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**THE INVESTIGATION OF SPOT CHANGES OF DOWNFALL IN NORTH-WEST OF
IRAN BY GIS, DIFFERENT ALGEBRAIC METHODS AND GEOSTATIC, PROPOSE
BEST MODEL**

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ABSTRACT

Interpolation is one of the best methods that used by climatologist in zoning studies. Geostatic theory is a branch of applied statistics which plays vital role in earthy observations. From the geostatic point of view there is a relation between each sample and nearest sample to it. In fact according to geostatic theory, there is possibility that nearer samples to each other have same features. It hopes geostatic be more accurate by considering correlation and structure of data positions and potentials between parameters. In this study different models of interpolation such as LP (Local Polynomial Interpolation), GP (GLOBAL Polynomial Interpolation) Kriging and CoKriging (ordinary, simple) and Gaussian and Spherical methods with using Arc GIS software, analyze thirty years average of downfall in north-west of Iran. By analyzing interpolations methods, this result reveals that CoKriging and Ordinary Kriging are the best patterns among interpolations techniques to calculate average of downfall at north-west of Iran.

Keywords: Interpolation, north-west of Iran, CoKriging and Kriging, GIS

INTRODUCTION

Interpolation is a process of estimating quantitative values for a spot without data by assisting data of adjacent spot. Interpolation carry out by climatologist because of

limitations of spot datum and need for maps (same downfall, same temperature. There are two ways to carry out Interpolation: local and global. Global interpolation use data of a

distinct spot to estimate value of indistinct spot. Local interpolation use only few samples of distinct spots to estimate values of indistinct spots. In another division, accuracy is a criteria to estimate. In accurate method, calculated values verified observations. Whereas in inaccurate method values are approximate and superficial. The third criteria of division of interpolation is based upon definite and indefinite estimation. In definite method, estimation values are free from error, but indefinite estimation may has error. All kinds of interpolations can be written in linear or non-linear equations.

In this regard, egosquiza (1998) In order to estimate downfall of gowdal horse aquiferous in north Spain used old methods such as Thiessen method and Kriging. Result shown that Kriging method was more reliable proud room and red 1999 in a study proved that using typography data help to predict rainfall in ordinary kriging method. Drogo et al (2002) in order to make a quasi-analysis downfall map mountains in north-east of France compare linear regression methods among analogize of morphology due digital, multi parameters methods of geostatic like kriging with CoKriging on 20 years network data include 150 stations with area 30000 Km².

In relation to make maps of downfall and drought in Iran, ghahroudi tali (1381) analyzed interpolation by using kriging method and wheiteng pictures in Kerman province. The results shown that kriging technique is much dependent on too many sampling spot and distance between each other. Thaghafian and Rahimi Bandar Abadi (1384) investigate the capabilities of many interpolation techniques such as linear weighted moving average and kriging to estimate distribution of downfall in each position at monthly and yearly. Comparison of techniques done by sectional validation shows that CoKriging technique shows changes of downfall spot more accurate and they were more compatible. Application of rebuilding data make some errors. Monthly and yearly downfall of Karoon area calculated by geostatic techniques and data of 28 aerology stations during 28 years of statistical period, by CoKriging and Kriging techniques with secondary parameters such as height and Weighting of pictures with exponentiation 1 to 4. Result shows that estimation of yearly and monthly downfall acquired by kriging was more reliable.

METHODOLOGY

Area of study:

Area of study is Azarbayjane-sharghi, Azarbaijane-gharbi and Ardabil. This study

analyzes data of 30 years average of downfall (1975-2005). This study investigate data of 14 aerology stations of north-west of Iran. This

study analyzed many interpolations techniques to acquire best results.

Chart 1: Data of average of 30 years downfall, aerology station in north-west of Iran

city	Mahabad	Piranshahr	Makoo	Khoori	Oroomie	Jolfa	Tabriz
rainfall	436	621	300	265	365	189	307
temperature	12/4	11/4	9/9	11/7	10/9	14/6	10/47
city	Pars Abad	Ardabil	Ahar	Sarab	Maraghe	Takab	Sardasht
rainfall	271	281	307	236	366	401	584
temperature	14/8	8/2	10	8/22	12/5	9/11	11/3

For interpolations following steps must be carry out:

1- Is data normally distributed?

If data are not normally distributed: it is a need to be distributed by existing functions in ARC Map (Arc Sin, Log و Box-Cox) software.

If data are correlated?

Because all data are normally distributed:

Skewness=0 and kurtosis=3, so according to investigations, suitable technique to make data normal and by paying attention to following chart, function is log. (figure1) (chart2)



Figure 1: histogram of normalization of data

Chart 2: choose suitable method to normalize data

Conversion type	Skewness	Kurtosis
None	1.025	3.161
Log	0.406	2.636
Box-Cox	1.025	3.161

1- Interpolation by IDW technique

This technique is absolute and Algebraic, distance plays important role in this technique. All of interpolation techniques developed based on this assumption that

nearer spots in comparison to farther spots have same values and correlations. It is defined by reverse function from spot to spot to neighbor spot. It must be noted that definition of radius of a neighbor to other

spots and function of reverse distant are important factors. This technique used when spot sample with available sufficient scattering exist in regional scale. Formula 1 used in this technique:

$$Z(s_0) = \sum \lambda_i \times Z(S_i) \quad (1)$$

In order to do this, three factors must be investigated:

Specify optimized exponentiation, specify searching for neighbor and validation.

2-Interpolation by Kriging technique

Kriging is one of the geostatic technique. It is one of the advanced and recommended technique to area investigation and regional distribution of data of spots. This technique is optimized estimation that used parameters in it somehow are random and does not follow geometric function. Generally Kriging has two main duty?

Variography: specify quantity of structure spots of dada (suit model according to position on data)

Production prediction: make prediction to x values in a special situation.

Formula 2 used in this situation

$$Z(s_0) = \sum \lambda_i \times Z(S_i) \quad (2)$$

Ordinary kriging and Simple Kriging by Spherical and Gaussian

Formula 3 used

$$Z(s) = \mu + \varepsilon(s)$$

(3)

3- GLOBAL Polynomial Interpolation technique

This technique is one the algebraic. It suits when values changes in sample spot

Are not too much. This technique is sensitive to outlier. Results of global Polynomial Interpolation are one level of smoothed math. This technique shows gradual trends. Follow are the application of this technique:

1- Surface suit for sampled spot, when surface changes gradually from one spot to other.

2- To test or remove effects of trends.

4- Local Polynomial Interpolation technique

It is one the algebraic technique, this technique suits when there is no upheaval among data. This technique is sensitive to distant of neighbors.

5- Cokriging technique

This technique used two set of interpolation and investigate effect of two set on each other. This article investigate two sets of temperatures data and downfall of north-west.

Regarding to abundance of techniques, in following we discuss about only some interpolations techniques.

- IDW technique

IDW technique, is one of the interpolations that estimation based upon values of nearest

spots to desired spot sample. So Weighting based upon reverse distant of spot (figure 2). In other words, weighting more allocated to nearest spot in comparison to farther spot. This technique unlike cokriging does not follow assumptions related to spot connection of data. The only assumption here

is nearer spots have same value to estimated spot in comparison to farther spots.

In IDW technique, optimized exponent calculated by RMS. (best exponent have the least error). RMS is a statistical stage and make and investigated in cross validation. For having the least error, different exponent (optimized exponent 1, 2, and 4) calculated.

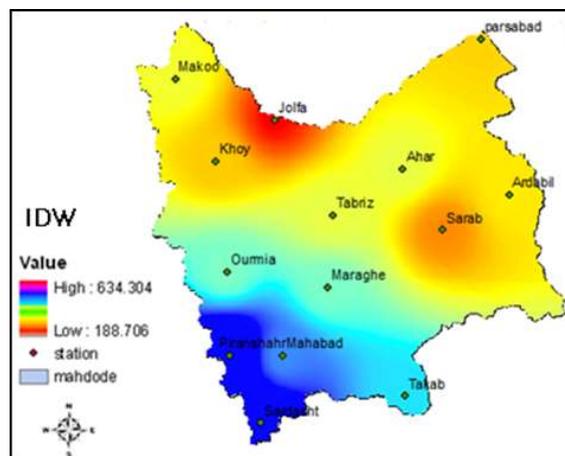


Figure 2: interpolation by IDW with optimized exponent

optimized exponent	exponent4	exponent2	exponent1
72.74	75.49	76.22	91.53

Chart 3: calculated RMS with different IDW

-Simple Kriging with Spherical method

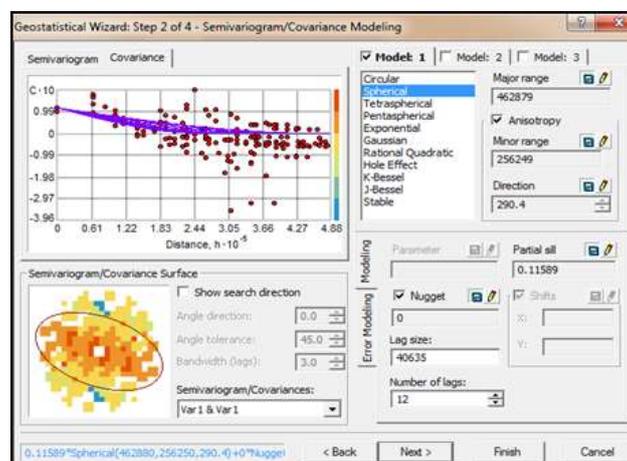


Fig 3: semi-Variogram/co-variance

This interpolation technique used two sets of data, and then investigate effects of two sets on each other. In the following, effect of two

sets of data temperature and downfall of north-west has been investigated. (Fig 4 and 5)

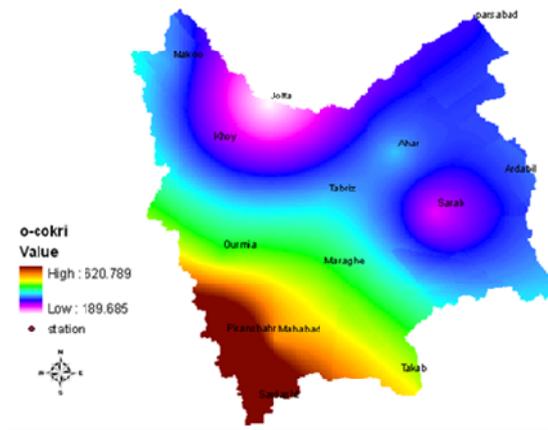


Fig 4 interpolation by Ordinary Cokriging

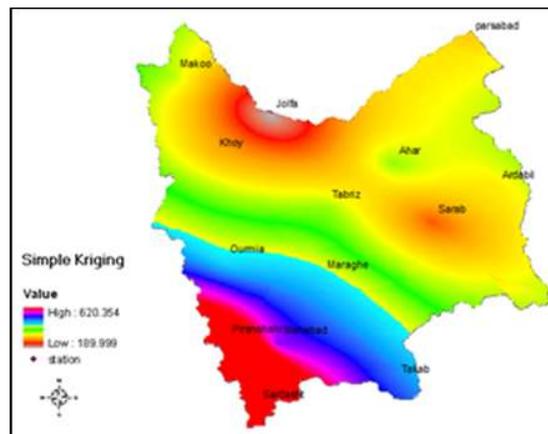


Fig5: interpolation by simple kriging

Following results achieved by doing compare command: (figs 6 and 7)

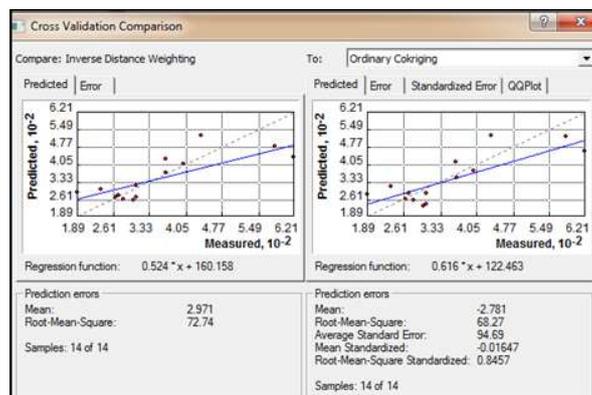


Fig 6: comparison of IDW technique to Ordinary Cokriging

By comparing RMSs. Ordinary Cokriging has few RMS, so this technique was better than IDW.

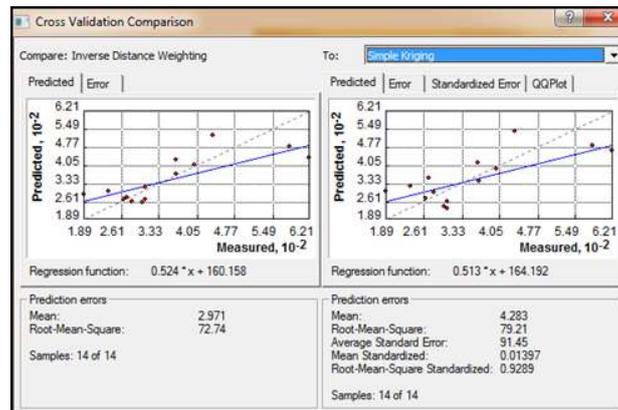


Fig7: comparison of IDW technique to simple kriging

IDW technique proved that it was proper to show distribution of data, and cokriging was proper to show trend of data changes. By comparing RMSs, IDW technique has few RMS so, was better than simple kriging. Descriptions of done techniques and choosing best model:

- 1- Best model is standardized mean near to zero. (Mean Standardized ≈ 0)
- 2- RMS (Root-Mean-Square) must be at lowest predicted value
- 3 - ASE (Average Standard error) must be nearer to RMS
- 4- RMSS (Root-Mean-Square-Standardized) must be nearer to one. (RMSS ≈ 1)

	Interpolation method	RMS	Mean
1	LP	74.49	3.38
2	GP	482.5	-462.4
3	IDW Optimize power	72.74	2.971
4	IDW power=1	91.53	-1.836
5	IDW power=2	76.22	1.677
6	IDW power=4	75.49	3.634
7	Ordinary kriging Method :Spherical	69.04	-2.852
8	Ordinary kriging Method :Gaussian	65.95	-3.253
9	Simple kriging Method :Spherical	79.21	4.283
10	Simple kriging Method :Gaussian	103.1	5.493
11	Ordinary Cokriging Method :Spherical	68.27	-2.78
12	Ordinary Cokriging Method :Gaussian	64.57	- 4.515
13	Simple Cokriging Method :Spherical	81.94	4.865
14	Simple Cokriging Method :Gaussian	104.5	7.163

Chart 4: achieved results from different interpolations technique

RESULTS AND DISCUSSION

This study investigates different interpolations techniques (14 techniques) on average of downfall data from 14 aerology stations in north-west of Iran. Following results achieved:

1- In each technique, all data from 14 aerology stations at north-west of Iran has been investigated. Whatever RMS is lower, result was more reliable. RMS used as a criteria in comparing all techniques.

2- While using IDW, different exponent such as optimized exponent was investigated. Achieved results from optimized exponent has less errors, in comparison to other exponents.

3- In order to normalize data, after investigating EDSA and observing histogram, best converter in order to normalize data was using log as a function.

4- While using kriging technique, ordinary and simple was investigated. Each one of these techniques investigated one time with Spherical and other time by Gaussian. Achieved results from Gaussian

was more reliable in O-kriging, but in S-Kriging technique, results from spherical was more proper.

5- While using Co-kriging technique, simple and ordinary was investigated. Each one of these techniques investigated one time with Spherical and other time by Gaussian. Achieved results from Gaussian was more reliable in O-cokriging, but in S-Kriging technique, results from spherical was more proper.

6- In comparing LP and GP technique, it was observed that difference between RMS was upheaval. So regarding changes in data, GP technique was completely improper to investigating this kind of data.

7- Finally, by investigating 14 interpolations technique and comparing RMSs, result of Ordinary Cokriging with Gaussian model was $RMS=64.579$ and Ordinary Kriging with Gaussian model $RMS=65.95$. So it is proved that they were best interpolations techniques for north-west of Iran. Between two above chosen techniques, ordinary kriging with Gaussian is recommended.

Interpolation type	Regression function	model	RMS
Ordinary Cokriging	$0.668^*X+112.397$	Gaussian	64.579
Ordinary Kriging	$0.670^*X+112.931$	Gaussian	65.95

Chart 5: best recommended interpolation technique

NOMENCLATURE

GENERAL AND ABBREVIATION

Z (so) position of unknown spots; λ_i : calculated weight (distant) at i spot; Z (si: calculated values from i spot; $Z(s)$: parameter; $\varepsilon(s)$: random error; μ : fixed constant

REFERENCES

- [1] Drogue, G., J. Humbert, J., Deraisme, N., Mahr, and N. Freslon. 2002. A statistic altographic model using an omni directional parameterization of the relief for mapping orographic rainfall. *Inter. J. Climate*. 22(5): 599-613.
- [2] Igúzquiza, E. P., 1998. Comparison of geostatistical methods for estimating the areal average climatological rainfall mean using data on precipitation and topography. *Inter. J. Climate*. 8(9): 1031– 1047.
- [3] Prudhomme, C. and D. Redd. 1999. Mapping extreme rainfall in a mountainous region using geostatistical techniques: A case study in Scotland. *Inter. J. Climate*. 19: 1337-1356.
- [4] Ghohroudi Tully, M. 1385 "Evaluation of the kriging interpolation", *Studies in Geography*, 43 Page 14 of 27.
- [5] Saghafian B, fourth / summer 1390, "The regional variation in annual rainfall geostatistical methods Bakarbrd (Case study: Fars)", *Journal of Water Resources Engineering*, page 12 to 23