Spatial Variation of Socio-Economic Attributes of Population At Governorates Level in Jordan

Issa El-Shair*

Abstract

This research is primarily concerned with analyzing the key social indicators in Jordan by using the statistical technique of factor analysis. This technique lessens a multitude of variables into few specific factors. In the present study, 39 variables for the 12 Jordanian governorates were considered in the analysis. The principal component analysis was the extracted adopted method. A main aim of this research was to find the total variance explained. By using eigenvalues = 1, five factors were produced. The cumulative percentage explained was 93.106. After specifying the contributions of the variables in the extracted factors, known as the communalities, and the total variance explained, the rotation procedure was used to determine a form where each variable has a high loading on only one factor i.e. a search for factors representing a cluster of highly correlated variables. The five factors produced by the rotated component matrix were (1) population and service establishments; (2) medical centers; (3) urbanization and literacy; (4) life expectancy; and (5) income and unemployment. The total variance explained by each of these factors were 51.572 percent, 14.500 percent, 13.434 percent, 7.602 percent, 5.999 respectively. Finally, a hierarchical cluster analysis was used to show the general cluster pattern between the twelve Jordanian governorates. Three clusters, with same characteristics for each, were obtained. These clusters were (a) Amman, (b) Zarqa and Irbid, and (c) others. The technique proved to be very important in explaining the key social indicators in Jordan with cluster analysis to be more useful.

Introduction

Factor Analysis is a mathematically sophisticated technique, of the family of multivariate analysis. It was initially invented by psychologist Charles Spearman about 100 years ago. Quite apart from the traditional approaches where certain characteristics of some phenomena are fully examined, this mathematical technique reduces a multitude of features into numerically viable factors trying to explain the implicit features of the data set to which they associate. Many geographers used it since the seventieth of last century. This is due to the fact that geography deals with tens of physical or human variables,

* Department of Geography, Faculty of Arts, Yarmouk University, Irbid, Jordan.

and hundreds of cases or observations that correlate with each other in a complex manner (Saleh and Siriani 2000: 425- 465).

The analysis starts with a great number of basic variables which are subjected to product moment correlation analysis. The output of this analysis, the inter-correlation matrix, is subject to factor analysis. Subsequent clusters of highly inter-correlated variables (factors) are obtained. The loadings of the variables on the factors are called factor loadings. These loadings weighted by the original data matrix, give the weighted factor score matrix, which shows the loadings of each of the variables on each of the factors (Markandey 1982).

In addition to the possibility of the tabular presentation of these factor scores, showing them in a graphical manner is also possible. They can be plotted either in factor space (identified by factor axis) or in geographical space (identified by spatial units on the map).

It is worthy of mentioning that the factors which are extracted from the data are representatives of the common pattern found in the data. They account for a large portion of the variance in the raw data. Due to the fact that this technique attempts to simplify and complex phenomena, factor analysis aims to reduce the unneeded repetition in data. In short the most important applications of factor analysis technique are: (1) to reduce the number of variables and (2) to classify variables.

Although there are several factor models that can be used in social science research, two of them are most frequently used in geography. These are the common factor model and the principal components model. There are few differences between the two types of models. The most important difference is that the principal component analysis proceeds on the basis of the assumption that the variables used to define the universe of study explain the entire variation that exists in this universe. On the other hand, common factor analysis assumes that only a part of the variation in a given universe is explained by the used variables. Thus, whereas principal component analysis may be described as a deterministic approach, the common factor analysis is a more probabilistic approach (Markandey 1982).

Problems of applying factor analysis in geography:

In spite of its increasing popularity in geographic research, the technique of factor analysis has some limitations. Flexibility which is sometimes associated with this technique may become annoying when the technique is used for a wide variety of purposes with the same data input.

One limitation of the technique is related to the fact that the factors are named on the basis of the pattern of loading of variables on the factors. It is

noteworthy that when many variables load high on a factor, then labeling becomes difficult and incomplete.

Another problem in applying factor analysis is that the resultant factors are dependent on the input data. In this case, the choice depends on the availability of data and does not depend on theoretical framework. This involves the choice between several factor analysis techniques available for extracting the major dimensions. Each technique might come up with a different solution which may lead to wrong conclusions (Ankary 1983; see also Schwirian 1974).

Nevertheless, the technique is gaining a stronghold and popularity in social science research including geography. This may explain why the researcher chose factor analysis for this current study dealing with the key social indicators at governorates level in Jordan.

Literature Review:

Concepts of factor analysis and their uses in geographical studies are found in several books and articles. Samples of useful books on this technique are Ankary's (1983) book titled *A Comparative Factorial Ecology: Kuwait City, Kuwait and Jacksonville, Florida*; Cole and King's (1968) *Quantitative Geography: Techniques and Theories in Geography*; Johnson's (1978) *Multivariate Statistical Analysis in Geography*; Kim and Mueller's (1978) *Introduction to Factor Analysis: What It is and how to do It*; and Yeates book (1974) *Introduction to Quantitative Analysis in Human Geography*.

Samples of valuable articles using factor analysis include: Berry and Rees's (1969) "The Factorial Ecology of Calcutta"; Davies and Barrow's (1973) "A Comparative Factorial Ecology of Three Canadian Prairie Cities"; and Hebert's (1968) "Principal Component Analysis and British Studies of Urban-Social Structures".

A more recent and interesting article was written by Jansen et al (2005) titled "Geography, Livelihoods and Rural Poverty in Honduras: An Empirical Analysis Using an Asset-base Approach". The overall objective of this paper was to develop an appropriate conceptual and analytical framework to better understand how prospects for growth and poverty reduction can be stimulated in rural Honduras. Factor and cluster analysis techniques were used to identify and group different livelihood strategies; and econometric analysis was used to investigate the determinants of different livelihood strategies and the major factors that impact on income.

Three valuable studies done in Jordan should be also mentioned. These studies which were written in Arabic belong to Abu-Sabha (1983), Al-Hunaiti (1991) and Saleh and Ghuraib (1996). Abu-Sabha in his research "Analysis of

Factorial Ecology: A Study of the Internal Structure of Cities" introduced the concept of factorial ecology to the Arab geographers and mainly to those who are interested in urban affairs. Abu-Sabha described the statistical method of factor analysis in building a theory that can demonstrate the internal structure of cities. He also included some applications of the factor analysis technique.

Al-Hunaiti in his paper "Development Inequality among Governorates of Jordan" highlighted this inequality through a multivariate dimension scale. The conceptual framework of the study showed that developing countries are unable to adapt a strategy that can reduce development inequality. According to Al-Hunaiti the inequality within the northern governorates in Jordan is higher than it is within the southern ones.

Saleh and Ghuraib in their study "Spatial Analysis of Chemical Industries in Amman Region" examined the spatial analysis of chemical industries in Amman region of Jordan. They were aiming to determine the spatial distribution of chemical industries as well as their patterns. In order to fulfill their aim they used factor analysis and cluster analysis techniques. The writers concluded that three factors explained 96 percent of the total variance as follows: 54.2 percent was explained by industrial significance factor; 26 percent was explained by the size of investment factor, and 15.7 percent by the number of factories factor.

In addition to these studies several unpublished Master theses written by population or geography students at Jordan University may be mentioned too. Samples of these students include Salman (1993) and Al-Weshah (1998).

Salman investigated development variations in Amman governorates by using factor analysis and cluster analysis. Thirty two variables representing development, economic and services sectors in 84 villages in Amman governorate were examined. The researcher recommended the providing of new housing policies, increasing health and educational services, and adopting new agricultural policies that may enhance the development in the study area.

Al-Weshah studied the development variation in Balqa governorate. Al-Wishah was mainly interested in determining the factors influencing the development process in the study area. Through factor analysis and cluster analysis, many problems were found to affect Balqa governorates, particularly the great shortage of healthy housing and infrastructure as well as the unfair distribution of health and educational services.

In other countries two research articles, written by Singh and Singh (1983) and Ahmed (1997), are worthy of mentioning and will be reviewed.

The Singh and Singh article titled "The Socio-Economic Patterns of Population in Varanasi" relates to the intra-city socio-economic structure of

Varanasi, India. 17 variables concerning social status, economic status, and ethnicity were analyzed with the help of factor Analysis. Five factors emerged providing the clue to assess the functional and spatial significance of the five dimensions namely: Acquired economic status, traditional social status, economic activities, male concentration, and segregation of religious groups. The 17 variables have explained the total character of the city to the extent of over 83 percent.

Ahmed was studying climatic classification of Saudi Arabia. His study aimed to be a contribution to climatic regionalization of Saudi Arabia. The study applied a multivariate factor-cluster analysis technique. The data was obtained from 56 meteorological stations. The application of the technique was made into two stages. In the first stage, factor analysis alone was considered and its results were discussed. In the second stage, the resultant factor scores were taken as an input in a cluster analysis process to obtain climatic regions. The factor-cluster analysis was found advantageous over many of the traditional methods, as it produced richer regions and showed clear climatic variations within Saudi Arabia.

It is concluded from the above-mentioned references that while factor analysis was often used since the late 1960s, it is loosing popularity in recent years. The importance of this technique in current geographical research, however, cannot be underestimated.

Research Generalizations:

This research tries to examine the following generalizations:

1- There is a very high correlation between a certain variable (key social indicator) and a cluster of the variables of the study.

2- It is assumed that the most important factor that accounts for most of the variance explained is related to urbanization and income.

3- With the exception of Amman, Zarqa, and Irbid governorates, all the governorates of Jordan have the same characteristics.

To examine these generalizations, the researcher was interested in the following:

- finding the communalities of the thirty-nine variables used in the study i.e. the contributions of the variables in the extracted factors.

-finding the total variance explained according to the initial eigenvalues or according to pre-determined number of factors.

-plotting the variables of the study on a scree plot to show the main factors that can be extracted.

-searching for factors that present a cluster of variables that is very highly associated.

-To find out the general cluster pattern between the governorates.

Data Source and Methodology:

The raw data that was used in the analysis was obtained from Jordan Human Development Report 2004 published by Jordanian Ministry of Planning and by United Nations Development Program. Maps of the study area were modified by the writer as follows:

- Location map of Jordan was modified after ESRI's book titled Mapping World, 2003. GIS ArcView 3.2 software was used for drawing the map.
- The Jordanian governorates map was modified after Google: *http://en.wikipedia.org/wiki/Governorates_of_Jordan*

The methodology of the research was mainly statistical. Factor analysis technique was the one used to test the above-mentioned hypotheses. As implied earlier, Factor analysis is a statistical technique used to (1) estimate factors or latent variables, or (2) reduce the dimensionality of a large number of variables to a fewer number of factors. Two main methods mentioned-above for factor analysis are used by geographers. The difference of the two methods is mainly in the treatment of the error term. First, the principal component analysis method does not include an error term in its model. The result is a set of factors whose maximum variance equals the number of variables (Ankary 1983; also Johnston 1978b).

Second, the common factor analysis method includes an error term. Also in this method, the variance is composed of two types: common variance, which is the portion of the total variance that correlates with other variables, and the specific variance, which does not correlate with any other variable (Cole and King 1968).

In this research, the principal component analysis method was adopted. Eigenvalue =1 was used to find the sum of the loadings on each factor. In addition to the eigenvalue, extraction by the number of factors =4 was also used to see if it gives better results.

Rotation is an important part of the analysis. Two types of rotation are common. The first type is the orthogonal rotation which assumes no interaction between the factors. The second type is the oblique rotation which assumes the existence of some correlation between the factors (Taylor 1977).

In this study, the varimax rotation which is one of several methods of the orthogonal rotation was used. It was chosen here because it is the most common method of rotation. Statistical Package for Social Scientists (SPSS) version 11 was the software that was used to run the technique.

The descriptive methodology was also used to provide a logical explanation of the results of the analysis. This methodology was also useful to give a background for the social characteristics of the Jordanian governorates as well as for demonstrating the geographic settings of the study area.

Geographic settings of the study area

Jordan is a Middle Eastern country, bordered by Syria to the north, Iraq to the northeast, Saudi Arabia to the east and south and Occupied Palestine 48 and West Bank to the west. All these border lines add up to 1,619 kilometres. The Gulf of Aqaba and the Dead Sea also touch the country, and thus Jordan has a coastline of 26 kilometres.

Jordan consists mostly of arid desert plateau in the east, with highland area in the west. The Great Rift Valley of the Jordan River separates Jordan and Palestine. The lowest in the country, and the whole world, is 486 meters below sea level at the Dead Sea. The highest point is 1854 meters above sea level at Jabal Um Al-Dami in Rum Area (29˚ 18´ N and 35˚ 26´ E). (See www.cdb.int/doc/world/jo/jo-03-en.doc also http://mahtours.tripod.com/modern.htm).

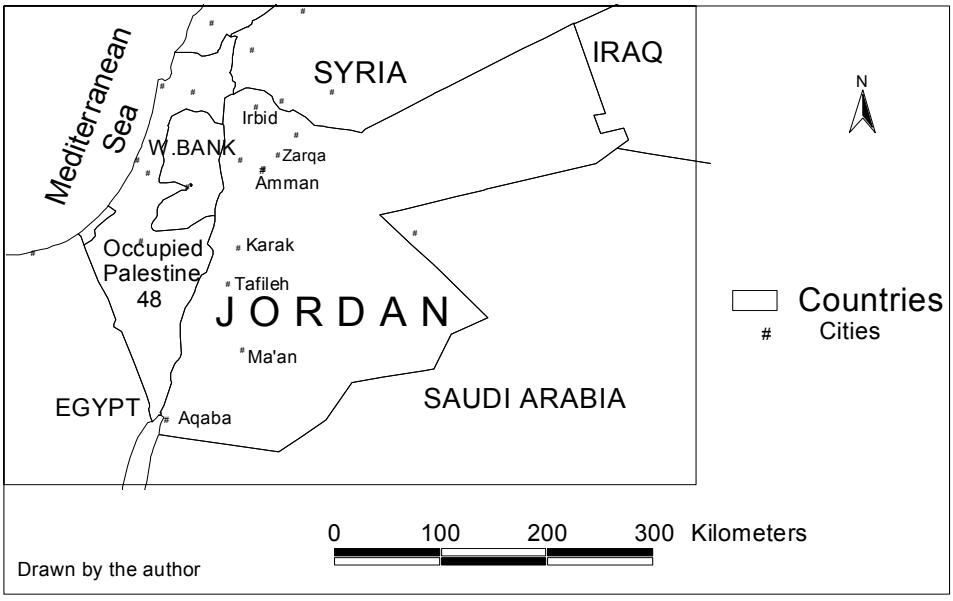

Fig. 1: Location Map of Jordan

Jordan is part of a region considered to be "the cradle of civiliza-tion". Major cities include the capital Amman in the north-west, Irbid and Az Zarqa, both in the north (Fig. 1). The climate in Jordan is dry and hot. However, the western part of the country receives greater precipitation during the rainy season from November to April.

Administratively, Jordan is divided into 12 governorates, each is headed by a governor appointed by the king. They are the sole authorities for all government departments and development projects in their respective areas. These governorates are: Ajlun, Amman, Aqaba, Balqa, Irbid, Jerash, Kerak, Ma'an, Madaba, Mafraq, Tafilah, and Zarqa (Fig. 2). For more details about the country of Jordan and the twelve Jordanian governorates see: http://en.wikipedia.org/wiki/Governorates_of_Jordan.

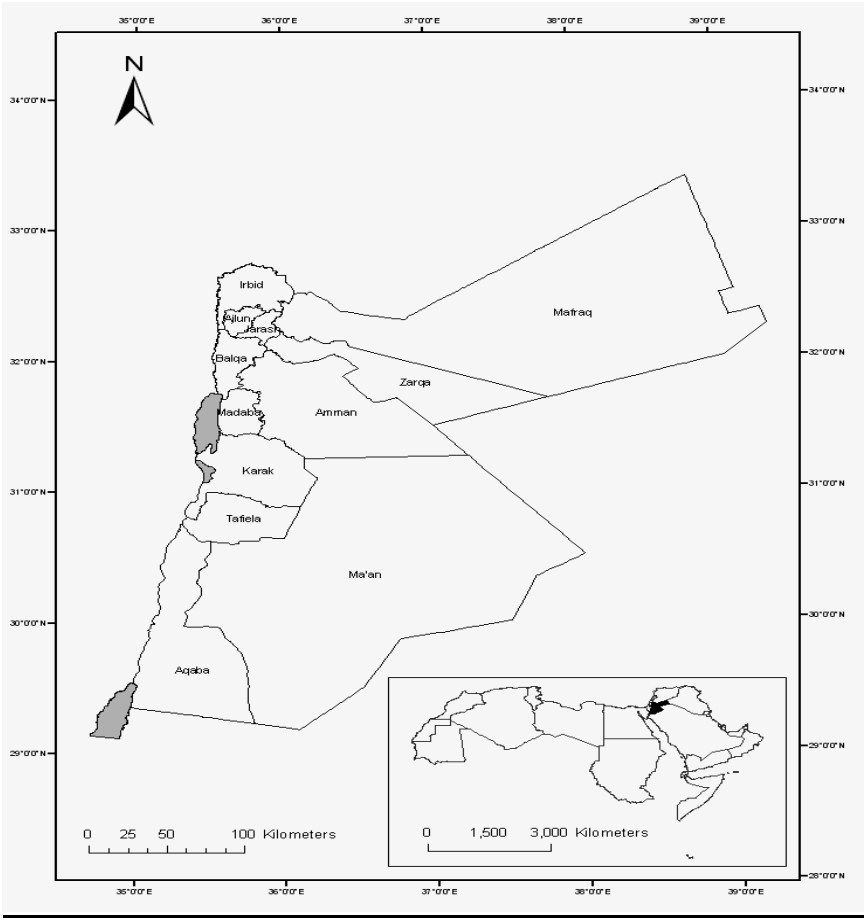

Fig. 2: Administrative Governorates of Jordan (from author's archive)

Analysis of the Results:

This study is concerned with analyzing the key socio-economic indicators in Jordan. The indicators include 39 variables for 12 governorates (Annex 1). Annex 2 shows the correlation matrix for all variables. The matrix illustrates the relationships between the variables that need to be reduced to a certain number of factors. From this matrix, it is possible to notice the mutual relationship between any two variables. For example it seems that the relationship between the first variable (population) and the fourteenth variable (water supply) is very strong and positive (.979). On the other hand, the relationship between population and the ninth variable (female life expectancy) is very weak and negative (-.203). Similar observations can be made for the rest of the variables.

There are several factor models, though two of them are most frequently used in geography. These are the common factor model and the principal component model. There are quite a few differences between the two types of models. The most important difference is that the principal component analysis proceeds on the basis of the assumption that the variable used to define the universe of study explain the entire variation that exists in the universe. Common factor analysis, on the other hand, assumes that only a part of the variation in a given universe is explained by the variable used to define the universe.

The principal component analysis is the extracted method used in this study. It is emphasized here that factors that account for less and less variance are extracted. To simplify matters, one usually starts with the correlation matrix, where the variances of all variables are equal to 1.0. Therefore, the total variance in that matrix is equal to the number of variables. In this study, we have 39 variables each with a variance of 1 then the total variability that can potentially be extracted is equal to 39 times 1. The contributions of the variables in the extracted factors are called communalities. In other words, it reflects the value of a correlation between a certain variable and a cluster of variables. It is noticed that, with the exception of the total members co-ops and population density, the values of the 39 variables are very high (between.767 and.998) which indicate a high correlation. Therefore, the first generalization is accepted (Table 1).

Table 1: Values of communalities of variables

	Initial	Extraction
POP	1.000	.985
POP_PERC	1.000	.986
POP_M	1.000	.986
POP_F	1.000	.985
POP_DENS	1.000	.689
URB_PERC	1.000	.933
LIFE_EXP	1.000	.915
LIF_EX_M	1.000	.824
LIF_EX_F	1.000	.908
UNEM_PER	1.000	.820
UNEM_P_M	1.000	.875
UNEM_P_F	1.000	.853
GDP_CA$	1.000	.784
WATER_MC	1.000	.963
NO_SCHOO	1.000	.996
AD_LT_15	1.000	.980
AD_LT15M	1.000	.891
AD_LT15F	1.000	.962
BOY_SCHO	1.000	.984
GIRL_SCH	1.000	.959
CO_EDU	1.000	.767
NO_STUDE	1.000	.998
STUDEN_M	1.000	.997
STUDEN_F	1.000	.998
HEALTH_C	1.000	.988
MAT_CH_C	1.000	.961
DENTL_CL	1.000	.971
NO_PHARM	1.000	.988
NO_MOH_H	1.000	.893
NO_P_HOS	1.000	.979
EST_SO_I	1.000	.984
HOU_C_ME	1.000	.952
WOM_C_ME	1.000	.687
TOT_NO_C	1.000	.958
TOT_ME_C	1.000	.968
WOM_ASSO	1.000	.979
CHAR_ASS	1.000	.998
REG_ENGI	1.000	.988
REG_LAWY	1.000	.981

Extraction Method: Principal Component Analysis.

The next step is to find out the total variance explained. By using eigenvalues = 1, five factors were produced. The first factor explained 51.57 percent of the variance, whereas the second factor explained 14.50 percent. Factors three, four, and five explained 13.43 percent, 7.60 percent, and 6.00 percent respectively. The cumulative percentage explained for the five factors were 93.11 (Table 2).

Another test may be used to determine the number of components (factors) that can be extracted. This test is called scree plot. Figure 3 shows the scree plot for the 39 variables used in this study. five components are evident in the plot. These components coincide well with the previous method of the total variance explained.

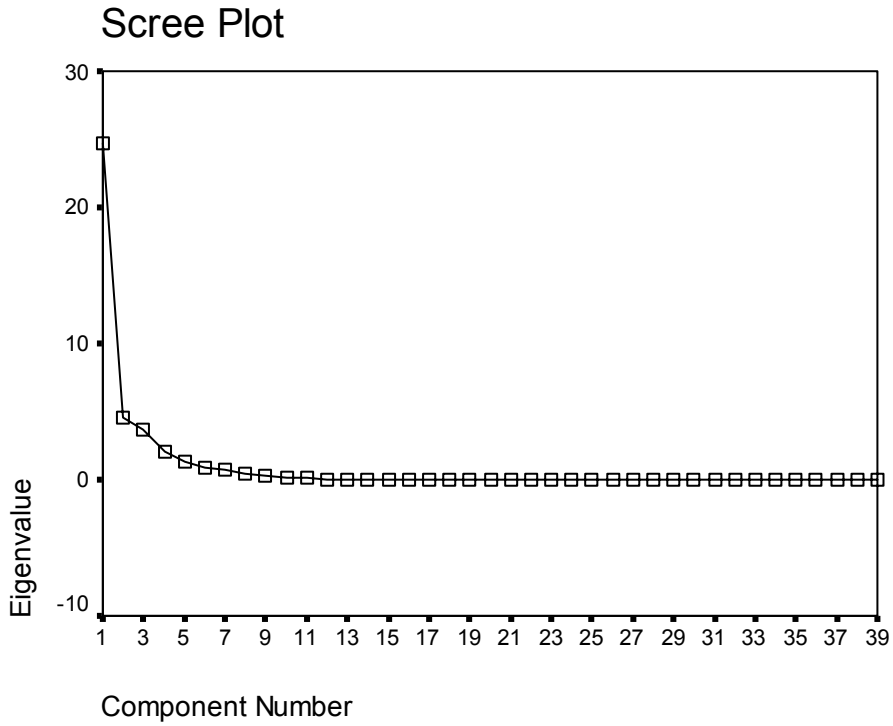

Fig. 3: Scree plot showing the importance of the main five components

Table 2: Total Variance Explained

	Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.642	63.183	63.183	24.642	63.183	63.183	20.113	51.572	51.572
2	4.491	11.515	74.699	4.491	11.515	74.699	5.655	14.500	66.072
3	3.683	9.443	84.142	3.683	9.443	84.142	5.239	13.434	79.506
4	2.108	5.404	89.546	2.108	5.404	89.546	2.965	7.602	87.108
5	1.388	3.560	93.106	1.388	3.560	93.106	2.340	5.999	93.106
6	.923	2.367	95.474						
7	.717	1.839	97.313						
8	.477	1.223	98.535						
9	.278	.713	99.249						
10	.204	.523	99.771						
11	8.912E-02	.229	100.000						
12	2.658E-15	6.815E-15	100.000						
13	1.892E-15	4.851E-15	100.000						
14	9.324E-16	2.391E-15	100.000						
15	6.639E-16	1.702E-15	100.000						
16	5.470E-16	1.402E-15	100.000						
17	4.488E-16	1.151E-15	100.000						
18	3.996E-16	1.025E-15	100.000						
19	3.593E-16	9.213E-16	100.000						
20	3.109E-16	7.972E-16	100.000						

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
21	2.384E-16	6.113E-16	100.000						
22	2.088E-16	5.353E-16	100.000						
23	1.637E-16	4.198E-16	100.000						
24	1.381E-16	3.540E-16	100.000						
25	3.668E-17	9.406E-17	100.000						
26	1.999E-17	5.126E-17	100.000						
27	-2.312E-18	-5.928E-18	100.000						
28	-7.918E-17	-2.030E-16	100.000						
29	-1.125E-16	-2.885E-16	100.000						
30	-1.986E-16	-5.093E-16	100.000						
31	-2.657E-16	-6.814E-16	100.000						
32	-2.761E-16	-7.078E-16	100.000						
33	-3.452E-16	-8.852E-16	100.000						
34	-3.873E-16	-9.931E-16	100.000						
35	-4.192E-16	-1.075E-15	100.000						
36	-5.832E-16	-1.495E-15	100.000						
37	-7.184E-16	-1.842E-15	100.000						
38	-9.119E-16	-2.338E-15	100.000						
39	-4.617E-15	-1.184E-14	100.000						

After specifying the communalities as well as the total variance explained, the rotation procedure has to be decided upon to arrive at a simple structure. In such a structure, each variable has a high loading on only one factor. This would mean a search for factors which present a cluster of variables which are very highly interrelated. Such factors would have a distinct identity of their own.

Two rotation procedures very commonly used in geography are the varimax rotation and the oblique rotation. In this research, the varimax rotation with Kaiser Normalization is adopted because it is non-deterministic method as there is no preconceived notion about the factors around which the variables would ultimately cluster. It is worthy mentioning that rotation was converged in seven iterations.

The rotated component matrix of the social indicators in Jordan produced five components (factors). These are shown in Table 3 as follows:

Table 3: Rotated component matrix (5 factors extracted)

	Component				
	1	2	3	4	5
POP	.887	.315	.306	-1.352E-02	7.502E-02
POP_PERC	.888	.314	.304	-1.335E-02	7.543E-02
POP_M	.889	.311	.304	-1.193E-02	7.435E-02
POP_F	.885	.320	.307	-1.533E-02	7.576E-02
POP_DENS	.448	-.329	-.446	-.361	-.224
URB_PERC	.356	-.118	.827	.179	.277
LIFE_EXP	.119	8.887E-02	.287	.896	-8.597E-02
LIF_EX_M	6.312E-02	-.435	.205	.743	.193
LIF_EX_F	-2.853E-02	-3.840E-02	-1.994E-02	.941	.143
UNEM_PER	-.458	-.338	-.686	-.113	.113
UNEM_P_M	5.835E-02	.304	.447	.276	.710
UNEM_P_F	-.132	.279	.130	-.213	.834
GDP_CA$	-.202	-.101	8.294E-03	-.339	-.786
WATER_MC	.925	.215	.236	4.857E-02	5.227E-02
NO_SCHOO	.859	.450	.211	6.926E-04	.103
AD_LT_15	.355	3.027E-02	.917	7.071E-02	8.143E-02
AD_LT15M	.326	2.869E-02	.877	.117	2.561E-02
AD_LT15F	.366	3.899E-02	.903	3.568E-02	.103
BOY_SCHO	.777	.586	.165	5.303E-03	.102
GIRL_SCH	.747	.536	.312	-2.973E-03	.130
CO_EDU	.759	.373	.127	-.103	.155
NO_STUDE	.889	.375	.245	1.710E-02	8.311E-02
STUDEN_M	.890	.374	.240	1.657E-02	8.153E-02
STUDEN_F	.887	.375	.249	1.757E-02	8.484E-02
HEALTH_C	.498	.836	1.616E-02	-5.314E-03	.203

	Component				
	1	2	3	4	5
MAT_CH_C	.379	.852	6.510E-02	-4.654E-02	.291
DENTL_CL	.596	.753	.142	8.720E-03	.173
NO_PHARM	.953	.137	.245	-1.426E-02	3.334E-02
NO_MOH_H	.380	.852	-4.158E-02	-3.796E-02	.141
NO_P_HOS	.967	7.837E-02	.187	3.381E-02	3.144E-02
EST_SO_I	.981	5.236E-02	.139	2.063E-02	-5.796E-03
HOU_C_ME	.958	-1.262E-02	.179	-5.035E-04	-4.804E-02
WOM_C_ME	.540	-.354	-1.001E-02	-.519	2.356E-02
TOT_NO_C	.960	.145	.101	4.442E-02	-6.115E-02
TOT_ME_C	.975	2.675E-02	.129	-5.635E-03	-2.693E-02
WOM_ASSO	.863	.430	.219	-2.410E-02	-8.166E-03
CHAR_ASS	.931	.328	.126	3.025E-02	8.043E-02
REG_ENGI	.973	7.506E-02	.188	5.078E-03	1.066E-02
REG_LAWY	.972	9.768E-02	.163	1.994E-02	6.227E-03

Rotation Method: Varimax with Kaiser Normalization.
(Rotation converged in 7 iterations)

Factor I:

This factor explained 51.57 percent of the total variance of the variables' matrix. This component showed a high degree of components saturations for 22 variables. These variables are: establishments with social insurance, total members co-ops, registered engineers, registered lawyers, number of private hospitals, total number co-ops, housing co-ops members, number of pharmacies, charitable societies, and water supply (saturation degrees are .981, .975, .973, .972, .967, .960, .958, .953, .931, and .925 respectively).

Other variables include male students, number of students, male population, population percentage, population, female students, female population, women associations, and number of schools with saturation degrees being .89, .889, .889, .888, .887, .887, .885, .863 ,.859 respectively. The remaining variables are boy's school (.777), co-education (.759), girl's school (.747). All the above twenty two variables are positive associates.

From the above-mentioned variable, a high correlation between this component and several demographic and service establishments is noticed. Therefore, the researcher decided to call this component "*demography and service establishments*". It is due to the fact that the variables of the demographic and service establishment factor had the highest saturation degrees that the second generalization is rejected.

Factor II:

This factor explained 14.50 percent of the total variance of the variables' matrix. There was a strong correlation between this component and four variables. The highest correlation was noticed between this component and number of Ministry of Health hospitals and maternity and child health centers with degrees of saturations reaching up to.852 in both cases. The other two variables were health centers and dental clinics with correlations being.836, and.852 respectively. All four variables are also positive associates.

The above four variables were in common related to medical centers. Therefore, the researcher found it is appropriate to call the second component "*medical centers factor*".

Factor III:

This factor explained 13.34 percent of the total variance of the variables matrix. A high degree of saturations were seen in the cases of adult literacy rate (saturation degree of.917), female adult literacy rate (.903), and male adult literacy rate (.877). In addition to literacy variables, there was a high degree of association in the case of percentage of urban population with saturation degree being.827. All the variables of this factor are negative associates. The researcher named this component "*urbanization and literacy*".

Factor IV:

This factor explained 7.60 percent of the total variance of the variables matrix. A high degree of saturations were seen in the cases of three variables namely female life expectancy (saturation degree of.941), life expectancy (.896), and male life expectancy (.743). These variables are all positive associates. The researcher named this component "*life expectancy factor*".

Factor V:

This factor explained 5.999 percent of the total variance of the variables matrix. Its positive associates are female unemployment rate and male unemployment rate (saturation degrees are.834 and.710 respectively). There was a negative associate in the case of GDP per capita (-.786). The researcher named this component "*income and unemployment factor*".

The above analysis showed that the main factors that explained the social indicators in Jordan were five factors. These factors were produced by the factor analysis technique for the variables of the study. Table 4 gives the importance of each factor as well as their eigenvalues in terms of their roles in explaining the variance of the key social indicators in the governorates of Jordan. Percentage of total variance explained by each factor is also given in Fig. 4.

Table 4: Outputs of the factor analysis of the study

Order of factors	Names of factors	% of total variance explained	Cumulative%
First	Population and service establish- ments	51.572	51.572
Second	Medical centers	14.500	66.072
Third	Urbanization and literacy	13.434	79.506
Fourth	Life expectancy	7.602	87.108
Fifth	Income and unemployment	5.999	93.106

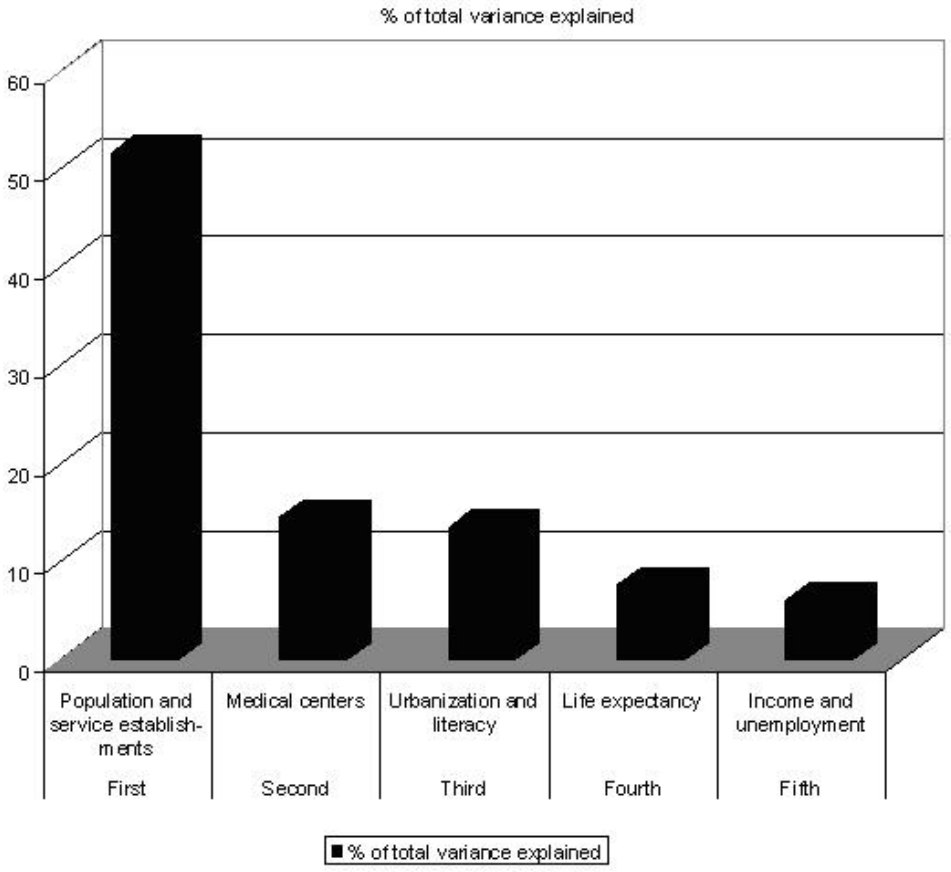

Fig. 4: Percentage of total variance explained by each factor

Hierarchical cluster analysis:

The last objective of this study was to find out the general cluster pattern between governorates. To achieve this objective a hierarchical cluster analysis was used. The analysis showed that the following three clusters were evident:

(a) Amman.

(b) Zarqa and Irbid.

(c) Other governorates including Madaba, Ajloun, Aqaba, Jerash, Tafela, Ma'an, Mafraq, Karak, and Balqa (Fig. 5).

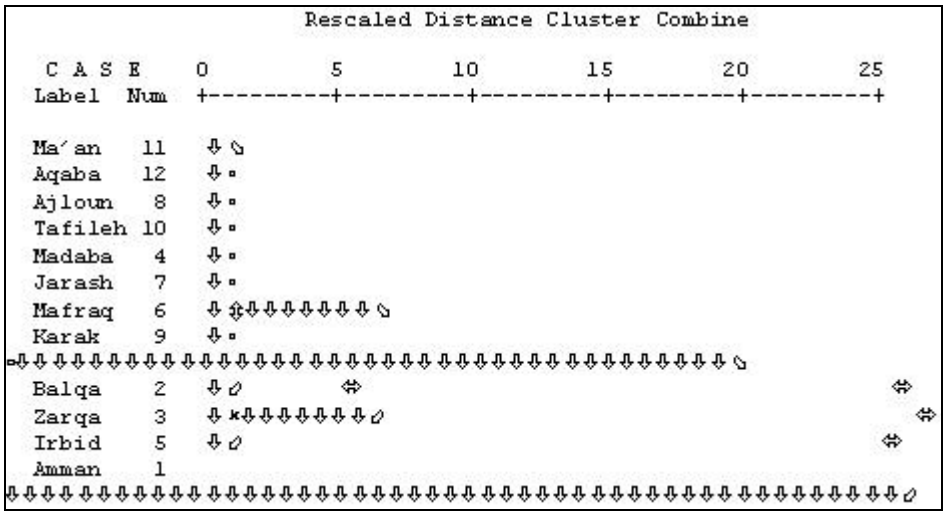

Fig. 5: Dendrogram using Average Linkage (Between Groups)

Amman governorate, being the governorate of the capital city of the country, has about 38 percent of the total population. Administrative, economic, educational, as well as other activities are concentrated in Amman. Zarqa and Irbid governorates have together about 34 percent of the total population. The remainder 28 percent of the population is distributed among the other ten governorates. It seems that there is a good association between population density and labor force. Amman, Zarqa, and Irbid governorates account for nearly eighty percent of the labor force leaving only twenty percent of the labor force for the other governorates (for more information see Ministry of Planning 2004).

The cluster analysis of the study emphasized the idea that while Amman has a unique situation in Jordan, Zarqa and Irbid are similar in their characteristics. On the other hand, the governorates of Ma'an, Aqaba, Ajloun, Tafileh, Madaba,

Jarash, Mafraq, Karak, and Balqa have common attributes as far as the key social indicators are concerned. Therefore, the third generalization is accepted.

Concluding Remark:

The statistical technique of factor analysis was used above to reduce the 39 variables of the social indicators in Jordan to few new factors. Eigenvalues = 1 and varimax rotation method were adopted. The researcher, however, would like to emphasize that other methodologies were also attempted. Examples of these attempts included Factors = 4 for the extraction and equamax for the rotation process. Nevertheless, better results were obtained by using eigenvalues=1 and varimax rotation.

In conclusion, factor-cluster analysis proved to be very useful in analyzing the key social indicators in Jordan. The findings of this research, however, need to be verified by additional researches, with maps based on the factor score matrix, before considering these findings for planning purposes.

** Special thanks are due to Prof. Mohammed Siriani of the Geography Department and Dr. Amjad Al Nasser of Statistics Department, both at Yarmouk University, for reading the original draft of this research.

التباين المكاني للخصائص الإقتصادية والإجتماعية للسكان على مستوى المحافظات في الأردن

عيسى موسى الشاعر، قسم الجغرافيا، جامعة اليرموك، إربـــد، الأردن.

ملخص

يهتم هذا البحث بشكل رئيسي بتحليل المؤشرات الإجتماعية الرئيسية في الأردن، وذلك باستخدام الأسلوب الإحصائي المعروف بالتحليل العاملي. إن هذا الأسلوب يحول عددا كبيرا من المتغيرات إلى عوامل محددة تقوم بتفسير المظاهر المتضمنة في البيانات المستخدمة. ولقد تم في هذا البحث استخدام 39 متغيرا للمحافظات الأردنية الإثنتي عشرة وإخضاعها لما يعرف بتحليل المكونات الرئيسية.إن أحد أهداف هذا البحث هو إيجاد التباين الكلي الذي يمكن تفسيره بواسطة العوامل المنتجة. وبتحديد قيمة الجذور الكامنة على أنها تساوي 1 فقد نتج عن التحليل خمسة عوامل فسرت 106. 93 بالمئة من التباين الكلي. وبعد تحديد الإشتراكيات، وهي مساهمة المتغيرات في العامل المستخرج، والتباين الكلي

المفسر تمت عملية التدوير التي بحسبها يتم تحميل كل متغير على عامل واحد، وبعبارة أخرى يتم البحث عن عوامل ذات متغيرات عالية الإرتباط. والعوامل التي نتجت عن عملية التدوير هي: (1) السكان والمؤسسات الخدمية، (2) المراكز الطبية، (3) التحضر والتعليم، (4) أمد الحياة، و(5) الدخل والبطالة. وكان نصيب هذه العوامل من تفسير التباين الكلي هو كما يلي 51.572%، 14.500%، 13.434%، 7.602%، 4.712%، و5.999% على الترتيب. وفي النهاية، تم إجراء التحليل العنقودي لمعرفة النمط العنقودي للمحافظات. وقد نتج عن التحليل ثلاثة عناقيد هي: (ا) عمّان، (ب) الزرقاء وإربد، و(ج) المحافظات الأخرى. وأكدت الدراسة الأهمية الكبرى للتحليل العاملي في شرح المؤشرات الإجتماعية الرئيسية في الأردن مع الأخذ بالإعتبار أن التحليل العنقودي كان أكثر فائدة.

* **The paper was received on Dec. 5, 2006 and accepted for publication on Nov. 22, 2007.**

References:

Abu-Sabha, Kayed, (1983), "Analysis of Factorial Ecology: A Study of the Internal Structure of Cities", *Dirasat*, Vol. 10, no. 1.

Ahmed, B., (Jan.1997), "Climatic Classification of Saudi Arabia: An application of factor-cluster analysis", *GeoJournal*, Vol. 41, No. 1, pp. 69 – 84.

Al-Ankary, Khalid, (1983), *A Comparative Factorial Ecology: Kuwait City, Kuwait and Jacksonville*, Florida, Riyadh: Aja Press.

Al-Hunaiti, Harb (1991), Development Inequality among Governorates of Jordan", *Dirasat*, Vol. 18A, no. 1.

Al-Weshah, Abla (1998), "*The Development Variation in Balqa Governorate*", unpublished master thesis, Department of Population Studies, Jordan University.

Berry, B. and P. Rees (1969), "The Factorial Ecology of Calcutta", *American Journal of Sociology*, Vol. 74, pp. 445 – 491.

Cole, John and C. King (1968), *Quantitative Geography: Techniques and Theories in Geography*, London, John Wiley and Sons.

Davies, W. and G. Barrow (1963), "A Comparative Factorial Ecology of Three Canadian Prairie Cities", *Canadian Geographer*, Vol. 17, pp. 327 – 353.

Hebert, D. (1976), "Principal Components Analysis and British Studies of Urban-Social Structure", *The Professional Geographer*, Vol. 20, pp. 280 – 283.

http://en.wikipedia.org/wiki/Governorates_of_Jordan

Jansen, H., P. Siegel, J. Alwang and F. Pichon (2005), "Geography, Livelihoods and Rural Poverty in Honduras: An Empirical Analysis Using an Asset-base Approach", *Ibero-America Institute for Economic Research***,** No 134, Research Discussion Papers.

Johnston, R. (1978), *Multivariate Statistical Analysis in Geography*, London: Longman.

Kim, J. and C. Mueller (1978), *Introduction to Factor Analysis: What It is and to do It*, Beverly Hills, Sage Publications.

Markandey, Kalpana (1982), "Factor Analysis in Geography", *Geographical Review of India*, Vol. 44, No. 2, pp. 89 – 93.

Ministry of Planning and International Cooperation and UNDP, (2004), *Jordan Human Development Report 2004*, Amman: Jordan.

Saleh, Hassan and Ahmed Ghuraib (1996), "Al Tahleel Al Makani li Assina'at Al Kimawiyyah fe Mantiqat Amman (Spatial Analysis of Chemical Industries in Amman Region)", *Dirasat,* Human and Social Sciences, Jordan University, Vol. 23, No. 1, pp. 78 – 89.

Saleh, Nasser and Mohammed Siriani (2000), *Al Goghrapyah Al Kammiyyah wa Al Ihsa'yyah* (Quantitative and Statistical Geography), Riyadh: Al Obaikan Bookstore.

Salman, No'man, (1993), "The Development Variation in Amman Governorate", unpublished Master thesis, Department of Population Studies, Jordan University.

Schwirian, Kent (ed.) (1974), *Comparative Urban Structure: Study in the Ecology of Cities*, Lexington, Mass.:D.C. Heath and Co.

Singh, Kailash and Tara Singh (1985), "The Socio-Economic Patterns of Population in Varanasi: A Traditional and Pilgrimage City", *Geographical Review of India*, Vol. 47, No. 1, pp. 1 – 12.

Taylor, P. (1977), *Quantitative methods in Geography: An Intoduction to Spatial Analysis*, Boston: Houghton Mifflin Co.

Yeates, Maurice (1974), *An Introduction to Quantitative Analysis in Human Geography*, New York: McGraw-Hill.

Annex 1: Key social indicators at governorates level in Jordan (2004)

Indicators	Amman	Balqa	Zarqa	Madaba	Irbid	Mafraq
01 Population	2027685	349580	838250	135890	950695	245665
02 Population (%)	38.1	6.6	15.7	2.6	17.8	4.6
03 Male population	1061890	183880	436900	70815	492270	128685
04 Female population	965795	165700	401350	65075	458425	116980
05 Population density	246.3	324.9	205.5	67.7	586.5	9.3
06 Urban population (%)	91.40	63.90	95.30	58.90	76.4	33.10
07 Life expectancy (Year)	72.1	69	71.4	74	72.9	71.1
08 Life expectancy (M)	71.8	68.6	70.8	72.7	72.0	68.4
09 Life expectancy (F)	72.5	69.5	72.5	75.9	74.3	74.3
10 Unemployment rate (%)	12.6	15.2	15.9	21.2	15.8	19
11 Male unemployment rate (%)	11.50	13.70	14.00	18.40	14.80	18.50
12 Female unemployment rate (%)	18.10	22.10	28.00	33.80	22.00	22.40
13 GDP per capita (PPP$US)	5099.2	3849.6	3078.4	3426.4	3766.0	2951.6
14 Water supply (million cubic m)	94.1	18.3	34.4	6.1	31.3	16.9
15 No. of schools	1634	388	554	173	1026	354
16 Adult literacy rate (age 15+)	92.3	87.1	91.7	87.48	90.01	80.88
17 Adult literacy rate (age 15+) M	96.46	92.62	95.86	93.14	95.94	88.52
18 Adult literacy rate (age 15+) F	88.24	81.66	87.52	81.81	84.03	73.33
19 Boys' schools	309	85	126	47	250	109
20 Girls schools	241	51	136	32	192	53
21 Co-education	1084	252	292	94	584	192
22 No. of students	521415	100191	142942	38059	283345	68788
23 Male students	265760	51924	71117	19395	143752	35793
24 Female students	255655	48267	71825	18663	139593	32995
25 Health centers	67	40	27	12	91	40
26 Maternity & child health centers	51	38	27	12	86	29
27 Dental clinic	47	25	18	9	55	20
28 No. of pharmacies	882	76	238	29	205	43
29 No. of MoH hospitals	4	4	2	1	7	3
30 No. of private hospitals	36	1	6	1	6	1
31 Establishments with social insurance	6854	250	705	99	989	226
32 Housing co-op members	14268	2363	1741	568	654	722
33 Women's co-op members	176	92	106	161	232	0
34 Total number co-ops	418	82	41	77	138	62
35 Total members co-ops	52174	9440	6438	5286	7461	3381
36 Women's associations	39	12	11	2	21	10
37 Charitable societies	290	54	73	29	140	59
38 Registers engineers	34939	1342	4731	677	5812	519
39 Registered lawyers	3711	70	333	41	708	98

Indicators	Jarash	Ajloun	Karak	Tafileh	Ma'an	Aqaba
01 Population	156675	118305	214225	81000	103915	107115
02 Population (%)	2.9	2.2	4	1.5	2	2
03 Male population	81550	60300	111995	42160	56350	60320
04 Female population	75125	58005	102230	38840	47656	46695
05 Population density	389.7	287.1	66.6	38.3	3.1	16.3
06 Urban population (%)	50.70	67.40	35.4	74.90	42.70	85.70
07 Life expectancy (Year)	69.8	72.6	70.1	67.7	68.8	74.7
08 Life expectancy (M)	69.3	73.5	68.5	65.1	66.4	72.7
09 Life expectancy (F)	70.4	72.5	71.1	70.9	72.8	77
10 Unemployment rate (%)	17.8	18.9	20.5	19.7	24.1	15.5
11 Male unemployment rate (%)	17.00	17.90	18.90	18.90	23.20	14.10
12 Female unemployment rate (%)	23.50	23.80	27.10	24.30	30.20	25.20
13 GDP per capita (PPP$US)	3278.9	33167	3887.3	3584.7	3098.2	4065.942
14 Water supply (million cubic m)	4.2	3.5	11.2	3.0	8.0	14
15 No. of schools	184	142	284	119	182	97
16 Adult literacy rate (age 15+)	88.2	86.96	83.89	87.86	80.52	89.24
17 Adult literacy rate (age 15+) M	94.04	95.01	89.88	93.52	89.26	94.25
18 Adult literacy rate (age 15+) F	82.24	79.26	78.16	82.07	71.65	83.91
19 Boys' schools	56	36	7 8	30	52	20
20 Girls schools	37	26	68	16	17	16
21 Co-education	91	80	138	73	113	61
22 No. of students	47846	37796	60.331	25.034	30.748	31.058
23 Male students	24568	19242	30943	12893	15850	15922
24 Female students	23278	18554	29388	12141	14898	15136
25 Health centers	16	14	42	12	18	10
26 Maternity & child health centers	12	18	41	15	15	7
27 Dental clinic	12	13	21	9	10	8
28 No. of pharmacies	19	7	40	9	14	19
29 No. of MoH hospitals	1	1	2	0	2	0
30 No. of private hospitals	0	0	3	0	0	2
31 Establishments with social insurance	166	105	335	0	278	278
32 Housing co-op members	316	316	141	0	42	1082
33 Women's co-op members	265	165	177	219	79	40
34 Total number co-ops	71	71	44	25	60	38
35 Total members co-ops	3938	3938	6373	1530	3968	4614
36 Women's associations	6	8	7	3	2	3
37 Charitable societies	25	24	49	18	45	25
38 Registers engineers	503	489	945	208	215	454
39 Registered lawyers	77	51	111	17	13	39

Source: Ministry of Planning and International Cooperation and UNDP, (2004), *Jordan Human Development Report 2004*, Amman: Jordan, Annex 6.

Annex 2: Correlation matrix of the 39 variables of the study *

Correlation Matrix

		POP	P_PE	OP_	OP_	P_DE	B_PE	E_E	_EX	_EX	EM_P	EM_P	EM_P	OP_C	TER_	SCH	_LT	_LT1	_LT1	Y_SC	RL_SC	D_ED	STU	UDEN
Corre	POP	.000	1.000	.000	.000	.129	.559	.206	-.027	.023	-.698	.337	.087	-.235	.979	.980	.601	.552	.615	.940	.955	.852	.985	.984
	POP_	.000	1.000	.000	.000	.130	.558	.206	-.027	.022	-.697	.337	.086	-.236	.979	.980	.600	.551	.614	.940	.954	.851	.985	.984
	POP_	.000	1.000	.000	.000	.131	.559	.206	-.025	.021	-.699	.335	.084	-.237	.980	.980	.600	.550	.614	.939	.953	.851	.985	.984
	POP_	.000	1.000	.000	.000	.126	.559	.206	-.030	.024	-.697	.339	.090	-.234	.977	.981	.602	.554	.615	.942	.957	.853	.985	.984
	POP_	.129	.130	.131	.126	1.000	-.208	-.417	-.036	.455	.227	-.491	-.479	.169	.163	.114	-.279	-.178	-.316	.044	-.015	.261	.141	.143
	URB_	.559	.558	.559	.559	-.208	1.000	.367	.495	.171	-.704	.618	.190	-.323	.533	.459	.897	.885	.867	.376	.497	.375	.500	.496
	LIFE_	.206	.206	.206	.206	-.417	.367	.000	.637	.826	-.324	.346	-.218	-.270	.219	.193	.386	.417	.356	.189	.238	.056	.213	.211
	LIF_E	.027	-.027	-.025	.030	-.036	.495	.637	.000	.700	-.051	.326	-.174	-.346	.014	-.074	.281	.386	.200	-.141	-.100	-.022	-.019	-.021
	LIF_E	.023	-.022	-.021	.024	-.455	.171	.826	.700	.000	.023	.383	-.054	-.300	.026	-.014	.040	.059	.015	.006	.001	-.120	-.011	-.013
	UNEM	.698	-.697	.699	.697	.227	-.704	-.324	-.051	.023	1.000	-.366	.020	.215	-.700	-.662	-.775	-.698	-.791	-.616	-.661	-.439	-.686	-.685
	UNEM	.337	.337	.335	.339	-.491	.618	.346	.326	.383	-.366	1.000	.586	-.639	.270	.368	.517	.476	.511	.390	.432	.224	.346	.342
	UNEM	.087	.086	.084	.090	-.479	.190	-.218	-.174	-.054	.020	.586	1.000	-.519	.017	.129	.112	.046	.145	.176	.212	.172	.087	.084
	GDP_	.235	-.236	-.237	-.234	.169	-.323	-.270	-.346	.300	.215	-.639	-.519	.000	-.274	-.271	-.167	-.094	-.202	-.240	-.255	-.236	-.272	-.273
	WATE	.979	.979	.980	.977	.163	.533	.219	.014	.026	-.700	.270	.017	-.274	1.000	.946	.539	.466	.566	.887	.891	.791	.960	.960
	NO_S	.980	.980	.980	.981	.114	.459	.193	-.074	.014	-.662	.368	.129	-.271	.946	1.000	.519	.484	.528	.984	.967	.863	.994	.994
	AD_L	.601	.600	.600	.602	-.279	.897	.386	.281	.040	-.775	.517	.112	-.167	.539	.519	1.000	.955	.988	.452	.581	.430	.560	.556
	AD_L	.552	.551	.550	.554	-.178	.885	.417	.386	.059	-.698	.476	.046	-.094	.466	.484	.955	1.000	.899	.425	.538	.428	.527	.523
	AD_L	.615	.614	.614	.615	-.316	.867	.356	.200	.015	-.791	.511	.145	-.202	.566	.528	.988	.899	1.000	.459	.592	.423	.566	.563
	BOY_	.940	.940	.939	.942	.044	.376	.189	-.141	.006	-.616	.390	.176	-.240	.887	.984	.452	.425	.459	1.000	.974	.858	.962	.962
	GIRL_	.955	.954	.953	.957	-.015	.497	.238	-.100	.001	-.661	.432	.212	-.255	.891	.967	.581	.538	.592	.974	1.000	.887	.949	.947
	CO_E	.852	.851	.851	.853	.261	.375	.056	-.022	.120	-.439	.224	.172	-.236	.791	.863	.430	.428	.423	.858	.887	.000	.856	.854
	NO_S	.985	.985	.985	.985	.141	.500	.213	-.019	.011	-.686	.346	.087	-.272	.960	.994	.560	.527	.566	.962	.949	.856	1.000	1.000
	STUD	.984	.984	.984	.984	.143	.496	.211	-.021	.013	-.685	.342	.084	-.273	.960	.994	.556	.523	.563	.962	.947	.854	1.000	1.000
	STUD	.986	.986	.986	.986	.138	.504	.215	-.017	.010	-.686	.349	.089	-.272	.960	.995	.564	.531	.570	.963	.951	.858	1.000	1.000
	HEAL	.716	.715	.713	.719	-.064	.145	.115	-.265	.039	-.498	.438	.313	-.361	.640	.826	.245	.225	.256	.896	.844	.741	.778	.778
	MAT_	.634	.633	.630	.638	-.102	.162	.093	-.258	.081	-.447	.503	.407	-.405	.532	.748	.262	.260	.265	.827	.796	.704	.696	.696
	DENT	.806	.806	.804	.809	-.018	.295	.171	-.168	.041	-.598	.465	.257	-.348	.728	.897	.393	.391	.391	.941	.901	.790	.865	.865
	NO_P	.975	.975	.976	.973	.222	.528	.180	.011	.031	-.652	.216	.003	-.217	.987	.936	.559	.501	.579	.866	.872	.799	.959	.959
	NO_M	.599	.599	.596	.603	.015	.072	.064	-.290	.065	-.410	.449	.203	-.262	.513	.721	.137	.152	.132	.806	.734	.588	.661	.661
	NO_P	.942	.943	.944	.940	.241	.483	.203	.052	.002	-.616	.160	-.022	-.253	.971	.906	.519	.457	.542	.826	.825	.783	.936	.936
	EST_S	.923	.924	.925	.921	.305	.443	.169	.055	.019	-.586	.110	-.073	-.217	.956	.892	.475	.427	.491	.809	.791	.765	.925	.927
	HOU_	.890	.891	.893	.887	.306	.465	.153	.033	.056	-.637	.089	-.131	-.208	.944	.844	.487	.420	.513	.744	.727	.655	.883	.885
	WOM_	.385	.387	.386	.384	.574	.110	-.351	-.188	.390	.098	-.056	-.127	.208	.360	.326	.168	.144	.178	.251	.257	.303	.346	.346
	TOT_I	.903	.904	.904	.902	.323	.375	.205	.039	.013	-.570	.125	-.129	-.181	.917	.904	.445	.432	.446	.836	.788	.733	.934	.936
	TOT_I	.899	.900	.901	.896	.339	.417	.155	.022	.065	-.595	.086	-.118	-.233	.941	.866	.464	.405	.488	.774	.753	.710	.903	.905
	WOM_	.961	.961	.961	.961	.160	.439	.173	-.110	.095	-.722	.249	.049	-.229	.941	.977	.509	.487	.516	.947	.922	.813	.981	.982
	CHAR	.974	.975	.975	.974	.207	.423	.188	-.023	.008	-.616	.277	.057	-.279	.969	.984	.461	.424	.473	.948	.920	.851	.990	.990
	REG_	.942	.943	.944	.940	.273	.481	.176	.045	.027	-.611	.151	-.040	-.215	.965	.909	.517	.470	.533	.829	.819	.775	.940	.941
	REG_	.936	.936	.937	.934	.271	.454	.180	.046	.016	-.600	.143	-.039	-.217	.957	.912	.497	.456	.510	.836	.817	.780	.943	.944

[a]This matrix is not positive definite.

* Full table of the matrix is available from the author upon request; it was not possible to show the whole of it on this page.