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APPLICATION OF STRUCTURAL EQUATION MODEL IN LOCATION OF INDUSTRIES

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ABSTRACT

Structural equation model (SEM) is a statistical technique for testing and estimating casual relations using a combination of statistical data and qualitative casual assumptions. The applications of structural equation modality to neural systems make use of the neuro-anatomy to define a network and express the interaction among brain regions. It is in the light of this, the paper applied it to location of industry considering market, raw materials and capital. And the result shows strong relations and influence of the factors on location of any industry.

KEYWORDS: Neural network, residual influence path coefficient, industry.

INTRODUCTION

Neural network is a network of inter connected elements. These elements were inspired from studies of biological nervous systems. Neural networks are an attempt to create machines that work in a similar way to the human brain by building machine using components that behave like biological neurons (Phil, 2000). Also neural network is to produce an output pattern when presented with an input pattern.

Structural equation modeling (SEM) is a statistical technique for testing and estimating casual relation using a combination of statistical data and qualitative casual consumptions. The application of SEM to neural system makes use of the neuroanatomy to define a network and express the interaction among brain (Wiley-Liss,inc 1994). The theoretical and technical issues of the equations have been researched by (Bentler, 1985; and Berry, 1984). Recent trends in the analysis of brain imaging data have focused on the interactions among brain regions (Friston *et al*, 1993, Moeller 1991). They all extract information about neural interactions through covariance of activities.

SEM or path analysis has been proved to be powerful way to combine functional neuroimagine data with anatomical circuitry to determine the functional neuroanatomy underlying a particular task (Moeller and Strother, 1991, McIntosh and Gonzalez-Lima, 1991). A measure of covariance represents the degree to which activities of two regions are related to one another or how they vary together. Covariances are studied in many scientific disciplines but in neural system, the dependent variables (regional activity of brain areas) are anatomically connected to one another, while in other fields such as social science, there may be no priori connective relationships between dependent variables (Wiley –Liss Inc,

1994). Path coefficient is the direct proportional functional influence one region has on another region through their direct anatomical connection with all other regions left unchanged. A part coefficient is the expected change in the activity of one region given unit change in the given region influencing it. Location and distribution of industry are more complex and dynamic because of the following reasons (David, 1995):

i. Some locations were chosen before the industrial revolution and many more during
ii. New location factors which were not applicable last century like cheaper & efficient transport systems, energy in the form of electricity.
iii. Before the 20th century, industry was usually financial and organized by individual entrepreneurs but now by the state or multinational companies.
iv. The sites of many early factors were chosen by individual preference or by chance. Apart from the factors that make complexity in location of industry, there are many factors to be considered or that influence location of an industry. Such factors include raw materials, markets, capital, power, transport labour, government policies, land and environment. Due to the complexity of location of industry, this paper attempts to use the SEM to neural system to determine the gravity and interaction of market, raw materials and capital in location of industry and the influence of each one.

Models

The relationship between brain areas can be described using a simple linear mathematical expression of the covariance of region as influence by the variance of another is

$$Y = \alpha + \beta_{y,x} x + \psi ----(1)$$

Where Y and X are measures of the activity in two inter connected regions.

A simple extension of equation (1) can represents effects of and additional area Z in the regional activity of area Y. The extension of equation (1) is

$$Y = \alpha + \beta_{y,x} x + \beta_{y,z} Z + \psi ---- (2)$$

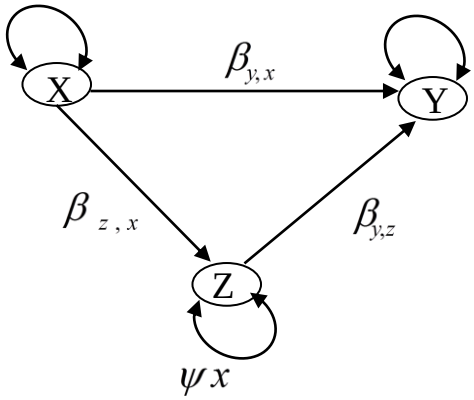

Figure 1: Flow diagram of relationship of the regions

The circles represent the measure variance from regions X, Y and Z unidirectional arrows represent the path for the influences of these sources of variance on each order and the curved bidirectional arrows represent residual influences whose sizes is indicated by ψ (Wiley-Liss,inc 1994)

Modified model

Parameters:

A. - industry
B. - Market
C. - Raw materials
D. - Capital

Ψ residual influences representing the variance
ΨA residual influence of A
ΨB residual influence of B
ΨC residual influence of C
ΨD residual influence of D
w size of influence of B on A
v size of influence of C on A
y size of influence of B on C
x size of influence of D on A
z size of influence of B on D

The neural system representation of the network and the interaction among the industry A and the factors B, C and D is portrayed by the flow diagram below.

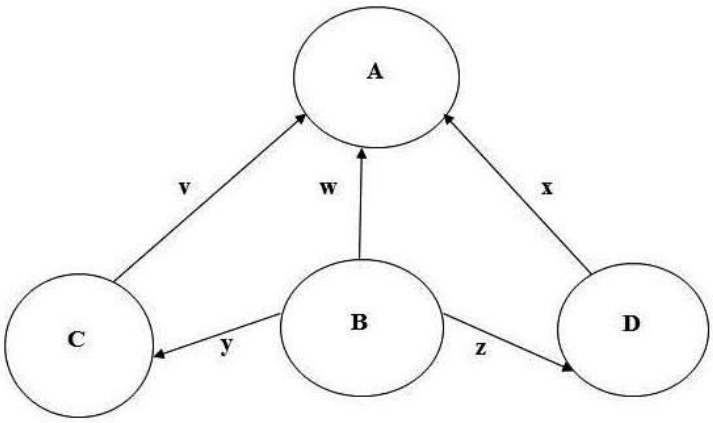

Figure 2: Interaction of industry A and the factors B,C,D.

Assumptions

- **i.** The industry depends on the factors B, C and D
- **ii.** Each of factor have influence on the industry.
- **iii.** Some of the factors have influence on one another.

From our assumptions and flow diagram (2) we have the following neural system Equations

A = ΨA…… . ..1

B = wA+ΨB……2

C = vA + yB +ΨC …….……3

D = xA + zB + ΨD …...…….4.

Equations 2, 3, 4 Can be modified as follows:

A = ΨA ……. 5

$B = {}^{1}/_{2}\,\Psi A^{2} + \Psi B$…….. 6

$C = {}^{n}/_{10}\,\Psi A + {}^{n}/_{2}\,B + \Psi C$ ……...7

$D = {}^{n}/_{2}\,\Psi A + {}^{n}/_{5}\,B + 4D$ ……8

Where:

$n = {}^{1}/_{2}\,\psi A = w$

${}^{n}/_{10} = v$

${}^{n}/_{2} = y$

${}^{n}/_{5} = x = z$

Experimental Data

The following data is used to test the modified model.

(i) 2 Unit change in the Activities of A results to 1, 0.1 , 0.2 Unit changes in B, C, D respectively.

(ii) 1 Unit changes in the activities of B results to 0.5, 0.2 Unit changes in C and D respectively.

(iii) The residual influences of the region to be 1 Unit

Using the experimental data i - iii on equations 5-8, the values in the Table 1below are obtained

Table 1: Path Coefficients

ΨA	n	V	w	x	y	z	A	B	C	D
2	1	0.1	1	0.2	0.5	0.2	2	3	2.7	2
3	1.5	0.15	1.5	0.3	0.75	0.3	3	5.5	5.57	3.55
4	2	0.2	2	0.4	1	0.4	4	9	10.8	6.9

From the above table, three tables of size influence (path Coefficients) are obtained.

Table 2: ΨA = 2

	A	B	C	D
A				
B	1			
C	0.1	0.5		
D	0.2	0.2		
PSI	2	1	1	1

Table 3: ΨA =3

	A	B	C	D
A	1			
B	0.1			
C	0.2	0.5		
D	0.2	0.2		
PSI		1	1	1

Table 4: ΨA = 4

	A	B	C	D
A				
B	1			
C	0.1	0.5		
D	0.2	0.2		
PSI	2	1	1	1

Rows - variables being affected
Columns - Sources of effect
PSI - Residual influences on each variable.

DISCUSSION

From the table of values obtained the result shows that market, capital and raw materials influences location of industry. Also it has been observed that market has high influence on location of industry also market has influence on raw materials and capital. Therefore structural equation model is an instrument of testing or determining which factor plays most roles in location of industry.

CONCLUSION

Statistical techniques have been used for testing the statistical analysis from T-tests to canonical correlations but in the modified model we can use substitution of obtain data into the equations and obtained the result. Also the SEM can be used to measure some relations rather than on brain imaging activities.

The modified model equations may be regarded as one of the efficient tools for determining the gravity of change in our daily activities and how it affects community.

The model therefore provides a framework on related problems such as forecasting the standard of living of nation, effect of inflation in various economic sectors of a nation.

REFERENCE

Bentler, P. M (1985). Theory and implementation of EGS, A structural Equations programme. Los Angeles, BMDP statistical software.

Berry, W.D. (1984). *Non recursive casual models sage university paper series on Quantitative Applications in the social sciences. Beverly Hip.* Sage publications.

David, W. (1995). *Geog. An Integrated Approach* Nelson, 2nd Edition, UK.

Friston, K. J. Frith, C. D, Liddle P. F, Frackowiak, R. S. J (1993). Functional connectivity, the principal –component analysis of large (PET) data sets *j .celeb blood flow metab* 13:5-14.

Moeller J. R. and Strother, S. C (1991). A Regional covariance; Approach to the Analysis of functional patterns in position Emission Tomographic Data . *J.Celeb Blood flow metab* 11:A121—A 135 .

McIntosh, A. R. and Gonzalez-lima F. (1991). Structural modeling of Functional Neural path ways mapped with 2-Deoxyglucose. Effects of A Cautic stantle Habituation on the Auditory System Brain press 547:295-302.

Phil, P. (2000). *Neural Networks* 2nd edition, pal grave, New York.

Willey–Liss, Inc. (1994) Human Brain mapping 2:2-22.