BIBLIOGRAPHY

CRISANTA P. APIT, MARIFEE K.LOGRO, NOEMI S. PALUBOS. April 2008. Correspondence Analysis on the Number of Births in the Six Provinces of Cordillera Administrative Region during the years 2000-2006.Benguet State University, La Trinidad Benguet.

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ABSTRACT

Correspondence Analysis is a multivariate method for exploring cross-tabular data by converting such tables into graphical displays, called maps," and related numerical statistics. It is a tool commonly used in many disciplines to identify and visualize the association between two categorical variables.

The technique was applied to the contingency table on the number of births in the six provinces of the Cordillera Administrative Region during the Calendar years 2000-2006. The row variable consists of the six provinces of Cordillera Administrative Region namely: Abra, Apayao, Benguet, Kalinga, Mt. Province, Ifugao and in the City of Baguio. The column variable consists of the calendar year categories, namely: 2000, 2001, 2002, 2003, 2004, 2005 and 2006.

Correspondence Analysis was used to analyze the 7x7 (7 rows by 7 columns) contingency table on the number of births in the six provinces of CAR during the years 2000-2006. It also intended to determine the weights (masses), quality and variance (inertia) of the six provinces and Baguio City, and calendar year points.

Results of inertia and chi-square decomposition explained 77.44 cumulative percent of variance in the first two dimensions. The root of the total inertia 0.0311154 equals 0.1764 as the eigen value. This suggested that the first two dimensions appear to be satisfactory in representing the CAR provinces and calendar year profiles.

The Cordillera Administrative Region which was highly explained in the graph were Benguet and Mt. Province. The rest of the provinces were quite well represented by the dimensions, except Baguio which was poorly explained. The calendar year profile points were well represented, except the calendar year 2002 in the two-dimensional map. However, only the CY 2000 and 2004 were highly explained.

In the two-dimensional map, dimension 1 was defined by three provinces of CAR, namely: Benguet, Kalinga, and Mt. Province and the CY 2003, 2005 and 2006 defined the second dimension.

The categories with large mass meant high frequency and low mass implied low frequency with respect to the entire data set. A dimension with high contribution to point indicates that the dimension represents well the point in the dimensional map while the low contribution of a dimension to point shows that the dimension explains poorly the point in the map.

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INTRODUCTION

Background of the Study

Cordillera Administrative Region (CAR) is at the central part of northern Luzon. This Region is a land-locked region, consisting of six provinces: Abra, Apayao, Benguet, Ifugao, Kalinga, Mountain Province, and Baguio City, a first class, highly urbanized city, which is the regional center. Cordillera encompasses most of the areas within the Cordillera Central mountain ranges of Luzon, the largest ranges in the country. This Region is home to numerous indigenous tribes collectively called Igorots.

CAR is more heavily populated compared to other mountainous areas of the Philippines. Based on the 2000 census, its six provinces and one city have a total population of 1,365,220 people. With a land area of 18,294 square kilometers, the population density is 75 per square kilometer.

Among the six provinces of CAR, Benguet ranked first in terms of population size with 1,365,220 people in the 2000 census, its population density is 275 people per square kilometer. This province contributed 24.2% of the population in the region, and 0.43% to the Philippine population of 76.5 million. From 1995 to 2000, its annual growth rate is 1.0990, which is much lower than the national average of 2.43%. The average household is 5.2 persons, a little higher than the national average of 4.99. Benguet, with La Trinidad as its capital,

it is often called the Salad Bowl of the Philippines, It has agriculture, mining and tourism as major industries..

Abra has a rugged terrain, with mountains and hills rising along its perimeter and interior. This basin-like province is drained by the Abra River. Its population of 20,491 is the 12th smallest in the country with a density of 53 people per square kilometer. Abra's economy is agriculture. With its capital in Bangued.

Ifugao with Lagawe as its capital is also a landlocked mountainous region characterized by rugged terrain, river valleys, and massive forests. Its population of 161,623 is the 9th smallest in the country, with a density of 64 people per square kilometer. The 2000 year old Banaue Rice Terraces is the main tourist attraction of the province.

Kalinga is rugged and sloping with mountain peaks. Its population of 174,023 is the 11th smallest and its density of 56 people per square kilometer is the 6th lowest. The people of Kalinga are the most extensive rice farmers among the Cordillerans. Founded in 1995, its capital is Tabuk City.

Apayao become a province when it was separated from Kalinga in 1995. Kabugao became its capital. Its population is 97,129, which is the 4th smallest and it has the lowest density of 25 people per square kilometer.

Mountain Province was named as such because it is found in the Cordillera mountain range. Prior to 1966, Mountain Province included Benguet,

Kalinga-Apayao and Ifugao. Its population of 140,349 is the 6th smallest and its density of 67 people per square kilometer is the 10th lowest.

Objectives of the Study

The general objective of the study is to apply correspondence analysis to the number of births in the six provinces of CAR, including Baguio City, during the calendar years 2000-2006.Specifically, the study aimed to determine the association of the six provinces and calendar years on the number of births in the correspondence map.

Importance of the Study

The findings of the study would provide a comprehensive understanding on the distribution of the number of births when taking into consideration the six provinces of CAR including Baguio City and the seven calendar year period.

This study would also be a way of presenting graphically these CAR provinces in relation to the distribution on the number of births. Such information would be useful in the fiscal management of the Region since appropriate budgetary allocation could be given based on the groupings illustrated in the correspondence map.

Scope and Delimitation of the Study

The data used were on the six provinces of CAR including Baguio City during calendar years 2000-2006. The data were taken from the National Statistics Coordination Board.

Significance testing is not supported in the analysis, so model comparison and selection of a best fit model were performed. The reason that Correspondence Analysis is an exploratory, not a confirmatory technique. Visualization of agreement or association of the provinces and calendar years on the number of births were included.

REVIEW OF RELATED LITERATURE

Correspondence Analysis

Correspondence Analysis has been proven to be one of the successful techniques for graphical analysis of contingency data. It is considered to be a popular technique especially in France, United Kingdom and in the united States of America. Its growing popularity among statistical practitioners demonstrates the importance of applying correspondence analysis as a research tool.

Correspondence analysis has become a popular method in the social and environmental sciences. The Analysis incorporates steps in translating a table to a graphical display. First, it transforms the rows of the table into profiles, which is the rows divided by their row totals. Second, weights are assigned to the row profiles proportional to the marginal row totals of the contingency tables. Third, a standardization of the profiles elements is performed by dividing them by values proportional to the square root of the marginal column totals of the contingency totals. The third step implies a special distance function between the profiles, called the chi-squared distance. Finally, a weighted principal component analysis is performed on the row profiles, identifying the plane, which best fits the row profiles by minimizing the weighted the sum of squared (chi-squared) distances from the points to the plane. Then the profile points are projected unto this plane and their relative positions are interpreted. An identical and completely symmetric analysis can be performed on the column profiles. The two analysis are equivalent

and their solutions are based on the singular value decomposition of the same matrix (Greenacre, 1984).

Micheloud (1997) analyzed a table which reflected 169,836 people aged 15 or more, living in the Lausanne district of Geneva in Switzerland. Attributes considered were maximum level of schooling attained (variable I, in rows) and community of residence (variable J, in the column). The aim of this analysis was to find out if there was an attraction, independence, or even repulsion between rows and columns.

Huixin and Hao (1996) used the Correspondence Analysis in marketing research, conducted in Zhenzou City in China. The main purpose of the project was to estimate the market, but a new name recommended by the consulting company for a newly developed pure water product was also tested. The tables which were analyzed consisted of the product names marked against the product, and names marked against the feeling of respondents.

Correspondence Analysis seeks to represent the interrelationships of row and column variables on a two dimensional map. It can be thought of as trying to plot a cloud of data points (the cloud having height, width and thickness) on a single plane to give a reasonable summary of the relationships and variation within them.

One of the study was a research of lifestyle and culture consumption in a United Kingdom City (Featherstone et al, 1994). One aspect of the study looks at

the leisure activities of people living in the new inner city development. Included in the questionnaire were the questions about the use of local facilities, from pubs to art galleries, knowledge of and preferences in music and involvement in political issues.

The study of Bourdieu (1979) used Correspondence Analysis to provide detailed illustrations for his thesis which include determinant case, cultural discrimination and choice. Choice is described as the possession of two forms of capital, economic and cultural, with sub-groupings defined by seniority in possession and related mode of acquisition. This technique among English and American sociologists seems to have remained low until the publication of Greenacre text (1984) testifying to the easier availability of appropriate computer software (CA).This correspondence technique is versatile, it can be used with frequency data, with percentages, and with data in the formats of ratings with heterogeneous data sets.

The study of Neri, Solivas, and VJ.Albacea focuses on the application of Correspondence analysis to a particular 6 x 5 contingency table. The population of the study is the cross tabulation of graduates from the College of Arts and Sciences, University of the Philippine Los Banos during the ten years period of 1987-1996 classified into degree program and year graduated.

This study deals with the matrices and its components as a given by the singular value decomposition (SVD); the pre-decomposition method prior to

correspondence analysis and the post-decomposition method which out the row and column coordinates.

The Cordillera Administrative Region is more heavily populated compared to the other mountainous areas of the Philippines. In the year 2000 census, its provinces and one city had a total population of more than 356,272 while 792,922 lived in the rural areas

The distribution of the number of births naturally affects the rate of population growth. Birth statistics were obtained from the Certificates of Live Birth, which were transmitted by the City/Municipal Civil Registrar to the office of the Civil Registrar General for machine processing and archiving. The total number of Live Births reported in 2000 was 1,766,440. This was an 8.3 percent increase in ten years. The Daily Average of Birth occurrence was 4,826. This means an addition of three babies to the population every minute. In the country, approximately 23 live births per 1000 population had occurred in 2000. CAR has a similar birth rate.

Definition of Terms

Category masses are the marginal proportions of a discrete variable. In the terminology of correspondence analysis, the relative frequencies of the row totals and column totals are called the row mass and column mass, respectively.

Centroid or average profile is the weighted mean of the row and column profiles. It is the origin of the correspondence map.

Contingency table is a two-way table of categorical data or the row cross tabulation of the discrete variables with marginals. The variables must be discrete nominal, ordinal, or continuous variables segmented into ranges. The object of the correspondence analysis is to explain the inertia (variable) in the table.

Contribution of the dimensions to point is also known as squared correlations on quality of representation of the description of a point. These reflect how well the principal components model is explaining any given.

Correspondence map displays two of the dimensions which emerge from the principal components analysis of inertia, and points are displayed in relation to these dimensions.

Correspondence matrix P is defined as the original table X divided by the grand total.

Eigenvalues are the characteristics roots of the principal components solution. There is one eigenvalue for each dimension, sometimes labeled as inertia for that dimension.

Inertia means variance in the context of correspondence analysis.

Point distance refers to the chi-square distance rather than the Euclidean between points.

Profile point is one of the values (categories) of one of the discrete variables in the analysis.

Proportions if inertia accounted for by a given dimension are its eigenvalue divided by total inertia.

Quality of a point is defined as the ratio of the squared distance from the origin in the chosen number of dimensions, over the squared distance from the origin the space defined by the maximum number of dimension.

Relative inertia represents the proportion of the total inertia accounted for by the respective point.

Row and Column profiles are the relative frequencies of the row or column discrete variable. Profile elements are the entries in each row or column profile.

Scores in dimensions are the scores used as coordinates for point when plotting the correspondence map.

Singular value is the square root of an eigenvalue.

Total inertia is the sum of eigenvalues and the spread of points around the centroid. Total inertia may be interpreted as the percent of inertia (variance) in the original correspondence table explained by all computed dimensions in the correspondence analysis. It also defined as the total Pearson chi-square for two-way divided by the total sum.

THEORETICAL FRAMEWORK

To begin with the algebraic development of correspondence analysis, let X, with elements x_{ij}, be an I x J two-way table of unscaled frequencies of counts. The rows and columns of the contingency table X correspond to different categories of two different characterisitics.

If n is the total of the frequencies in the data matrix X, one must construct a matrix proportion $P=\{p_{ij}\}$ by dividing each element of X by n. Hence

$$P_{ji} = x_{ji} / n, \qquad I = 1,2,....,I, \text{ or} \qquad P=(1/n)X \quad (1)$$

The matrix is called the correspondence matrix.

Next define the vectors of row and column sums are and c respectively, and the diagonal matrices D_r and D_c with the elements of r and c on the diagonals.

Thus

$$r_i = \sum_{j=1}^{J} p_{iJ} = \sum_{j=1}^{J} x_{ij} \qquad j = 1,2,....,I, \quad or \quad r = PI_J \qquad (2)$$

$$c_j = \sum_{i=1}^{I} p_{ij} = \sum_{i=1}^{I} x_{ij}, \qquad j = 1,2,....,J, \text{ or} \qquad c = PI_I$$

where 1 is a J x 1 and 1_{ji} vector of 1's and

$$D_2^{1/2}=diag(\sqrt{c_1},..., \sqrt{c_J}) \qquad D_c^{-1/2}=diag(\sqrt{c_1},..., \sqrt{c_J})$$

for scaling purpose.

Correspondence analysis can be formulated as the weighted least squares problem.

to select $\hat{P} = \{p_{ij} - \hat{P}_{ij}\}$, a matrix if specified reduced rank, to minimize

$$\sum_{i=1}^{I}\sum_{j=1}^{J} 1/(r_i c_j)(P_{ij} - \hat{P}_{ij})^2 = tr[(D_r^{-1/2}(P - \hat{P})D_c^{-1/2})(D_r^{-1/2}(P - \hat{P})D_c^{-1/2} \quad (4)$$

since $(P_{ij} - P_{ij}) / \sqrt{r_i c_j}$ is the (i,j) element of $D_r^{-1/2}$

As a result (4) demonstrates, the term rc is common to the approximation $\hat{P}$ whatever the I x J correspondents to matrix P. The matrix $\hat{P} = rc$ can be shown to be the best rank 1 approximation to P.

The reduced rank s approximation to P, which minimizes the sum of squares (4), is given by

$$P = \sum_{k=1}^{s} \tilde{\lambda}_k (D_r^{1/2} \tilde{u}_k)(D_c^{1/2} \tilde{v}_k)' = rc' + \sum_{k=2}^{s} \tilde{\lambda}_k (D_r^{1/2} \tilde{u}_k)(D_c^{1/2} \tilde{v}_k)'$$

where the $\tilde{\lambda}_k$ are the singular values and the $Ix1$ vectors $\tilde{u}_k$ and the J x 1 vectors $\tilde{v}_k$ are the corresponding singular vectors of the $I \times J$ matrix $D_r^{-1/2} P D_c^{-1/2}$. The minimum value of (4) is $\sum_{k=s+1}^{J} \tilde{\lambda}_k^2$.

The reduced rank K> 1 approximation to $P - rc$ is

$$P - rc' \cong \sum_{k=1}^{K} \lambda_k (D_r^{1/2} u_k)(D_c^{1/2} v_k)'$$

Where the λ_k are the singular values and the I x 1 vector u_k and the J x 1 vectors v_k are the corresponding singular vectors of the I x J matrix $D_r^{-1/2}(P - rc) D_c^{-1/2}$.

Here $\lambda_k = \tilde{\lambda}_{k+1}, u_k = \tilde{u}_{k+1}$, and $v_k = \tilde{v}_{k+1}$ for $k = 1,\ldots,J-1$.

As proof, consider a scaled version $B = D_c^{-1/2} PD_c^{-1/2} PD_c^{-1/2}$ of the correspondence of the distance matrix P. The best low rank = s approximation $\hat{B}$ to $D_r^{-1/2} P D_r^{-1/2}$ is given by the first s terms in the singular value decomposition

$$D_r^{-1/2} P D_r^{-1/2} = \sum \tilde{\lambda}_k \tilde{u}_k \tilde{v}_k' \tag{6}$$

where

$$D_r^{-1/2} P D \tilde{v}_k = \tilde{\lambda}_k \tilde{u}_k \qquad \tilde{u}_k' D_r^{-1/2} P D_c^{-1/2} = \tilde{\lambda}_k \tilde{v}_k' \tag{7}$$

and

$$\left| (D_r^{-1/2} P D_c^{-1/2})(D_r^{-1/2} P D^{-1/2})' - \tilde{\lambda}_k^2 I \right| = 0 \qquad \text{for } k = 1,\ldots,J$$

then approximation P is then given by

$$\hat{P} = D_r^{1/2} \hat{B} D_c^{1/2} \cong \sum_{k \le s+1} \tilde{\lambda}_k (D_r^{1/2} \tilde{u}_k)(D_c^{1/2} \tilde{v}_k)'$$

and the error of approximation is $\sum_{k=s+1}^{J} \tilde{\lambda}_k^2$

Whatever correspondence matrix P, the term rc always provides a (the best) rank approximation. This corresponds to the assumption of independence of the rows and columns. To see this, let $\tilde{u}_1 = D_r^{1/2} 1_I$ and $\tilde{v}_1 = D_c^{1/2} 1_J$, where 1_I is the I x 1 and 1_J a J x 1 vector of I's. To verify (7) that holds for these choices.

$$\tilde{u}_1' (D_r^{-1/2} P D_c^{-1/2}) = (D_r^{1/2} 1_J)' (D_r^{-1/2} P D_c^{-1/2})$$

$$= 1_J' P D_c^{-1/2} = c' D_C^{-1/2}$$

$$= [\sqrt{c_1}, \ldots, \sqrt{c_J}] = (D_c^{1/2} 1_J)' = \tilde{v}_v'$$

that is,

$$((\tilde{u}_1, \tilde{v}_1) = (D_r^{1/2} 1_I, D_c^{1/2} 1_J)$$

are singular vectors associated with the singular value $\tilde{\lambda}_1 = 1$ for correspondence matrix, P, the common term in every expansion is

$$(D_r^{1/2}u_1v_1'D_c^{1/2}) = D_r 1_I 1_J' D_c = rc'$$

Therefore, the first approximation is established and (6) can always be expressed as $P = rc' + \sum_{k=2}^{J} \tilde{\lambda}_k (D_r^{1/2}\tilde{u}_k)(D_C^{1/2}\tilde{v}_k)'$

Because of the common term, the problem can be rephrased in terms of P – rc and its scaled version $(D_r^{-1/2}P - rc')D_c^{-1/2}$. By orthogonality of the singular vectors of $D_r^{-1/2}PD_c^{-1/2}$, then $\tilde{u}_k'(D_r^{1/2}1_I) = 0$ and $\tilde{v}_k'(D_c^{1/2}1_J) = 0$, for $k > 1$, so

$$D_r^{-1/2}(P - rc')D_c^{-1/2} = \sum_{k=2}^{J} \tilde{\lambda}_k \tilde{u}_k \tilde{v}_k'$$

is the singular decomposition of $D_r^{-1/2}(P - rc')D_c^{-1/2}$ in terms of the singular values and vectors obtained from $D_r^{-1/2}PD_c^{-1/2}$. converting the singular values and vectors λ_k, u_k and v_k from $D_r^{-1/2}(P - rc')D_c^{-1/2}$ k to k – 1 so $\lambda_k = \tilde{\lambda}_{k+1}$, $u_k = \tilde{u}_{k+1}$, and $v_k = \tilde{v}_{k+1}$ for $k = 1,\ldots,J-1$.

In terms of the singular value decomposition for $D_r^{-1/2}(P - rc')D_c^{-1/2}$, the expansion for P – *rc* takes the form

$$P - rc' \cong \sum_{k=1}^{K} \lambda_k (D_r^{1/2}\mu_k)D_c^{1/2}v_k)' \qquad (8)$$

the best rank *K* approximation to is given by $\sum \lambda_k u_k v_k'$. Then, the best approximation to $D_r^{-1/2}(P - rc')D_c^{-1/2}$ is $P - rc' \cong \sum_{k=1}^{K} \lambda_k (D_r^{1/2}\mu_k)(D_c^{1/2}v_k)'$

The vectors $D_r^{1/2}$ u_k and $D_c^{1/2}v_k$ in the expansion (8) of P – rc need not have length 1 but satisfy the scaling.

$$(D_r^{1/2}\mu_k)' D_r^{-1}(D_r^{1/2}v_k) = u_k' u_k = 1$$

$$(D_c^{1/2}\mu_k)' D_c^{-1}(D_c^{1/2}v_k) = v_k' v_k = 1$$

Let Λ, $U = [u_1,\ldots,u]$ and $V = [v_1,\ldots,v_J]$ be the matrices of the singular values and vectors obtained from $D_r^{-1/2}(P - re')D_c^{-1/2}$. It is usual in correspondence analysis to plot the first two or three columns of $F = D_r^{-1}(D_r^{1/2}U)\Lambda$ and $G = D_c^{-1/2}(D_c^{1/2}U)\Lambda$ or $\lambda_k D_r^{-1/2}u_k$ and $\lambda_k D_c^{-1/2}v_k$ for $k = 1,2$, and maybe 3.

As to the total inertia which is a measure of the variation in the count data, it is defined as the weighted sum of squares.

$$tr[(D_r^{-1/2}(P - rc')(D_c^{-1/2})(D_r^{-1/2}(P - rc')D_c^{-1/2})'] = \sum_i \sum_j (p_{ij} - r_i c_j)^2 / (r_i c_j) = \sum_{k=1}^{J-1} \lambda_k^2 \qquad (10)$$

where the λ_k are the singular values obtained from the singular decomposition of $D_r^{-1/2}(P - rc')D_c^{-1/2}$.

The inertia associated with the best reduced rank $K < J$ approximation to the centered matrix P – rc (the K-dimensional solution) hast he inertia $\sum_{k=1}^{K} \lambda_k^2$. The residual inertia (variation) not accounted for by the rank K is equal to the sum of the square of the remaining singular values $\lambda_{k+1}^2 + \lambda_{k+2}^2 + \ldots + \lambda_{J-1}^2$. For plots, the inertial associated with dimension k, λ_k^2, is ordinarily displayed along the k th coordinate axis.

METHODOLOGY

Location of the Study

The study was conducted at Benguet State University including the six Provinces of CAR and Baguio City during the calendar years 2000-2006.Figure 1 shows the location of the study namely: Abra, Apayao, Benguet, Ifugao, Kalinga, Mt.Province and Baguio City.

Figure 1.Location of the Study

Data Gathering Procedure

The data were taken from Regional Social Economic Trend 2006 0f NSCB and Population Census 2000-2004 of NSO.

The data set which was used on this study consisted of number of births on the six provinces of CAR and Baguio City during the calendar years 2000-2006. The distribution on the number of births by provinces and calendar years reflect a two-way contingency table.

Table1. Contingency table on the number of Births during the calendar years 2000-2006.

PROVINCES OF CAR	CALENDAR YEARS 2000	2001	2002	2003	2004	2005	2006
Abra	7382	7027	7244	7214	7965	6931	7246
Apayao	2125	2001	4102	3506	2784	2529	2843
Baguio	11708	8015	7922	9334	8179	9117	9672
Benguet	16348	16250	17128	15221	19052	19245	10242
Ifugao	6625	7210	7986	10599	7508	5580	7094
Kalinga	13703	12176	12295	7485	7828	7112	6949
Mt.Province	10111	6888	6174	5899	4676	4787	5870

Source: RSET-NSCB (Regional Social Economic Trend 2006) and Population Census-NSO (2000-2004).

Data Analysis

Correspondence analysis was used to analyze the tabulated 7x7 (7 rows by 7 columns) matrix contingency on the number of births in the six provinces of CAR during the CY 2000-2006.Correspondence analysis finds a low-dimensional graphical representation of the association of rows and columns of the contingency table, where categories of rows and column from the cell frequencies are depicted as points in a median Eucledian space. These determined so that squared distance between certain points in the derived space bear simple relationships to the original tabular entries.

Correspondence analysis consist of three parts; a pre-decomposition method where the original data or contingency table is transformed by certain conversion procedures; second, the transformed data is subjected to singular value decomposition where a set of row or column vectors together with its associated singular values are summarized; and third, a post decomposition method is applied where in the row and column vectors are used to come up with the row and column coordinates or scores.

The data were summarized, tabulated, analyzed and interpreted using Correspondence Analysis. Computations of summary statistics were facilitated with the use of the software STATA.

INPUT

Contingency table of the number of births in the six Provinces of CAR including Baguio City during the calendar years 2000-2006.

DATA ANALYSIS

Part I: Pre decomposition

1. Construct the correspondence matrix of the contingency table compute the relative frequencies of each entry.

Part II: Singular Value decomposition

1. Calculate the row profiles, row masses and average row profiles.
2. Compute the column profiles, column masses and average column profiles.

Part III: Post decomposition

1. Compute the inertia, quality and contribution of dimension to points.
2. Reduce dimensionality – look for a low dimensional space which is as close as possible to high dimensional true space.

OUTPUT

1. Tables of numerical results – mass, inertia, quality, principal inertias, eigen values, singular values, chi-squares, chi-square percents, and partial contribution to inertia of row and column points.
2. Correspondence map – two - dimensional map.

INTERPRETATION

Interpret numerical results and the two-dimensional map

Figure 2. Flowchart of the mathematics of correspondence analysis

RESULTS AND DISCUSSION

This section presents the discussion, analysis and interpretation of the findings drawn from the correspondence analysis on the number of births in the six provinces of CAR in the calendar years 2000-2006.

Contingency Table and Correspondence Matrix

The summary on the number of births and calendar year total with reference to Table 1 as the contingency was presented in Table 2. The results in Table 2 indicated that the provinces of Benguet, Kalinga, Baguio and Abra have a relatively large number of births distribution from 2000 to 2006. Among the six provinces, Benguet ranked first in terms of population size. This province contributed 24.4% to the 1.4 million populations in the region. Second in rank for the largest in number of births is the province of Kalinga.

The province of Benguet which had the largest number of births has thirteen municipalities contributing 10 % each. On the other hand, Kalinga's large number of births may be due to the richness of its capital, Tabuk City.

. Provinces of CAR with low number of birth population are Abra, Mt. Province and Apayao. Therefore, the possible reasons for the low population status maybe its land shape and land areas.

Table 2 represents the distribution of births in each province. Calendar year 2000 had the highest number of births and generally, a download trend was observed the succeeding years, except in 2002.

Table2. Number of Births Distribution in the Six Provinces of CAR and CY 2000-2006.

PROVINCES OF CAR	CALENDAR YEARS							
	2000	2001	2002	2003	2004	2005	2006	Total
Abra	7382	7027	7244	7214	7965	6931	7246	51009
Apayao	2125	2001	4102	3506	2784	2529	2843	19890
Baguio	11708	8015	7922	9334	8179	9117	9672	63947
Benguet	16348	16250	17128	15221	19052	19245	10242	113486
Ifugao	6625	7210	7986	10599	7508	5580	7094	52602
Kalinga	13703	12176	12295	7485	7828	7112	6949	67548
Mt.Province	10111	6888	6174	5899	4676	4787	5870	43905
Total	6800	5956	6285	5925	5799	5530	4941	41238

Table 3 is the correspondence matrix comprising the relative frequencies. The sum of the table entries in the correspondence matrix equaled to one. This showed how unit of mass were distributed across the cells. The row and column totals of the matrix of relative frequencies were the row and column mass respectively. These showed that in the provinces of CAR, the population during the year 2005 had Benguet with the highest relative frequency of 0.047. This is closely followed by Kalinga with 0.018 relative frequency. On the other hand Apayao had the lowest relative frequency of 0.00613.

A similar trend was discerned in the succeeding years, where Benguet was consistently highest in the relative frequencies of the number of births while Apayao was the lowest in the relative frequencies.

Table 3. Correspondence Matrix

PROVINCES OF CAR	CALENDAR YEARS						
	2000	2001	2002	2003	2004	2005	2006
Abra	0.0179	0.017	0.0175	0.0175	0.019	0.017	0.0176
Apayao	5.153^{-03}	4.852^{-03}	9.947^{-03}	8.502^{-03}	6.751^{-03}	6.132^{-03}	6.893^{-3}
Baguio	0.028	0.019	0.019	0.023	0.02	0.022	0.023
Benguet	0.04	0.039	0.042	0.037	0.046	0.047	0.025
Ifugao	0.016	0.018	0.019	0.026	0.018	0.014	0.017
Kalinga	0.033	0.03	0.03	0.018	0.019	0.018	0.017
Mt.Prov.	0.025	0.017	0.015	0.014	0.011	0.011	0.013

The study of Bendixen (1996) stated that examination of the row and column profiles allows the researcher to examine the relative position of the rows and columns to each other and thus establish distinguishing characteristics. The row and column profiles of the contingency table are presented in Tables 4 and 5. The last row of the row profiles and last column of the column profiles are labeled average.

These are the proportions of the number of births in the row and column. These values are used as averages and weights (masses) in the calculations of the weighted distances.

As reflected in Table 4, year 2000 had the highest number of births with 1.1377, followed by year 2002 with an average of 1.1014, then year 2003 with an average of 1.0445 number of births, year 2001 with the average of 0.9927 number of births, followed by the year 2004 with 0.9511 number of births average, year 2005 with 0.8956 average and finally year 2006 with the least average of 0.8865. The higher the average relative to others, the higher number of births for that particular year.

Table 4.Row profiles

PROVINCES OF CAR	CALENDAR YEARS 2000	2001	2002	2003	2004	2005	2006	MARGINAL TOTAL
Abra	0.145	0.1378	0.142	0.1414	0.1561	0.1359	0.142	1
Apayao	0.107	0.1006	0.206	0.1763	0.134	0.1271	0.0143	1
Baguio	0.183	0.1253	0.124	0.146	0.128	0.1426	0.1513	1
Benguet	0.144	0.1432	0.151	0.1341	0.1679	0.1696	0.0902	1
Ifugao	0.126	0.126	0.152	0.2015	0.1427	0.1061	0.1349	1
Kalinga	0.203	0.2029	0.186	0.1108	0.1159	0.1053	0.1029	1
Mt.Province	0.23	0.1569	0.141	0.1344	0.1065	0.109	0.1223	1
Average	1.1377	0.9927	1.1014	1.0445	0.9511	0.8956	0.8865	

In Table 5, the province with the highest average is Benguet with 1.93. However, the province with lowest column average is Apayao ranging with 0.34, as compared to Kalinga with a slight average of 1.132, Baguio City follows 1.0918, then with Ifugao with 0.8984, Abra with 0.8728 and Mt.Province with 0.7378. As with row profiles, the higher the average relative to others, the higher the number of births in the particular province.

Table 5.Column Profiles

PROVINCES OF CAR	CALENDAR YEARS 2000	2001	2002	2003	2004	2005	2006	AVERAGE
Abra	0.107	0.118	0.115	0.122	0.137	0.125	0.147	0.873
Apayao	0.031	0.034	0.065	0.059	0.049	0.045	0.058	0.34
Baguio	0.172	0.135	0.126	0.158	0.14	0.165	0.196	1.092
Benguet	0.24	0.273	0.273	0.257	0.329	0.348	0.208	1.93
Ifugao	0.096	0.121	0.127	0.179	0.13	0.101	0.144	0.899
Kalinga	0.202	0.204	0.196	0.126	0.135	0.129	0.141	1.132
Mt.Province	0.149	0.116	0.098	0.099	0.081	0.087	0.109	0.74
Marginal Total	1	1	1	1	1	1	1	

Table 6 shows the decomposed chi-square total inertia which is 0.0311165. It was derived by dividing the chi-square 12,832.07, by the number of births grand total of 412,387. In decomposing the chi-square, the extracted dimensions of the data set with a maximum value equal to the product of the number of rows (row-1), the number of columns (column-1) that is (7rows) x (7 columns 1) equals to 36. Correspondence Analysis allows the optimal representation of a contingency table in two dimensional space. In table 6, the result of the reduction of dimensions yielded six dimensions. The greatest inertia

is attributed to the first dimension with a principal inertia of 0.0146382, followed by the second dimension with a principal dimension of 0.0094567, and decreasing sequentially in the succeeding dimensions. This shows that the first dimension of the principal inertia is greater than the second dimension.

Table 6. Inertia and Chi-square Decomposition of the Data Set

NUMBER OF DIMENSION	SINGULAR VALUE	PRINCIPAL INERTIA	CHI-SQUARE	PERCENT OF INERTIA	CUMULATIVE PERCENT
1	0.12099	0.014638	6036.75	47.05	47.04
2	0.09725	0.094567	3899.91	30.39	77.44
3	0.06993	0.00489	2016.64	15.72	93.15
4	0.37723	0.001423	586.85	4.57	97.73
5	0.02595	0.000673	277.64	2.16	99.89
6	0.00589	0.0000346	14.28	0.11	100
		0.0311165	12832.07	100	

A singular value is interpreted as the maximum canonical correlation between the categories of the variables for any given dimensions. The first dimension reflects a singular value equivalent of 0.1209886 while the corresponding value for the second dimension is 0.0972457. This implies that the provinces of CAR and calendar years are strongly associated in the second dimension but weakly correlated in the first axis. Principal inertia reflects the relative importance of the dimension. Each principal inertia is the amount of variance that a given and dimension explains the contingency table. The total inertia which is 0.0311159 was explained lately and 30.39 percent of inertia in the second dimension.

Garson (2005) mentioned two criteria on how to stop interrupting dimensions. The first is the Kaiser criterion, which indicated that the rate of the total values of the principal inertia or eigenvalues must be less than 1. The second criterion is that variance explained should only have cumulative percent between 80 to 90 percent.

In relation to the research study of Neri et al (1998) on the application of correspondence analysis to a particular 7x7 contingency table of the number of births in the six provinces of CAR and calendar year 2000-2006, 88 percent of the total inertia was explained by the first and second dimensions.

Ocden (2006) also used two dimensions with .1853 as the eigenvalue and 84.53 cumulative percent, in representing the degree programs and school year profiles.

Quality, Mass and Inertia of CAR Province

Correspondence Analysis has been successful in representing the contingency table in tow dimensional space. The overall retention of 77.44 percent was done in the two dimensions. However, not all of the provinces of CAR and CY 2000-2006 were equally represented. Bendixen (1996) in his study mentioned that the quality of representation of a particular row or column provides additional richness to the interpretation of the relationships in the contingency table. The quality of representation of the description of a point reflects how well the principal components model is explaining the point.

Table 7 presents that the provinces of Benguet, Mt. Province, Kalinga, and Ifugao had a quality of 98.8 %, 91.4 %, 83.8 % and 77.1 % respectively, and were well represented by the two dimensions. On the other hand, provinces of Apayao, Abra, and Baguio with a quality of 54.7%, 49.2% and 28.6% respectively were poorly represented in the two dimensions. This implies that these three provinces were not yet heavily populated or that they have a low number of births.

The contributions for the mass, the provinces of Benguet, Baguio and Kalinga, with respective masses of 0.275, 0.164 and 0.155, have the highest values for masses. This can be interpreted that the Benguet and Kalinga province

have a large frequency on the number of births. However, Baguio has high contribution in its mass, but its quality of 28.6% shows poor representation. Large mass of a row point means relatively high frequency for that province whereas the relatively small mass implies low frequency for the other provinces. The sequence consisted of Mt. Province with 0.106, Abra 0.124 and Apayao 0.048

Over the years 2000-2006, Apayao province remains to have low population in terms of number of births because of its small land area.

The contribution of points to dimensions as reflected by the column inertia in Table 7 is used to intuit the meaning of correspondence dimensions.

It was observed that the six provinces have contributed small variance since less than 0.1 of inertia (variance) accounted for each point.

Table 7.Summary figures of CAR Provinces and Calendar years profiles

CAR PROVINCES	QUALITY	MASS	INERTIA
Abra	0.492	0.124	0.001
Apayao	0.547	0.048	0.003
Baguio City	0.286	0.155	0.003
Benguet	0.988	0.275	0.007
Ifugao	0.771	0.128	0.005
Kalinga	0.838	0.164	0.007
Mt.Province	0.914	0.106	0.004

In Table 8, the contribution of dimension to the six provinces of CAR is presented. The value obtained in each cell is the percent of variance in provinces profiles explained by the given dimensions, the province of Mt. Province, Kalinga and Benguet defined the first dimension for having high contribution of dimension 1 to points. The provinces of CAR which are important in the second dimension are those which got a high relative value on the contribution to the dimensions.

Table 8.Contribution of Dimensions to the six Provinces of CAR

Provinces of CAR	DIM 1	DIM 2
Abra	0.032	0.011
Apayao	0.080	0.057
Baguio City	0.001	0.092
Benguet	0.137	0.516
Ifugao	0.099	0.270
Kalinga	0.393	0.029
Mt.Province	0.259	0.026

In dimension 2, it was indicated that the provinces of Ifugao and Benguet had the largest contribution. Because of some expectation that if the point of one province are higher, we do believe that from any contribution, it will always be the largest in contributing to dimensions implying a high squared correlation. However, the reverse is not true. That is, if a point explains a lot variance in a dimension, usually that dimension will describe the point very well (high squared correlation).

Row Coordinates

Table 9 presents the row coordinates, which determines the position of points when plotted in the two dimensional space. The positive and negative coordinates in dimension 1 of the Province of CAR are to found at the right branch and left branch, respectively, of the horizontal axis. In like manner, positive and negative coordinates in dimension 2 are located upward and downward, respectively, of the vertical axis.

The first dimension group was composed of Baguio, Kalinga and Mt.Province as one while Abra, Apayao, Benguet and Ifugao were dimensions 2 have Benguet and Kalinga separated from Abra, Apayao, Baguio, Ifugao and Mt.Province.

Table 9.Two dimensional coordinates of the Provinces of CAR

PROVINCES OF CAR	DIM 1	DIM2
Abra	-0.177	0.091
Apayao	-0.448	0.34
Baguio City	0.026	0.24
Benguet	-0.245	-0.427
Ifugao	-0.306	0.453
Kalinga	0.538	-0.132
Mt.Province	0.543	0.154

Quality, Mass and Inertia of the Calendar Year Points

With reference to Table 10, Calendar Years 2000, 2003, 2004, 2005 and 2006 were well represented by the two-dimensional map as shown by the high quality of 91.1%, 73.6%, and 85.8%, 95.8%, 775% and 80.1% respectively. The calendar year 2002 has the lowest quality of 4.2%. The computed mass of CY 2000, 2002, 2003, 2001, 2004 and 2005 are almost the same in their points, the distances between those years are not far from each calendar years, so CY 2006 with 0.120 is near to the point of said other calendar years.

For the mass values, the highest contribution of 0.165 was from year 2000, though mass areas quite close to the other mass values. The inertia values were also similar, still with year 2000 as having the highest value of 0.008.

Table 10.Summary figures of the Calendar Year points

CALENDAR YEARS	QUALITY	MASS	INERTIA
2000	0.911	0.165	0.008
2001	0.736	0.144	0.003
2002	0.042	0.152	0.003
2003	0.858	0.144	0.005
2004	0.958	0.141	0.003
2005	0.775	0.134	0.005
2006	0.801	0.120	0.005

The contributions of the Calendar Years 2000-2006 in the dimensions of this study are presented in Table 11. The values of the calendar years are significant in dimension 1 and dimension 2 based on the points of the dimension. Calendar Year 2000 in dimension 1 and 2004 in dimension 2 had the highest relative values. The second dimension was defined by the Calendar Year 2003, 2005 and 2006 with comparatively high values. This meant that 2000 and 2004 were the important points to dimension 1 whereas 2004 was important to dimension 2.

Table 11.Contribution of Dimension to the Calendar Year Points

CALENDAR YEARS	DIM 1	DIM 2
2000	0.479	0.000
2001	0.108	0.042
2002	0.004	0.007
2003	0.127	0.239
2004	0.167	0.90
2005	0.112	0.233
2006	0.003	0.389

The two dimensional coordinates of the Calendar Year points in Table 12, showed that the three calendar years 2000, 2001 and 2002 were grouped as one and the last four calendar years 2003, 2004, 2005 and 2006 belonged to another group in dimension 1. In dimension 1 calendar year with positive values was located at the right side of the vertical axis and calendar years with negative values were located at the branch of the vertical axis. In the second dimension, calendar years 2003 had the only positive value and the rest dimension points were negative. Calendar years in dimension 2 with positive value were found above the horizontal axis and calendar years with negative value are found below the horizontal axis.

Calendar years which are located closer to each other have similar contributions on the number of births in the Region.

Table 12.Two Coordinates of the Calendar Years

CALENDAR YEARS	DIM 1	DIM 2
2000	0.593	-0.003
2001	0.304	-0.167
2002	0.55	-0.066
2003	-0.327	0.402
2004	-0.379	-0.250
2005	-0.317	-0.411
2006	-0.056	-0.562

The plot on the number of births points and calendar year points illustrated the overall view of both variables on the plot.

The two dimensional map consisted of the horizontal axis with dimension 1 and the vertical axis with dimension 2. The labels for number of births profiles in the correspondence map were Abra, Apayao, Baguio, Benguet, Ifugao, Kalinga and Mt. Province. The labels of the calendar year profiles were 2000, 2001, 2002, 2003, 2004, 2005 and 2006

Two dimensional plots representing row or column profiles may be examined to identify whether any row or column categories have similar profiles. Row or column categories that have similar profiles appeared in close proximity on the plot. This could be useful to determine whether any row or column categories could be continued in subsequent analysis. Another area of interest is how row and column categories interact with one another in contributing to the overall association. It also showed how the row and column contribute to the overall size of the residual.

FIGURE 3 showed that the horizontal axis separating high frequency provinces from low frequency. The other axis separated negative coordinates from positive coordinates. A row and column points close together implied a high frequency in that cell. Ifugao was closer to 2003, Benguet with 2005, Mt. Province and Kalinga close to 2000, the implication is that a higher number of births in Ifugao occurred in 2003, a higher number of births in Benguet occurred

in 2005; in Mt. Province and Kalinga a higher number of births occurred in 2000. A point could make high contribution to the inertia (variance) of a principal axis in two ways. When it had a large distance from the centroid, even if it has a small mass, or when it has a large mass, but small distance from the average profile. The province of Apayao made a high contribution to the inertia (variance) in terms of number of births, since it has large distance from the average mean (centroid) and had a small mass.

In addition, Baguio and Abra contributed a high inertia (variance), since it had a large mass but large distance. Dimension 1 separated the two calendar years from the three calendar years of the period and the year 2000 on the horizontal axis. Benguet had a high frequency but contributed low variance situated at the negative pole while Kalinga which contributed large variance and high frequency is located at the positive pole. Benguet and Ifugao which were far from the horizontal axis contributed largely to the inertia of Dimension 2.

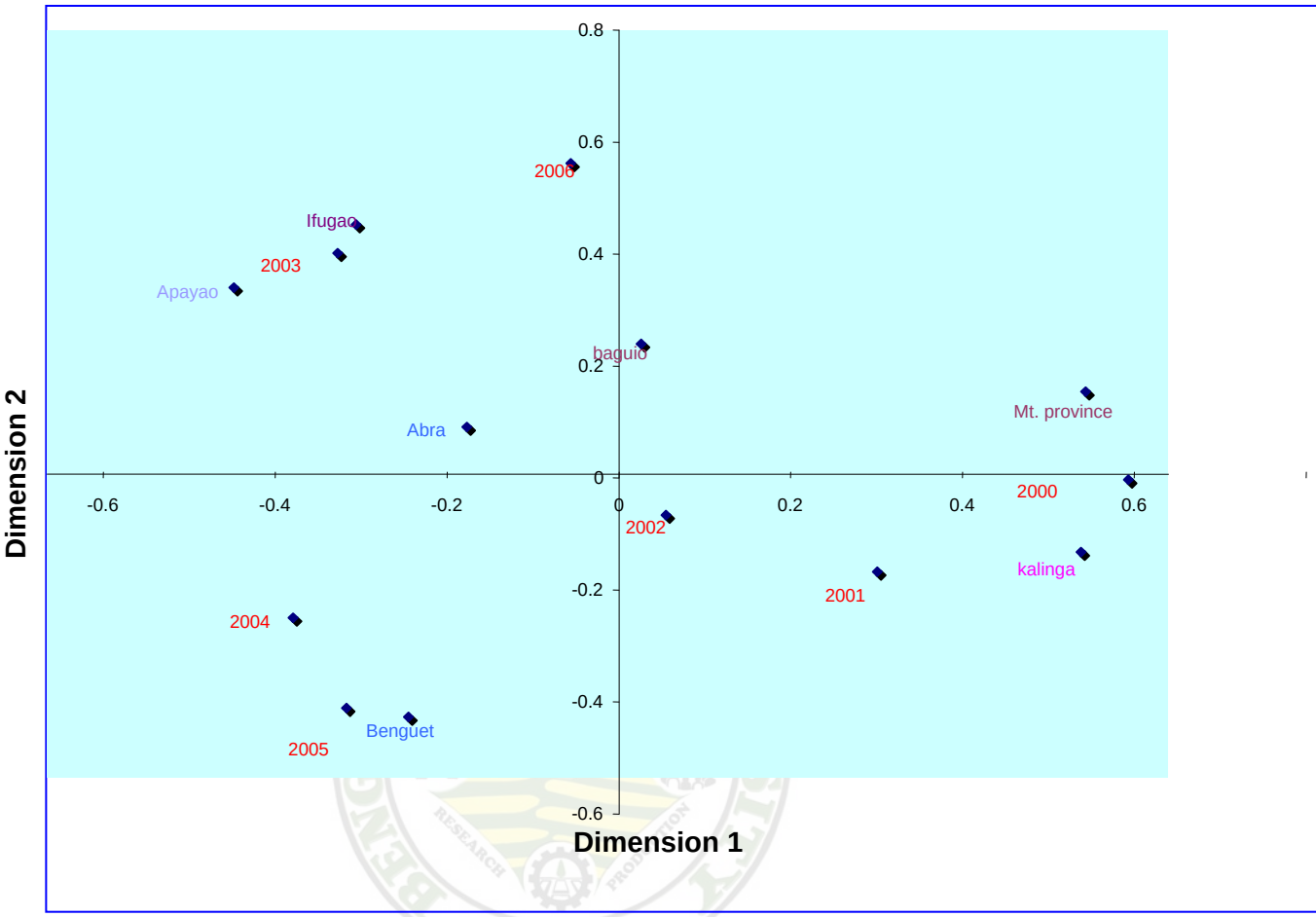

Figure.3 Correspondence analysis biplot on the number of births and the calendar years 2000-2006

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

Correspondence Analysis as a relatively new technique in exploratory analysis was used on the number of births in the six provinces of CAR during the calendar years 2000-2006. The technique was used for measuring the association of number of births among provinces and calendar years, at the same time, showing the location of this association. The correspondence solution decomposed the chi-square of the data set that resulted to the extraction of dimensions. Researchers found that the first two dimensions associated to the principal inertia's with 77.44 cumulative percent of inertia explained or represented well the number of births and calendar years points in a two dimensional space. The total inertia in the six dimension explained 3.11 percent of the variance in the original correspondence table. This means that 77.44 percent of the total inertia (variance) which is 3.11 percent in the original correspondence table was explained in the first and second dimensions.

The computed singular value in the first dimension is 0.120989 indicating weak relationship of the number of births and calendar year variables in Dimension 1.The second Dimension reflected strong relationship of the number of births and calendar year points as an interpretation for 0.097246 singular values.

Findings of the study are as follows:

1. Among the provinces of CAR, Baguio, Benguet, Kalinga, Ifugao and Mt. Provinces contributed greatly to the distribution on the number of births as reflected by the large masses of each. On the other hand, Apayao had the least contribution. The calendar years showed contributions to the number of births. The mass of each year had the same unit of mass and their distances from the cells were almost equal.

2. In the population data set on the number of births in the six provinces of CAR during the calendar years 2000-2006, 77.44% of the variance was explained by the Dimension 1 and Dimension 2. In the two dimensional space, the highly represented provinces were Benguet, Ifugao, Kalinga and Mt. Province. On the other hand Apayao was the only province of CAR which was well represented by the two dimensions in the Correspondence map. Moreover, the provinces of CAR which were poorly represented by the dimension in the Correspondence map were Abra and Baguio. As to year quality, calendar years 2000, 2001, 2003, 2004, 2005 and 2006 were well presented by the dimension in the two dimension map. Calendar year 2002 was poorly represented by the dimensional map.

3. The cumulative inertia 77.44% of variance was explained by Dimension 1 and Dimension 2. Among the six provinces of CAR, Benguet, Kalinga and Mountain Province contributed largely to the total inertia of the rest of the provinces had low contributions.

Conclusion

Based on the findings, the researcher arrived at the following conclusions:

1.Benguet, Kalinga and Mountain Province were the leading provinces as to number of births Furthermore, Apayao and Abra had the lowest number of births. On the other hand, the calendar years 2000, 2003, 2004 and 2006 recorded the highest number of births. Since Benguet, Kalinga and Mountain. Province obtained the largest masses; these provinces had a high birth growth. Likewise, calendar year 2000, 2003, 2004 and 2006 had the large masses.

2. The provinces of CAR which were highly explained by the dimensions were Benguet, Kalinga, and Mountain Province. The calendar year profiles, 2000, 2003, 2004, 2005, and 2006 were highly represented by the Dimension 1 and 2.

3. Using the correspondence map, Benguet was known for its large mass contribution.

Recommendations

The following recommendations are suggested in relation to the growing number of births in the six provinces of CAR and the use of the Correspondence Analysis method.

1. The government should be able to address the problem of high number of births, especially to province which were seen as consistently growing in population.

2. Correspondence Analysis may be used for researches on frequency data with multiple categories and with wider scope of geographical area.

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APPENDIX A. Letter of Request

Benguet State University
College of Arts and Sciences
MATH-PHYSICS-STATISTICS DEPARTMENT
La Trinidad, Benguet

February 6, 2008

BENJAMIN Y. NAVARRO
Head, NSCB- CAR
2/F JA Apartment, # 39
Upper Engineers Hill, 2600 Baguio City

Sir:

Greetings!

We are undergraduate students of Benguet State University taking Bachelor of Science in Applied Statistics. We are in the process of conducting our thesis entitled "Correspondence Analysis on the number of births in the six provinces of Cordillera Administrative Region during the years 2000-2006".

In this connection may we be permitted to get the necessary data for our study from good office. Rest assured that all data gathered will be held confidential and it shall be used only to serve the purposes of our study.

Your favorable response on this request will be highly appreciated.

Respectfully yours,

(Sgd) Crisanta P. Apit

(Sgd) Marifee K. Logro

(Sgd) Noemi S. Palubos

Noted:

DR. MARIA AZUCENA B. LUBRICA
Thesis Adviser

Benguet State University
College of Arts and Sciences
MATH-PHYSICS-STATISTICS DEPATRMENT
La Trinidad, Benguet

February 6, 2008

Engr.OLIVIA GULLA
Head, NSO - Regional
Junifer Bldg. Bonifacio Street
2600 Baguio City

Madam:

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(Sgd) Noemi S. Palubos

Noted:

DR.MARIA AZUCENA B. LUBRICA
Thesis Adviser

Appendix B. Number of Births Registered by Month and Provinces (2000-2006)

CY 2000	CAR	ABRA	APAYAO	BAGUIO CITY	BENGUET	IFUGAO	KALINGA	MT.PROVINCE
TOTAL	54169	7382	2125	11708	16348	6625	13703	10111
JANUARY	6380	448	210	988	1592	584	1109	2647
FEBRAURY	4676	818	331	946	865	730	1361	902
MARCH	4784	756	227	822	1250	482	1361	935
APRIL	5088	376	180	879	1317	587	2075	733
MAY	3930	611	160	778	1347	511	748	713
JUNE	4972	725	115	922	1375	782	1319	771
JULY	4586	823	143	888	1423	569	1106	665
AUGUST	3946	549	141	854	1281	522	1070	524
SEPTEMBER	4323	618	210	945	1497	514	1088	606
OCTOBER	3744	516	178	980	1434	426	762	606
DECEMBER	3806	552	120	1146	1490	477	852	435

CY 2001	CAR	ABRA	APAYAO	BAGUIO	BENGUET	IFUGAO	KALINGA	MT. PROVINCE
TOTAL	49551	7027	2001	8015	7210	12176	6888	16250
JANUARY	3547	510	152	610	463	750	409	1415
FEBRAURY	3589	763	204	580	562	786	472	1006
MARCH	3946	424	115	637	504	1184	576	1258
APRIL	4146	461	117	650	695	1052	669	1269
MAY	3999	596	139	683	529	1008	493	1373
JUNE	4836	796	152	690	517	1419	615	1489
JULY	4423	762	175	540	645	1114	617	1285
AUGUST	4409	613	181	684	513	1241	715	1327
SEPTEMBER	4272	626	193	710	709	901	515	1461
OCTOBER	3876	621	194	674	755	787	353	1360
NOVEMBER	4652	603	178	715	774	1024	697	1554
DECEMBER	3856	252	201	850	544	910	697	1453

CY 2002	CAR	ABRA	APAYAO	BAGUIO	BENGUET	IFUGAO	KALINGA	MT. PROVINCE
TOTAL	50827	7244	4102	7922	7986	12295	6174	17128
JANUARY	3117	426	307	450	367	992	465	867
FEBRAURY	4676	830	319	582	529	1143	368	1894
MARCH	4043	582	486	650	614	1053	481	1313
APRIL	3855	437	696	669	508	1374	323	1213
MAY	4729	680	455	730	705	1360	323	1661
JUNE	4581	790	287	790	790	1119	413	1469
JULY	4421	643	292	835	750	1087	473	1468
AUGUST	4375	613	268	816	599	801	1088	1274
SEPTEMBER	4361	603	276	830	707	807	883	1361
OCTOBER	4375	665	244	590	655	963	435	1657
NOVEMBER	4302	393	267	420	1047	859	461	1542
DECEMBER	3904	582	205	530	715	737	461	1409

CY 2003	CAR	ABRA	APAYAO	BAGUIO	BENGUET	IFUGAO	KALINGA	MT, PROVINCE
TOTAL	59258	7214	3506	9334	10559	7485	5899	15221
JANUARY	5043	738	241	777	757	720	464	1346
FEBRUARY	4729	561	352	904	897	732	416	867
MARCH	5506	568	312	616	1308	747	466	1489
APRIL	4194	536	239	679	506	562	466	1206
MAY	4652	699	256	677	526	798	460	1236
JUNE	5221	666	320	922	721	702	573	1317
JULY	5351	539	311	778	941	670	630	1482
AUGUST	4568	501	283	654	679	510	530	1411
SEPTEMBER	4889	676	361	845	769	501	500	1237
OCTOBER	5289	639	257	910	1763	545	518	657
NOVEMBER	5130	585	330	825	843	553	438	1556
DECEMBER	4686	506	244	747	889	445	438	1417

CY 2004	CAR	ABRA	APAYAO	BAGUIO	BENGUET	IFUGAO	KALINGA	MT. PROVINCE
TOTAL	49813	7965	2784	8179	7508	7828	4676	8179
JANUARY	4686	778	247	758	839	524	445	758
FEBRUARY	4434	657	331	865	784	666	470	865
MARCH	5062	694	250	635	1138	793	451	635
APRIL	4152	683	192	542	717	646	366	542
MAY	4237	784	262	641	549	731	392	641
JUNE	4787	846	264	543	710	972	407	543
JULY	3553	595	203	520	516	373	363	520
AUGUST	3879	682	236	652	465	579	265	652
SEPTEMBER	3997	700	161	630	483	676	361	630
OCTOBER	4275	667	215	854	475	777	426	854
NOVEMBER	3432	549	202	753	434	619	385	753
DECEMBER	3319	330	221	786	398	472	345	786

CY 2005	CAR	ABRA	APAYAO	BAGUIO	BENGUET	IFUGAO	KALINGA	MT. PROVINCE
TOTAL	46013	6931	2529	9117	5580	7112	4787	19254
JANUARY	3574	575	221	789	430	472	457	1559
FEBRUARY	4348	670	221	720	459	725	436	1837
MARCH	4013	681	204	680	502	693	418	1515
APRIL	3715	350	195	630	486	675	364	1645
MAY	3863	594	269	759	396	492	415	1697
JUNE	3889	714	163	856	238	766	430	1578
JULY	4134	630	204	588	478	785	381	1656
AUGUST	3972	546	209	723	734	645	405	1433
SEPTEMBER	3681	535	225	840	489	490	343	1599
OCTOBER	3700	667	215	759	475	483	361	1539
NOVEMBER	3519	529	199	820	412	451	326	1602
DECEMBER	3605	440	204	953	481	435	451	1594

CY 2006	CAR	ABRA	APAYAO	BAGUIO	BENGUET	IFUGAO	KALINGA	MT. PROVINCE
TOTAL	44343	7246	2843	9672	7094	6949	5370	10242
JANUARY	4335	885	219	885	494	603	385	864
FEBRUARY	3720	740	279	680	379	483	407	752
MARCH	4353	980	344	758	507	497	382	885
APRIL	3344	577	194	610	402	459	323	779
MAY	4456	809	271	769	587	588	450	982
JUNE	4680	809	272	985	514	668	479	953
JULY	3763	466	199	669	756	554	412	707
AUGUST	4005	521	180	820	746	454	491	793
SEPTEMBER	4151	542	193	850	689	459	614	804
OCTOBER	4615	542	255	835	943	729	515	871
NOVEMBER	2921	467	230	954	596	680	495	876
DECEMBER	3621	450	207	857	481	775	417	976

Appendix C. Inertia and Chi-square Decomposition

Singular Value	Principal Inertia	chi-square	Percent of Inertia
0.120989	0.014638	6036.75	47.04
0.097246	0.094567	3899.91	30.39
0.069929	0.00489	2016.64	15.72
0.377229	0.001423	586.85	4.57
0.025947	0.000673	277.64	2.16
0.005885	3.46E-05	14.28	0.11
	----------	12832.07	100

Row Coordinates

CAR Provinces	Dim 1	Dim2
Abra	-0.177	0.091
Apayao	-0.448	0.340
Baguio	0.026	0.240
Benguet	-0.245	-0.427
Ifugao	-0.306	0.453
Kalinga	0.538	- 0.132
Mt.Province	0.543	0.154

Column Coordinates

Calendar Years	Dim 1	Dim 2
2000	0.593	-0.003
2001	0.304	-0.167
2002	0.55	-0.066
2003	-0.327	0.402
2004	-0.379	-0.250
2005	-0.317	-0.411
2006	-0.056	-0.562

Appendix D. STATA OUTPUT

CA PROVINCE YEAR [fweight = FREQUENCY]

Correspondence analysis — Number of obs= 412387
Pearson chi2 (36) = 12827.59 — Number of dim. = 2
Expl. Inertia (%)=77.43

Prob > chi2 = 0.0000
Total inertia = 0.0311
7 active rows
7 active columns

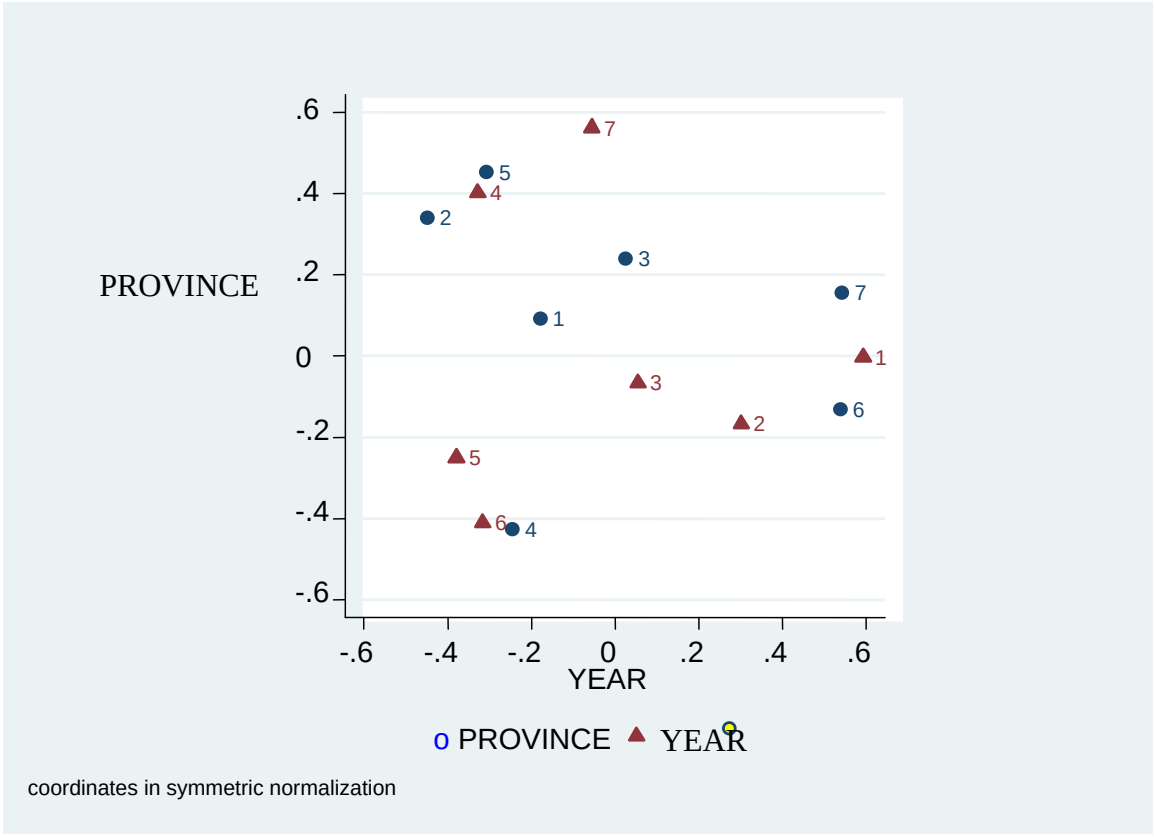
Singular Dimensions	principal values	inertia	chi2	percent	cumul percent
Dim 1	.1209764	.0146353	6035.40	47.05	47.05
Dim 2	.0972101	.0094498	3896.98	30.38	77.43
Dim 3	. 0699272	.0048898	2016.49	15.72	93.15
Dim 4	.0377264	.0014233	586.94	4.58	97.73
Dim 5	.0259401	.0006729	277.49	2.16	99.89
Dim 6	.0058858	.0000346	14.29	0.11	100.00
Total	.0311057	12827.59	100		

Statistics for row and column categories in symmetric normalization.

Overall Categories	mass	quality	inertia	dimension_1 coord	sqcorr	contrib.
PROVINCE						
1	0.124	0.492	0.001	-0.178	0.407	0.032
2	0.048	0.546	0.003	-0.448	0.374	0.080
3	0.155	0.286	0.003	0.026	0.004	0.001
4	0.275	0.988	0.007	-0.245	0.286	0.136
5	0.128	0.771	0.005	-0.306	0.280	0.099
6	0.164	0.838	0.007	0.538	0.800	0.393
7	0.106	0.914	0.004	0.543	0.858	0.259
YEAR						
1	0.165	0.911	0.008	0.593	0.911	0.479
2	0.144	0.736	0.003	0.302	0.590	0.109
3	0.152	0.042	0.003	0.054	0.019	0.004
4	0.144	0.858	0.005	-0.328	0.389	0.128
5	0.141	0.958	0.003	-0.379	0.710	0.167
6	0.134	0.774	0.005	-0.317	0.329	0.111
7	0.120	0.801	0.005	-0.056	0.010	0.003

	dimension_2		
Categories	coord	sqcorr	contrib.
PROVINCE			
1	0.091	0.085	0.010
2	0.339	0.172	0.057
3	0.240	0.282	0.092
4	-0.427	0.701	0.516
5	0.453	0.491	0.269
6	-0.131	0.038	0.029
7	0.154	0.056	0.026
YEAR			
1	-0.003	0.000	0.000
2	-0.167	0.146	0.042
3	-0.067	0.023	0.007
4	0.402	0.469	0.238
5	-0.250	0.248	0.091
6	-0.411	0.445	0.233
7	0.562	0.791	0.389

Appendix E. Plot of Correspondence Solution



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