ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Automated Cartographic Generalization For Network Cells in Spatial Date An Empirical Study of the cartographic (map Algebra method)

(Case study Basrah, Babylon -Iraq)

Dr Najeeb Abdul Rahman Mahmood Al-Zaidi [1],Ahmed Mohammed Jihad Al-Kubaisi[2]

1. Department of Geography, college of Education, Tikrit University, Iraq
2. Al-Fallujah Education Department, General Directorate of Al-Anbar Education, Iraq.

Manuscript Info

Manuscript History:

Received: 22 March 2014
Final Accepted: 19 April 2014
Published Online: May 2014

Key words:
GIS ,Automated Generalization ,Map Algebra , Digital maps

Corresponding Author

DrNajeeb Abdul Rahman Mahmood Al-Zaidi

Abstract

The study of Geography that is subsidized by the applicable aspect has become on one of the issues which achieves success in educational and scientific programs, after applying modern contemporary technologies and geographic process for solving natural and human problems. The computer technology and software had the highest effect on developing the tools of geographic analysis which achieved the most precise results designed to be obtained by researchers digitally.

The research aims at applying one of the methods of statistical cartographic (map) network cells in spatial data, which are the spatial patterns method and analysis of the direction of the surface method (trend) to employ the geographic information system technology through the IDRISI program which was produced by Clark University –USA. The research was applied to models of spatial data in Iraq(Basrah, Babylon)sensed from satellites after treatment, analysis and production in a digital form. The research has gone over three stages:-

1-sources of spatial data and the used technology
2-Applying the method of statistical cartographic Algebra for Automated Generalization.
3-Testing and Evaluating the results of automated Generalization

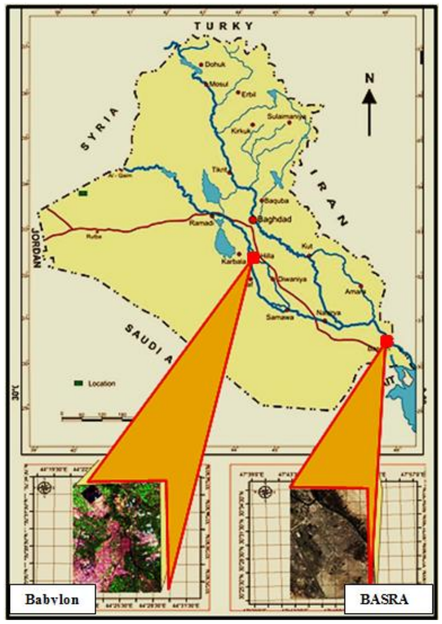
Introduction

Geography will not be characterized scientifically unless it adheres to the research means and modern technology so that Geographers head to probe the jungles of Geographic relations. Keeping pace with the information revolution(**digital**) or what we can call in this partial(**Technological Geography**), and scientific awareness of Geographical information technologies and diving in its merit joints is an issue which no two can differ on. These can cause changes in the quality of Geography and its inputs.

The practical side gives an indication of the truth of the results and gives scientific and logical brevity in terms of approach and style when studying actuality. Following the steps of work stages in the applications of information systems(GIS) by the method of(**step by step**) provides easiness information awareness so that the user is acquainted with the basic functions and his her awareness for its ability and role in Geographic studies. The research consisted of three stages:

First:- the spatial data sources and use technology in the research.
Secondly:-the statistical cartographic algebra method for automated Generalization.
Thirdly:- testing and evaluating the results of automated Generalization, and coming up with cartographic and graphic results.

The research deals with presenting the automated Generalization step to apply the statistical cartographic algebra method and to process analyses and produce this method. It was applied to chosen models from Iraq (Basrah-Babylon)..



Map(1) clarifies the geographical location of the spatial data models

Objective of the Research:-

The research aims at employing the(GIS) technology through the IDRISI program which is used for the first time at the level of geographical research in Iraq to get to know some of the statistical methods (cartographic algebra) specialized for automated Generalization of network cells. This is conducted by presenting the steps of data input and import and how to treat, generalize and produce the data in the digital form.

Research Hypothesis:-

The research hypothesis is based on the ability to apply Automated Generalization by statistical means with high efficiency according to the way dealt with network cells through using statistical operations and testing its results.

The Problem:-

The research in Applied Geography requires dealing with Geographical data and how to save, process and analyses this data in an accurate way which may be difficult for implementation by traditional means(**manual**) which require complex statistical analyses that cannot be achieved unless by modern software technology. The problem of research lies by asking the following questions:

1 . How is contemporary software employed in Automated Generalization?
2 . What are the statistical methods that can be used in the process of network data Generalization?
3 . Dose the spatial discriminatory accuracy of spatial data have in impact on the operations of Generalization.

Research Methodology:

The research has depended on systems analysis approach in dealing with geographic data according to raster or grid data analysis which is based on grid (raster) spatial visualizations.

Research stage:

1 . Spatial and technological data source used in the research.
2 .Applying the statistical cartographic (**map**) algebra method for Automated Generalization.
3 . Testing and evaluating the automated Generalization result.

1 . Spatial and technological data source used in the research:

The data input stage in the practical aspect is considered one of the important stages in preparing the geographical information system within the modern programs. Through this research we have gained the assistance of the world wide web (www.) sites to import the spatial visualization source within the sites list of open source provided by the production companies specialized in the field of spatial sciences. The electronic site[(1)] was relied on which provides a reference data base for source of remote sensing from the different types of spatial data .the sensing study models where imported from satellites (Land Sat ETM,QUICK Bird) where and saved to the computer . through the main window of the site, we choose (name of satellite) and choose the geographical site (Iraq) so that the spatial data are downloaded . As in table (1) which clarifies the characteristic

NO	sources	Data	Format	Resolution(m)
1	(Land sat-7) ETM+1	2002	Mr Sid	14.24
2	(Quikbird) (QB)	2007	Mr Sid	0.60

table (1) which clarifies the importing of research models.

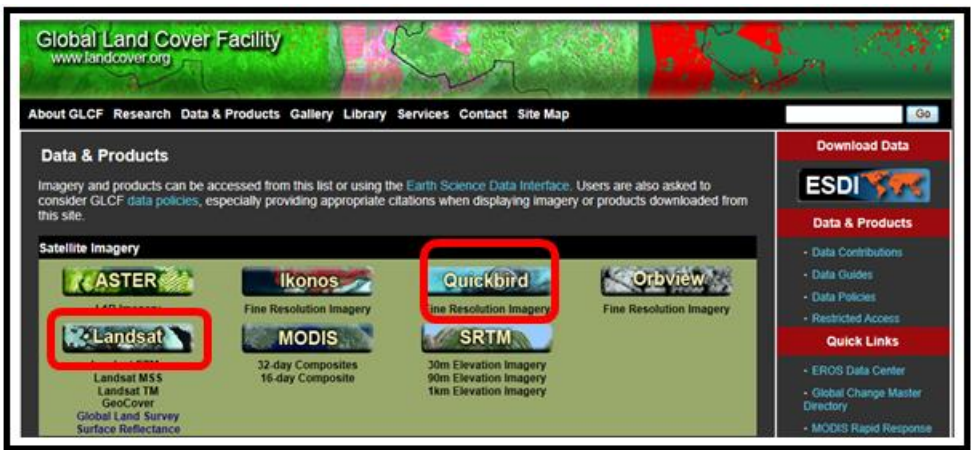


Figure (1): importing spatial data of the research sampled from the international web.

The geographical information system (GIS) requires a number of devices which must have high efficiency technological characteristics to implement its tasks completely. The electronic devices are considered basic elements in GIS, since different operation cannot be performed to process data without its availability [(2)], and the researcher has depended on the following devices:

1 .A computer which is an important basic element in the management and work of GIS: Its main characteristics:

A-Laptop type HP, 1U4..

B-CPU 4GH2

C-SP3 system, windows 7

D-Hard 500, RAM GB4

2 .Printer: type f3000, HP desk Jet Coeur

3 .Scanner type f380, HP Desk e A

The technology of the program (IDRISI) was employed. It is software of Clark university laboratories in side George Perkins Marsh institute, and was designed by the scientist (peter chanter) to enhance development and understand geographical analysis with the aid of the computer [3], figure (2).

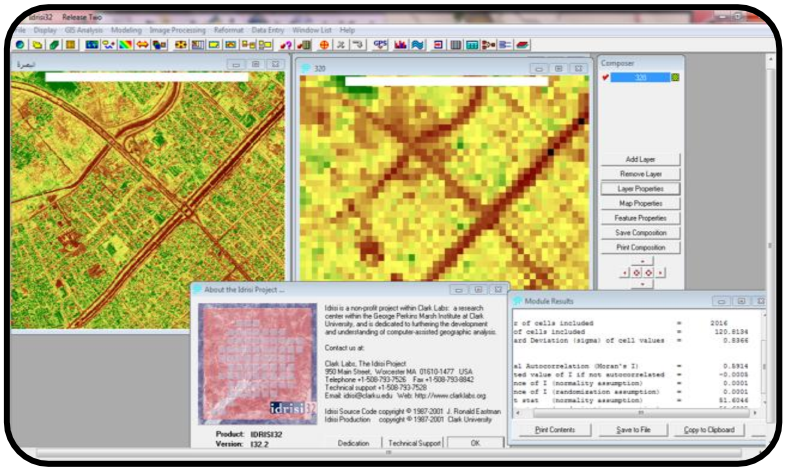
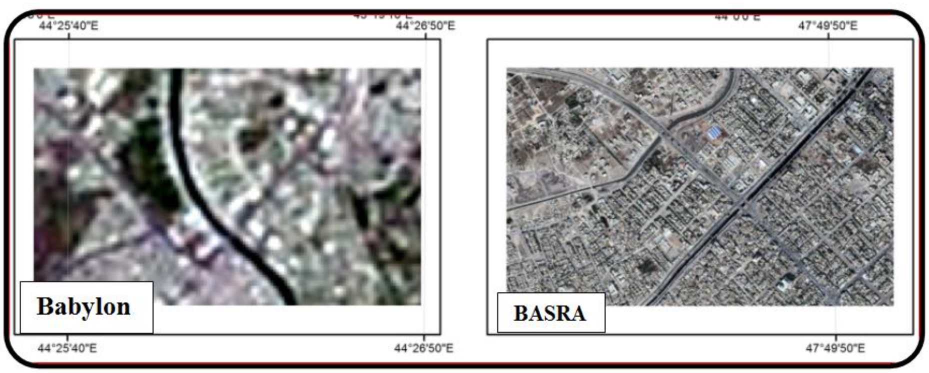


Figure (2): the main page for the program (Idrisi)

The research areas were sectioned depending on the source map according to the drawing scale (1:10000) figure (3), than processed and classified to (5) classes according to the great probability method. Thus, the data must be classified to change its original values to alternative values before conducting the automated Generalization and the automated classification procedure in the IDRISI program as in the figure(4)



Figure(3): source map with a scale(1:10000) for the research areas

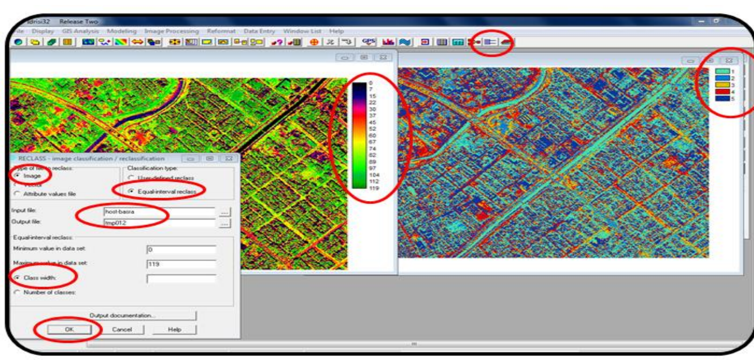


Figure (4): step for conducting automated classification in the IDRISI program

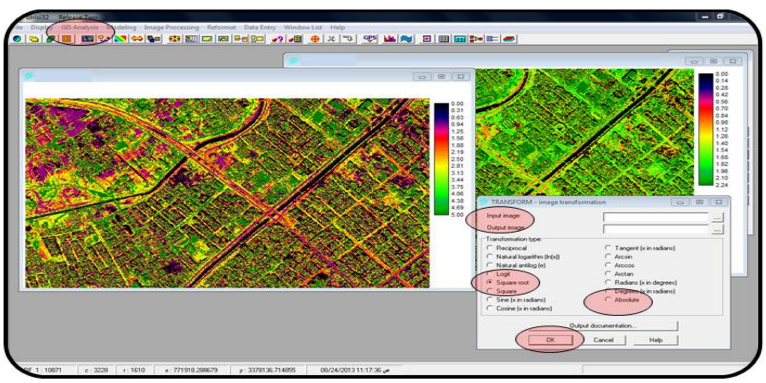
2 .The special statistical cartographic Algebra method of automated Generalization:

The (IDRISI) program has been used to conduct the Automated Generalization processes on the data of the research samples. It consists of lists for Generalization methods and special tools to implement the application of the statistical Generalization methods such as the (**MAP Algebra**)(4) methods. The (IDRISI) program is provided with several automated Generalization tools (mathematical and statistical) through special lists within the main tool bar of the main program window. This method consists of two types of calculation methods which are:

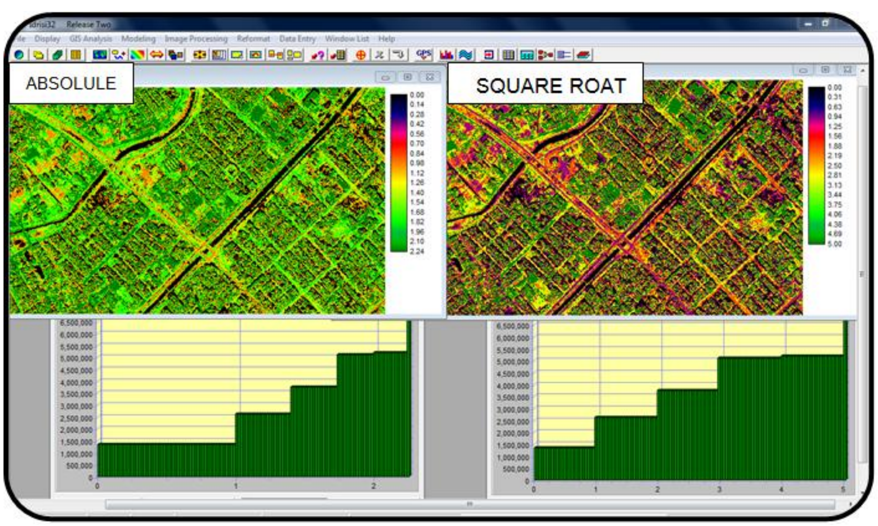
A-mathematical Algebra method:

Using the tool(TRANSFORM) which consists of a large list of mathematical operations and conducting experiment and training on the research samples, two types of operations within this tool were chosen which are(square Root) and(Absolute Numbers) for two reasons, the first of which: the experiment operation has given clear analytic and positive results for the research sample. Second, it is one of the operations used in analyzing the network cell values within the (Roaster) data to specify the relations and spatial differences between the cell units.

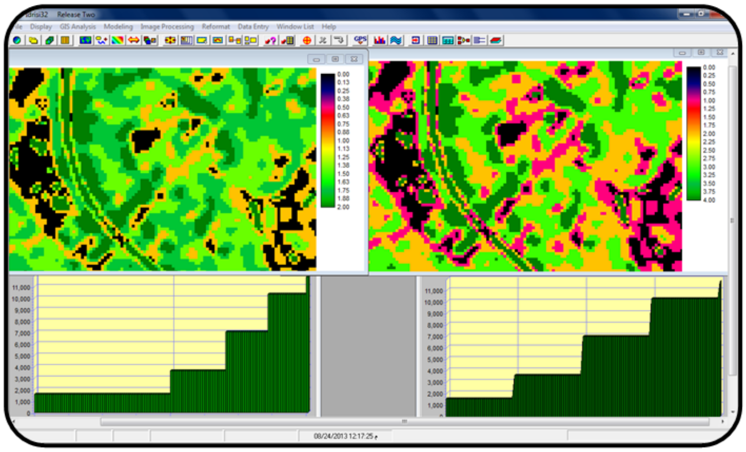
From the main program window, we choose the order(GIS ANALYSIS) and from the list we choose the tool(TRANSFORM) which show us the window(TRANSFORM-IMAGE TRANSFORM ATION), and in the field(INPUT IMAGE) we choose the study type(image) and in the field(OUTPUT) we write a new name for the Generalization map. From the list (TRANSFORM TION TYPE) we choose (SQUARE ROOT) then (OK). Figure (5) clarifies the application of the operation on the sample (Basrah). Then, we repeat all the previous steps to apply the ABSOLUTE NUMMBER METHOD). The figure (6) clarifies the Generalization results of the two methods. We apply the same application step on the sample (Babylon), figure (7)



Figure(5): Applying the method of(SQUARE ROOT) on automated Generalization



Figure(6): Generalization results of the mathematical operation(TRANSFORMATION) for the Basrah sample



Finger(7): Generalization results of the mathematical operation(TRANSFORMATION) for the Babylon sample.

.**B-The statistical Algebra method:**

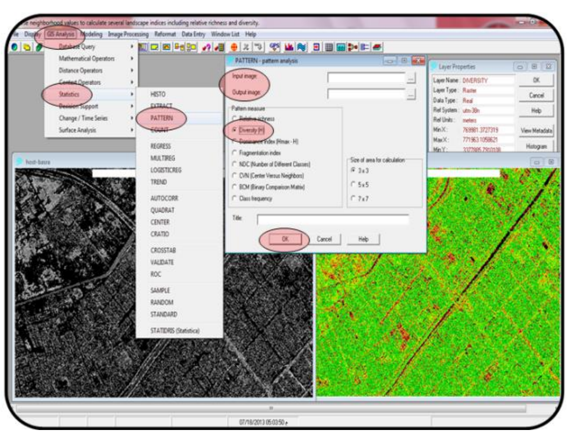
This method consists two statistical procedures used in the automated Generalization operations within the main program window which are:

1 .The spatial pattern procedure:

This tool consists of several procedures to measure the relation between spatial patterns within the window list such as:

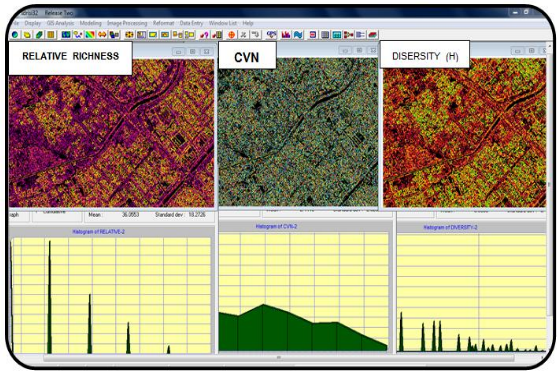
1. RELATIVE RICHNESS
2. DISERSITY (H)
3. CVN
4. FREQMENTAION INDEX
5. BCM

Three type of measurement patterns were chosen and applied to the research samples since it is related to spatial relations and measurement of neighboring values of network cells, in addition to the numerous experiment results which have proved success in research sample. These are relative richness, (**CVN,Diversity CH**,**and RELATIVE RICHNESS**). From the main program window, we choose the order(GIS ANALYSIS), and from its list we choose(**STATISTICS**), and from this we choose(**PATTERN**) which shows us a new window, and in the field(INPUT IMAGE) we choose importing the study sample, and in the field(OUTPUT IMAGE) we write a new name for the Generalization map. From the field (**MEASUREPATTERN**) we choose the three patterns separately and apply it each time, and then we choose the order (OK). The figure (8) clarifies the application of the method on the (Basrah) data. We repeat the operation on the (Babylon) sample.

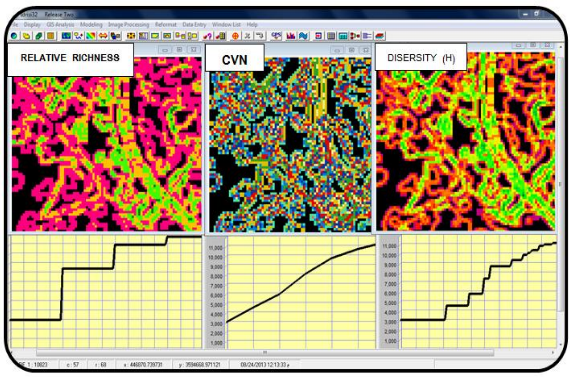


Figure(8): Application of the statistical pattern on the Basrah sample

We obtained the results of the Generalization cartographic analysis according to the three patterns which were applied on the two samples, with the graphic figure. Figure (9) clarifies the Generalization result of the (Basrah) sample, and figure (10) clarifies the Generalization results of the (Babylon) sample.



Figure(9): Generalization results according to the statistical pattern for the Basrah sample



Figure(10): Generalization results according to the statistical pattern for the Babylon pattern

2. The surface Analysis trend method:

This tool consists of three special statistical procedures of Algebra method to Generalization maps, which are the linear, Quadratic and cubic. It is one of the procedures for measuring the network cell values of a certain area to clarify the surface trend or direction depending on the geographical coordinates(X,Y)[5], This was applied on all the research samples(**Models**) separately on the classified source map. Figure (11) clarifies the implementation steps talking in to consideration the repetition of steps on the research models and choice of statistical procedure each time

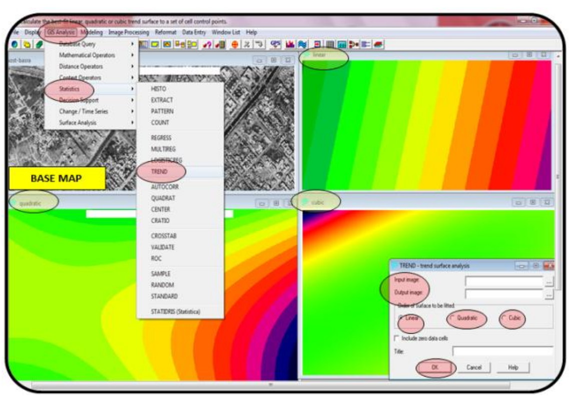


Figure (11): steps for applying the statistical Algebra trends on the Basrah model

.The outputs of the analysis have shown Generalization maps according to the three procedure of the statistical Algebra trend for the Basrah model(figure 12) and Babylon model(figure 13)

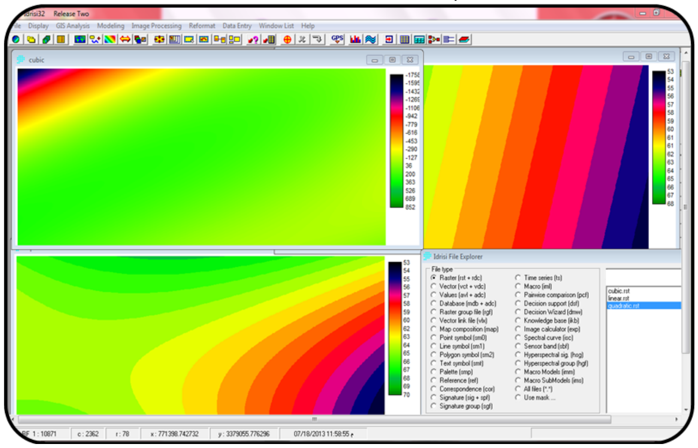


Figure (12): Generalization results of the statistical algebra trend for the Basrah model

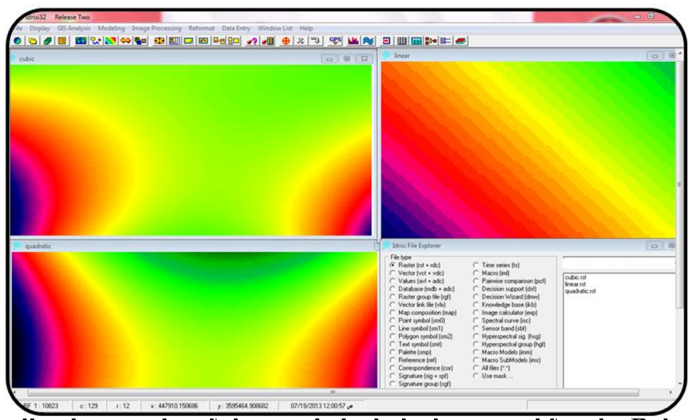
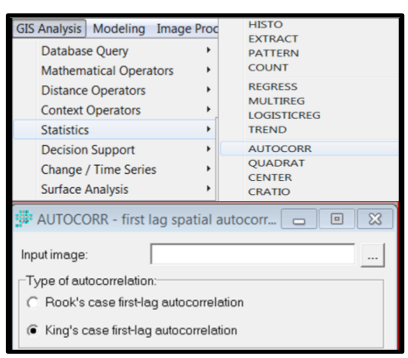


Figure (13): Generalization results of the statistical algebra trend for the Babylon model

3-Testing and Evaluating the Automated Generalization results:

The IDRISI program consists of numerous measuring, statistical and mathematical means to test the cartographic analysis results through the tools list (**GIS ANALYSIS**) in the main frontage of the program (figure 14). These mean have provided tools to measure and test the Automated Generalization results of the generalized maps to know the extent of accuracy and validity of the results which have been reached by the research.



Figure(14): The statistical Analysis tools list of the spatial correlation coefficient

The (**Spatial Statistical Analysis Tools**) are considered in the geographical information systems(GIS) as the optimal means in the spatial analysis operations of geographical phenomena and how to relate between these phenomena by laws to detect the exchanging relations and coordination's in order to construct a (**Spatial Models**)of geographic phenomena using the spatial statistical means which are capable of dealing with statistical data base.(6) Occasionally, the visual analysis of the map is enough and give a statistical interpretation, but mostly there is a difficulty in extracting information from the map or conducting analytic and conclusive operations on the maps. Thus, the spatial statistical analysis measurement means assist and complete the visual and traditional statistical means in an analyzing spatial data.(7)

Perhaps the most important thing presented by statistical technologies is the ability for verification of reached results since it provides us with indicators to specify the probability of the validity of the result according to a specific statistical degree of confidence.

The Quantities Evaluation can measure the extent of surface correlation which represents the map elements that measuring the extent of homogeneity of the network representing surface from the spatial correlation reality of cell values which means the effect of spatial proximity and remoteness on cell values. Thus, an indicator can be presented that refers to the resemblance of each cell with the other. Whenever the resemblance increases, that refers to the homogeneity of the surface so that the value of the indicator reaches(1+) as the maximum extent of homogeneity, and vice versa when the surface is in heterogeneity so that the value is (1-) in case the cell are completely not in resemblance. When the value approaches(zero), the surface is close to random.(8)

In this research, the spatial autocorrelation coefficient indicator (**Moran's index**)(9) was relied on to measure the spatial ordering and the extent of change in this ordering. It measures the first change (distancing-directional) and finding the indicator for the second, third, fourth, etc. change and soon. The index is used to measure the difference in spatial ordering in maps generalized by the statistical cartographic algebra method. The main idea is that the converged areas are similar, and neighboring values are similar so that it resembles the surrounding conditions. When the values of the neighboring phenomena are similar more than the remote values, we say that there is a positive exchanging spatial autocorrelation but if the neighboring phenomena values are differ. We say that there is a negative exchanging spatial auto correlation which means that there is a lack of spatial auto correlation. As for geographical phenomena the auto spatial correlation is considered the most common state.(10)

A-The mathematical basis of the model:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2}$$

Mitchell, Andy. The ESRI Guide to GIS Analysis, Volume 2. ESRI Press, 2005.P.186

Value of(I+) =similar (collection)(positive spatial relation)

Value of(I-) =Remoteness (negative spatial relation)

Value of(zero) =Random

The auto correlation coefficient is present in the (**IDRISI**) program within the main analysis tools list (**GIS Analysis**). It was used to test the map result generalized by statistical method and consists of two procedures, the first: (king's) procedure and the second :(Rook's) procedure. The Generalization test was applied using (king's) procedure on the two models(Basrah-Babylon).

B. Results of the testing and valuation of generalized maps using king's procedure:

1 .Basrah model:

A-The statistical method Results(Transform) (square Root)

The test results show the following table which consists of the special value details for each model.

Number of cells included=6701787

Mean of cell included=7.1741

Standard Deviation (sigma) of cell values=0.0012

Spatial Auto correlation (morons I)=1.1898

Expected value of I if not auto correlated=-0.0000
Variance of I (normality assumption)=0.0000
Variance of I (randomization assumption)=0.0000
Z test stat (normality assumption)=4960.3911
Z test stat (randomization assumption)=4960.3906

```
Case  : King's Case

Number of cells included                      =     6701787
Mean of cells included                        =        7.1741
Standard Deviation (sigma) of cell values     =        0.0012

Spatial Autocorrelation (Moran's I)           =        1.1898
Expected value of I if not autocorrelated     =       -0.0000
Variance of I (normality assumption)          =        0.0000
Variance of I (randomization assumption)      =        0.0000
z test stat   (normality assumption)          =     4960.3911
z test stat   (randomization assumption)      =     4960.3906
```

A-The statistical method Results (TRANSFORM)(square Root numbers (figure 15)

```
Case  : King's Case

Number of cells included                      =     6701787
Mean of cells included                        =       60.5492
Standard Deviation (sigma) of cell values     =        0.0142

Spatial Autocorrelation (Moran's I)           =        1.2202
Expected value of I if not autocorrelated     =       -0.0000
Variance of I (normality assumption)          =        0.0000
Variance of I (randomization assumption)      =        0.0000
z test stat   (normality assumption)          =     5087.1626
z test stat   (randomization assumption)      =     5087.1621
```

B-The statistical method Results (TRANSFORM)(Absolute numbers (figure 16)

```
Case  : King's Case

Number of cells included                      =     6701787
Mean of cells included                        =       41.5903
Standard Deviation (sigma) of cell values     =        0.0033

Spatial Autocorrelation (Moran's I)           =        0.9839
Expected value of I if not autocorrelated     =       -0.0000
Variance of I (normality assumption)          =        0.0000
Variance of I (randomization assumption)      =        0.0000
z test stat   (normality assumption)          =     4101.9644
z test stat   (randomization assumption)      =     4101.9658
```

C- The statistical method Results (TRANSFORM)(CVN) (figure 17)

```
Case  : King's Case

Number of cells included                      =     6701787
Mean of cells included                        =       16.0793
Standard Deviation (sigma) of cell values     =        0.0026

Spatial Autocorrelation (Moran's I)           =        1.2345
Expected value of I if not autocorrelated     =       -0.0000
Variance of I (normality assumption)          =        0.0000
Variance of I (randomization assumption)      =        0.0000
z test stat   (normality assumption)          =     5146.7222
z test stat   (randomization assumption)      =     5146.7222
```

D- The statistical method Results (PATTERN)(RELATIVE RICHNESS)(Figure 18)

```
Case   : King's Case

Number of cells included                       =      6701787
Mean of cells included                         =         1.5038
Standard Deviation (sigma) of cell values      =         0.0002

Spatial Autocorrelation (Moran's I)            =         1.0933
Expected value of I if not autocorrelated      =        -0.0000
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat    (normality assumption)          =      4558.2754
z test stat    (randomization assumption)      =      4558.2754
```

E- The statistical method Results (PATTERN)(DIVERSITY-H)(Figure 19)

```
Case   : King's Case

Number of cells included                       =      6701787
Mean of cells included                         =        44.1033
Standard Deviation (sigma) of cell values      =         0.0881

Spatial Autocorrelation (Moran's I)            =         1.2393
Expected value of I if not autocorrelated      =        -0.0000
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat    (normality assumption)          =      5166.9512
z test stat    (randomization assumption)      =      5166.9556
```

F- The statistical method Results (TREND)(CUBIC)(Figure 20)

```
Case   : King's Case

Number of cells included                       =      6701787
Mean of cells included                         =        63.9187
Standard Deviation (sigma) of cell values      =         0.0014

Spatial Autocorrelation (Moran's I)            =         1.3401
Expected value of I if not autocorrelated      =        -0.0000
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat    (normality assumption)          =      5587.0396
z test stat    (randomization assumption)      =      5587.0400
```

G- The statistical method Results (TREND)(LINEAR)(Figure 21)

```
Case   : King's Case

Number of cells included                       =      6701787
Mean of cells included                         =        62.5853
Standard Deviation (sigma) of cell values      =         0.0016

Spatial Autocorrelation (Moran's I)            =         1.3028
Expected value of I if not autocorrelated      =        -0.0000
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat    (normality assumption)          =      5431.8740
z test stat    (randomization assumption)      =      5431.8735
```

H- The statistical method Results(TREND)(Quadratic's)(figure 22)

2-Babylon model:

```
Case  : King's Case

Number of cells included                       =      11815
Mean of cells included                         =        10.6661
Standard Deviation (sigma) of cell values      =         0.0274

Spatial Autocorrelation (Moran's I)            =         0.8451
Expected value of I if not autocorrelated      =        -0.0001
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat   (normality assumption)           =       179.8651
z test stat   (randomization assumption)       =       179.8667
```

A-The statistical method Results (Transform)(square Root)(figure 23)

```
Case  : King's Case

Number of cells included                       =      11815
Mean of cells included                         =       122.6581
Standard Deviation (sigma) of cell values      =         0.5252

Spatial Autocorrelation (Moran's I)            =         0.8369
Expected value of I if not autocorrelated      =        -0.0001
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat   (normality assumption)           =       178.1107
z test stat   (randomization assumption)       =       178.1046
```

B- The statistical method Results (Transform)(Absolute numbers)(figure 24)

```
Case  : King's Case

Number of cells included                       =      11815
Mean of cells included                         =        42.5419
Standard Deviation (sigma) of cell values      =         0.1151

Spatial Autocorrelation (Moran's I)            =         0.7678
Expected value of I if not autocorrelated      =        -0.0001
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat   (normality assumption)           =       163.4196
z test stat   (randomization assumption)       =       163.4465
```

C- The statistical method Results (TRANSFORM)(CVN) (figure 25)

```
Case  : King's Case

Number of cells included                       =      11815
Mean of cells included                         =         9.5351
Standard Deviation (sigma) of cell values      =         0.0299

Spatial Autocorrelation (Moran's I)            =         0.8388
Expected value of I if not autocorrelated      =        -0.0001
Variance of I (normality assumption)           =         0.0000
Variance of I (randomization assumption)       =         0.0000
z test stat   (normality assumption)           =       178.5257
z test stat   (randomization assumption)       =       178.5269
```

D- The statistical method Results (PATTERN)(RELATIVE RICHNESS)(Figure 26)

```
Case  : King's Case


Number of cells included                     =      11815
Mean of cells included                       =         1.9970
Standard Deviation (sigma) of cell values    =         0.0023


Spatial Autocorrelation (Moran's I)          =         0.6134
Expected value of I if not autocorrelated    =        -0.0001
Variance of I (normality assumption)         =         0.0000
Variance of I (randomization assumption)     =         0.0000
z test stat   (normality assumption)         =       130.5486
z test stat   (randomization assumption)     =       130.5887
```

E- The statistical method Results (PATTERN)(DIVERSITY-H)(Figure 27)

```
Case  : King's Case


Number of cells included                     =      11815
Mean of cells included                       =       122.6581
Standard Deviation (sigma) of cell values    =         0.0721


Spatial Autocorrelation (Moran's I)          =         0.9866
Expected value of I if not autocorrelated    =        -0.0001
Variance of I (normality assumption)         =         0.0000
Variance of I (randomization assumption)     =         0.0000
z test stat   (normality assumption)         =       209.9773
z test stat   (randomization assumption)     =       209.9713
```

F- The statistical method Results (TREND)(CUBIC)(Figure 28)

```
Case  : King's Case


Number of cells included                     =      11815
Mean of cells included                       =       122.6651
Standard Deviation (sigma) of cell values    =         0.2524


Spatial Autocorrelation (Moran's I)          =         0.9750
Expected value of I if not autocorrelated    =        -0.0001
Variance of I (normality assumption)         =         0.0000
Variance of I (randomization assumption)     =         0.0000
z test stat   (normality assumption)         =       207.5007
z test stat   (randomization assumption)     =       207.5055
```

G- The statistical method Results (TREND)(LINEAR)(Figure 29)

```
Case  : King's Case


Number of cells included                     =      11815
Mean of cells included                       =       122.6655
Standard Deviation (sigma) of cell values    =         0.2141


Spatial Autocorrelation (Moran's I)          =         0.9776
Expected value of I if not autocorrelated    =        -0.0001
Variance of I (normality assumption)         =         0.0000
Variance of I (randomization assumption)     =         0.0000
z test stat   (normality assumption)         =       208.0618
z test stat   (randomization assumption)     =       208.0591
```

H- The statistical method Results(TREND)(Quadratic's)(figure 30)

Results and Discussion:

From the research result, the spatial auto correlation index analysis king procedure for generalized maps and test result, the following has been clarified:

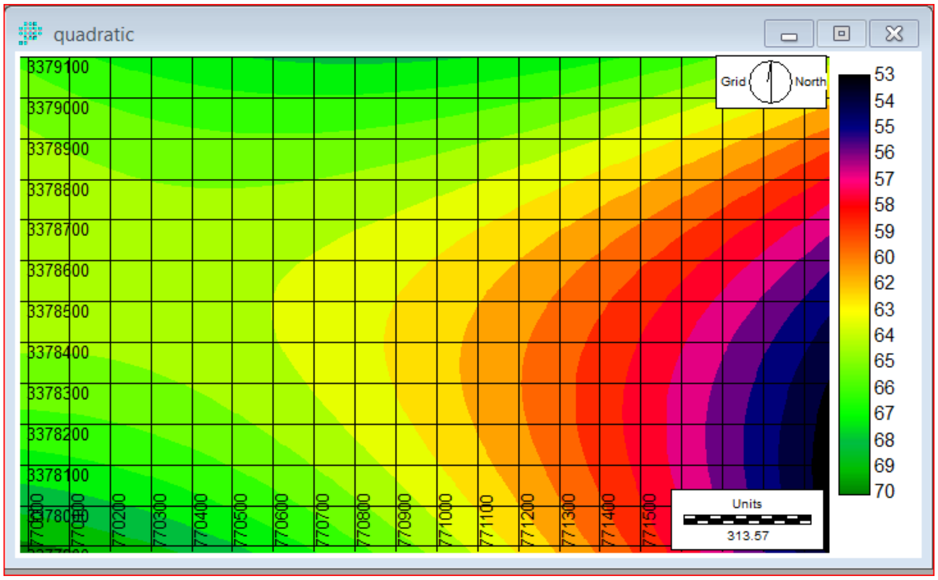
1 –Basrah model:

A –Generalizing the map the algebra method and transform procedure according to the absolute numbers, the correlation index reached (1.22) which is better than the square root procedure which reached (1.88).

B –The algebra method with the pattern procedure according to relative richness reached (1.2345) which is better than the two procedures (CVN) and (diversity-H), since the correlation index reached (0.9839) and (1.0933) respectively.

C –The algebra method with the trend procedure according to the Quadratic root reached (1.3407) compared to the two procedures which are the cubic that reached (1.2393) and linear that reached (1.3028).

Compared to all the procedure of the map algebra method which were used in analysis and from the test result s, it is shown that the quad procedure which reached a spatial correlation index of (1.3407) is the highest index for all the procedure,(figure 31).



Figure(31): Generalized map according to the QUAD procedure of the algebra method for the Basrah model

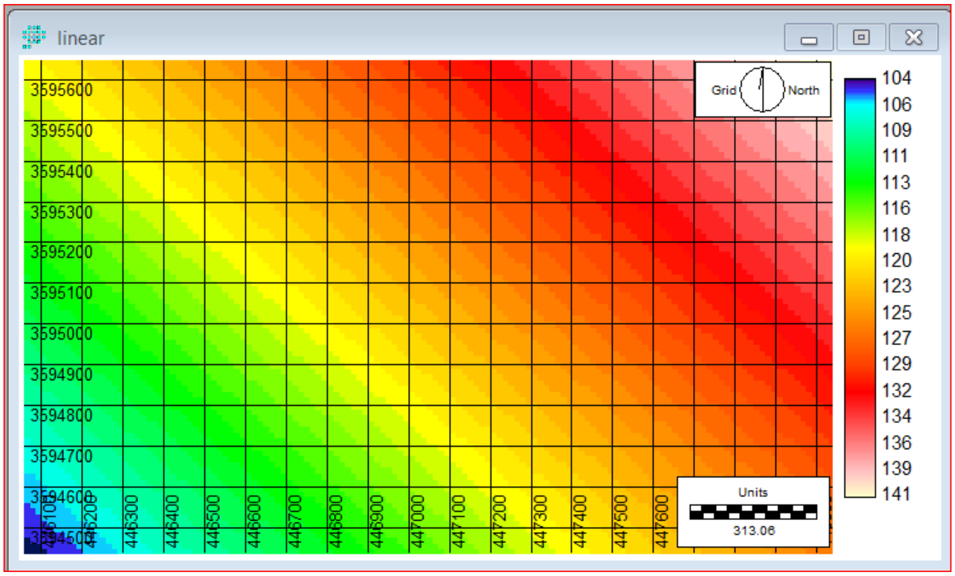
2 -Babylon model:

A -Generalizing the map the algebra method and transform procedure according to absolute number reached a correlation index of (0.8457) and this is better than the square root procedure whichreached (0.8369).

B –The algebra method and pattern procedure according to relative richness reached (0.8388) and this is better than the two procedures, CVN and Diversity-H, in which the correlation index for both was (0.7678) and (0.6134) respectively.

C –The algebra method and trend procedure according to the linear reached (0.9866) compared to the two procedures of quad which reached (0.9776) and cubic which reached (0.9750).

Compared to all the procedure of the map algebra method which was used in analysis and from the test result, it is shown that the linear procedure which reached a spatial correlation index of (0.9866) is the highest index for all the procedure.,(figure 32).



(figure 32) Generalized map according to the(trend/ linear)procedure of the algebra method for the Babylon model

Reference:

1- Dawod, Gomaa M., 2012, An Introduction to digital Maps (in Arabic), Holy Makkah, Saudi Arabiap.186.
2- IDRISI Source Code, HELP,2005.
3- Rolf.A.de &Authors , Principles of Geographic Information Systems , 2009,p.304
4- Rolf.A.de &Authors, Op, cit,309.
5- Al azawialiabd ,2010, Spatial Statistical Analysis in GIS (in Arabic)university of Mosel, college of education,p.3.
6- Dickinson, G.C. " Statistical Mapping". Edward Arnold Ltd. London.1987.P.142
7- Al Gamdi , ali bin madtha ,2003, random method of cells thinning in Generalization map network and new proposition method ,journal of sociologic science , vol 31,No 4,p.888.
8- Al Gamdi ,ali bin madtha , Op,Cit,p.889 .
9- Al azawi ail abd, Op,Cit,p.7.
10- Mitchell, Andy. The ESRI Guide to GIS Analysis, Volume 2. ESRI Press, 2005.P.186