Application of Machine Learning to Clustering Countries Based on Dominant Parameters of Happiness Index

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Abstract

Background: Several researches have been done to study the role of various psychological factors to predict the happiness. The terms happiness, well-being, quality of life is used interchangeably. There is no universal definition of happiness, as happiness means different things to different people. It changes with time, age, place etc. Some of the countries have started measuring growth rate on the basis of happiness index of their nation’s population.

Purpose: To explore the relationship among the various parameters of happiness index and designing a classification model for the various countries on the basis of their happiness.

Materials and Methods: In this research work we have applied machine learning model on the datasets available for the year 2018 to 2020 to find the correlation between various global parameters adapted for identifying the impact of those parameters on the happiness index for the 156 countries.

Results: With the help unsupervised K-means learning method, we can analyze the importance of various parameters and can put the country in the class/cluster like excellent, moderate, average or below average. The above-mentioned classes signify the placement of the country and accurate classification on basis of various parameters.

Conclusions: This paper discusses the current factors effecting the happiness index of the country. The concept of happiness index and dimensions that effects the happiness index of the nations is always the matter of discussion and contradiction. There is no such comprehensive work done on the global parameters of happiness index in the machine learning field.

Keywords: machine learning, classification, K-Means method, happiness, world record.


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Introduction

In the last few years, the research towards happiness has attracted increased attention. The information about the happiness has exploded drawing attention of researchers from diverse backgrounds are contributing towards it. Attempts are being made to create, explore and document a wealth of knowledge about parameters that makes an individual happy. The world’s happiness...
The world happiness index is a modification of human right development. It uses the same statistical aggregation method with the objective to measure the happiness of the country. The following standard parameters are considered for analyzing the happiness of the residents of the country: security and peace, democracy, human rights and freedom, life style/living standards, education, research, communication, culture. The world happiness report is a land mark survey of the state of global happiness that ranks countries by how happy their citizens perceive themselves to be (Han et al., 2018). The World happiness report is a milestone review of the condition of worldwide joy. The report keeps on acquiring worldwide acknowledgment as governments, associations, and common society progressively uses bliss markers to devise their strategy deciding. The driving specialists across fields like financial aspects, brain research, overview examination, public insights, wellbeing, public arrangement, and that’s just the beginning – portray how estimations of prosperity can be utilized viably to evaluate the advancement of countries.

Happiness could be an important indicator for presenting how well the society is doing. (Han et al., 2018) carried out a subjective evaluation of people’s quality of life and demonstrated how various environmental parameters can impact an individual’s well-being. He attempted to predict the happiness on the basis of air pollution and the level of air index quality required to get the optimal happiness score. Jassmi et al. (2019) applied a machine learning model to predict the happiness and life quality from the data received from OCED regional statistics of BLI of different countries of last four years to formulate psychological tracking process.

The happiness score is prepared by interviewing random sample of population from individual country, to think about the happiness ladder index with best possible life for them and the worst possibility of living standard. The metrics supplied by each country affects the happiness score. Both linear regression and multiple linear regression with a number of parameters are applied to predict the happiness score of the country. This is completely an artificial exercise where multiple linear regression model of machine learning is used for experiment. This study evaluated the effectiveness of automating happiness tracking as a leading indicator for parameters calculation. (Bullen, 2016) presented a supervised machine learning model to predict the life satisfaction score of the country based on various parameters. He applied the models on dataset of 187 countries, the applied algorithm identified the parameters needed to be improved by various countries to improve the happiness index of the citizens.

From the above discussion it is evident that no comprehensive machine learning model is applicable to classify for all the important factors’ affecting happiness index of the various countries based on the essential parameters for the world. The proposed unsupervised machine learning model uses K-means clustering method to classify the happiness index. The K-means algorithm is used to make the clusters of unlabeled data. The datasets of 156 countries are downloaded from the Kaggel (https://www.kaggle.com, n.d.), which show the happiness index based on the different parameters like GDP, corruption, social support, life expectancy etc. The K-means algorithm is applied to divide the datasets into number of clusters. We have made five clusters to group the data into similar classes. Choosing an appropriate value of k is a challenging task, iteratively changing the value of k and performing different number of iterations can help to get the optimize value of k with proper partitioning of datasets into clusters. Clusters are labeled to check the accuracy of system. Datasets are further partitioned into training data and testing data. K-means algorithm provides the accuracy where we have a similar type of dataset available and troubles in creating the clusters with varying size of dataset. Outliers can be identified and tracked by retrieving the centroid of the clusters formed (Faik, 2020; Laconic Machine Learning, 2019).

**The aim of the study.** To explore the relationship among the various parameters of happiness index and designing a classification model for the various countries on the basis of their happiness.

**Materials and Methods**

Step 1: data is partitioned into two separate partitions, where happiness index could be classified into two different sections of happiness.

Step 2: data is partitioned into training and test datasets (Alba, 2019; Diener, 2000; Pérez-Benito, 2019; Seligman & Csikszentmihalyi, 2000). Following python libraries are used in the machine learning model:

1) Matplotlib is used for visualizing the required information.
2) NumPy is used for manipulating the high dimensional arrays, for creating the data frames.
3) Pandas and Scikit libraries are used to perform statistical operations required to apply machine learning algorithms.

**Results**

The dataset was taken from Kaggel (https://www.kaggle.com, n.d.) of last three years 2018-2020. The Happiness Score is a national average of the responses to the main life evaluation question asked in the Gallup World Poll (GWP), which uses the Happiness metrics – Cantril Ladder, economic metrics include – GDP per capita & health life expectancy at birth, Social Metrics – social support, Generosity, freedom to make life choices and perception of corruption. To apply the ML model, firstly data set must be normalized, scaled and applied feature
transformation according to requirements. The process is called data wrangling/data cleaning. Data preparation helps to accurately analyses and process the data. A similarity metric must be created for to form the clusters based on the similarity of the dataset. We have selected only the important parameters from the dataset only relevant variables are considered (Figure 1).

Figure 1
Loading the Dataset

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K-Means machine learning model is applied on the above Data frame of 156 countries where Happiness Index/Score is depending upon various features like GDP Per Capita, Social support, Health life expectancy, Freedom to make Choice, Generosity, Corruption. Overall ranking of the countries is provided on the cumulative features.

Figure 2
Applying K-Means Machine Learning Model

K-Means machine learning model is applied on the above Data frame of 156 countries where Happiness Index/Score is depending upon various features like GDP Per Capita, Social support, Health life expectancy, Freedom to make Choice, Generosity, Corruption. Overall ranking of the countries is provided on the cumulative features.

The most important is to apply the optimal value of K, thumb rule to define the k is square root of n, where n is the total observations. K-Means machine learning model (Figure 2) is applied to take the cluster of the countries that are having similarity in the happiness score. In the figure, all the rows and columns of input data frames are divided into five clusters, total 3000 iterations are applied in the algorithm.

In Figure 2 K-Means module is imported from Sklearn, all the machine learning models are prebuilt in the Sklearn library and according to the objective and type of dataset, the desired machine learning model can be applied. In the above process we have applied 3000 iterations to train the model and check the accuracy of the proposed system.
The clustering process is based on the similarity of the dataset and the centroid of the cluster is used to map all the elements. In Figure 3 all the centroids are calculated, five different centroids and their mapping neighboring elements are combined and kept into class/cluster.

**Figure 3**
Calculation of Centroid Applied Prediction on Input Data Frame

In the Figure 3 the centers of all the five clusters are computed through which neighboring elements are placed together in to five individual clusters. Clusters are defined by various parameters which are not specifically based on the happiness, they are measurement of GDP, health life expectancy, generosity, social support, freedom to live life and corruption etc.

In Figure 4 visualization of the clustering/classes is presented with five different clusters, the centroid of each cluster pointing the cluster.

**Figure 4**
Matrix Distribution of All the Rows into 5 Clusters

If we “pretend” that we don’t have survey happiness scores for the countries listed in the test data-set, we can use our K-Means model created in Figure 2 to predict their happiness based on the metrics GDP, Social Support, Life Expectancy, Freedom, Generosity, Corruption.

we are going to check the correlation between different features of the dataset. To find the Pearson correlation, use the Pandas correlation function. Correlations are used to get the quick insight about the data, identifying the casual relationship between the data elements is very crucial in decision making for example country with high life expectancy tend to be average happy does not mean that people with long life will not evaluate their life badly or good healthcare system can make their life happiest. To handle such type of questions, it is necessary to use statistical tools like regression.

In Figure 5 the correlation between all the parameters used in the dataset is described. From the Figure 5 we can easily identify parameters influencing the overall score as well as the parameters which are more interdependent. In Figures 6-8 it is clearly visible that all the individual clusters are isolated (cluster 0 – excellent, cluster1 – high, cluster 2 – moderate, cluster 3 – average, cluster 4 – below average). No overlapping and intersection of the clusters is found. It is evident that the applied algorithm has given the accurate clusters/classification on the basis of similarity features detected by algorithms.
Figure 5
Correlation Matrix of Parameters of Dataset

Figure 6
Visualization of Cluster (Datasets 2019)
Above clusters are created on the basis of happiness index rating, on this basis the countries are distributed in different clusters. Any of the country could be identified within the defined classes.

The designed machine learning model is applied on the data set of 2020, with the input parameters mentioned in above section. The clustering of the regions provides the accurate results with the prediction value of 0.5. The generalized model can be adopted for any timeframe to design an optimal classification of the countries.

**Discussion**

In this paper, we have proposed a model which is working on some of the few global parameters that can compute and provide overall happiness indexing. The statistical evaluation relates the growth with the happiness index and on the basis of happiness score retrieved the growth in terms of classes/cluster mentioned can be predicted. This model will help agencies responsible for the happiness index. It can be used to achieve the desired level by improving parameters which will positively impact the overall index. As we have compiled the dataset of 156 countries and possibly made the classification based on the important parameters effecting the happiness level of the country. From the last few years countries have started quantifying their state wise happiness level. Which will be helping the state/center government to
decide their action plans and policies for the people. Although in 2020 and 2021 there is drastic variation in the happiness index of the various countries due to COVID-19. Although, there were significant increases in average sadness and worries, we found that overall life evaluations, and happiness rankings, were surprisingly stable. The top countries before the pandemic remained the top countries in 2020, so there was little change in the overall rankings. The top countries already had higher levels of trust and lower levels of inequality, both of which helped them to keep death rates low and social cohesion high, and hence to maintain their favorable positions.

Conclusions
The proposed model is working with the total 156 countries of 2018 and 2019 dataset. The concept of happiness index and dimensions that effects the happiness index of the nations is always the matter of discussion and contradiction. There is no such comprehensive work done on the global parameters of happiness index in the machine learning field. Although there are various classification models available, which can be applied to train and test the dataset. But K-Means algorithm is also providing the optimal results without any overlapping.

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Conflicts of Interests
The authors declare that there is no conflict of interests.

References


The happiness Index.

В работе были применены модели машинного обучения для оценки страны. Алгоритм K-средних позволяет определение влияния этих параметров на индекс счастья для 156 стран.

Цель: Исследовать взаимосвязь между различными параметрами индекса счастья и разработан был метод классификации для разных стран на основе их счастья.

Вступ

Введение: Проведено несколько исследований, чтобы изучить роль различных психологических факторов в предсказании счастья. Термин счастье, благополучие, качество жизни используется как синонимы. Универсального определения счастья не существует, так как счастье означает разные вещи для разных людей.

В этой работе мы применили модель машинного обучения к датам, доступным за 2018–2020 годы, чтобы найти корреляцию между различными глобальными параметрами.

Результаты: За допомогою метода K-средних мы можем проанализировать важность разных параметров и внести изменения в такие классы: отличный, помеший, средний или ниже среднего. Эти классы означают розміщення країни та точну класифікацію за різними параметрами.

Выводы: В этой статье обсуждаются текущие факторы, влияющие на индекс счастья в стране. Концепция индекса счастья и параметры, влияющие на индекс счастья наций, всегда являются предметом дискуссий и противоречий. В области машинного обучения такой комплексной работы по глобальным параметрам индекса счастья не проводится.

Ключевые слова: машинное обучение, классификация, метод K-средних, счастье, мировой рекорд.

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