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Analysis of the Index of Gender Inequality in the World by a Neural Approach

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Abstract: The neuronal approach has interested a large number of researchers for analysis and in various fields. In this article, we use Kohonen Self-Organizing Map (SOM) which is an unsupervised neural network algorithm that projects high-dimensional data to predict dimension classification of the gender inequality index. This study covers 145 countries, demonstrates the relevance of the neural approach in this field of research. It was possible to determine an "optimal map" which involves a classification of countries and a view of the situation of inequalities in order to draw several relevant conclusions. The classification was carried out by the level of evolution of each dimension of the gender inequality index. Each group of countries classified in the same cell implies that these countries have suffered similar effects for the inequality indicators or that they have applied the same strategy to fight inequality. Grouping countries by zone shows, on the one hand, that countries with high inequalities are characterized by a strong correlation between dimensions. Second, African and Asian countries have the greatest deficit in education, health and the labor market.

Keywords: Gender Inequality Index, Self-Organizing Maps**,** Classification of Countries

1. Introduction

Since the 1990, the United Nations Development Programme (UNDP) has paid particular attention to the question of the extent of gender inequalities. Many attempts arming to quantify and measure gender inequality have been made. Similarly, several specific objectives specific to the promotion of the status of women have been set. To encourage some of these goals, UNDP included "The promotion of gender equality and empowerment of women «like the third Millennium Development. The conclusions which resulted from the World Economic Forum in Geneva (2007) showed that the advancement of women has economic and social importance of having a significant impact on growth. The work of UNDP was based on the construction of an index of gender inequality, called Global Gender Gap Indies (GGGI). This index is an important step for the measurement and analysis of gender inequality. It therefore drew the attention of academicians on the issue of gender inequality [4] and its relationship with economic growth.

Indeed, in 1995UNDP, the published two sensible indices to account for the gender inequality. The first is the Gender Development Index (GDI) developed by [4] designed to measure well-being, in analogy with the human development index (HDI). The second is the index of women's participation (IPF) which is intended to the economic and political power of women. Both indices have been heavily criticized for the methodological and theoretical weaknesses they present [13, 18, 6]. This is led the UNDP to rethink its methodology and propose the GGGI in 2010, as an alternative to both measures. In fact, the GGGI is a composite index intended to measure a broad and multi-dimensional concept, such as gender inequality. On the one hand the analysis of the concept should take into account all these dimensions and the interaction between them. On the other hand, the composite indicators raise several problems related to their construction methodology. It is therefore important to handle them with great care. The purpose of this study is to present a multidimensional analysis of three

components of the GGGI index using self-organizing Kohonen maps. It is an unsupervised neural method which was used, to prove itself in several areas [28].

This work is organized as follows: Section 2 is devoted to present the index of gender inequality the most used according to the UNDP in the literature. Section 3 presents the most used neural method, how they work and how they are used in the classification of countries around the world according to the dimensions of our index. Section 4 is reserved for an application of this technique on the dimensions of the gender inequality index observed in the world. The conclusions of this work are presented in the last section.

2. Of the Gender Inequality Index

The Gender Inequality Index (GII) is a UN-created index designed to assess gender differences in the distribution of progress and to estimate the loss of human development due to differences in treatment between men and women. The Gender Inequality Index was designed to overcome the major limitations of the HDI and GDI. To this end, it proposed new dimensions to capture gender inequality and a new functional form to summarize multidimensional information in a real number that can possibly be used to compare the performance of countries over time. In choosing the dimensions and indicators to include in the GII, [2] have kept in mind some basic criteria for the selection of indicators.

At the global level given the serious limitations of quality data, there is considerable exchange between relevance / importance of data and geographical coverage. Fortunately, GII designers have been able to identify highly relevant indicators for quite a large number of countries covering most parts of the world [3, 5, 7].

The 3 basic dimensions are:

Reproductive health: This is an extremely relevant dimension for assessing the well-being levels of people who were completely absent from other composite indexes that are well known to UNDP. To analyze reproductive health situations in countries, two indicators were used: the maternal mortality rate and the adolescent fertility rate. The maternal mortality rate, defined as the number of maternal deaths per 100,000 live births, is one of the leading causes of death and disability among women of childbearing age in developing countries. The adolescent fertility rate is the number of births per 1,000 women aged 15 to 19, so it represents the risk of procreation for teenage girls [15].

Education: is an essential factor contributing to knowledge creation and self-confidence. It is widely recognized, both theoretically and empirically, as an essential condition in the world and to assess the level of countries. Education brings empowerment that is measured by the share of parliamentary seats occupied by each gender and by the number of graduates from secondary and higher education. As well as because it enhances the capacity of people to question and act according to their condition and increases the accessibility of information necessary for this purpose [8, 10].

Labour market: this dimension is measured by the participation of women in the labor market. [6, 12] show that this is an important variable that replaces the problem component of earned income that was used in the other UNDP indices. This component has been estimated in many the measurement of the participation rate in the labor market is much more reliable, even if it is not exempt from certain problems. [2], observes that labor force participation, as traditionally measured, ignores women's significant contributions to unpaid work and may perpetuate the undervaluation of these critical activities. Therefore [22, 23] [24], shows that much more needs to be done about the appropriate measurement tools to capture the informal economy and care sectors in which women are generally overrepresented.

3. The Self-organizing Kohonen Map (SOM)

In this work, we apply the self-organizing maps of Kohonen, which were introduced by Teuvo Khonen in 80 years. In the contexts of the data analysis, this technique appears to be a particularly interesting method of classification [1, 14, 17, 19]. This is an unsupervised type of algorithm which can also be viewed as a nonlinear extension of the main analysis components, due to their ability to stretch and twist so that they can best encompass the cloud of points [9].

Kohonen Topological maps consist of two layers:

1) The input layer is only used for the presentation of forms to be classified and the states of all its neurons which are forced to the values of the input data;
2) The matching layer is formed of a lattice of neurons previously mentioned. The choice of the network geometry used is made a priori. The neurons used at this level are linear where; each of them is connected to all the elements of the input layer. To identify the self - organization process, the weights linking the two layers are determined adaptively.

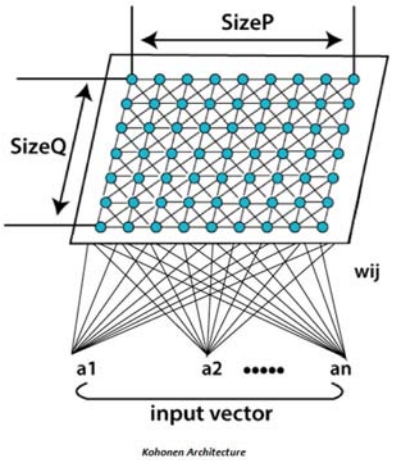

Figure 1. *The topological map of Kohonen.*

4. Empirical Investigation and Results

The three dimensions of the index of gender inequality considered by UNDP were used to construct a new composite indicator. In the first step, we proceed to self organization of countries using a Kohonen map. Data on 145 countries were used to study learning the Kohonen map through Matlab software. The obtained map is shown in Figure 2. the first observation made is that the distribution of the countries on the map explains very well the way in which the combination was effected. On the bottom left of the map, we find the majority of the OECD countries with the level of education of the largest health and labor market. This level falls gradually as we moves away from this area (going to the top of the card). At the top of the map, we find essentially classes containing the majority of the African countries. However, card should be read carefully. Indeed, the classes are equally spaced; however this can in no way help conclude that they have the same levels of gender inequality index.

Burkinafao Mauritania	Guatemala Sierraleone	Mali Rwanda Tanzanie Yemen	Soudan Burundi	Bénin Cameroun Myanmar	Mozambiqe Panama Senegal
Côtedivoir Haïti	Malte	Liberia	Lesotho Centra-African Republic		Gambia Malte
Bhoutan Ouganda Suriname Zambia	Morocco	Cambodia Reparab syria	ArabieSAU Belize	Togo Vietnam	Afghanistan Algéria
Gabon India Irak	Colombia	Bangladesh Pakistan Qatar	Égypte Kenya Répubdomin Thaïlande Turquie	Namibia	Brésil Congo Iran Liban Paraguay
Ghana Népal		salvador Koweït Tunisie		Swaziland Uruguay Équateur	Maurice
Nicaragua Papouasie- Nouvelle-Guinée	Libya Portugal	Malte Oman Rép.démo Tonga	Srilinka	Jordanie	Argentine Bolivie
Venezuela	Croatia	Hongrie	Botswana Chili Guyana Mongolia Ukraine	Mali Trinité-et-Tobago	Costa Rica Géorgia
Pérou Zimbabwe	Jamaïque	South Africa Arménie Mexica	Azerbaïdjan	Bangladesh Émirats Pérou	Albanie Bulgarie
Chine Moldova Royaume-Uni Tadjikistan	Cuba États-Unis	Bangladesh Barbade Kirghizistan	Kazakhstan Lettonie Roumaine	NowZealand	Australia brazil Philippines Poland
Luxembourg		Lituanie	Canada		Irlande Norvège
Grèce Réptchek Slovaquie Slovénie	Chypres CoréeRépu France Israël	Espagne	Danemark Estonie Finlande Islande	Allemagne Autriche Suède	Italia Japan Singapour Suitserland

Figure 2. *Map obtained for 145 countries.*

Using the code vectors, it is possible to obtain what is called the map of distances (or U-matrix), which illustrates the distance between the cells of the Kohonen map. On this card, a blue color indicates small distances between the cells, which help to detect a homogeneous area (the countries which have similar characteristics). On the other hand, a red color indicates a significant distance between the cells and reveals a border zone.

An important result that can be reached from the U-matrix is that the areas located at the bottom of the map, where all the OECD and the majority of the Asia and Latin American countries are concentrated, are characterized by some

homogeneity in their reunion. However, at the map where we find most of the African countries, there is a clear heterogeneity. This dissimilarity is enenobserved within the sub regional groups.

A second conclusion from the Kohonen map consists in determining a weight map for each of the three variables. In this map, a red color is associated with a high value of the variable in question and a blue color indicates a low value. The results for the three strands of the Gender Inequality Index show that the countries of the bottom of the map are characterized by a high level of all three dimensions. However, the African countries, which are mostly located at the top of the map, show the most significant deficits for the three dimensions. In addition, the variables seem to have similar projections, which means that were is a strong correlation between them (we should recall that this point was the subject of most harsh criticism addressed to the UNDP index).

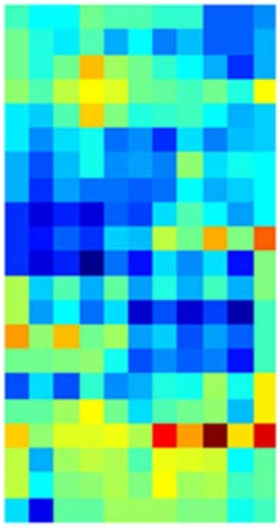

Figure 3. *Map distances: U-matrix.*

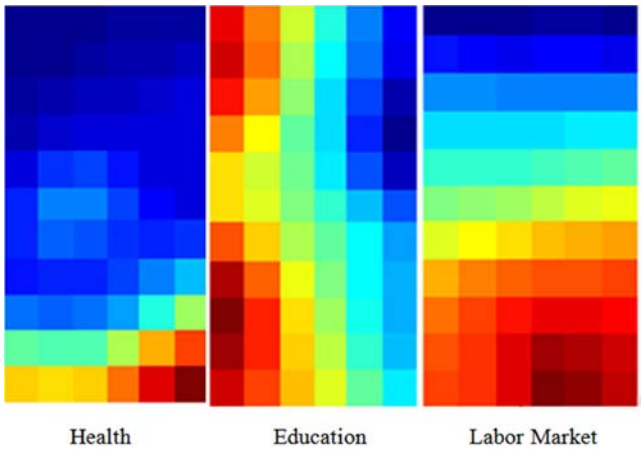

Figure 4. *Maps variables.*

5. Conclusion

In this article, the focus has been primarily on the artificial intelligence branch by applying neural network tool as an interesting method to traditional statistics which helps the classify the countries on the basis of a composite indicator so as to predict the quality of the of gender inequality index in the world. The results obtained through the analysis of 145 countries in the world for the year 2012 show that this method of classification gives an optimal Kohonen map where the countries are classified into four areas. Each corner of the map includes a number of countries. The OECD countries are at the bottom, the MENA and the Asian countries at the top. This classification was best explained through the map of each variable.

A 'low dispersion of the variable health in MENA and Asian countries on the other hand, there is some kind of homogeneity of intensity of the Labor for Countries variable for the countries located on the right of the map, sow as Swaziland, Togo, Vietnam etc. Thus, the African and Asian countries are correlated in terms of education and health since they have the largest deficits.

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