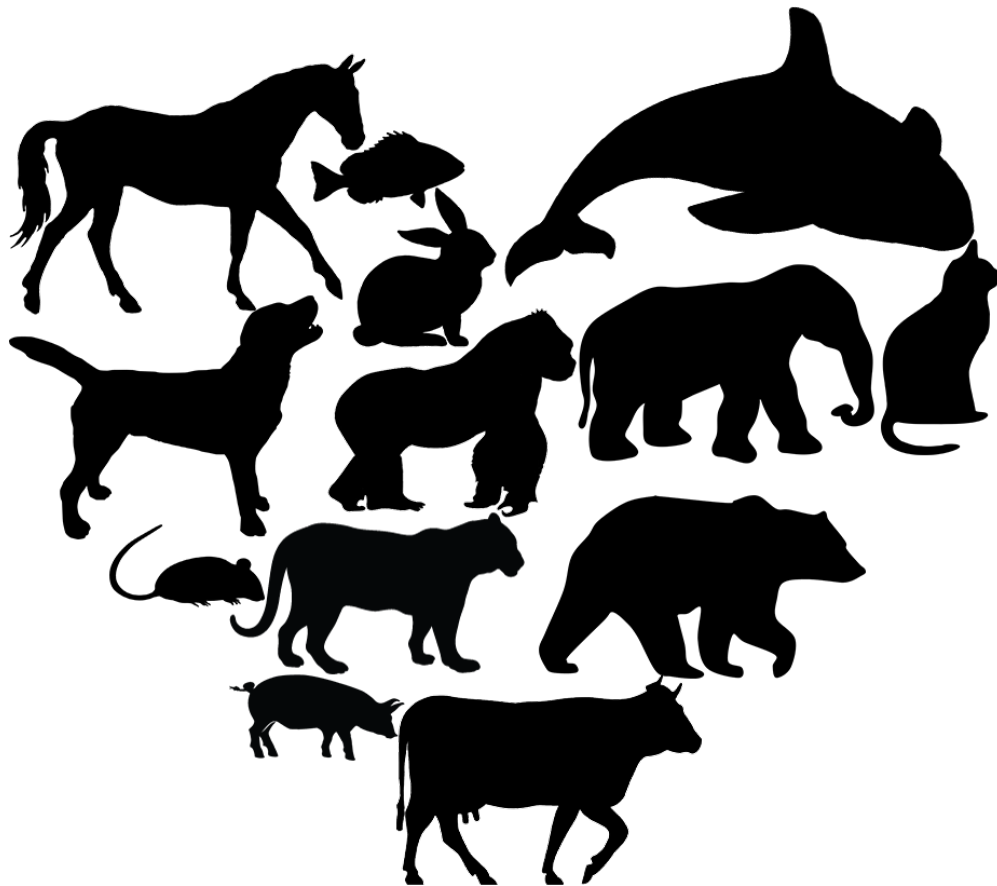# Exploring Animal Rights:
A Multivariate Analysis of Global Perspectives and Practices

1. About the Data

About

- Animal rights laws vary significantly around the world. Animal rights activists argue that animals are sentient beings that deserve a life free from suffering. From recognition of animal sentience to fur-farming bans, many countries are taking a stand against animal cruelty in any way they can. Other considerations, such as pesticide use and meat consumption, can impact animal health and welfare.
- The dataset gathers statistics from key international data sources to create this comprehensive "Animal Rights Index," which helps identify which countries are the best and worst regarding animal rights.

Data Source

- Link: https://theswiftest.com/animal-rights-index/#:%5C
- Data: https://data.world/makeovermonday/2024week-8-animal-rights

Data Dictionary

- Country: The name of the Country.
- Recognition of Animal Sentience (full weight): Acknowledgement that animals feel pleasure and pain.
- Recognition of Animal Suffering (full weight): Acknowledgement that animals should not needlessly suffer.
- Recognition of Animal Suffering (full weight): Acknowledgement that animals should not needlessly suffer.
- Any Laws Against Animal Cruelty (full weight): Any official laws regarding animal cruelty
- Fur Bans (full weight): Bans on fur farming or partial bans on farming furs of specific animals.
- Support for the Universal Declaration on Animal Welfare (half weight): Pledged support for the Universal Declaration on Animal Welfare, an agreement proposed to the United Nations to recognize that animals are sentient, to prevent cruelty and reduce animal suffering, and to promote standards for the welfare of animals including wildlife, farm animals, pets, and animals involved in scientific research.
- Meat Consumption per Capita in Kilograms (half negative weight)
- Percentage of Terrestrial Protected Areas (half weight): Percentage of total land area that is classified as totally or partially rotected areas of at least 1,000 hectares that the government designates as national parks, national monuments, wildlife sanctuaries, nature reserves, protected landscapes, and scientific reserves with limited public access * Kilograms of Pesticides per Hectare of Cropland (half negative weight)
- Environmental Performance Score (half weight): A Yale University ranking of 32 factors to determine environmental health and ecosystem vitality.
- Total Score: Total Animal Index Score

Analyzing the data

Stars Plot

- The Total Score column has been excluded from the analysis as it summarises the rest of the columns.
- The stars function helps us identify immediate commonalities between countries.

## 2. The Multivariate Analysis aims to do the following

- Investigate animal rights and the differences between countries. (Through Cluster Analysis)
- Exploring the interrelationships between the countries based on their animal rights variables. (Through Principal Component Analysis (PCA))
- Identify the relation between the animal rights variables and how they can be clubbed. (EFA)
- Identify the key factors underlying the animal rights variables and examine the relationships between countries concerning these factors.
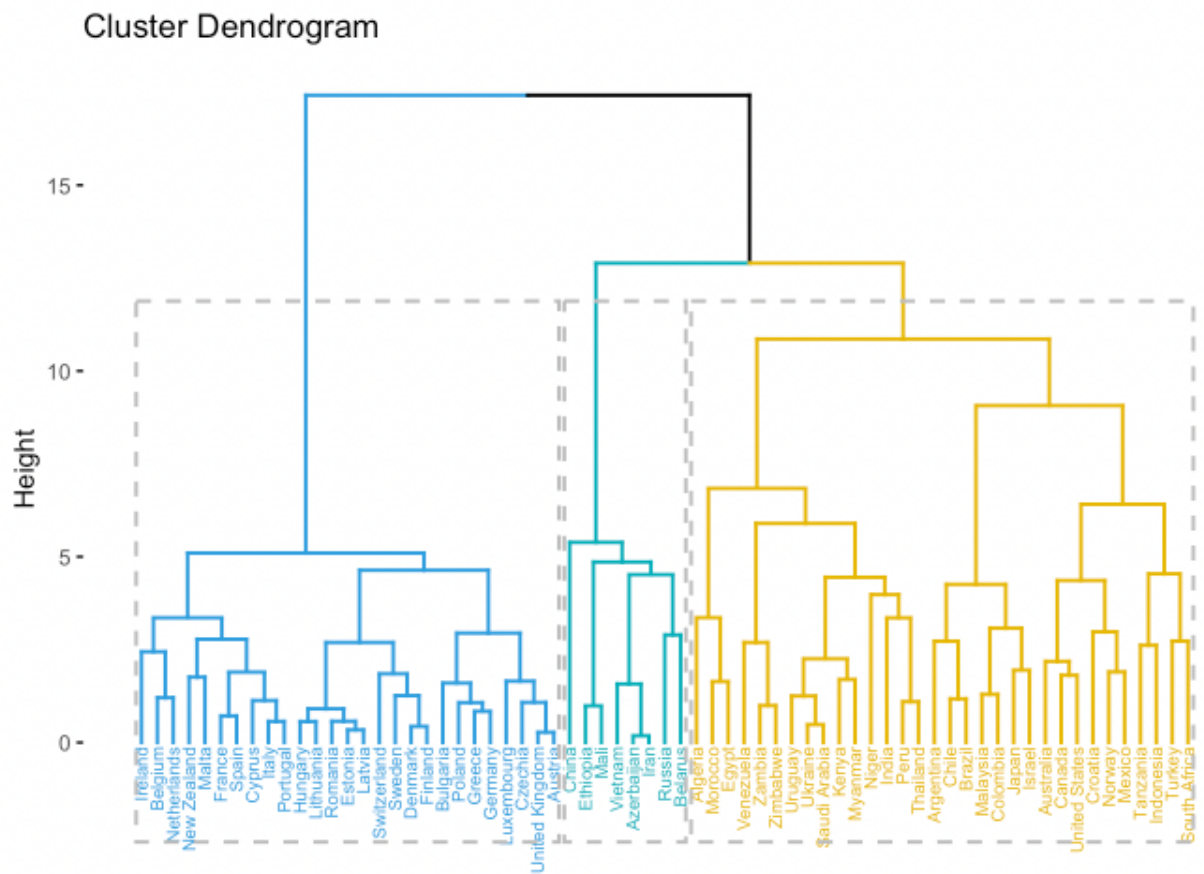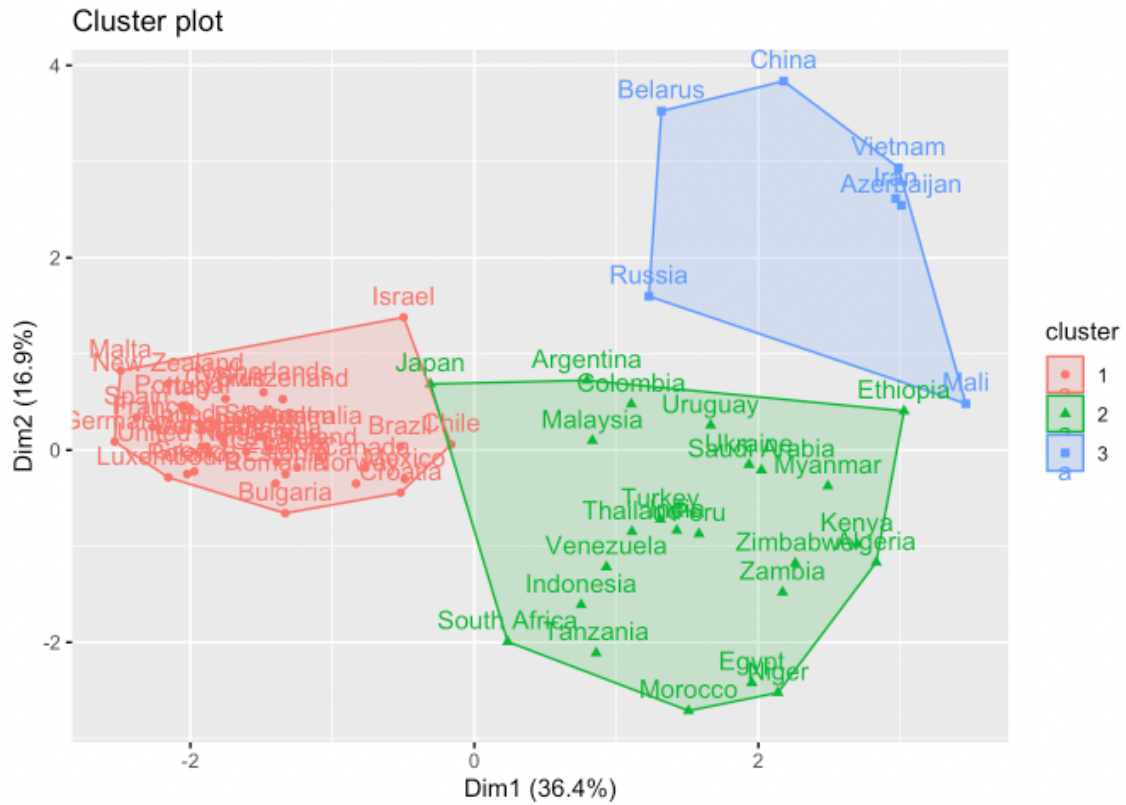
3. Cluster Analysis

Cluster analysis categorizes data points into groups based on similarities, revealing patterns and structures within datasets. It aids in exploring relationships, uncovering trends, and facilitating segmentation for targeted strategies in various domains such as business, healthcare, and social sciences. By identifying distinct clusters, analysts can make informed decisions and tailor interventions for more effective outcomes, making cluster analysis an essential tool for data-driven insights and decision-making.

Clustering organizes data points into groups, or "clusters," based on their similarities. It helps us see patterns and similarities within the data, making it easier to understand and analyze.

First, we must define the ideal number of clusters to divide the data into. We can check using a couple of tests.
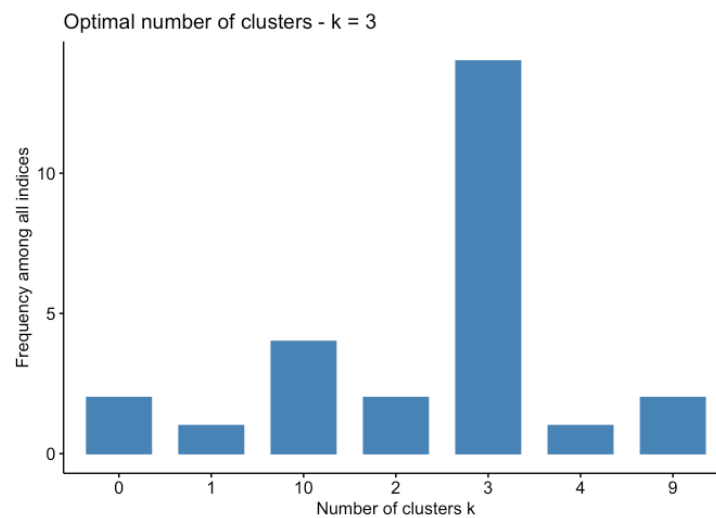
- The test suggests that the optimal number of clusters should be 3.

Cluster plot

Cluster Dendrogram

- We can see that the top 25-30 countries are in a cluster.
- The bottom 8 countries are in a cluster, and the rest are in a different cluster.
- Although we did not consider the final Total scores, the cluster analysis identified the bifurcation between the countries. It could form 3 different clusters which align with our total scores division.
- We can further analyse this in the principal component analysis to understand which animal rights factors influenced this difference in the countries.

4. Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is a statistical technique for dimensionality reduction and data visualization. It aims to transform a set of possibly correlated variables into a new set of uncorrelated variables called principal components. These principal components are linear combinations of the original variables and are ordered by the amount of variance they explain in the data.

PCA finds the directions, or principal components, along which the data varies the most. The first principal component explains the most significant amount of variance in the data, with each subsequent component explaining as much of the remaining variance as possible, subject to the constraint that it is orthogonal (uncorrelated) to the previous components.

Principal Component Analysis (PCA) is like a magic trick that helps you simplify this big table into something easier to understand. It does this by finding patterns in the data.

PCA gives the same number of principal components as the number of columns, which, in our analysis, is 9. The nine principal components that we obtained are as follows:

```
## Importance of components:
##                          PC1    PC2    PC3    PC4     PC5     PC6     PC7
## Standard deviation     1.9715 1.4455 1.142 0.83144 0.67296 0.55836 0.40099
## Proportion of Variance 0.4319 0.2322 0.145 0.07681 0.05032 0.03464 0.01787
## Cumulative Proportion  0.4319 0.6640 0.809 0.88583 0.93615 0.97079 0.98865
##                           PC8        PC9
## Standard deviation      0.31955 2.814e-17
## Proportion of Variance 0.01135 0.000e+00
## Cumulative Proportion  1.00000 1.000e+00
```

Further, we can check the schematic diagram to identify how many principal components to consider for our analysis.
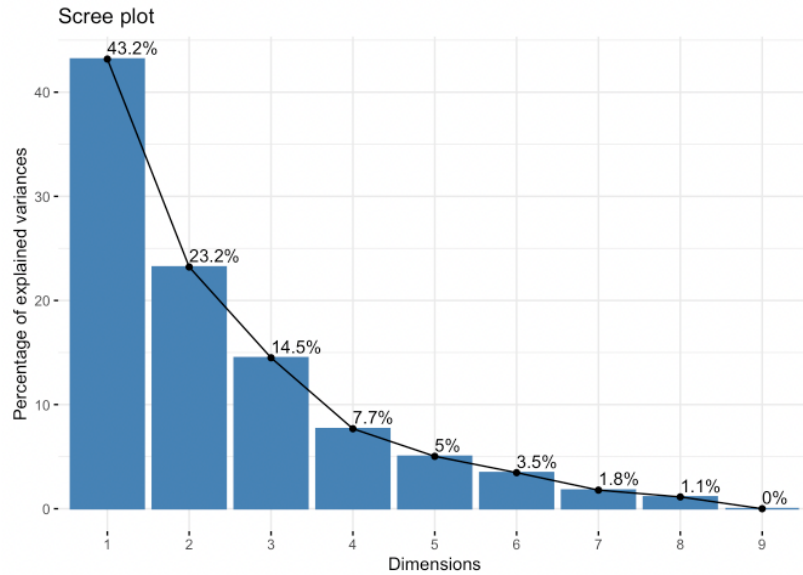
Scree plot

- The scree plot determines how many Principal Components (PCs) to use for the analysis.
- The significant bend in the plot is used to determine the number of PCs to be used.
- The plot shows us the number of components to be considered is 2. (65.4% of variance)
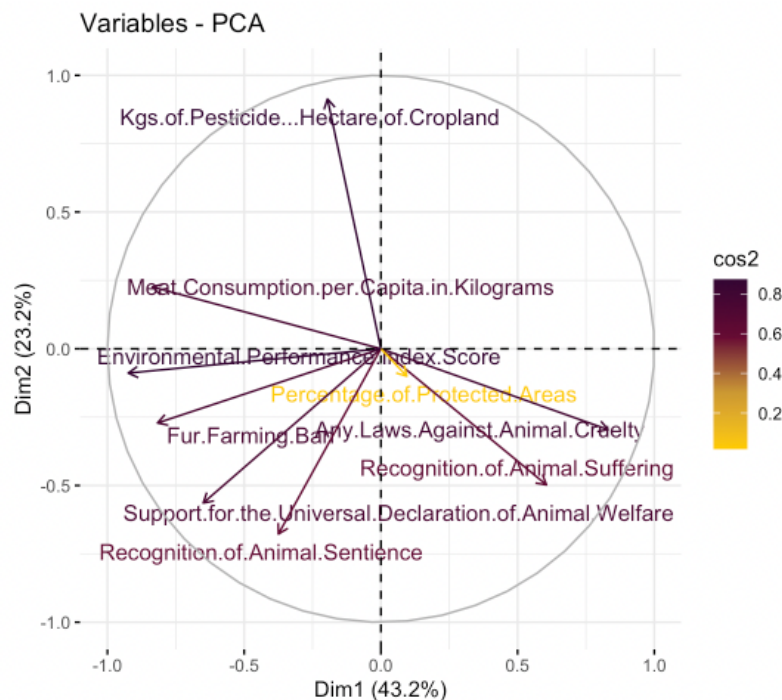
Variables - PCA

- The distance between points in a biplot reflects the generalized distance between them.
- The length of the vector reflects the variance of the variable.
- Correlation of the variables reflected by the angle between them. The smaller the angle, the more significant the correlation.
- For example, environmental performance and the Fur Farming Ban are strongly correlated.
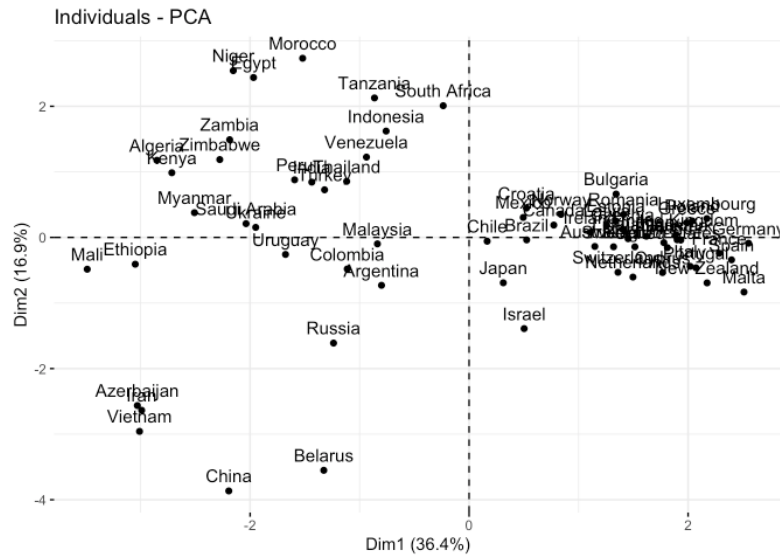
Individuals - PCA

- The countries have been plotted based on their PCA values in the individual PCA plot.
- The countries are allocated based on their similarities.
- Around 30 countries accumulate near the positive X-axis, and the rest are scattered towards the negative X-axis.
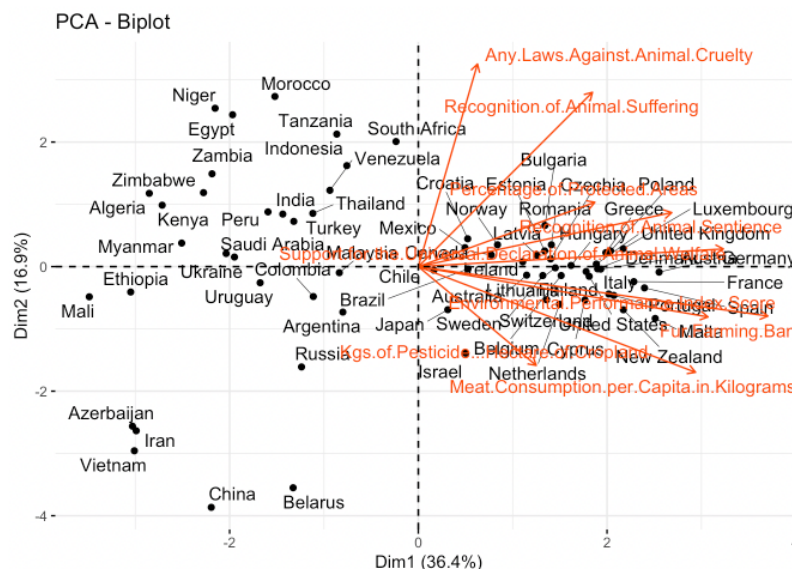

PCA - Biplot

- The combination of the variables and individual PCAs gives us the PCA biplot.
- The dataset shows that all the top 25-30 countries are on the positive X-axis.
- Some countries like Chile, Brazil, Japan, and Mexico are near zero.
- The Animal Rights variables define the placement of the countries. For example, in Any Laws Against Animal Cruelty, 5 countries (Belarus, Azerbaijan, Iran, Vietnam, China) are on the opposite side of that line on the biplot.
- The Biplot helps us understand the data much better than checking the numbers. It gives us information about countries that have similarities and which can fall under the same bucket.

5. Exploratory Factor Analysis (EFA)

EFA is a valuable tool for exploring complex relationships among variables and uncovering the underlying structure of data sets, which can provide insights into the underlying factors driving observed patterns.

In this case, we use EFA to reduce the dimensionality. As the data has many columns, we reduce them into fewer factors and associate columns with each factor. We can define each factor by the columns associated with it.

First, let us look at how many factors are to be considered.

Parallel Analysis Scree Plots
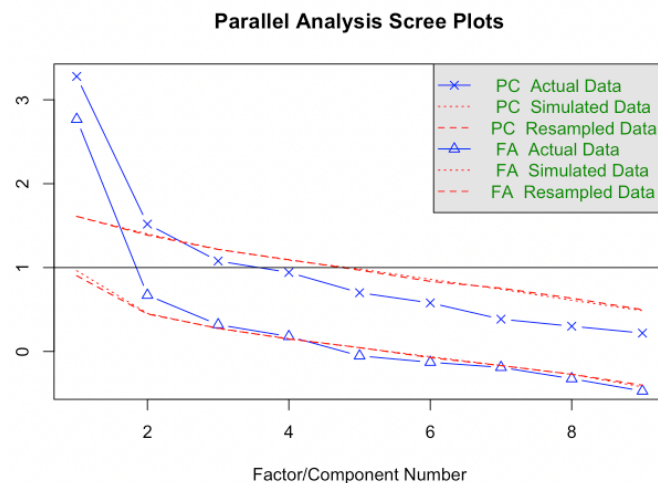
- Even in EFA, we did not consider the Total Score.
- The parallel plots show us that the ideal number of factors to be used is 2.

Components Analysis
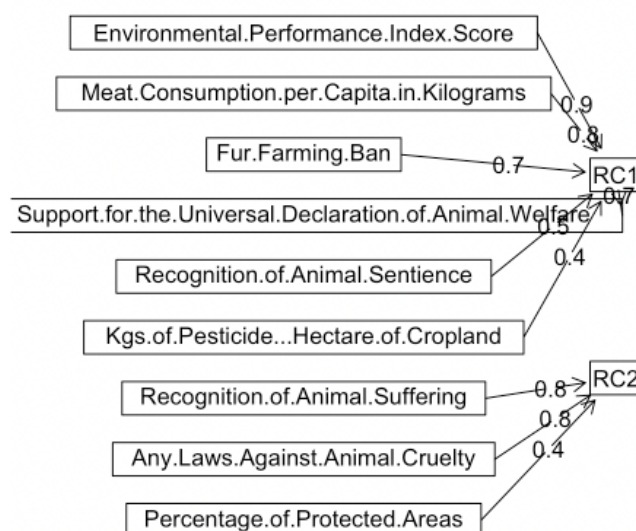
Defining the factors obtained

RC1: Metric related to animal welfare
- 4 factors towards the welfare of animals contribute majorly towards RC1.
- We can summarize this as a metric towards animal welfare.

RC2: Metric related to animal cruelty
- Recognition of animal cruelty and laws against animal cruelty contribute to RC2.
- We can summarize this as a metric for animal cruelty.

In the final section, we can review additional support material for our findings and conclude.

6. Observations and Conclusion

- Although we did not consider the total score column, we could cluster the countries through cluster analysis, which aligned with the score ranking.
- Similarly, we supported the cluster analysis through PCA, which gave us a visual of why certain countries are clustered based on the dataset's various measured parameters.
- Finally, the EFA helped us reduce the column by showing how to club columns and refine them to RCs.
- For both PCA and Clustering, we found that the countries have been segregated into four segments – Progressive Protectors, Mixed Practices Melting Pot, and Developing Dynamics.

A deeper analysis is done to identify the root cause for this classification. The findings are as follows:

Progressive Protectors
(Luxembourg, United Kingdom, Austria, Czechia, Belgium, Croatia, Sweden, Netherlands, Bulgaria, Switzerland, Greece, Denmark, Germany, Poland, Estonia, Finland, New Zealand, France, Ireland, Latvia, Hungary, Spain, Lithuania, Norway, Italy, Portugal, Cyprus)

This group comprises countries that strongly emphasise animal rights and welfare. They have well-established laws and policies to protect animals from cruelty and promote their welfare. Many of these nations have a long history of activism and public awareness regarding animal rights issues. Their cultures often prioritize compassion towards animals, leading to comprehensive legislation and enforcement measures.

Mixed Practices Melting Pot
(Malta, Romania, Tanzania, Chile, Brazil, Mexico, Canada, Japan, Indonesia, India, Peru, Israel, United States, Venezuela, Australia, Thailand, Turkey, Zambia, Malaysia, Zimbabwe, Kenya, Ukraine, Saudi Arabia, South Africa, Myanmar, Uruguay, Colombia, Morocco, Niger, Argentina, Egypt, Russia)

This group includes countries with varying degrees of animal rights practices. While some may have robust animal welfare laws and regulations, others may lag. The reasons for their inclusion in this group could stem from a mix of cultural, historical, and socio-economic factors. For example, some countries in this group might have a strong tradition of animal welfare, while others may face challenges in implementing effective policies due to political or economic constraints.

Developing Dynamics
(Ethiopia, Mali, Algeria, Belarus, Azerbaijan, Iran, Vietnam, China)

This group comprises countries where animal rights and welfare may not be prioritized as other nations. They might need more comprehensive legislation or enforcement mechanisms to protect animals from cruelty. Reasons for this could include cultural attitudes towards animals, limited resources for implementing welfare measures, or competing priorities in developing economies. These countries may also have different historical and cultural perspectives on the treatment of animals, leading to varying levels of protection and advocacy efforts.

7. Future Scope

- Using the different methods, we can use individual reduction methods and perform multiple regression to check where a new country stands.
- Based on the error value, we can decide which method gives the best possible results.