ as it is observed that these two are negatively correlated. Best example of this striking conclusion is USA where MHQ is below average while GHSI is highest of the world.
- Correlation between MHQ and Climate Change Performance Index is found to be negative. This fact is clearly visible in the case of the United Kingdom which has highest Climate Change Performance Index and the lowest MHQ.

CONCLUSIONS:

We have observed that the economic prosperity of a country does not imply better social and mental wellbeing of the society. This contradicts the popular belief that more wealth translates to more happiness. We have seen that Gross Domestic Product and Human Development Index have negative impact on mental health. Also, we know that better Global Health Security Index (GHSI) and Climate Change Performance Index (CCPI) of a country implies better economic condition of that country. Therefore, negative impact of GHSI and CCPI on Mental Health Quotient supports our claim that economic prosperity does not imply better mental health. We also observe that Multidimensional Poverty Index have positive impact on Mental Health Quotient. This means that economic adversity does not translate mental health from better to worse. Therefore, we conclude that there should be a balanced progress that should give equal weightage to all the positive needs of a country, not alone the economy and the infra structure.

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APPENDIX A

(DATA USED)

Country	MHQ	EPP	EA	HS	PE	MPI	GDP
Venezuela	91	0.617	0.998	0.98	0.199	NA	NA
Spain	85	0.699	0.998	0.965	0.491	NA	1425777
Democratic public of congo	82	0.571	0.658	0.976	0.099	0.112	NA
Switzerland	82	0.743	0.992	0.964	0.494	NA	812867
Peru	78	0.629	0.981	0.964	0.31	0.029	223249
Argentina	75	0.639	1	0.977	0.398	NA	491493
Belgium	75	0.709	1	0.968	0.48	NA	599879
Singapore	74	0.749	0.99	0.963	0.208	NA	396987
Ecuador	74	0.675	0.997	0.968	0.318	0.018	106166
UAE	73	0.51	0.987	0.963	0.403	NA	358867
Tunisia	73	0.445	0.97	0.969	0.212	0.003	NA
France	73	0.71	1	0.97	0.457	NA	2937473
Cote d'lvoire	72	0.664	0.828	0.979	0.076	0.236	NA
Chile	71	0.61	1	0.97	0.283	NA	317059
Nigeria	71	0.687	0.806	0.967	0.047	0.254	440777
Cameroon	71	0.706	0.885	0.973	0.202	0.232	NA
Mexico	71	0.59	0.997	0.975	0.468	NA	1293038
Guatemala	70	0.56	0.969	0.979	0.112	0.134	NA
Columbia	70	0.708	1	0.975	0.216	0.02	314322
Morocco	70	0.407	0.956	0.961	0.126	0.027	132725
Algeria	69	0.456	0.966	0.958	0.151	0.005	167983
Saudi Arabia	68	0.39	0.98	0.964	0.077	NA	833541
Yemen	64	0.282	0.717	0.968	0.001	NA	NA
United States	63	0.754	1	0.97	0.329	NA	22996100
Canada	63	0.741	1	0.968	0.381	NA	1990762
Egypt	60	0.421	0.973	0.968	0.196	NA	404143
New Zealand	59	0.763	1	0.966	0.63	NA	249992
Iraq	57	0.228	0.807	0.968	0.136	0.033	207889
India	56	0.326	0.962	0.937	0.276	0.123	3173398
Ireland	56	0.733	0.998	0.964	0.504	NA	498560
Australia	54	0.7	1	0.968	0.258	NA	1542660
Uk	46	0.716	0.999	0.966	0.419	NA	3186860
South Africa	46	0.658	0.994	0.979	0.493	NA	419946

Country	HDI	GHSI	CCPI	Continent	BINARY
Venezuela	0.691	20.9	NA	SOUTH AMERICA	1
Spain	0.905	60.9	45.02	EUROPE	1
Democratic public of congo	0.479	26.1	NA	AFRICA	1
Switzerland	0.962	58.8	60.85	EUROPE	1
Peru	0.762	54.9	NA	SOUTH AMERICA	1
Argentina	0.842	54.4	40.48	SOUTH AMERICA	1
Belgium	0.937	59.3	45.11	EUROPE	1
Singapore	0.939	57.4	NA	ASIA	1
Ecuador	0.74	50.8	NA	SOUTH AMERICA	1
UAE	0.911	39.6	NA	ASIA	1
Tunisia	0.731	31.5	NA	AFRICA	1
France	0.903	61.9	53.72	EUROPE	1
Cote d'lvoire	0.55	31.2	NA	AFRICA	1
Chile	0.855	56.2	64.05	SOUTH AMERICA	1
Nigeria	0.535	38	NA	AFRICA	1
Cameroon	0.576	28.6	NA	AFRICA	1
Mexico	0.758	57	48.76	NORTH AMERICA	1
Guatemala	0.627	29.1	NA	NORTH AMERICA	1
Columbia	0.752	53.2	NA	SOUTH AMERICA	1
Morocco	0.683	33.6	67.59	AFRICA	1
Algeria	0.745	26.2	43.27	AFRICA	1
Saudi Arabia	0.875	44.9	22.46	ASIA	0
Yemen	0.455	16.1	NA	ASIA	0
United States	0.921	75.9	19.75	NORTH AMERICA	0
Canada	0.936	69.8	24.82	NORTH AMERICA	0
Egypt	0.731	28	54.33	AFRICA	0
New Zealand	0.937	62.5	51.3	AUSTRALIA	0
Iraq	0.686	24	NA	ASIA	0
India	0.633	42.8	63.98	ASIA	0
Ireland	0.945	55.3	45.47	EUROPE	0
Australia	0.951	71.1	28.82	AUSTRALIA	0
Uk	0.929	67.2	69.66	EUROPE	0
South Africa	0.713	45.8	46.13	AFRICA	0

ABBREVIATIONS:

MHQ: - Mental Health Quotient

EPP: - Economic Participation and Opportunity

EA: - Education Attainment

HS: - Health and Survival

PE: - Political Empowerment

MPI: - Multidimensional Poverty Index

GDP: - Gross Domestic Product

HDI: - Human Development Index

GHSI: - Global Health Security Index

CCPI: - Climate Change Performance Index

APPENDIX B

(SOURCE CODE)

```
data<-read.csv("FINAL PROJECT DATA.csv")
data
```

```
##                        Country MHQ.SCORE
## 1                    Venezuela        91
## 2                        Spain        85
## 3  Democratic public of congo        82
## 4                  Switzerland        82
## 5                         Peru        78
## 6                    Argentina        75
## 7                      Belgium        75
## 8                    Singapore        74
## 9                      Ecuador        74
## 10                         UAE        73
## 11                     Tunisia        73
## 12                      France        73
## 13               Cote d'lvoire        72
## 14                       Chile        71
## 15                     Nigeria        71
## 16                    Cameroon        71
## 17                      Mexico        71
## 18                   Guatemala        70
## 19                    Columbia        70
## 20                     Morocco        70
## 21                     Algeria        69
## 22                Saudi Arabia        68
## 23                       Yemen        64
## 24               United States        63
## 25                      Canada        63
## 26                       Egypt        60
## 27                New  Zealand        59
## 28                        Iraq        57
## 29                       India        56
## 30                     Ireland        56
## 31                   Australia        54
## 32                          Uk        46
## 33                South Africa        46
##    Economic.Participation.and.opportunity Education.Attainment
## 1                                   0.617                0.998
## 2                                   0.699                0.998
## 3                                   0.571                0.658
## 4                                   0.743                0.992
## 5                                   0.629                0.981
## 6                                   0.639                1.000
## 7                                   0.709                1.000
## 8                                   0.749                0.990
## 9                                   0.675                0.997
## 10                                  0.510                0.987
## 11                                  0.445                0.970
## 12                                  0.710                1.000
## 13                                  0.664                0.828
## 14                                  0.610                1.000
## 15                                  0.687                0.806
```

```
## 16                                0.706                0.885
## 17                                0.590                0.997
## 18                                0.560                0.969
## 19                                0.708                1.000
## 20                                0.407                0.956
## 21                                0.456                0.966
## 22                                0.390                0.980
## 23                                0.282                0.717
## 24                                0.754                1.000
## 25                                0.741                1.000
## 26                                0.421                0.973
## 27                                0.763                1.000
## 28                                0.228                0.807
## 29                                0.326                0.962
## 30                                0.733                0.998
## 31                                0.700                1.000
## 32                                0.716                0.999
## 33                                0.658                0.994
##    Health.and.Survival Political.Empowerement Poverty.Index
## 1                0.980                  0.199            NA
## 2                0.965                  0.491            NA
## 3                0.976                  0.099         0.112
## 4                0.964                  0.494            NA
## 5                0.964                  0.310         0.029
## 6                0.977                  0.398            NA
## 7                0.968                  0.480            NA
## 8                0.963                  0.208            NA
## 9                0.968                  0.318         0.018
## 10               0.963                  0.403            NA
## 11               0.969                  0.212         0.003
## 12               0.970                  0.457            NA
## 13               0.979                  0.076         0.236
## 14               0.970                  0.283            NA
## 15               0.967                  0.047         0.254
## 16               0.973                  0.202         0.232
## 17               0.975                  0.468            NA
## 18               0.979                  0.112         0.134
## 19               0.975                  0.216         0.020
## 20               0.961                  0.126         0.027
## 21               0.958                  0.151         0.005
## 22               0.964                  0.077            NA
## 23               0.968                  0.001            NA
## 24               0.970                  0.329            NA
## 25               0.968                  0.381            NA
## 26               0.968                  0.196            NA
## 27               0.966                  0.630            NA
## 28               0.968                  0.136         0.033
## 29               0.937                  0.276         0.123
## 30               0.964                  0.504            NA
## 31               0.968                  0.258            NA
## 32               0.966                  0.419            NA
## 33               0.979                  0.493            NA
##    Gross.Domestic.Product Human.Development Global.Health.Index
## 1                      NA             0.691                20.9
```

```
## 2                 1425777             0.905                60.9
## 3                      NA             0.479                26.1
## 4                  812867             0.962                58.8
## 5                  223249             0.762                54.9
## 6                  491493             0.842                54.4
## 7                  599879             0.937                59.3
## 8                  396987             0.939                57.4
## 9                  106166             0.740                50.8
## 10                 358867             0.911                39.6
## 11                     NA             0.731                31.5
## 12                2937473             0.903                61.9
## 13                     NA             0.550                31.2
## 14                 317059             0.855                56.2
## 15                 440777             0.535                38.0
## 16                     NA             0.576                28.6
## 17                1293038             0.758                57.0
## 18                     NA             0.627                29.1
## 19                 314322             0.752                53.2
## 20                 132725             0.683                33.6
## 21                 167983             0.745                26.2
## 22                 833541             0.875                44.9
## 23                     NA             0.455                16.1
## 24               22996100             0.921                75.9
## 25                1990762             0.936                69.8
## 26                 404143             0.731                28.0
## 27                 249992             0.937                62.5
## 28                 207889             0.686                24.0
## 29                3173398             0.633                42.8
## 30                 498560             0.945                55.3
## 31                1542660             0.951                71.1
## 32                3186860             0.929                67.2
## 33                 419946             0.713                45.8
##    Climate.Change.Performance.Index     Continent BINARY.FORM
## 1                                NA SOUTH AMERICA           1
## 2                             45.02        EUROPE           1
## 3                                NA        AFRICA           1
## 4                             60.85        EUROPE           1
## 5                                NA SOUTH AMERICA           1
## 6                             40.48 SOUTH AMERICA           1
## 7                             45.11        EUROPE           1
## 8                                NA          ASIA           1
## 9                                NA SOUTH AMERICA           1
## 10                               NA          ASIA           1
## 11                               NA        AFRICA           1
## 12                            53.72        EUROPE           1
## 13                               NA        AFRICA           1
## 14                            64.05 SOUTH AMERICA           1
## 15                               NA        AFRICA           1
## 16                               NA        AFRICA           1
## 17                            48.76 NORTH AMERICA           1
## 18                               NA NORTH AMERICA           1
## 19                               NA SOUTH AMERICA           1
## 20                            67.59        AFRICA           1
## 21                            43.27        AFRICA           1
```

```
## 22                            22.46          ASIA           0
## 23                               NA          ASIA           0
## 24                            19.75 NORTH AMERICA           0
## 25                            24.82 NORTH AMERICA           0
## 26                            54.33        AFRICA           0
## 27                            51.30     AUSTRALIA           0
## 28                               NA          ASIA           0
## 29                            63.98          ASIA           0
## 30                            45.47        EUROPE           0
## 31                            28.82     AUSTRALIA           0
## 32                            69.66        EUROPE           0
## 33                            46.13        AFRICA           0
```

```
head(data)
```

```
##                       Country MHQ.SCORE Economic.Participation.and.opportunity
## 1                   Venezuela        91                                   0.617
## 2                       Spain        85                                   0.699
## 3 Democratic public of congo        82                                   0.571
## 4                 Switzerland        82                                   0.743
## 5                        Peru        78                                   0.629
## 6                   Argentina        75                                   0.639
##   Education.Attainment Health.and.Survival Political.Empowerement
## 1                0.998               0.980                  0.199
## 2                0.998               0.965                  0.491
## 3                0.658               0.976                  0.099
## 4                0.992               0.964                  0.494
## 5                0.981               0.964                  0.310
## 6                1.000               0.977                  0.398
##   Poverty.Index Gross.Domestic.Product Human.Development Global.Health.Index
## 1            NA                     NA             0.691                20.9
## 2            NA                1425777             0.905                60.9
## 3         0.112                     NA             0.479                26.1
## 4            NA                 812867             0.962                58.8
## 5         0.029                 223249             0.762                54.9
## 6            NA                 491493             0.842                54.4
##   Climate.Change.Performance.Index     Continent BINARY.FORM
## 1                               NA SOUTH AMERICA           1
## 2                            45.02        EUROPE           1
## 3                               NA        AFRICA           1
## 4                            60.85        EUROPE           1
## 5                               NA SOUTH AMERICA           1
## 6                            40.48 SOUTH AMERICA           1
```

```
tail(data)
```

```
##         Country MHQ.SCORE Economic.Participation.and.opportunity
## 28         Iraq        57                                   0.228
## 29        India        56                                   0.326
## 30      Ireland        56                                   0.733
## 31    Australia        54                                   0.700
## 32           Uk        46                                   0.716
## 33 South Africa        46                                   0.658
```

```
##    Education.Attainment Health.and.Survival Political.Empowerement
## 28                0.807               0.968                  0.136
## 29                0.962               0.937                  0.276
## 30                0.998               0.964                  0.504
## 31                1.000               0.968                  0.258
## 32                0.999               0.966                  0.419
## 33                0.994               0.979                  0.493
##    Poverty.Index Gross.Domestic.Product Human.Development Global.Health.Index
## 28         0.033                 207889             0.686                24.0
## 29         0.123                3173398             0.633                42.8
## 30            NA                 498560             0.945                55.3
## 31            NA                1542660             0.951                71.1
## 32            NA                3186860             0.929                67.2
## 33            NA                 419946             0.713                45.8
##    Climate.Change.Performance.Index Continent BINARY.FORM
## 28                               NA      ASIA           0
## 29                            63.98      ASIA           0
## 30                            45.47    EUROPE           0
## 31                            28.82 AUSTRALIA           0
## 32                            69.66    EUROPE           0
## 33                            46.13    AFRICA           0
```

```
str(data)
```

```
## 'data.frame':    33 obs. of  13 variables:
##  $ Country                                : chr  "Venezuela" "Spain" "Democratic public of congo" "Sw
##  $ MHQ.SCORE                              : int  91 85 82 82 78 75 75 74 74 73 ...
##  $ Economic.Participation.and.opportunity: num  0.617 0.699 0.571 0.743 0.629 0.639 0.709 0.749 0.67
##  $ Education.Attainment                   : num  0.998 0.998 0.658 0.992 0.981 1 1 0.99 0.997 0.987 .
##  $ Health.and.Survival                    : num  0.98 0.965 0.976 0.964 0.964 0.977 0.968 0.963 0.968
##  $ Political.Empowerement                 : num  0.199 0.491 0.099 0.494 0.31 0.398 0.48 0.208 0.318 
##  $ Poverty.Index                          : num  NA NA 0.112 NA 0.029 NA NA NA 0.018 NA ...
##  $ Gross.Domestic.Product                 : int  NA 1425777 NA 812867 223249 491493 599879 396987 106
##  $ Human.Development                      : num  0.691 0.905 0.479 0.962 0.762 0.842 0.937 0.939 0.74
##  $ Global.Health.Index                    : num  20.9 60.9 26.1 58.8 54.9 54.4 59.3 57.4 50.8 39.6 ..
##  $ Climate.Change.Performance.Index       : num  NA 45 NA 60.9 NA ...
##  $ Continent                              : chr  "SOUTH AMERICA" "EUROPE" "AFRICA" "EUROPE" ...
##  $ BINARY.FORM                            : int  1 1 1 1 1 1 1 1 1 1 ...
```

```
names(data)
```

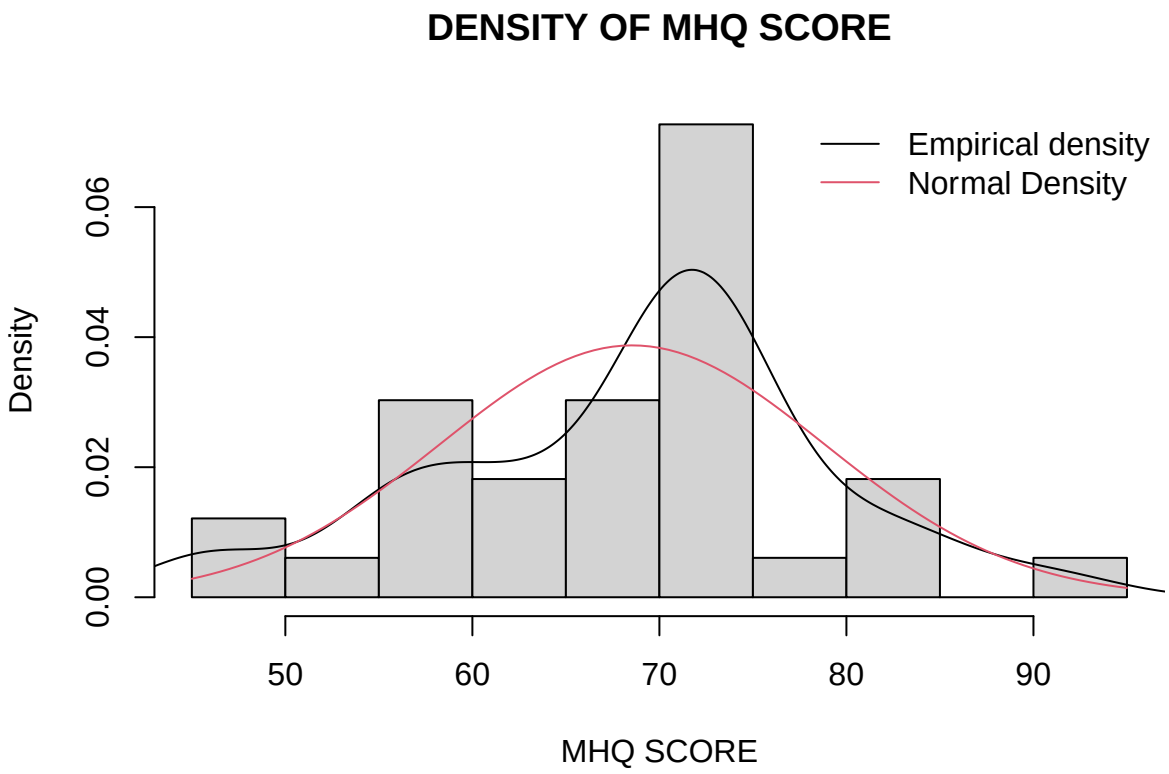
```
##  [1] "Country"
##  [2] "MHQ.SCORE"
##  [3] "Economic.Participation.and.opportunity"
##  [4] "Education.Attainment"
##  [5] "Health.and.Survival"
##  [6] "Political.Empowerement"
##  [7] "Poverty.Index"
##  [8] "Gross.Domestic.Product"
##  [9] "Human.Development"
## [10] "Global.Health.Index"
## [11] "Climate.Change.Performance.Index"
## [12] "Continent"
## [13] "BINARY.FORM"
```

```
summary(data)
```

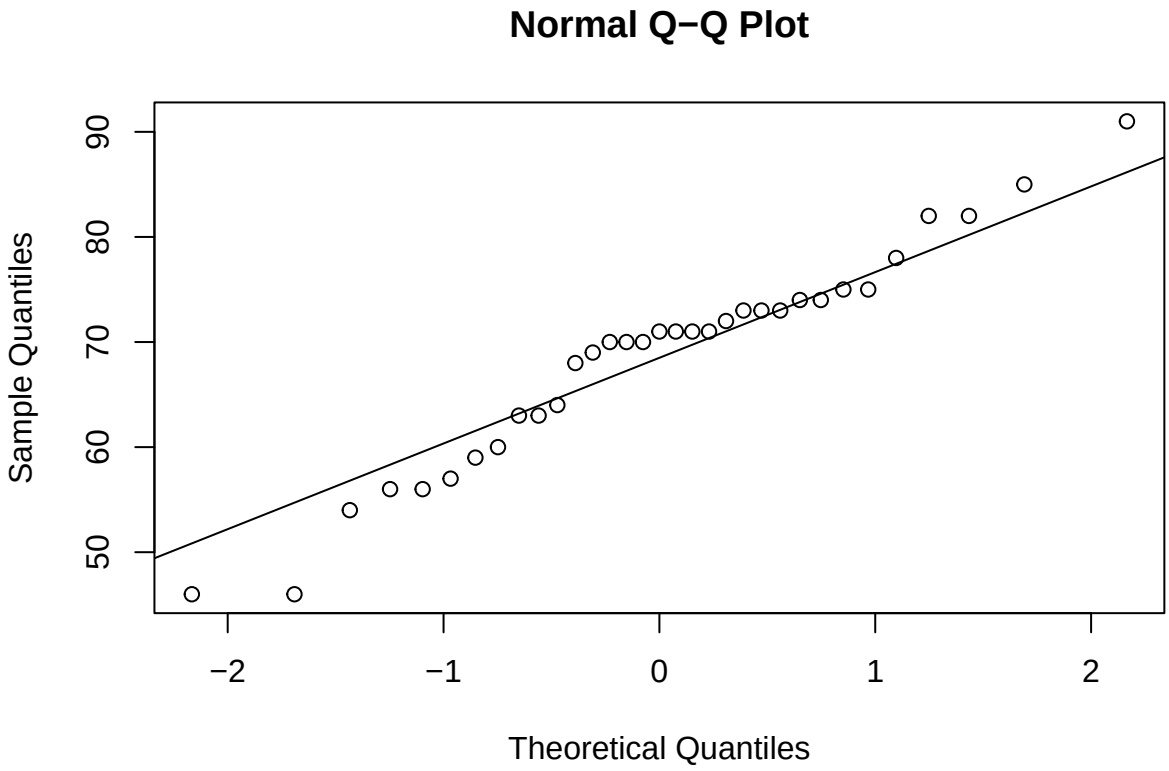
```
##    Country            MHQ.SCORE     Economic.Participation.and.opportunity
##  Length:33          Min.   :46.00   Min.   :0.2280
##  Class :character   1st Qu.:63.00   1st Qu.:0.5100
##  Mode  :character   Median :71.00   Median :0.6580
##                     Mean   :68.55   Mean   :0.5999
##                     3rd Qu.:74.00   3rd Qu.:0.7090
##                     Max.   :91.00   Max.   :0.7630
##
##  Education.Attainment Health.and.Survival Political.Empowerement
##  Min.   :0.6580       Min.   :0.9370      Min.   :0.0010
##  1st Qu.:0.9660       1st Qu.:0.9640      1st Qu.:0.1510
##  Median :0.9920       Median :0.9680      Median :0.2760
##  Mean   :0.9518       Mean   :0.9682      Mean   :0.2864
##  3rd Qu.:1.0000       3rd Qu.:0.9730      3rd Qu.:0.4190
##  Max.   :1.0000       Max.   :0.9800      Max.   :0.6300
##
##  Poverty.Index     Gross.Domestic.Product Human.Development
##  Min.   :0.00300   Min.   :  106166       Min.   :0.4550
##  1st Qu.:0.02000   1st Qu.:  315006       1st Qu.:0.6860
##  Median :0.03300   Median :  466135       Median :0.7580
##  Mean   :0.09431   Mean   : 1750866       Mean   :0.7756
##  3rd Qu.:0.13400   3rd Qu.: 1392592       3rd Qu.:0.9210
##  Max.   :0.25400   Max.   :22996100       Max.   :0.9620
##  NA's   :20        NA's   :7
##  Global.Health.Index Climate.Change.Performance.Index  Continent
##  Min.   :16.10       Min.   :19.75                     Length:33
##  1st Qu.:31.20       1st Qu.:41.88                     Class :character
##  Median :50.80       Median :46.13                     Mode  :character
##  Mean   :46.45       Mean   :47.14
##  3rd Qu.:58.80       3rd Qu.:57.59
##  Max.   :75.90       Max.   :69.66
##                      NA's   :14
##   BINARY.FORM
##  Min.   :0.0000
##  1st Qu.:0.0000
##  Median :1.0000
##  Mean   :0.6364
##  3rd Qu.:1.0000
##  Max.   :1.0000
##
```

0.1 NORMALITY ASSUMPTION

```
hist(data$MHQ.SCORE,prob=TRUE,main="DENSITY OF MHQ SCORE",xlab="MHQ SCORE")
lines(density(data$MHQ.SCORE))
curve(dnorm(x,mean(data$MHQ.SCORE),sd(data$MHQ.SCORE)),col=2,add=T)
legend("topright",legend=c("Empirical density", "Normal Density"),lwd=1,col=c(1,2),bty="n")
```




```
qqnorm(data$MHQ.SCORE)
qqline(data$MHQ.SCORE)
```




```
ks.test(data$MHQ.SCORE,"pnorm",mean(data$MHQ.SCORE),sd(data$MHQ.SCORE))
```

```
## Warning in ks.test.default(data$MHQ.SCORE, "pnorm", mean(data$MHQ.SCORE), :
## ties should not be present for the Kolmogorov-Smirnov test
```

```
##
##  Asymptotic one-sample Kolmogorov-Smirnov test
##
## data:  data$MHQ.SCORE
## D = 0.16222, p-value = 0.3503
## alternative hypothesis: two-sided
```

```
library(nortest)
ad.test(data$MHQ.SCORE)
```

```
##
##  Anderson-Darling normality test
##
## data:  data$MHQ.SCORE
## A = 0.62741, p-value = 0.09355
```

```
shapiro.test(data$MHQ.SCORE)
```

```
##
```

```
##  Shapiro-Wilk normality test
##
## data:  data$MHQ.SCORE
## W = 0.96198, p-value = 0.2938
```

0.2 FIT1

```
fit1<-lm(MHQ.SCORE~Economic.Participation.and.opportunity,data=data)
fit1
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Economic.Participation.and.opportunity,
##     data = data)
##
## Coefficients:
##                               (Intercept)
##                                    63.172
## Economic.Participation.and.opportunity
##                                     8.957
```

```
summary(fit1)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Economic.Participation.and.opportunity,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -23.586  -6.926   1.812   5.260  22.301
##
## Coefficients:
##                                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)                             63.172      7.566   8.349 1.98e-09
## Economic.Participation.and.opportunity   8.957     12.249   0.731     0.47
##
## (Intercept)                             ***
## Economic.Participation.and.opportunity
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.37 on 31 degrees of freedom
## Multiple R-squared:  0.01696,    Adjusted R-squared:  -0.01475
## F-statistic: 0.5348 on 1 and 31 DF,  p-value: 0.4701
```

```
anova1<-aov(fit1)
summary(anova1)
```

```
##                                       Df Sum Sq Mean Sq F value Pr(>F)
## Economic.Participation.and.opportunity  1     58   57.56   0.535   0.47
## Residuals                              31   3337  107.63
```

```
par(mfrow=c(2,2))
plot(fit1)
library(lmtest)
```

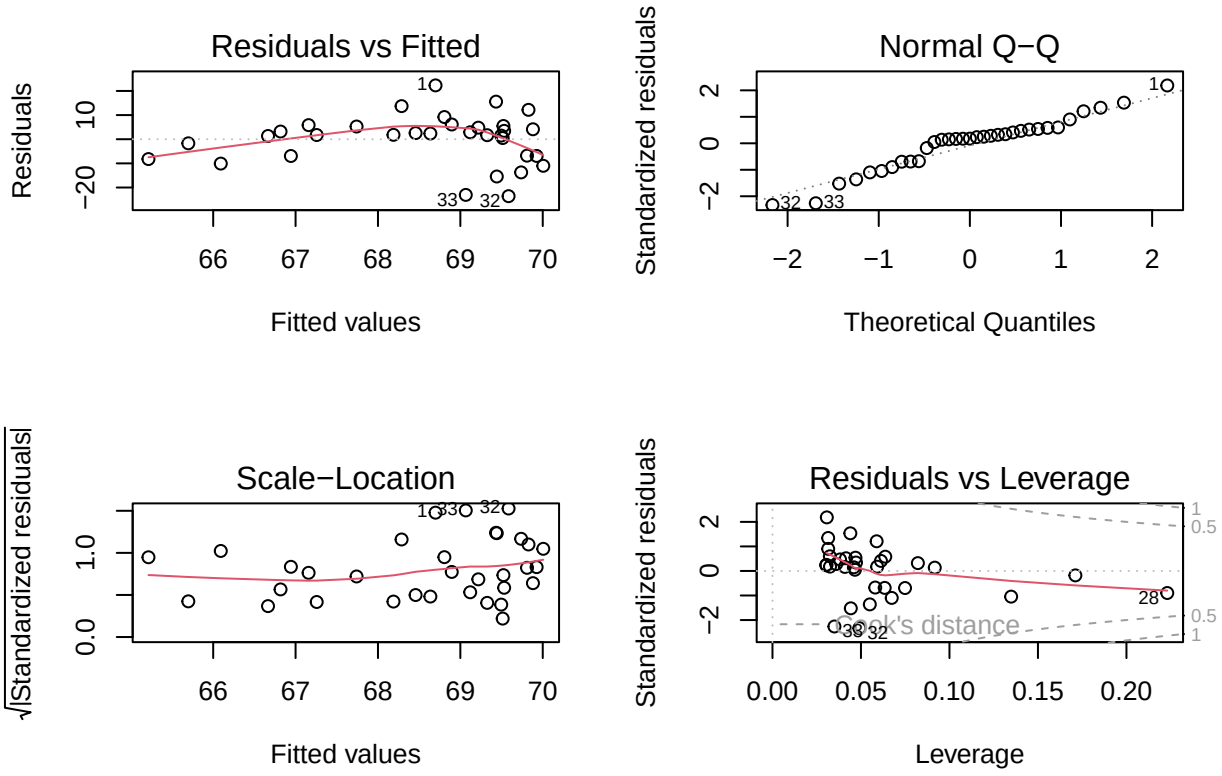
```
## Warning: package 'lmtest' was built under R version 4.2.2
```

```
## Loading required package: zoo
```

```
## Warning: package 'zoo' was built under R version 4.2.2
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```




```
bptest(fit1)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit1
## BP = 1.6905, df = 1, p-value = 0.1935
```

0.3 FIT2

```
fit2<-lm(MHQ.SCORE~Education.Attainment,data=data)
fit2
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Education.Attainment, data = data)
##
## Coefficients:
##          (Intercept)  Education.Attainment
##               77.426                -9.331
```

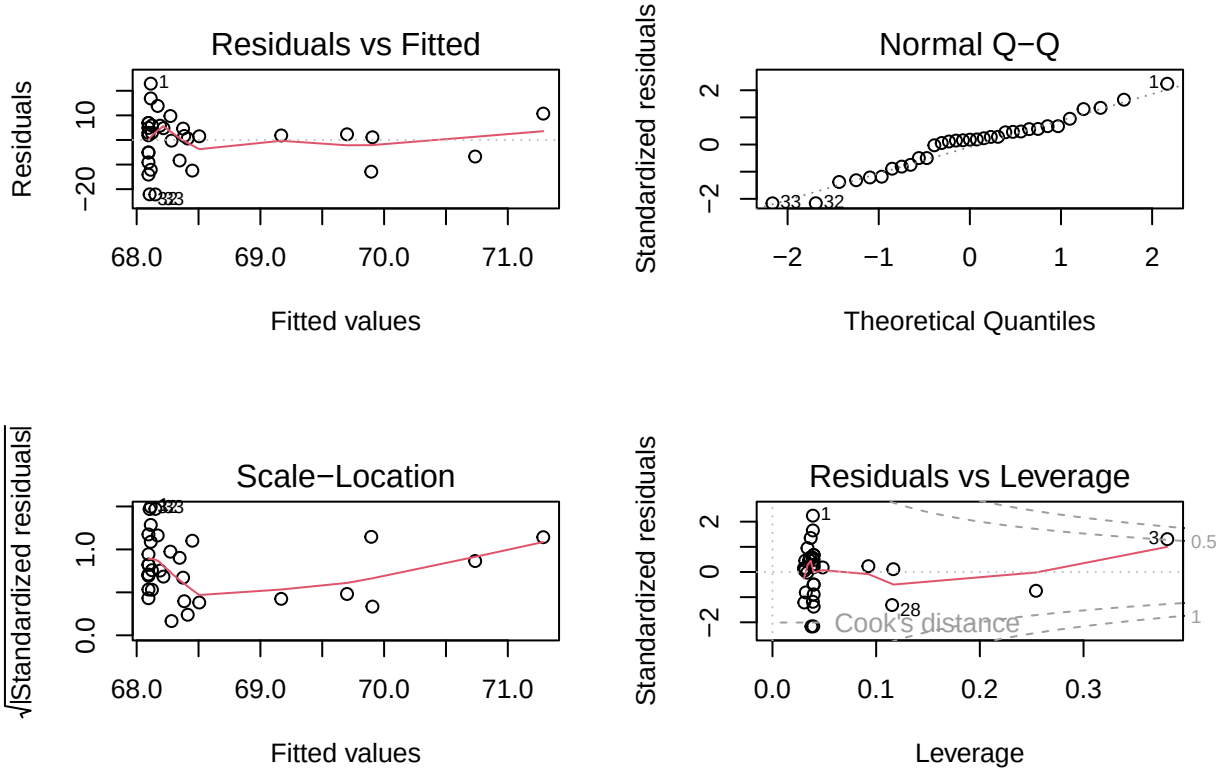
```
summary(fit2)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Education.Attainment, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -22.151  -6.736   1.832   5.811  22.886
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)            77.426     20.088   3.854 0.000547 ***
## Education.Attainment   -9.331     21.020  -0.444 0.660188
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.43 on 31 degrees of freedom
## Multiple R-squared:  0.006317,   Adjusted R-squared:  -0.02574
## F-statistic: 0.1971 on 1 and 31 DF,  p-value: 0.6602
```

```
anova2<-aov(fit2)
summary(anova2)
```

```
##                      Df Sum Sq Mean Sq F value Pr(>F)
## Education.Attainment  1     21   21.44   0.197   0.66
## Residuals            31   3373  108.80
```

```
par(mfrow=c(2,2))
plot(fit2)
```




```
bptest(fit2)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit2
## BP = 0.67925, df = 1, p-value = 0.4098
```

0.4 FIT3

```
fit3<-lm(MHQ.SCORE~Health.and.Survival,data=data)
fit3
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Health.and.Survival, data = data)
##
## Coefficients:
##         (Intercept)  Health.and.Survival
##              -211.0                288.7
```

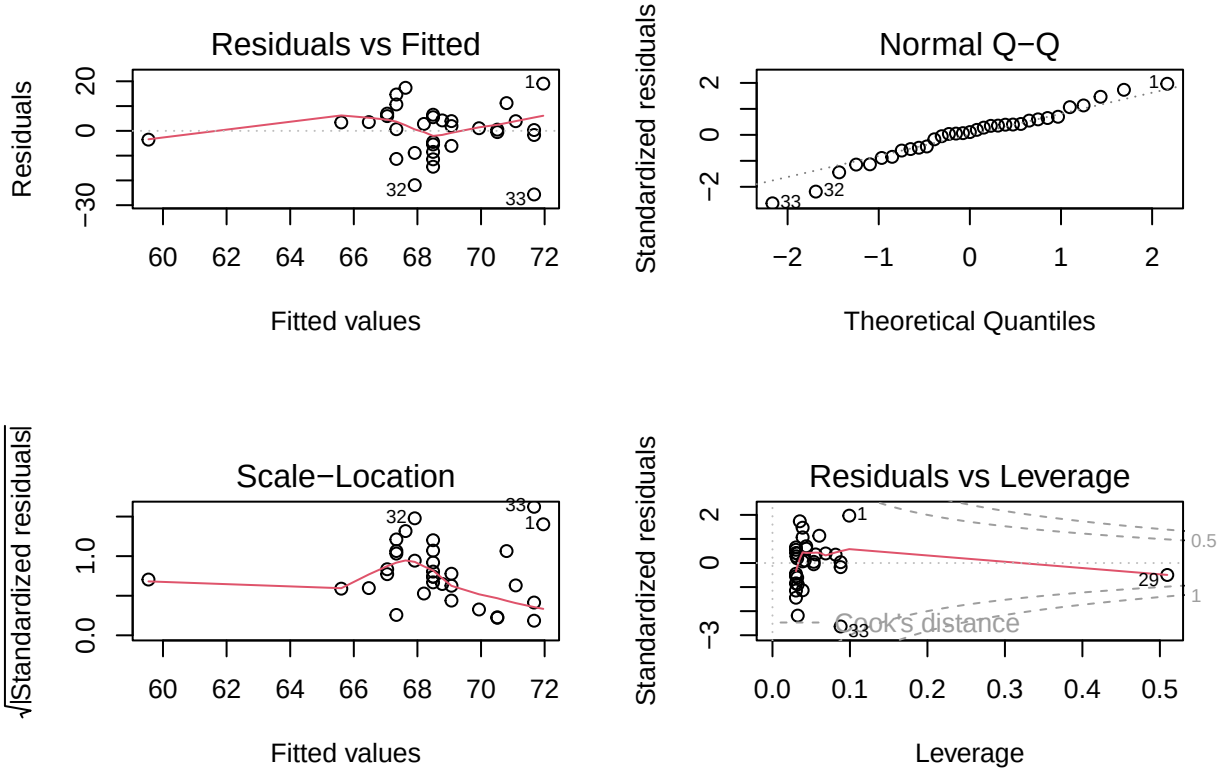
```
summary(fit3)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Health.and.Survival, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -25.669  -5.493   1.064   5.507  19.043
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -211.0      219.2  -0.962    0.343
## Health.and.Survival    288.7      226.4   1.275    0.212
##
## Residual standard error: 10.2 on 31 degrees of freedom
## Multiple R-squared:  0.04982,    Adjusted R-squared:  0.01917
## F-statistic: 1.625 on 1 and 31 DF,  p-value: 0.2118
```

```
anova3<-aov(fit3)
summary(anova3)
```

```
##                     Df Sum Sq Mean Sq F value Pr(>F)
## Health.and.Survival  1    169   169.1   1.625  0.212
## Residuals           31   3225   104.0
```

```
par(mfrow=c(2,2))
plot(fit3)
```




```
bptest(fit3)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit3
## BP = 1.2087, df = 1, p-value = 0.2716
```

0.5 FIT4

```
fit4<-lm(MHQ.SCORE~Political.Empowerement,data=data)
fit4
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Political.Empowerement, data = data)
##
## Coefficients:
##             (Intercept)  Political.Empowerement
##                  70.952                  -8.403
```

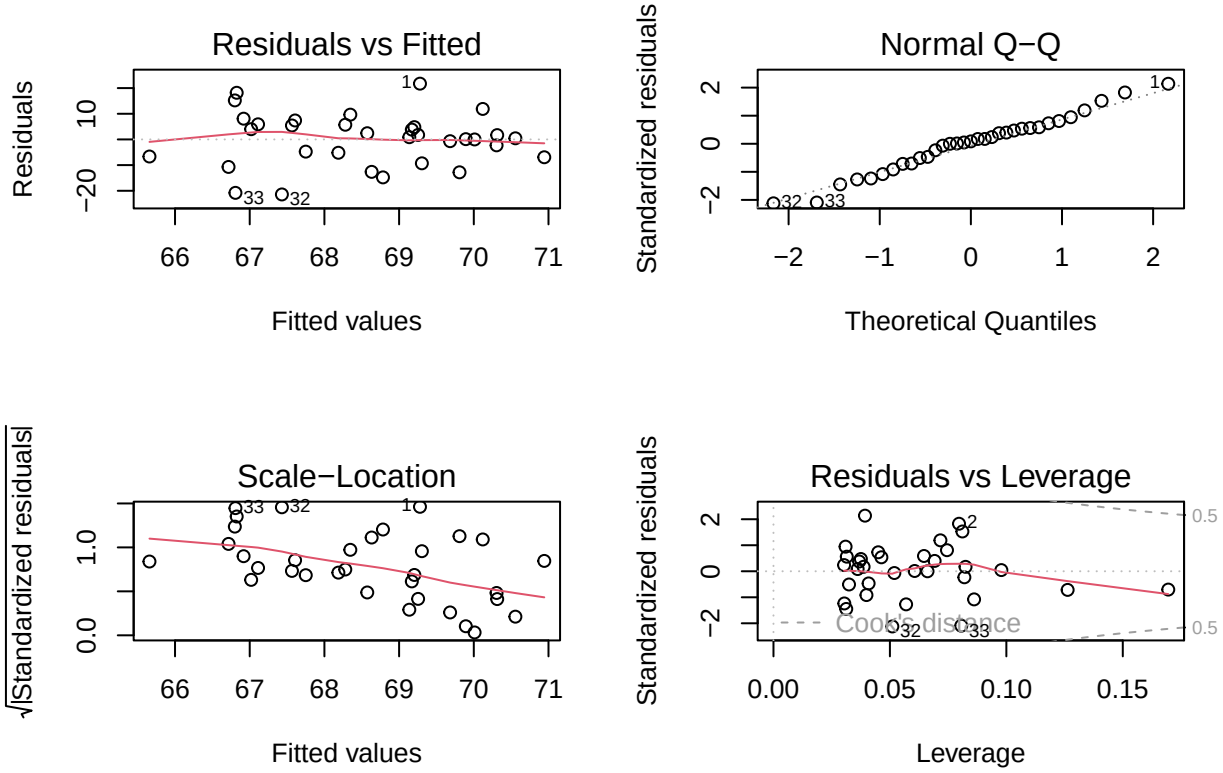
```r
summary(fit4)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Political.Empowerement, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.4308  -6.6577   0.8632   5.7204  21.7204
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)               70.952      3.696  19.198   <2e-16 ***
## Political.Empowerement    -8.403     11.261  -0.746    0.461
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.37 on 31 degrees of freedom
## Multiple R-squared:  0.01765,    Adjusted R-squared:  -0.01404
## F-statistic: 0.5569 on 1 and 31 DF,  p-value: 0.4611
```

```r
anova4<-aov(fit4)
summary(anova4)
```

```
##                         Df Sum Sq Mean Sq F value Pr(>F)
## Political.Empowerement   1     60    59.9   0.557  0.461
## Residuals               31   3334   107.6
```

```r
par(mfrow=c(2,2))
plot(fit4)
```




```
bptest(fit4)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit4
## BP = 2.9853, df = 1, p-value = 0.08402
```

0.6 FIT5

```
fit5<-lm(MHQ.SCORE~Poverty.Index,data=data)
fit5
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Poverty.Index, data = data)
##
## Coefficients:
##   (Intercept)  Poverty.Index
##        70.076          1.639
```

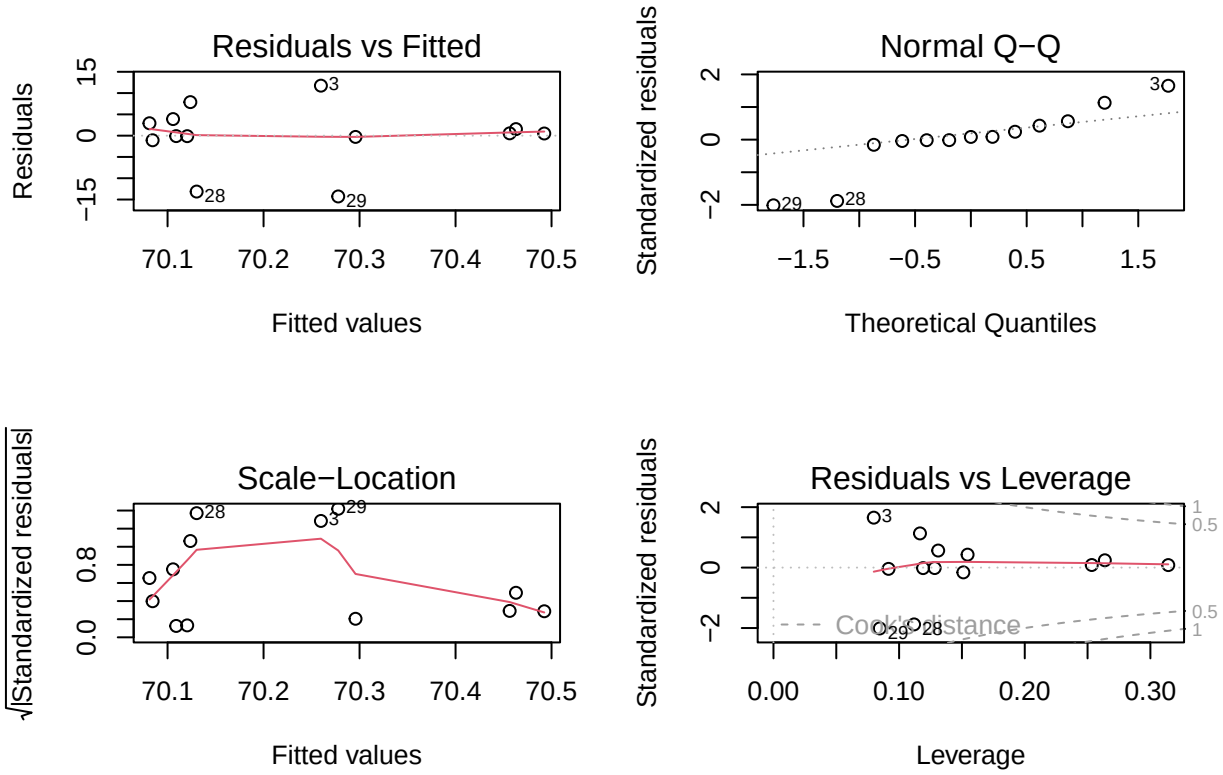
```r
summary(fit5)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Poverty.Index, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.2778  -0.2958   0.5076   2.9188  11.7402
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)     70.076      2.961  23.665 8.73e-11 ***
## Poverty.Index    1.639     22.605   0.072    0.944
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.41 on 11 degrees of freedom
##   (20 observations deleted due to missingness)
## Multiple R-squared:  0.0004774,  Adjusted R-squared:  -0.09039
## F-statistic: 0.005254 on 1 and 11 DF,  p-value: 0.9435
```

```r
anova5<-aov(fit5)
summary(anova5)
```

```
##               Df Sum Sq Mean Sq F value Pr(>F)
## Poverty.Index  1    0.3    0.29   0.005  0.944
## Residuals     11  604.0   54.91
## 20 observations deleted due to missingness
```

```r
par(mfrow=c(2,2))
plot(fit5)
```




```
bptest(fit5)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit5
## BP = 0.11536, df = 1, p-value = 0.7341
```

0.7 FIT6

```
fit6<-lm(MHQ.SCORE~Gross.Domestic.Product,data=data)
fit6
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Gross.Domestic.Product, data = data)
##
## Coefficients:
##             (Intercept)  Gross.Domestic.Product
##               6.744e+01               -3.148e-07
```

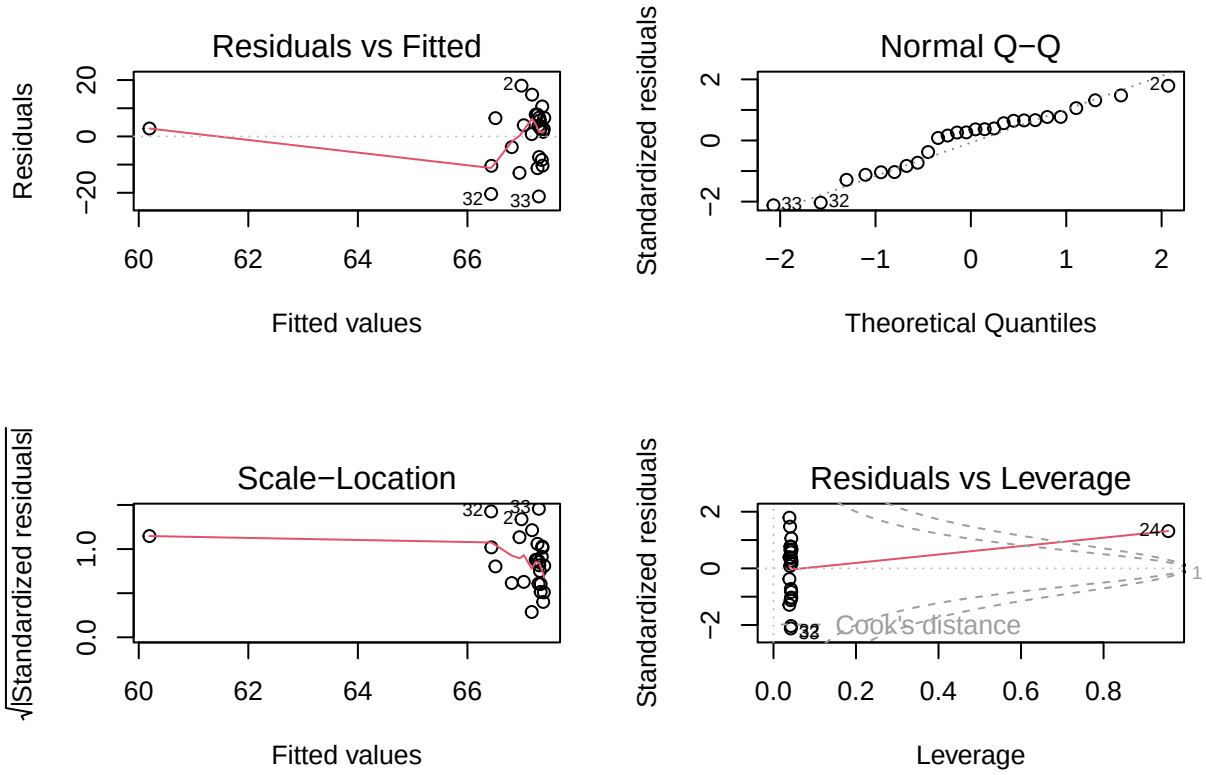
```r
summary(fit6)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Gross.Domestic.Product, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -21.304  -8.095   2.734   6.570  18.013
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)              6.744e+01  2.170e+00   31.08   <2e-16 ***
## Gross.Domestic.Product -3.148e-07  4.630e-07   -0.68    0.503
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.26 on 24 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.01891,    Adjusted R-squared:  -0.02197
## F-statistic: 0.4625 on 1 and 24 DF,  p-value: 0.503
```

```r
anova6<-aov(fit6)
summary(anova6)
```

```
##                        Df Sum Sq Mean Sq F value Pr(>F)
## Gross.Domestic.Product  1   48.7   48.72   0.463  0.503
## Residuals              24 2527.9  105.33
## 7 observations deleted due to missingness
```

```r
par(mfrow=c(2,2))
plot(fit6)
```




```
bptest(fit6)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit6
## BP = 0.14682, df = 1, p-value = 0.7016
```

0.8 FIT7

```
fit7<-lm(MHQ.SCORE~Human.Development,data=data)
fit7
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Human.Development, data = data)
##
## Coefficients:
##       (Intercept)  Human.Development
##            74.587             -7.789
```

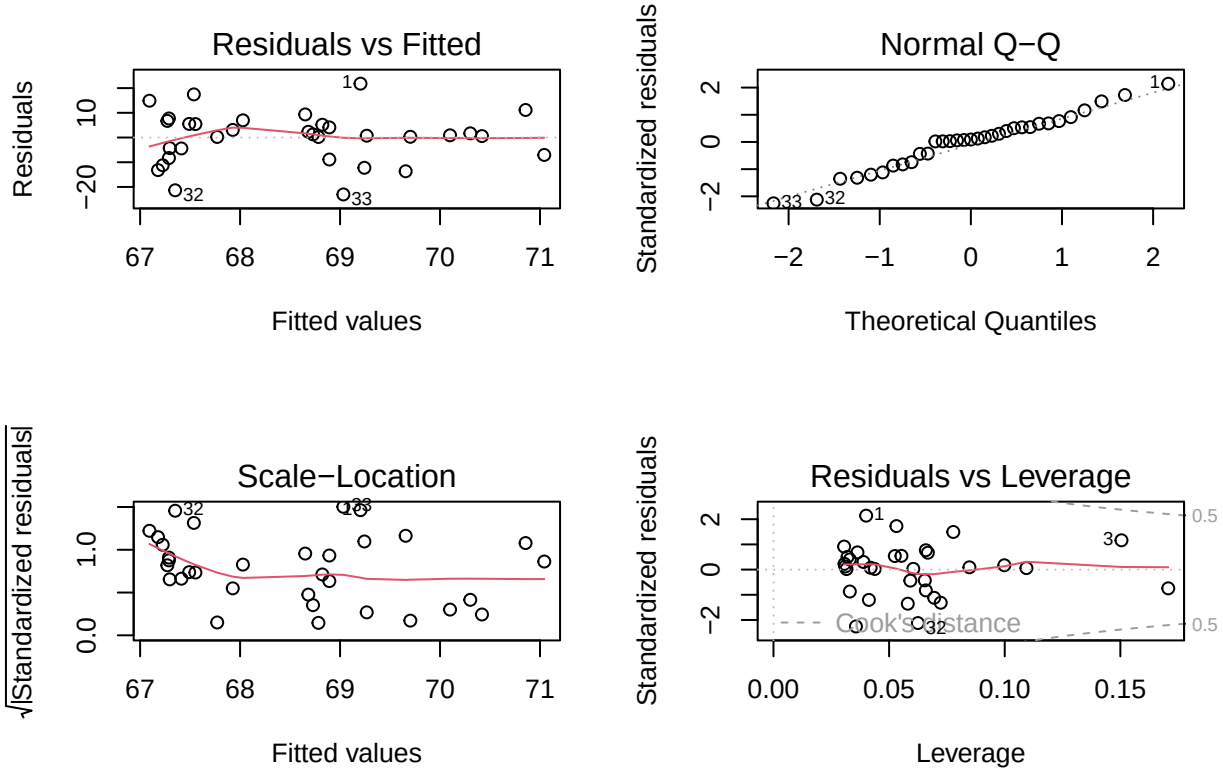
```
summary(fit7)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Human.Development, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -23.0331  -7.0428   0.8998   5.5092  21.7955
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)         74.587      9.596   7.773 9.04e-09 ***
## Human.Development   -7.789     12.150  -0.641    0.526
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.4 on 31 degrees of freedom
## Multiple R-squared:  0.01309,    Adjusted R-squared:  -0.01875
## F-statistic: 0.411 on 1 and 31 DF,  p-value: 0.5262
```

```
anova7<-aov(fit7)
summary(anova7)
```

```
##                   Df Sum Sq Mean Sq F value Pr(>F)
## Human.Development  1     44   44.41   0.411  0.526
## Residuals         31   3350  108.06
```

```
par(mfrow=c(2,2))
plot(fit7)
```




```
bptest(fit7)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit7
## BP = 0.3759, df = 1, p-value = 0.5398
```

0.9 FIT8

```
fit8<-lm(MHQ.SCORE~Global.Health.Index,data=data)
fit8
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Global.Health.Index, data = data)
##
## Coefficients:
##         (Intercept)  Global.Health.Index
##              74.167               -0.121
```

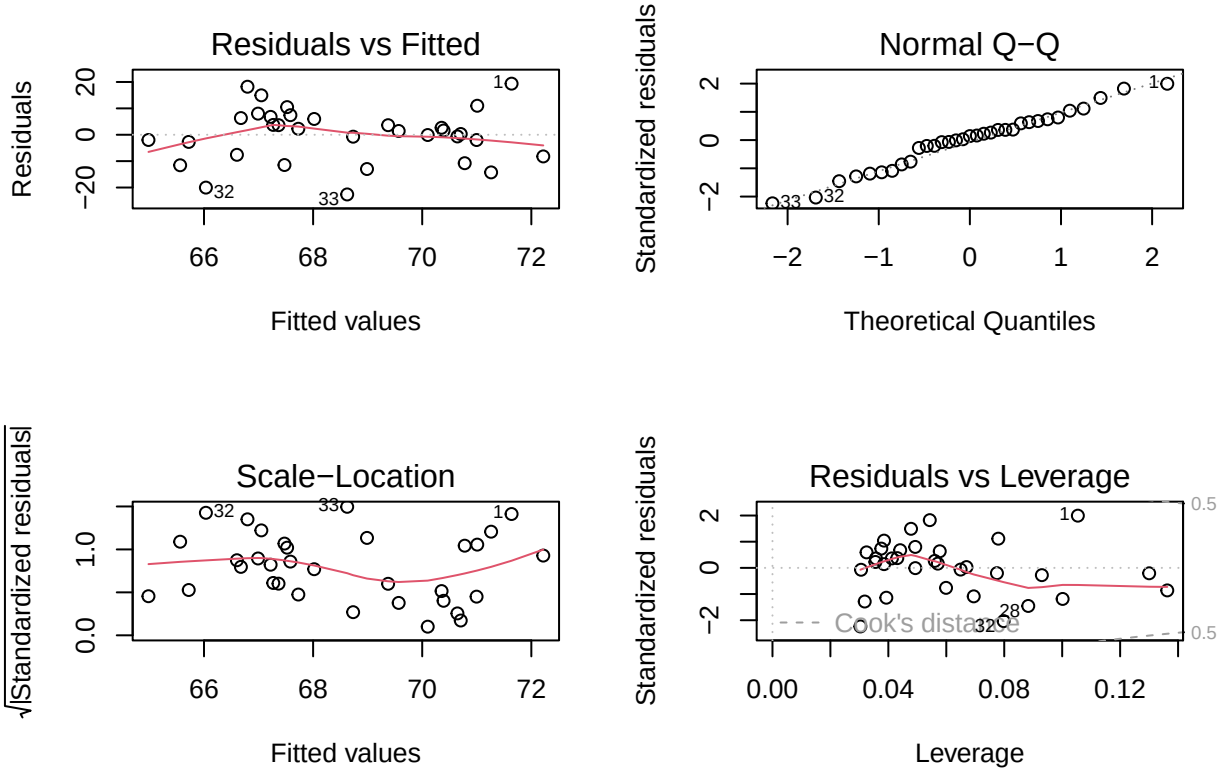
```r
summary(fit8)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Global.Health.Index, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -22.625  -7.604   1.431   6.324  19.362
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          74.1675     5.4174  13.691  1.1e-14 ***
## Global.Health.Index  -0.1210     0.1101  -1.099     0.28
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.27 on 31 degrees of freedom
## Multiple R-squared:  0.03752,    Adjusted R-squared:  0.006472
## F-statistic: 1.208 on 1 and 31 DF,  p-value: 0.2801
```

```r
anova8<-aov(fit8)
summary(anova8)
```

```
##                     Df Sum Sq Mean Sq F value Pr(>F)
## Global.Health.Index  1    127   127.3   1.208   0.28
## Residuals           31   3267   105.4
```

```r
par(mfrow=c(2,2))
plot(fit8)
```




```
bptest(fit8)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit8
## BP = 0.069852, df = 1, p-value = 0.7916
```

0.10 FIT9

```
fit9<-lm(MHQ.SCORE~Climate.Change.Performance.Index,data=data)
fit9
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Climate.Change.Performance.Index, data = data)
##
## Coefficients:
##                         (Intercept)  Climate.Change.Performance.Index
##                           65.656581                          -0.006113
```

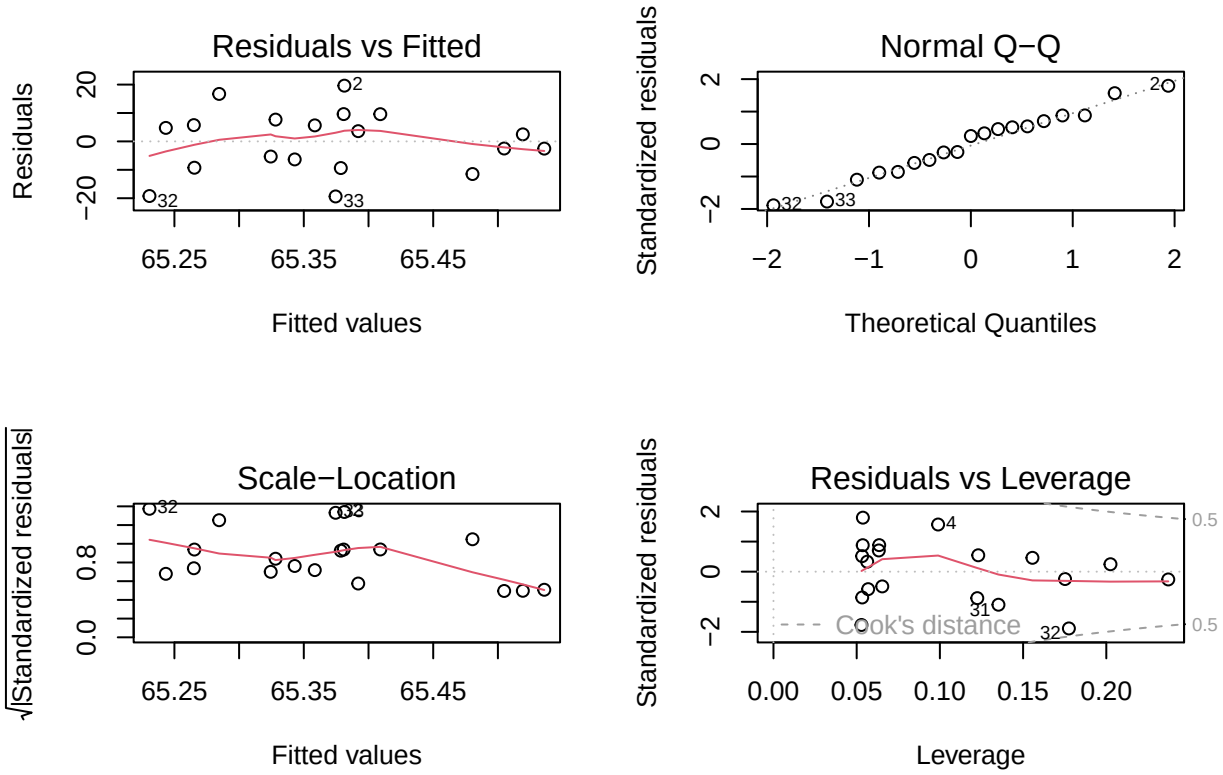
```r
summary(fit9)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Climate.Change.Performance.Index, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -19.375  -7.804   2.481   6.703  19.619
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     65.656581   8.699857   7.547    8e-07 ***
## Climate.Change.Performance.Index -0.006113   0.176284  -0.035    0.973
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.24 on 17 degrees of freedom
##   (14 observations deleted due to missingness)
## Multiple R-squared:  7.074e-05,  Adjusted R-squared:  -0.05875
## F-statistic: 0.001203 on 1 and 17 DF,  p-value: 0.9727
```

```r
anova9<-aov(fit9)
summary(anova9)
```

```
##                                 Df Sum Sq Mean Sq F value Pr(>F)
## Climate.Change.Performance.Index  1    0.2    0.15   0.001  0.973
## Residuals                        17 2146.3  126.25
## 14 observations deleted due to missingness
```

```r
par(mfrow=c(2,2))
plot(fit9)
```




```
bptest(fit9)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  fit9
## BP = 1.5725, df = 1, p-value = 0.2098
```

1 MLR

```
mlr<-lm(MHQ.SCORE~Economic.Participation.and.opportunity+Education.Attainment +Health.and.Survival+Poli
mlr
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Economic.Participation.and.opportunity +
##     Education.Attainment + Health.and.Survival + Political.Empowerement +
##     Global.Health.Index + Human.Development, data = data)
##
## Coefficients:
##                               (Intercept)
##                                   42.9908
```

```
## Economic.Participation.and.opportunity
##                                38.1356
##                     Education.Attainment
##                                 2.0117
##                      Health.and.Survival
##                                 9.0148
##                   Political.Empowerement
##                               -10.6671
##                      Global.Health.Index
##                                -0.4397
##                        Human.Development
##                                20.0070
```

```
summary(mlr)
```

```
##
## Call:
## lm(formula = MHQ.SCORE ~ Economic.Participation.and.opportunity +
##     Education.Attainment + Health.and.Survival + Political.Empowerement +
##     Global.Health.Index + Human.Development, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.7755  -3.7336  -0.1393   6.2049  18.5564
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         42.9908   267.6892   0.161   0.8736
## Economic.Participation.and.opportunity  38.1356    20.5825   1.853   0.0753 .
## Education.Attainment                 2.0117    33.1733   0.061   0.9521
## Health.and.Survival                  9.0148   277.1868   0.033   0.9743
## Political.Empowerement             -10.6671    17.3495  -0.615   0.5440
## Global.Health.Index                 -0.4397     0.2410  -1.824   0.0796 .
## Human.Development                   20.0070    26.3531   0.759   0.4546
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.24 on 26 degrees of freedom
## Multiple R-squared:  0.1975, Adjusted R-squared:  0.01232
## F-statistic: 1.067 on 6 and 26 DF,  p-value: 0.4074
```

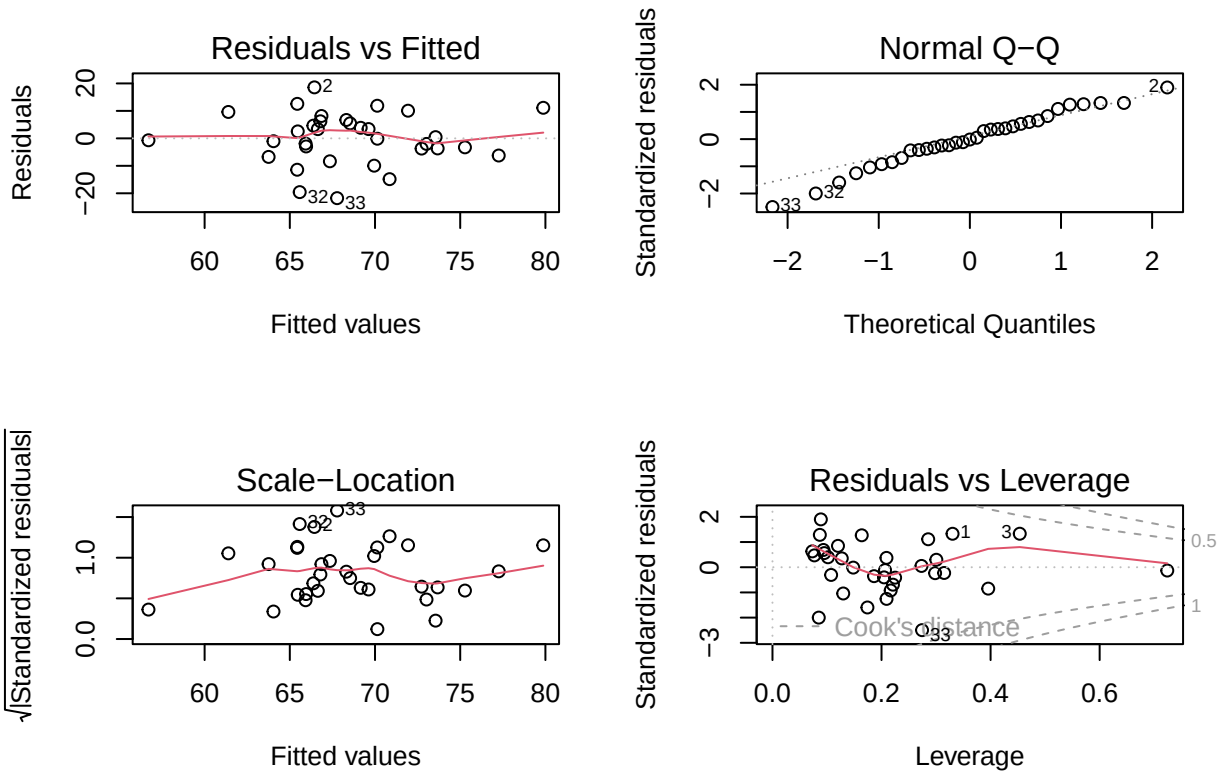
```
anova<-aov(mlr)
summary(anova)
```

```
##                                    Df Sum Sq Mean Sq F value Pr(>F)
## Economic.Participation.and.opportunity  1   57.6   57.56   0.549  0.465
## Education.Attainment                 1   69.4   69.40   0.662  0.423
## Health.and.Survival                  1   81.1   81.08   0.774  0.387
## Political.Empowerement               1  106.6  106.63   1.018  0.322
## Global.Health.Index                  1  295.3  295.34   2.819  0.105
## Human.Development                    1   60.4   60.38   0.576  0.455
## Residuals                           26 2723.8  104.76
```

```
fitted(mlr)
```

```
##        1        2        3        4        5        6        7        8
## 79.87428 66.44362 71.93866 70.13233 65.43906 66.85755 68.31718 73.55437
##        9       10       11       12       13       14       15       16
## 68.53895 69.62087 69.15993 66.79515 75.27750 66.38380 73.02125 77.25919
##       17       18       19       20       21       22       23       24
## 61.39425 73.67500 70.13933 66.64410 72.73358 65.46618 65.92657 64.04239
##       25       26       27       28       29       30       31       32
## 65.95637 69.95143 67.35126 63.75597 56.70489 70.85532 65.43332 65.58085
##       33
## 67.77550
```

```
par(mfrow=c(2,2))
plot(mlr)
```




```
library(lmtest)
bptest(mlr)
```

```
##
##  studentized Breusch-Pagan test
##
## data:  mlr
## BP = 10.089, df = 6, p-value = 0.121
```

```
library("olsrr")
```

```
## Warning: package 'olsrr' was built under R version 4.2.2
```

```
##
## Attaching package: 'olsrr'
```

```
## The following object is masked from 'package:datasets':
##
##     rivers
```

```
ols_vif_tol(mlr)
```

```
##                                Variables Tolerance      VIF
## 1 Economic.Participation.and.opportunity 0.3446882 2.901173
## 2                   Education.Attainment 0.3866133 2.586564
## 3                     Health.and.Survival 0.6720344 1.488019
## 4                  Political.Empowerement 0.4103390 2.437010
## 5                     Global.Health.Index 0.2073789 4.822090
## 6                       Human.Development 0.2060704 4.852710
```

1.1 LOGISTIC MODEL

1.2 LOGISTIC 1

```
logistic1<-glm(data$BINARY.FORM~data$Economic.Participation.and.opportunity,family=binomial,data)
logistic1
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ data$Economic.Participation.and.opportunity,
##     family = binomial, data = data)
##
## Coefficients:
##                                   (Intercept)
##                                        -1.154
## data$Economic.Participation.and.opportunity
##                                         2.888
##
## Degrees of Freedom: 32 Total (i.e. Null);  31 Residual
## Null Deviance:       43.26
## Residual Deviance: 41.86     AIC: 45.86
```

```
summary(logistic1)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Economic.Participation.and.opportunity,
##     family = binomial, data = data)
```

```
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6432  -1.1658   0.8292   0.9247   1.1682
##
## Coefficients:
##                                             Estimate Std. Error z value
## (Intercept)                                   -1.154      1.500  -0.769
## data$Economic.Participation.and.opportunity    2.888      2.470   1.169
##                                             Pr(>|z|)
## (Intercept)                                    0.442
## data$Economic.Participation.and.opportunity    0.242
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 41.860  on 31  degrees of freedom
## AIC: 45.86
##
## Number of Fisher Scoring iterations: 4
```

1.3 LOGISTIC 2

```
logistic2<-glm(data$BINARY.FORM~data$Education.Attainment,family=binomial,data)
logistic2
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ data$Education.Attainment, family = binomial,
##     data = data)
##
## Coefficients:
##               (Intercept)  data$Education.Attainment
##                     0.709                     -0.157
##
## Degrees of Freedom: 32 Total (i.e. Null);  31 Residual
## Null Deviance:       43.26
## Residual Deviance: 43.26     AIC: 47.26
```

```
summary(logistic2)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Education.Attainment, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.4389  -1.4190   0.9510   0.9535   0.9537
##
## Coefficients:
##                           Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept)                  0.709      4.021   0.176     0.86
## data$Education.Attainment   -0.157      4.206  -0.037     0.97
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 43.260  on 31  degrees of freedom
## AIC: 47.26
##
## Number of Fisher Scoring iterations: 4
```

1.4 LOGISTIC 3

```
logistic3<-glm(data$BINARY.FORM~data$Health.and.Survival,family=binomial,data)
logistic3
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ data$Health.and.Survival, family = binomial,
##     data = data)
##
## Coefficients:
##              (Intercept)  data$Health.and.Survival
##                   -71.94                    74.91
##
## Degrees of Freedom: 32 Total (i.e. Null);  31 Residual
## Null Deviance:       43.26
## Residual Deviance: 41.01     AIC: 45.01
```

```
summary(logistic3)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Health.and.Survival, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7967  -1.3594   0.7361   0.9475   1.2552
##
## Coefficients:
##                           Estimate Std. Error z value Pr(>|z|)
## (Intercept)                -71.94      53.94  -1.334    0.182
## data$Health.and.Survival    74.91      55.73   1.344    0.179
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 41.006  on 31  degrees of freedom
## AIC: 45.006
##
## Number of Fisher Scoring iterations: 4
```

1.5 LOGISTIC 4

```
logistic4<-glm(data$BINARY.FORM~data$Political.Empowerement,family=binomial,data)
logistic4
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ data$Political.Empowerement,
##     family = binomial, data = data)
##
## Coefficients:
##                  (Intercept)  data$Political.Empowerement
##                       0.9517                      -1.3475
##
## Degrees of Freedom: 32 Total (i.e. Null);  31 Residual
## Null Deviance:       43.26
## Residual Deviance: 42.91     AIC: 46.91
```

```
summary(logistic4)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Political.Empowerement,
##     family = binomial, data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.5983  -1.3456   0.8680   0.9606   1.0586
##
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   0.9517     0.7640   1.246    0.213
## data$Political.Empowerement  -1.3475     2.2732  -0.593    0.553
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 42.907  on 31  degrees of freedom
## AIC: 46.907
##
## Number of Fisher Scoring iterations: 4
```

1.6 LOGISTIC 5

```
logistic5<-glm(data$BINARY.FORM~Poverty.Index,family=binomial,data)
logistic5
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ Poverty.Index, family = binomial,
##     data = data)
```

```
##
## Coefficients:
##   (Intercept)  Poverty.Index
##         1.488          2.479
##
## Degrees of Freedom: 12 Total (i.e. Null);  11 Residual
##   (20 observations deleted due to missingness)
## Null Deviance:       11.16
## Residual Deviance: 11.08     AIC: 15.08
```

```
summary(logistic5)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ Poverty.Index, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.9733   0.4868   0.5619   0.6239   0.6359
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      1.488      1.061   1.403    0.161
## Poverty.Index    2.479      9.041   0.274    0.784
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11.162  on 12  degrees of freedom
## Residual deviance: 11.083  on 11  degrees of freedom
##   (20 observations deleted due to missingness)
## AIC: 15.083
##
## Number of Fisher Scoring iterations: 4
```

1.7 LOGISTIC 6

```
logistic6<-glm(data$BINARY.FORM~Gross.Domestic.Product,family=binomial,data)
logistic6
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ Gross.Domestic.Product, family = binomial,
##     data = data)
##
## Coefficients:
##            (Intercept)  Gross.Domestic.Product
##              1.031e+00              -6.826e-07
##
## Degrees of Freedom: 25 Total (i.e. Null);  24 Residual
##   (7 observations deleted due to missingness)
## Null Deviance:       35.43
## Residual Deviance: 31.34     AIC: 35.34
```

```
summary(logistic6)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ Gross.Domestic.Product, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.5706  -1.1365   0.8161   0.8842   1.6090
##
## Coefficients:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)             1.031e+00  6.036e-01   1.708   0.0876 .
## Gross.Domestic.Product -6.826e-07  4.778e-07  -1.429   0.1531
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 35.426  on 25  degrees of freedom
## Residual deviance: 31.338  on 24  degrees of freedom
##   (7 observations deleted due to missingness)
## AIC: 35.338
##
## Number of Fisher Scoring iterations: 6
```

1.8 LOGISTIC 7

```
logistic7<-glm(data$BINARY.FORM~data$Human.Development,family=binomial,data)
logistic7
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ data$Human.Development, family = binomial,
##     data = data)
##
## Coefficients:
##            (Intercept)  data$Human.Development
##                  2.523                  -2.506
##
## Degrees of Freedom: 32 Total (i.e. Null);  31 Residual
## Null Deviance:       43.26
## Residual Deviance: 42.27     AIC: 46.27
```

```
summary(logistic7)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Human.Development, family = binomial,
##     data = data)
```

```
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7928  -1.2539   0.8079   0.9301   1.1299
##
## Coefficients:
##                         Estimate Std. Error z value Pr(>|z|)
## (Intercept)                2.523      2.075   1.216    0.224
## data$Human.Development    -2.506      2.578  -0.972    0.331
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 42.268  on 31  degrees of freedom
## AIC: 46.268
##
## Number of Fisher Scoring iterations: 4
```

1.9 LOGISTIC 8

```
logistic8<-glm(data$BINARY.FORM~data$Global.Health.Index,family=binomial,data)
logistic8
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ data$Global.Health.Index, family = binomial,
##     data = data)
##
## Coefficients:
##               (Intercept)  data$Global.Health.Index
##                    1.6714                   -0.0235
##
## Degrees of Freedom: 32 Total (i.e. Null);  31 Residual
## Null Deviance:       43.26
## Residual Deviance: 42.2  AIC: 46.2
```

```
summary(logistic8)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ data$Global.Health.Index, family = binomial,
##     data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7525  -1.2168   0.7958   1.0157   1.0869
##
## Coefficients:
##                           Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 1.6714     1.1767   1.420    0.155
## data$Global.Health.Index   -0.0235     0.0232  -1.013    0.311
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 43.262  on 32  degrees of freedom
## Residual deviance: 42.196  on 31  degrees of freedom
## AIC: 46.196
##
## Number of Fisher Scoring iterations: 4
```

1.10 LOGISTIC 9

```
logistic9<-glm(data$BINARY.FORM~Climate.Change.Performance.Index,family=binomial,data)
logistic9
```

```
##
## Call:  glm(formula = data$BINARY.FORM ~ Climate.Change.Performance.Index,
##     family = binomial, data = data)
##
## Coefficients:
##                       (Intercept)  Climate.Change.Performance.Index
##                           -2.4034                             0.0483
##
## Degrees of Freedom: 18 Total (i.e. Null);  17 Residual
##   (14 observations deleted due to missingness)
## Null Deviance:       26.29
## Residual Deviance: 24.23     AIC: 28.23
```

```
summary(logistic9)
```

```
##
## Call:
## glm(formula = data$BINARY.FORM ~ Climate.Change.Performance.Index,
##     family = binomial, data = data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6032  -1.0974  -0.6493   1.1476   1.3727
##
## Coefficients:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -2.4034     1.7995  -1.336    0.182
## Climate.Change.Performance.Index   0.0483     0.0360   1.342    0.180
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 26.287  on 18  degrees of freedom
## Residual deviance: 24.228  on 17  degrees of freedom
##   (14 observations deleted due to missingness)
## AIC: 28.228
##
## Number of Fisher Scoring iterations: 4
```

In [2]:
```
import pandas as pd
Data=pd.read_csv(r"C:\Users\compaq\Documents\PROJECT College\FINALDATA.csv")
Data
```

Out[2]:

	Country	MHQ SCORE	Economic Participation and Opportunity	Education Attainment	Health and Survival	Political Empowerement	Poverty Index	Gross Domestic Product	D
0	Venezuela	91	0.617	0.998	0.980	0.199	0.000	NaN	
1	Spain	85	0.699	0.998	0.965	0.491	0.000	1425277.0	
2	Democratic public of congo	82	0.571	0.658	0.976	0.099	0.112	NaN	
3	Switzerland	82	0.743	0.992	0.964	0.494	0.000	812867.0	
4	Peru	78	0.629	0.981	0.964	0.310	0.029	223249.0	
5	Argentina	75	0.639	1.000	0.977	0.398	0.000	491493.0	
6	Belgium	75	0.709	1.000	0.968	0.480	0.000	599879.0	
7	Singapore	74	0.749	0.990	0.963	0.208	0.000	396987.0	
8	Ecuador	74	0.675	0.997	0.968	0.318	0.018	106166.0	
9	UAE	73	0.510	0.987	0.963	0.403	0.000	358867.0	
10	Tunisia	73	0.445	0.970	0.969	0.212	0.003	NaN	
11	France	73	0.710	1.000	0.970	0.457	0.000	2937473.0	
12	Cote d'Ivoire	72	0.664	0.828	0.979	0.076	0.236	NaN	
13	Chile	71	0.610	1.000	0.970	0.283	0.000	317059.0	
14	Nigeria	71	0.687	0.806	0.967	0.047	0.254	440777.0	
15	Cameroon	71	0.706	0.885	0.973	0.202	0.232	NaN	
16	Mexico	71	0.590	0.997	0.975	0.468	0.000	1293038.0	
17	Guatemala	70	0.560	0.969	0.979	0.112	0.134	NaN	
18	Columbia	70	0.708	1.000	0.975	0.216	0.020	314322.0	
19	Morocco	70	0.407	0.956	0.961	0.126	0.027	132725.0	
20	Algeria	69	0.456	0.966	0.958	0.151	0.005	167983.0	
21	Saudi Arabia	68	0.390	0.980	0.964	0.077	0.000	833541.0	
22	Yemen	64	0.282	0.717	0.968	0.001	0.000	NaN	

	Country	MHQ SCORE	Economic Participation and Opportunity	Education Attainment	Health and Survival	Political Empowerement	Poverty Index	Gross Domestic Product	D
23	United States	63	0.754	1.000	0.970	0.329	0.000	22996100.0	
24	Canada	63	0.741	1.000	0.968	0.381	0.000	1990762.0	
25	Egypt	60	0.421	0.973	0.968	0.196	0.020	404143.0	
26	New Zealand	59	0.763	1.000	0.966	0.630	0.000	249992.0	
27	Iraq	57	0.228	0.807	0.968	0.136	0.033	207889.0	
28	India	56	0.326	0.962	0.937	0.276	0.123	3173398.0	
29	Ireland	56	0.733	0.998	0.964	0.504	0.000	498560.0	
30	Australia	54	0.700	1.000	0.968	0.258	0.000	1542660.0	
31	Uk	46	0.716	0.999	0.966	0.419	0.000	3186860.0	
32	South Africa	46	0.658	0.994	0.979	0.493	0.000	419946.0	

In [3]:
```
data1=Data.groupby("Continents")
data1.describe()
```

Out[3]:

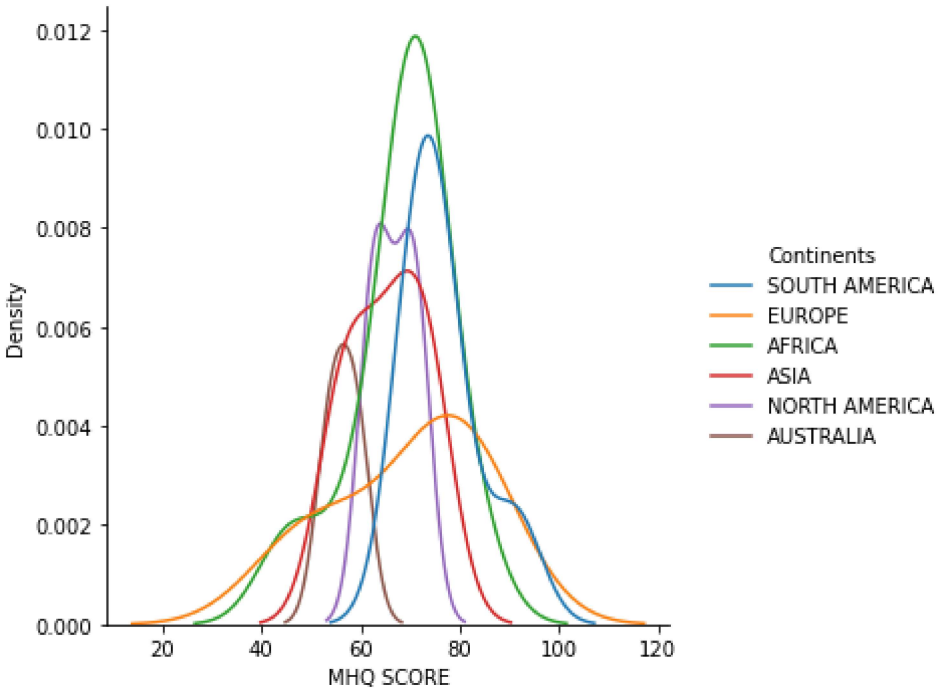
	MHQ SCORE								Economic Participation and Opportunity		...	
	count	mean	std	min	25%	50%	75%	max	count	mean	...	75%
Continents												
AFRICA	9.0	68.222222	10.047111	46.0	69.00	71.0	72.00	82.0	9.0	0.557222	...	33.600
ASIA	6.0	65.333333	7.737355	56.0	58.75	66.0	71.75	74.0	6.0	0.414167	...	44.375
AUSTRALIA	2.0	56.500000	3.535534	54.0	55.25	56.5	57.75	59.0	2.0	0.731500	...	68.950
EUROPE	6.0	69.500000	15.319922	46.0	60.25	74.0	80.25	85.0	6.0	0.718333	...	61.650
NORTH AMERICA	4.0	66.750000	4.349329	63.0	63.00	66.5	70.25	71.0	4.0	0.661250	...	71.325
SOUTH AMERICA	6.0	76.500000	7.661593	70.0	71.75	74.5	77.25	91.0	6.0	0.646333	...	54.775

6 rows × 80 columns

In [4]:
```
import seaborn as sns
```

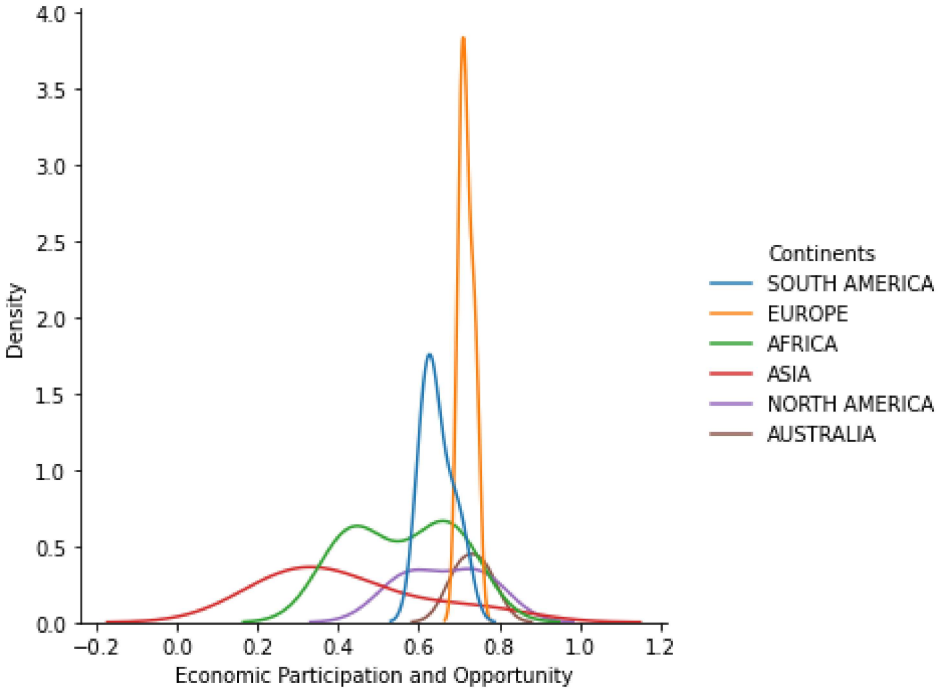
In [19]:
```
sns.displot(Data,x="MHQ SCORE", kind='kde', hue='Continents')
```

Out[19]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f68beb0>
```



In [7]:
```
sns.displot(Data,x='Economic Participation and Opportunity', kind='kde', hue='Contin
```

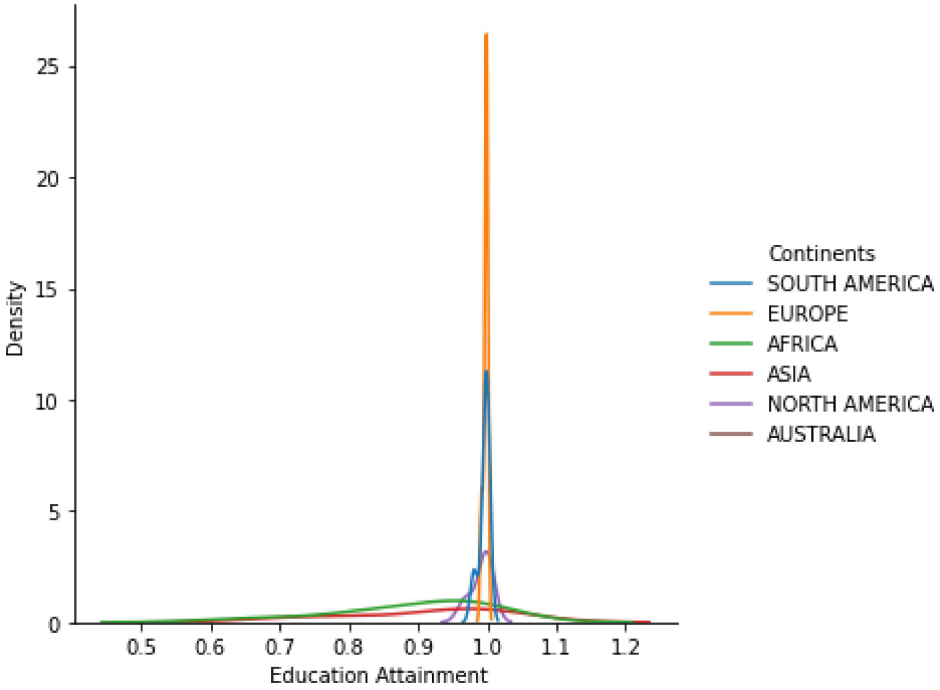
Out[7]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3c3a0d90>
```



In [10]:
```
sns.displot(Data,x=' Education Attainment',kind='kde', hue='Continents')
```

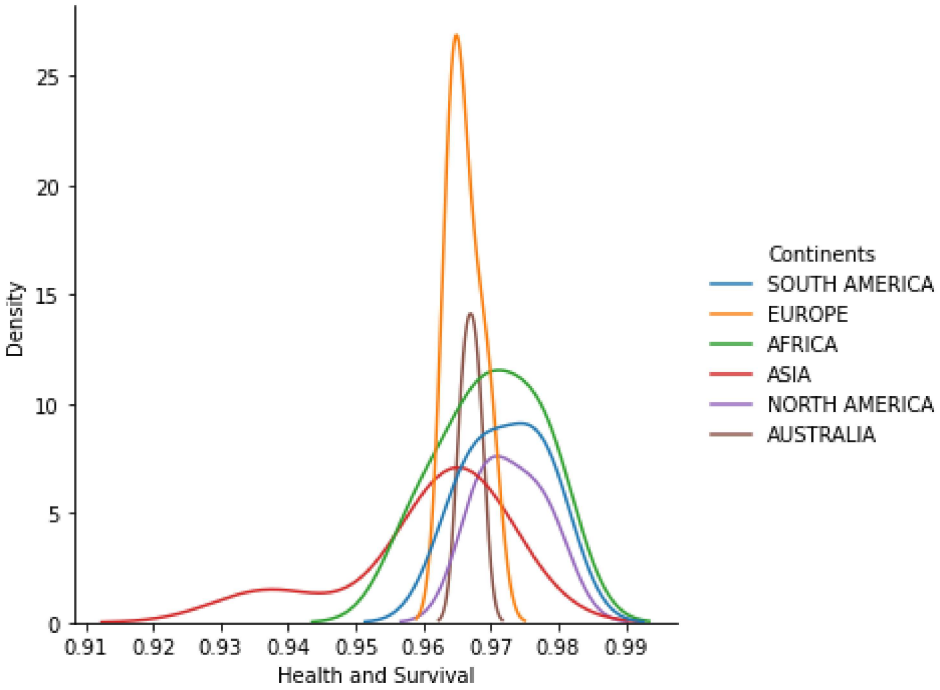
```
C:\ProgramData\Anaconda3\Anaconda\lib\site-packages\seaborn\distributions.py:316: Us
erWarning: Dataset has 0 variance; skipping density estimate. Pass `warn_singular=Fa
lse` to disable this warning.
  warnings.warn(msg, UserWarning)
```

Out[10]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f346f10>
```



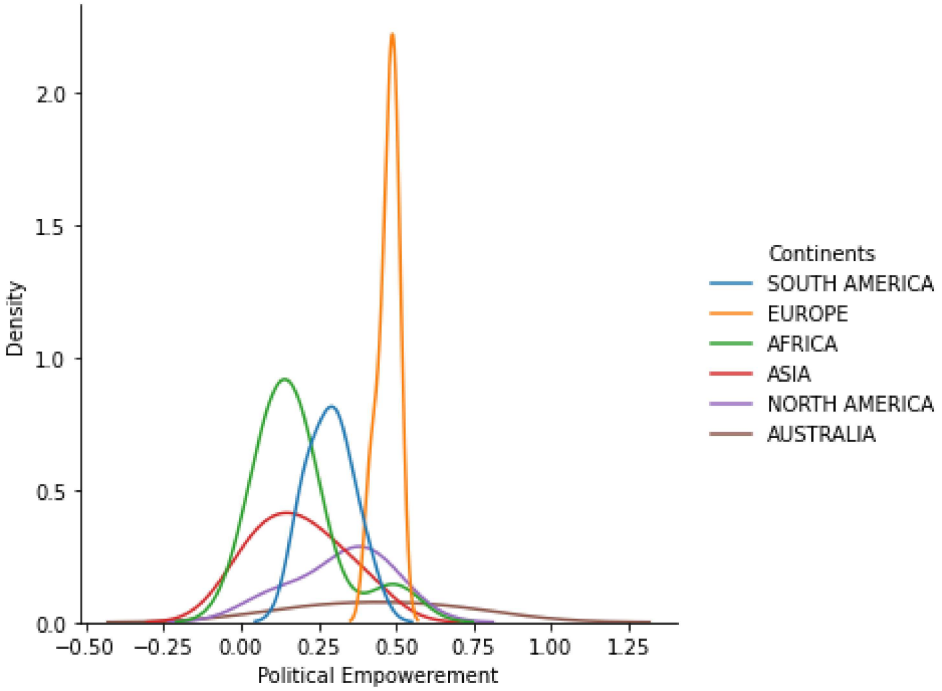
In [8]:
```
sns.displot(Data,x='Health and Survival', kind='kde', hue='Continents')
```

Out[8]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f0cba00>
```



In [11]:
```
sns.displot(Data,x='Political Empowerement', kind='kde', hue='Continents')
```

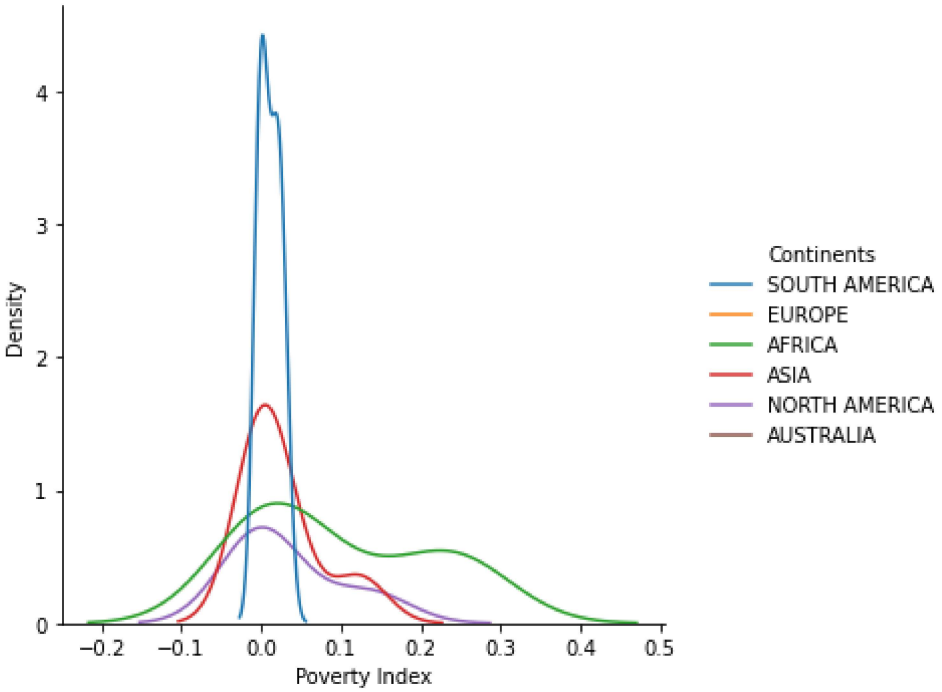
Out[11]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3c212a30>
```



In [12]:
```
sns.displot(Data,x='Poverty Index', kind='kde', hue='Continents')
```

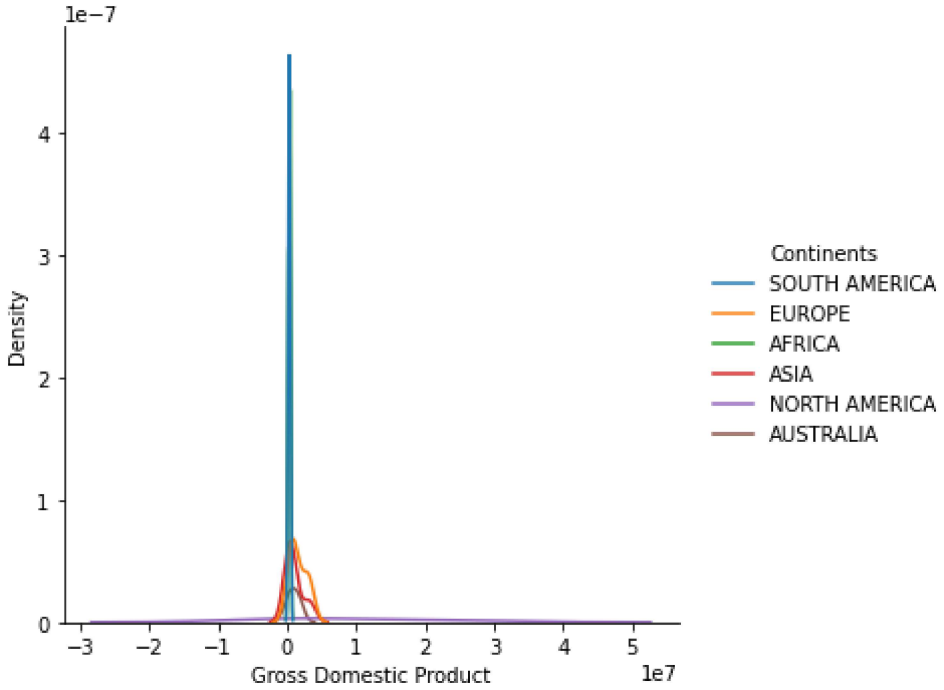
```
C:\ProgramData\Anaconda3\Anaconda\lib\site-packages\seaborn\distributions.py:316: UserWarning: Dataset has 0 variance; skipping density estimate. Pass `warn_singular=False` to disable this warning.
  warnings.warn(msg, UserWarning)
```

Out[12]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f31d3a0>
```



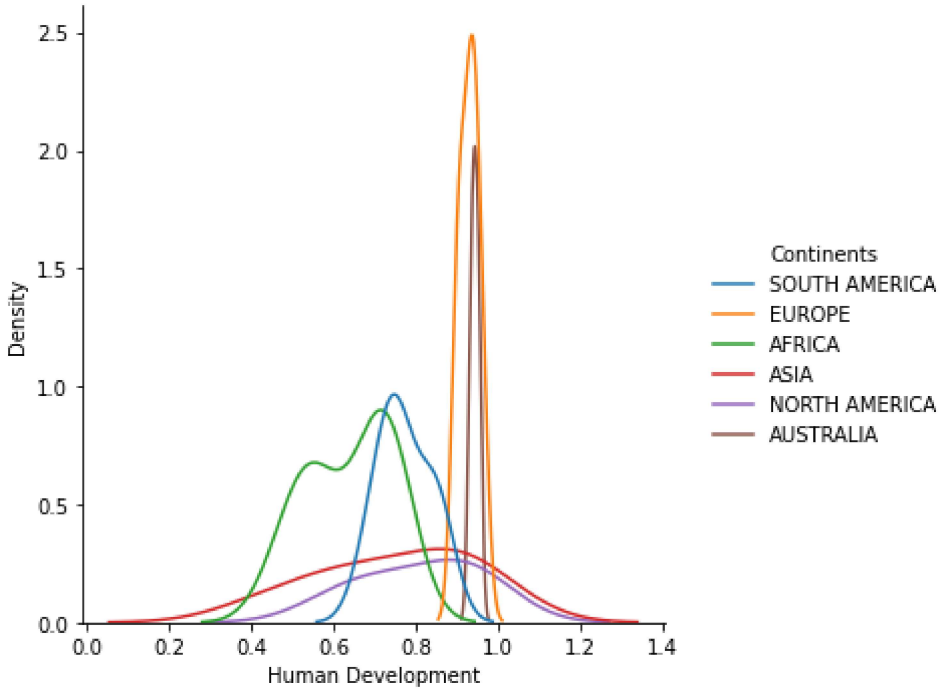
In [13]:
```
sns.displot(Data,x='Gross Domestic Product', kind='kde', hue='Continents')
```

Out[13]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f401e20>
```



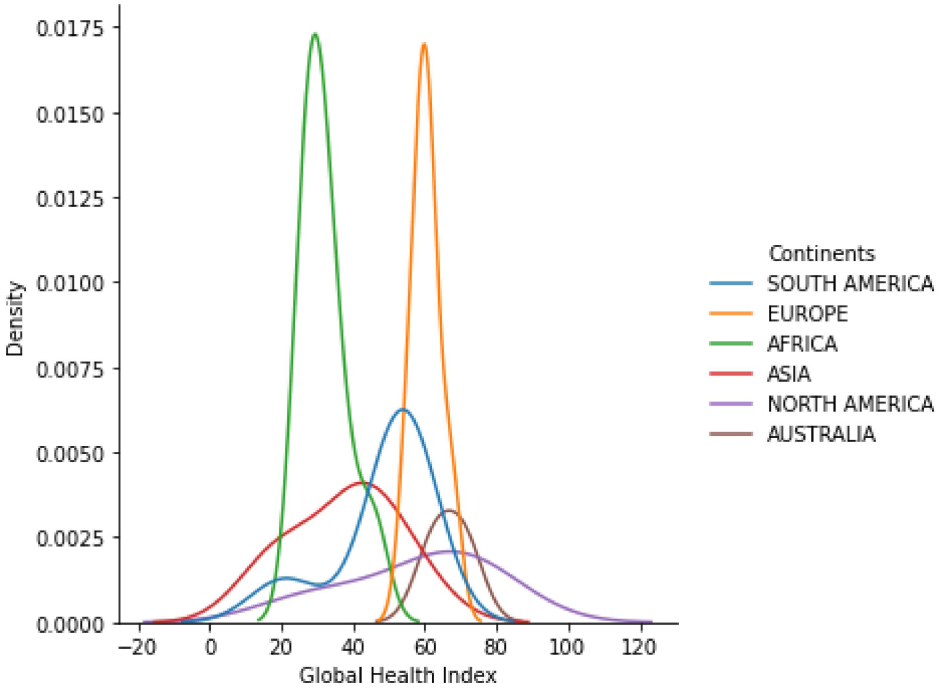
In [14]:
```
sns.displot(Data,x='Human Development', kind='kde', hue='Continents')
```

Out[14]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f597490>
```



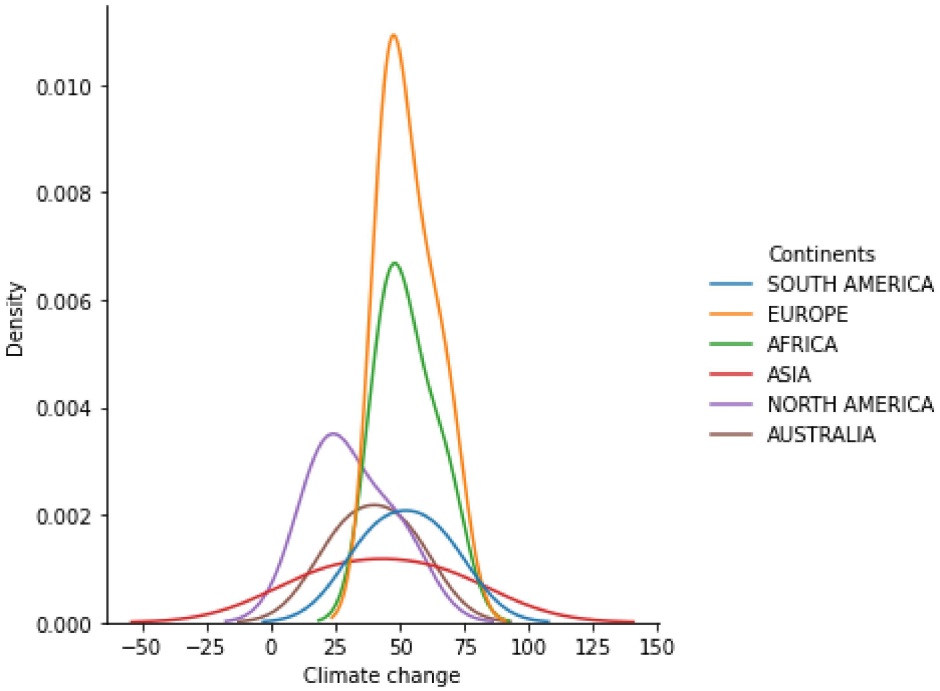
In [15]:
```
sns.displot(Data,x='Global Health Index', kind='kde', hue='Continents')
```

Out[15]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f5b0d90>
```



In [17]:
```
sns.displot(Data,x='Climate change', kind='kde', hue='Continents')
```

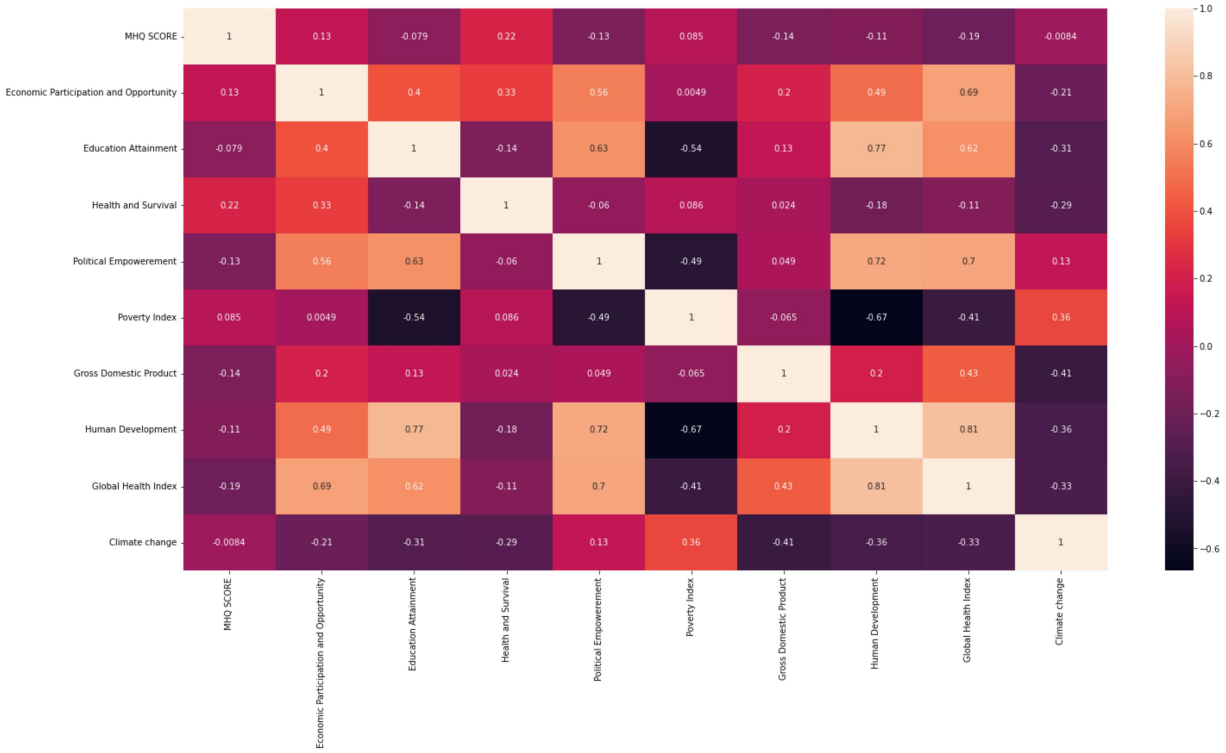
Out[17]:
```
<seaborn.axisgrid.FacetGrid at 0x17f3f6545b0>
```



In [20]:
```
import numpy as np
import matplotlib.pyplot as plt
```

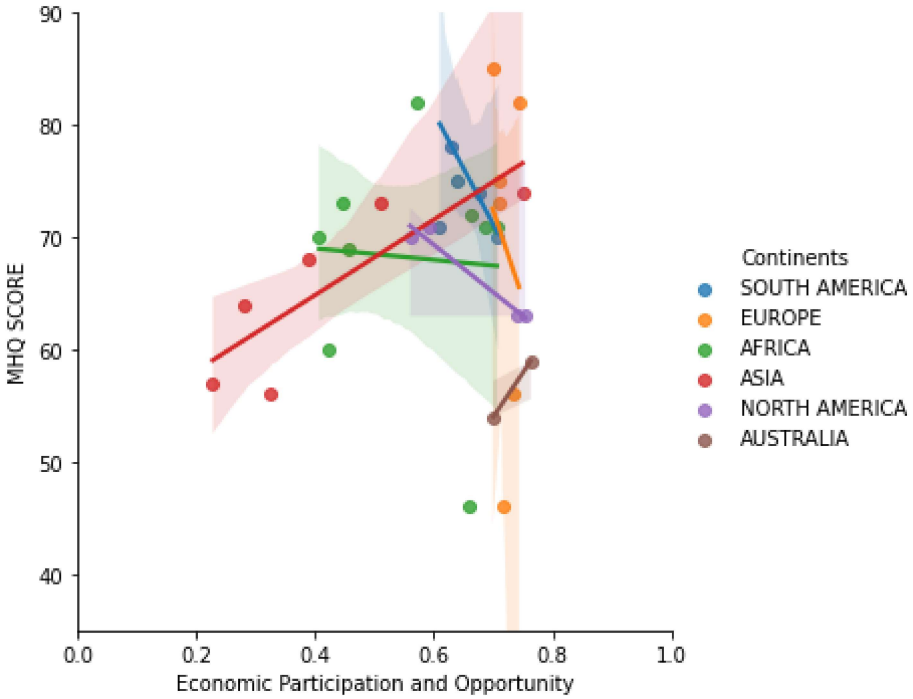
In [21]:
```
plt.figure(figsize=(24,12))
sns.heatmap(Data.corr(),annot=True)
```

Out[21]:
```
<AxesSubplot:>
```



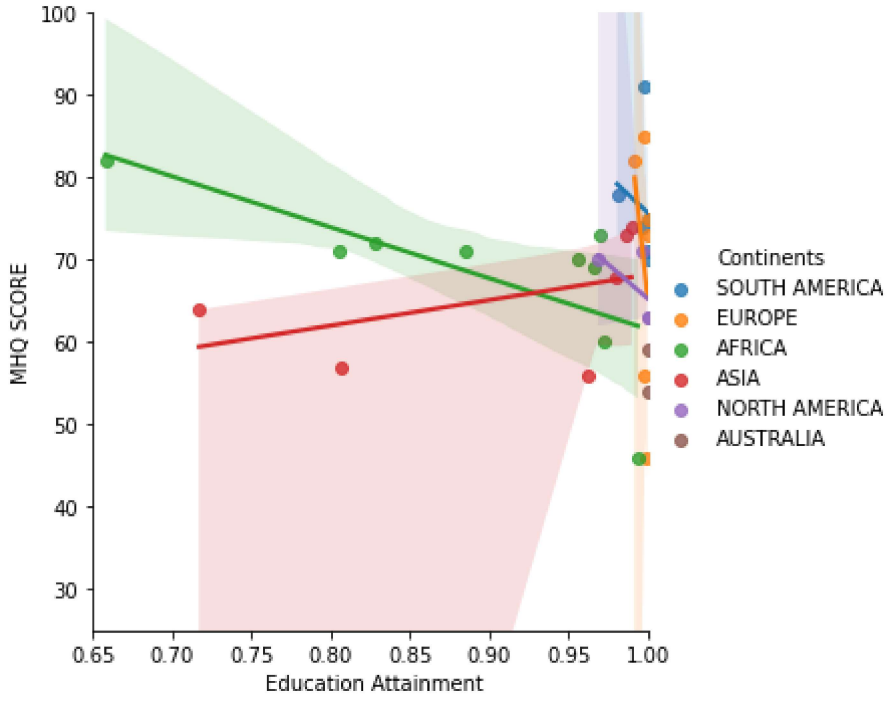
In [22]:
```
g=sns.lmplot(data=Data,x="Economic Participation and Opportunity", y="MHQ SCORE",hue
g.set(xlim=(0,1),ylim=(35,90))
```

Out[22]:
```
<seaborn.axisgrid.FacetGrid at 0x17f4101b6a0>
```



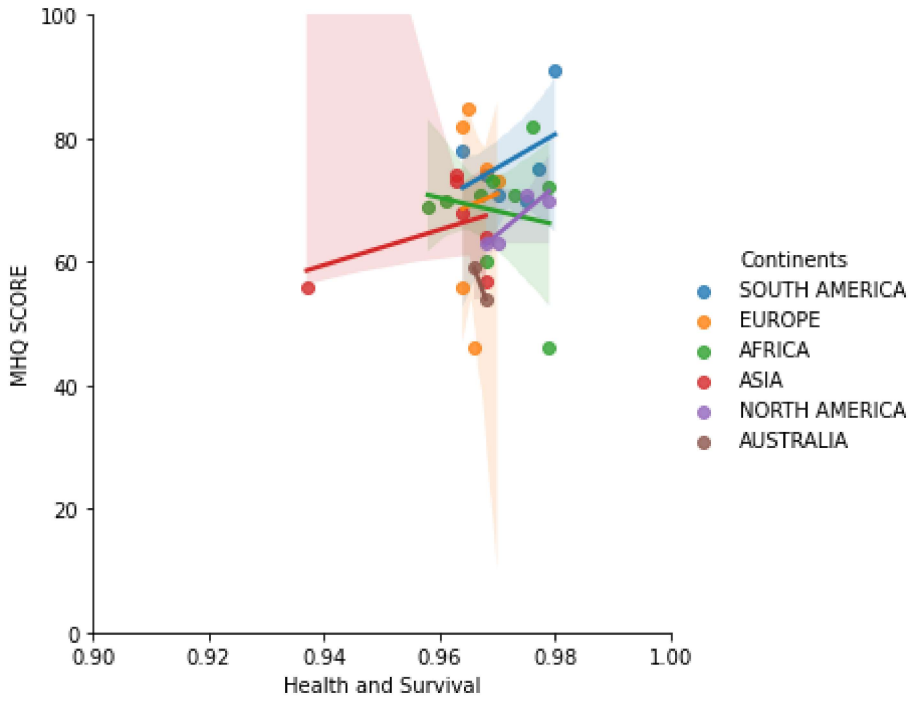
In [23]:
```
g=sns.lmplot(data=Data,x=" Education Attainment", y="MHQ SCORE",hue="Continents")
g.set(xlim=(0.65,1),ylim=(25,100))
```

Out[23]:
```
<seaborn.axisgrid.FacetGrid at 0x17f40ff9a30>
```



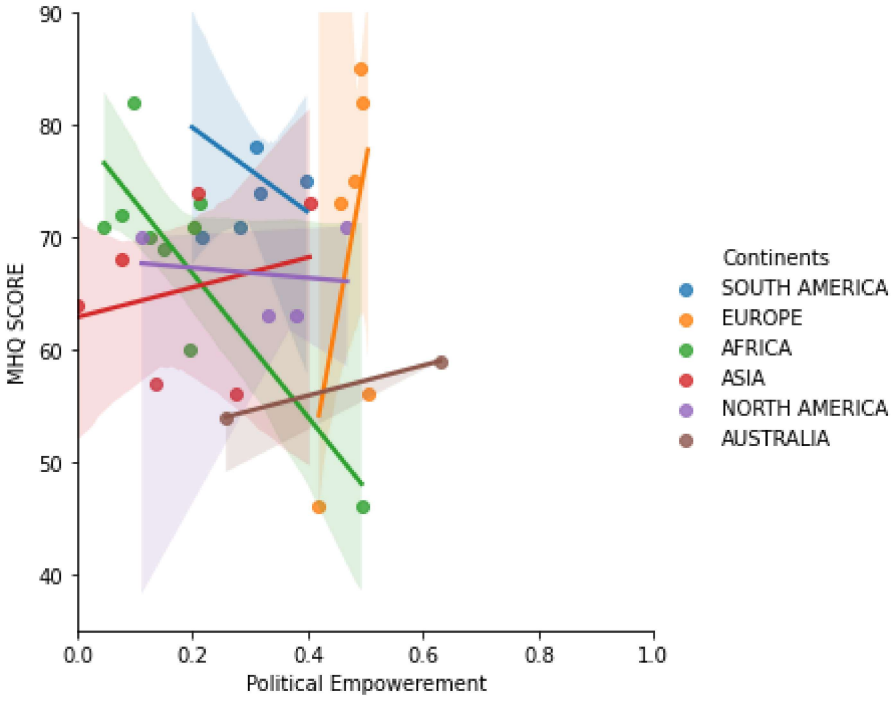
In [24]:
```
g=sns.lmplot(data=Data,x="Health and Survival", y="MHQ SCORE",hue="Continents")
g.set(xlim=(0.9,1),ylim=(0,100))
```

Out[24]:
```
<seaborn.axisgrid.FacetGrid at 0x17f409d6970>
```



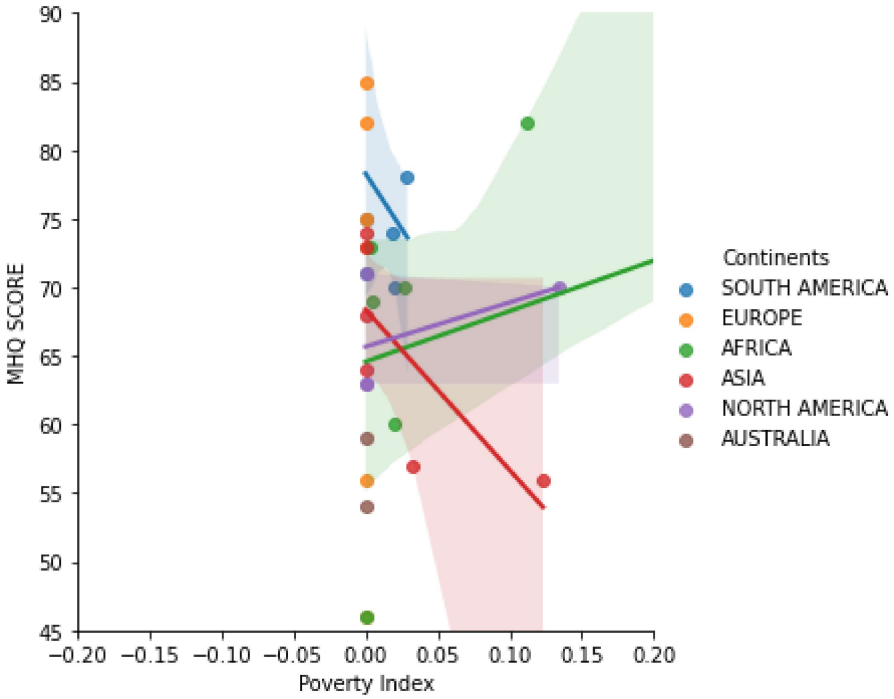
In [25]:
```
g=sns.lmplot(data=Data,x="Political Empowerement", y="MHQ SCORE",hue="Continents")
g.set(xlim=(0,1),ylim=(35,90))
```

Out[25]:
```
<seaborn.axisgrid.FacetGrid at 0x17f40ff92b0>
```

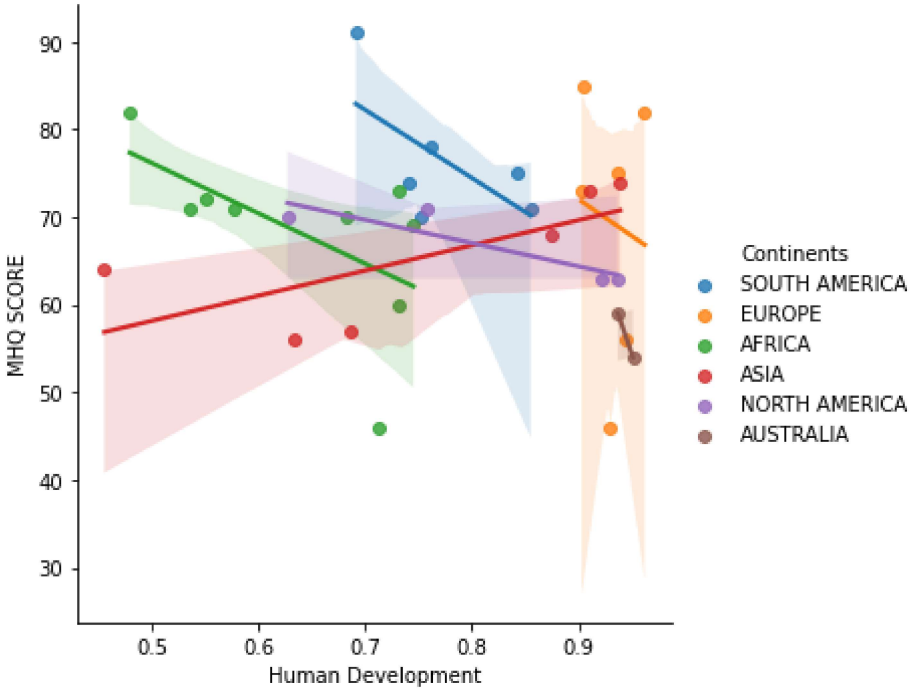


In [26]:
```
g=sns.lmplot(data=Data,x="Poverty Index", y="MHQ SCORE",hue="Continents")
g.set(xlim=(-0.2,0.2),ylim=(45,90))
```

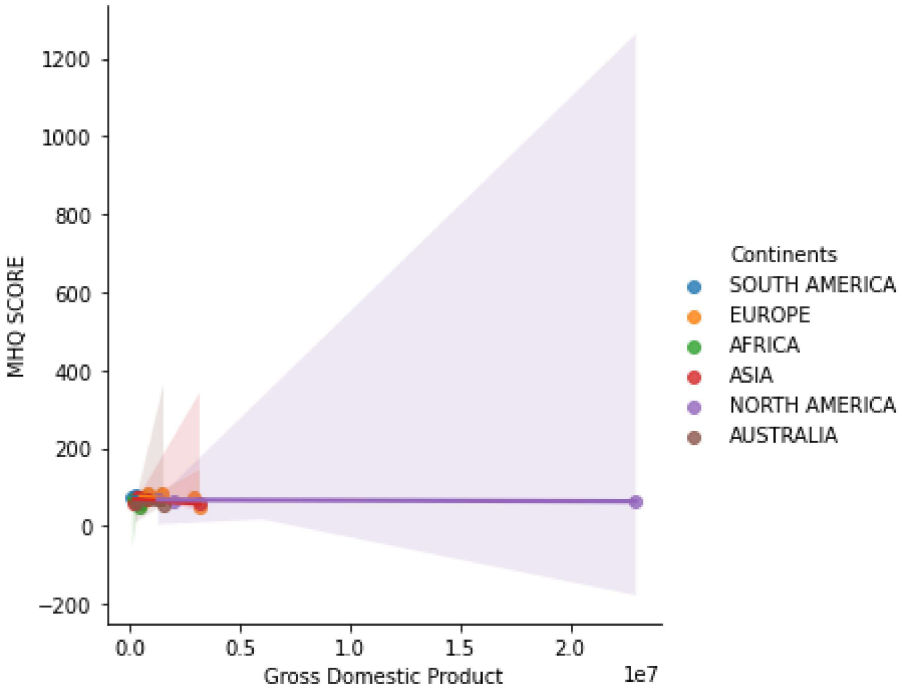
Out[26]: <seaborn.axisgrid.FacetGrid at 0x17f418090a0>



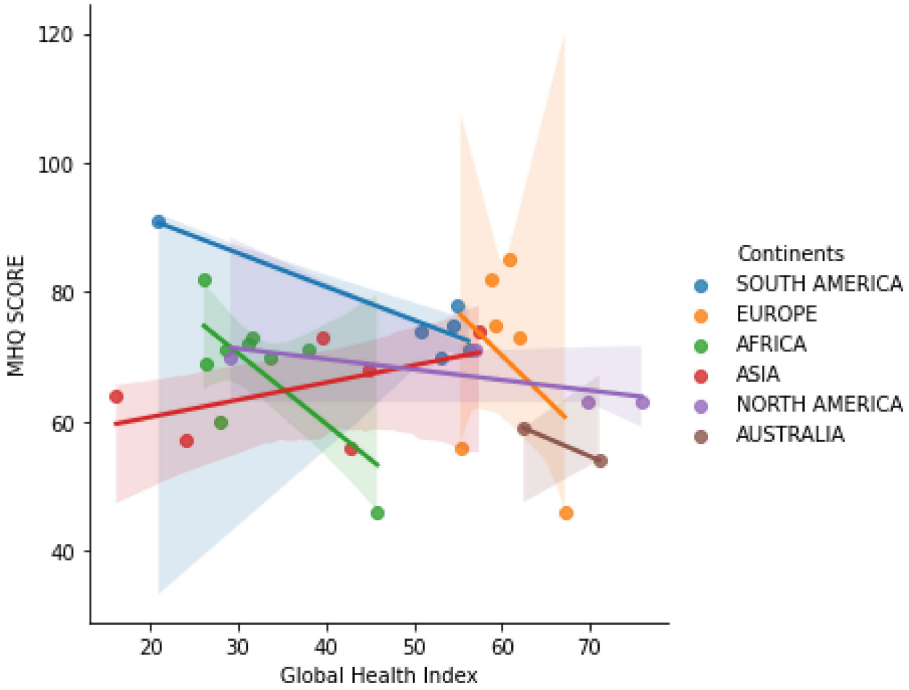
In [27]:
```
g=sns.lmplot(data=Data,x="Human Development", y="MHQ SCORE",hue="Continents")
```



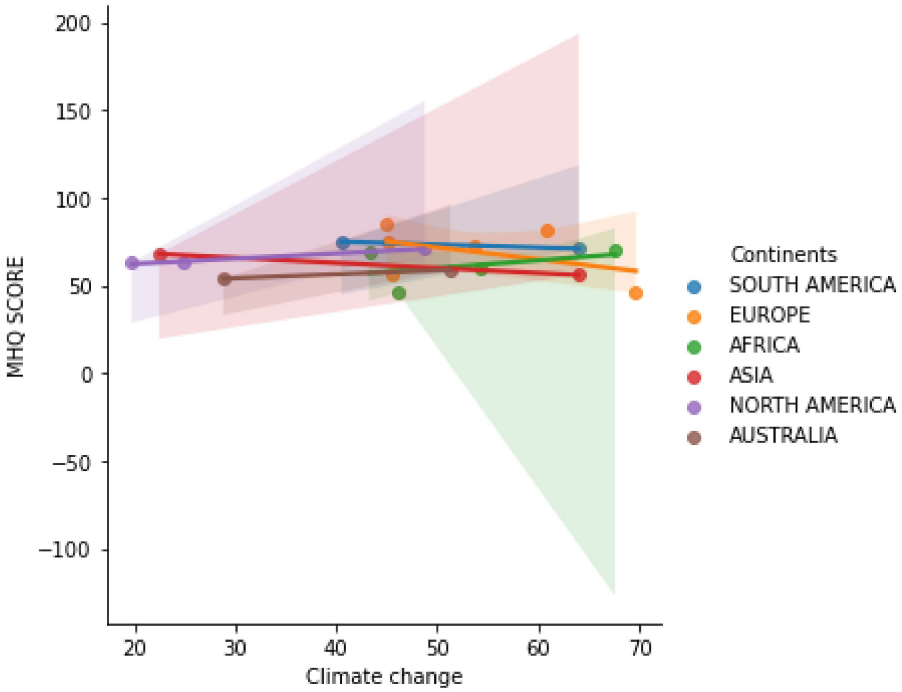
In [28]:
```
g=sns.lmplot(data=Data,x="Gross Domestic Product", y="MHQ SCORE",hue="Continents")
```



In [29]:
```
g=sns.lmplot(data=Data,x="Global Health Index", y="MHQ SCORE",hue="Continents")
```



In [31]:
```
g=sns.lmplot(data=Data,x="Climate change", y="MHQ SCORE",hue="Continents")
```



In [ ]: