Spatial Approach to Capitalization Rate and Risk Premium Determination in the Residential Market Segment: a case in Manfredonia (Italy)

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Abstract This paper is an empirical study of the capitalization rates for 41 residential properties in Manfredonia from 2012 to 2014. While literature is normally focused on the cap rate determination (Macdonald et al., 2008) and his linkage with time series and with models such as band of investment analysis and their relationship with the equity determination in this work a spatial approach to cap rate and risk premium determination is proposed. It will be shown how it is possible to use cap rate as a tool for real estate market analysis. Evidence from the application of spatial technique to cap rate and risk premium determination demonstrates the importance of this technique in the real estate market analysis.

Keywords: Capitalization rates, Residential Properties, Property Valuation

1 Introduction

The capitalization rate has a critical role in property valuation and investment. In the valuation process the selection of an accurate cap rate can be premise for an accurate value determination in the valuation especially of commercial or residential properties. Using income approach the value can be seen as the ratio between the net operate income and the cap rate. According to International Valuation Standards methods falling under the income approach include"…income capitalisation where an all risks or overall capitalization rate is applied to a representative single period income…"(IVS 2013, IVS Framework, para 60). There are several ways to address the problem of capitalization rate determination the paper explores the relationship between cap rate determination and his spatial dimension. The paper is organized as follows. In the following paragraph a brief profile of the literature review concerning cap rate analysis and cap rate determination is provided. The next paragraph will highlight a kriging analysis applied to the cap rate determination. In a further paragraph will be proposed a model to address risk premium maps trying to develop a spatial analysis of the risk premium. Final remarks and future directions of research will be offered at the end.

2. Literature Review

Literature on cap rate is normally focused on office building cap rate (Macdonald et al., 2008) determination. In this field a former group of works links the variability of cap rate along the time to capital markets and other variables (Nourse,1987; Ambruose et al, 1993; Jud and Winkler, 1995). In particular (Nourse, 1987) analysed a time series for multifamily non residential properties. The author showed that debt service payment increases the cap rate while the percentage of amortized loan had negative. Ambrose and Nourse (1993) based their analysis on national data on individual property types, and estimated a time-series, cross-section model in which the capitalization rate is a function of financial variables finding that the coefficients of the debt and equity variables were found to be positive correlated and highly statistically significant. The coefficient of the earnings divided for price ratio was found to be negative correlated and highly statistically significant. The study by Jud and Winkler (1995) proposed a financial model based on the capital asset pricing model (CAPM) that includes the variables the earlier studies had employed. In this model the capitalization rate minus the risk-free interest rate is a function of the spread between the long-term debt and risk-free rate, the expected return to the market portfolio minus the risk-free rate (the traditional CAPM variable), and the expected growth rate of the income stream. A latter group of contribution is focused on the cross section variation of capitalization rate across the property types and metropolitan areas. Among others contributions Sirmans et al. (1986), Sivitanides and Sivitanidou (1996), and Sivitanidou and Sivitanides (1999). The study by Sirmans et al. (1986) is based on market-extracted capitalization rates for apartment buildings in the Chicago metropolitan area. This study showed a relationship among location, physical characteristics of the property and capitalization rate. Sivitanides and Sivitanidou (1996) found that the vacancy rate and the lagged capitalization rate had positive effects, and absorption and the size of the stock of office space had negative effects on the capitalization rate. The work was developed in a metropolitan area Sivitanidou and Sivitanides (1999), using panel data found that the average capitalization rate in a metropolitan area was negatively related to local demand variables. This paper is based on financial information from apartment properties. There are several kinds of models to determine capitalization rates. They can be derived from ratio between rent and price, in other case they can be subtracting from the discount rate the rate of growth (Gordon Shapiro,1952) a further model is the underwriter method (Gettel,1978) and the weighted mean between equity and mortage according to the specific loan to value ratio (Kazdin, 1944). In this paper the attention will be focused on overall capitalization rate determination based on the Gordon Shapiro model. The role of spatially modelled variable in real estate has been highlighted in several different works (Des Rosiers et al., 2003; Des Rosiers et al., 2005). In this paper it will be shown how spatial technique such as kriging may be useful to model cap rate and risk premium in the residential real estate market. Furthermore the limits of addressing the problem of risk premium determination without dealing with a spatial dimension will be quite evident. This is particularly true in the direct real estate market. Although the failure of Capital Asset Price Method previoulsy highlighted (Draper and Findlay,1982) the method is still proposed as a way to estimate risk premium for valuation and assessment of worth purposes. In this contribution it is highlighted the weight of the spatial component to determine the risk premium and consequently the need of a different approach to risk premium estimation rooted in the real estate transactions.

3.Data

The data for the study are the records of 41 sold residential apartments in condominium in Manfredonia with a relative rent. Manfredonia is a small urban center in the Foggia province in Puglia. It is located in the northern part of the region at south east Italy. The data have been collected by several real estate broker agencies in the area. The data are listed in the table 1 of appendix 1 The data consists in the records of 41 sold residential apartments in condominium in Manfredonia with prices and relative rents. The sample has an approximate normal distribution the Shapiro Wilk test showed the normality of the sample. In order to define a spatial relationship between cap rates and spatial a kriging application will be proposed. Before applying this method it is necessary to analyse the degree of spatial autocorrelation of the spatial variable x in this case the cap rate and the coordinates. The most commonly used and robust indicator was proposed by the statistician Moran (Moran,1948; Moran,1950) and is normally indicated as Moran I test indicated in the formula n.1 below

$$I = \frac{N\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})^2} \quad (1)$$

where x is the variable (the market basket value), and wij represents the set of weight j for observation i. In this case the inverse squared distance among the observations has been considered according to previous works (Des Rosiers et al., 1999). The Moran's I range from -1 to +1 and each observation is only compared with its relevant neighbourhood. Positive Moran's I showed positive autocorrelation as a consequence high values for x or cap rates should be located near other high values while lower cap rates should be located near other cap rates. A significantly negative Moran's I implies spatial heterogeneity, or that high values are near low, or viceversa. In our case the value is positive of 0,4501 showing a positive correlation between cap rates. This offers the opportunity to apply kriging techniques. Kriging geostatistical procedure (Journel and Huijbregts 1978) is one of the more frequently used methods of interpolation data spatially correlated. The essence of this method consists in carrying out the optimal interpolation of mean values of parameters and the correct interpretation of the spatial structure of data (Cellmer 2014 for Namyslowska-Wilczynska 2006). Kriging is a group of geostatistical estimation methods, which achieves the best unencumbered linear estimation of the value of the analyzed variable. Its estimates are a linear combination of the available data, whether one wishes to estimate the standard error is equal to zero. This method allows for the identification of general regularities in the distribution of spatial data, and then based on these regularities allows you to make spatial interpolation. It is mainly used for quantitative data expressed on a scale quotient or interval (Longley et al. 2005). The difference between the kriging and other spatial interpolation methods lies in the fact that allocating a set of weights for the analyzed variable, minimizes the variance of the estimator (kriging variance) (Cellmer 2014). Kriging as a method of stochastic is considered the best method of interpolation heterogeneous phenomenas. It takes into account the general trend of data and is especially useful in situations where the data is distributed unevenly (Davis 1986). The final application of linear kriging technique is showed in the following figure 1 indicated in the appendix 1 (Ciuna et al., 2014; Salvo et al., 2014). In three dimensions the wire frame indicates the spatial distribution of cap rate confirming that the cap rates tend to increase in the peripheral and semi peripheral areas and tend to decrease in the central areas because of the growth of the price of the home. In some semi central place it is possible to observe some peaks that are mainly connected to new refurbishment of houses. The first wireframe proposed is indicated in the figure 2 in the appendix 1 to this work. A further step is the definition of risk premium model based on the formula of direct capitalization. In fact as it will be seen risk premium is a component of cap rate. Therefore it is possible to define also specific risk premium maps.

4. Risk Premium Maps Model D

Following previous works on regressed DCF (d'Amato and Kauko, 2012; d'Amato, 2017) The work propose a risk premium map determination starting from the Dividend Discount Model (Gordon Shapiro, 1956; Gordon, 1962). The work starts from a previous spatial approach to risk premium which links risk premium determination to space. In the previous work three different models for risk premium maps have been estimated called A,B and C. The approach will demonstrate the role of spatial dimension in risk assessment determination. In order to apply the proposed model D for spatial determination of risk premium it is important to start from the Dividend Discount Model whose formula is indicated below:

$$P = \frac{NOI}{Y - g} \quad (2)$$

In the formula 2 P is the price, NOI is the net operate income of the property or the rent of the property, Y is the discount rate while g is the growth factor that can be both positive and negative. Therefore it is possible to write

$$Y - g = \frac{NOI}{P} \quad (3)$$

Assuming Y as a discount rate composed by a risk free and a risk premium we have

$$\frac{NOI}{P} = R_f + R_p - g \quad (4)$$

Therefore it is easy to write that risk premium is

$$R_p = \frac{NOI}{P} - R_f + g \quad (5)$$

Therefore it is possible propose a risk premium map based on direct capitalization Rent growth may be a good proxy for NOI growth when net rents prevail in the lease market as, for example, in the office rental market. In other market settings, such as for apartments, rent growth may not approximate NOI growth nearly as well but will be a possible solution. The risk free will be the gilt. In this case will be the Italian gilt. The g factor can be calculated as the product between a sinking fund factor and the perspective rate of growth. Following the Inwood premise both the product will be operated considering the same discount rate (d'Amato,2015). The perspective growth of the properties has been calculated using the following variation ratio among the similar property in the neighbourhood multiplying the growth rate Δ for a sinking fund factor a :

$$\Delta a = \frac{R_t - R_0}{R_0 t} \frac{Y}{(1+Y)^n - 1} \quad (6)$$

The ratio will be applied to the closer observations.Therefore we have the data following in the table 2 in the appendix 1. In the table 2 the first and the second column provide the latitude and the longitude of the 41 observations considered in Manfredonia, whilst the third column indicates the risk premium as a difference in each observation calculated as indicated in the formula 5. The data are spatially autocorrelated and even in this case the Shapiro Wilk test confirmed the normality of the sample. In the figure 3 in the appendix 1 is possible to observe the spatial distribution of the risk premium. In three dimensions the wire frame indicates the spatial distribution of risk premium in the residential real estate market as in the figure 4 in the Appendix 1. Observing the fig.4 it is quite clear that there is a direct proportionality between the real estate risk premium and the cap rate. In the analysis of the spatial distribution of risk premium it is evident how risk premium decrease in the city centre and increase in the areas distant from the centre.

5. Conclusion and Future Directions of Research

The paper showed a possible application of spatial analysis to cap rate determination and risk premium maps. This tool is may have a potential application for risk mitigation and for real estate market analysis. Analysis confirm the importance of the spatial dimension of risk premium showing variability of risk premium and cap rate in a small town in the south east of Italy . A consequence is that financial procedures for risk premium and cap rate determination present limits to analyse reality. Future directions of research may be the use of spatio temporal modelling in order to join spatial and temporal information and improve market analysis and cap rate determination.

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Appendix 1

	LAT	LONGIT	PRICE	RENT	CAP RATE
1	41,63515833	15,92651111	155000	4560	0,0294
2	41,62670833	15,91057222	150000	4320	0,0288
3	41,625225	15,89404166	255000	5160	0,0202
4	41,63450555	15,92544166	250000	5160	0,0206
5	41,62622777	15,90914166	150000	4800	0,0320
6	41,63436666	15,90640555	185000	5400	0,0292
7	41,63049166	15,91410833	130000	4200	0,0323
8	41,63109722	15,91511666	120000	3840	0,0320
9	41,62483611	15,89415	155000	5040	0,0325
10	41,62306111	15,89472777	150000	5040	0,0336
11	41,62338888	15,89500555	200000	5040	0,0252
12	41,62748888	15,91327777	160000	6000	0,0375
13	41,62641388	15,89476111	180000	5040	0,0280
14	41,62195833	15,90226666	130000	4200	0,0323
15	41,63856666	15,91506944	130000	4320	0,0332
16	41,61729444	15,92145277	180000	4800	0,0267
17	41,62182777	15,902125	150000	4200	0,0280
18	41,63085555	15,91591111	180000	4560	0,0253
19	41,625825	15,90996111	210000	5160	0,0246
20	41,62605833	15,91158611	200000	5040	0,0252
21	41,63437777	15,92689722	200000	5400	0,0270
22	41,63706944	15,90974722	125000	3600	0,0288
23	41,63774722	15,91441944	160000	4200	0,0263
24	41,63605833	15,92293055	120000	3840	0,0320
25	41,62046388	15,90383611	150000	3600	0,0240
26	41,63461388	15,91258055	210000	5160	0,0246
27	41,62357777	15,90644444	180000	4800	0,0267
28	41,62672777	15,90999444	140000	4200	0,0300
29	41,62536944	15,89365277	100000	3600	0,0360
30	41,63497777	15,92925	165000	3840	0,0233
31	41,62445	15,907675	200000	4320	0,0216
32	41,63723611	15,90968888	125000	4080	0,0326
33	41,62699166	15,90883055	140000	3720	0,0266
34	41,62354444	15,89679166	230000	4920	0,0214
35	41,62609444	15,89622222	152000	4560	0,0300
36	41,62304722	15,90585	148500	4800	0,0323
37	41,63623333	15,92598611	155000	5400	0,0348
38	41,62546388	15,89676111	230000	5040	0,0219
39	41,62535277	15,89506944	150000	4800	0,0320
40	41,62483611	15,8927	210000	5400	0,0257
41	41,62370277	15,89325	150000	5760	0,0384

Table 1 – Sample of properties in Manfredonia

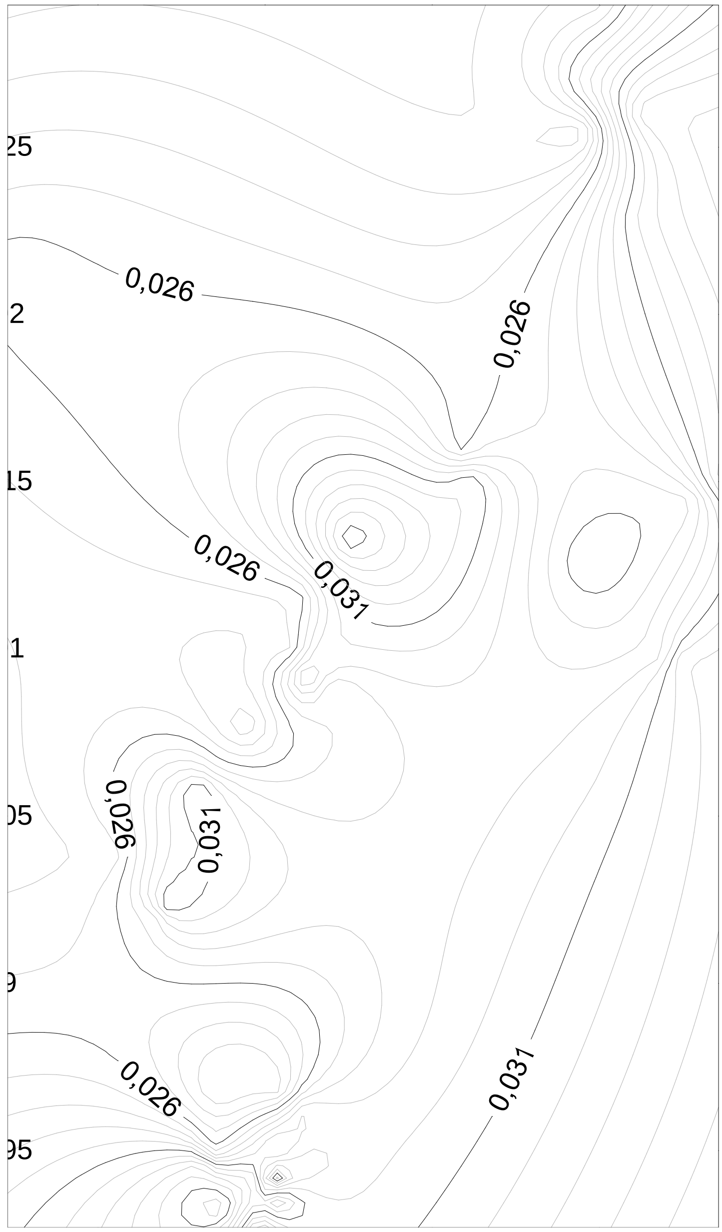

Figure 1 – Application of Kriging Technique to Capitalization Rates distribution

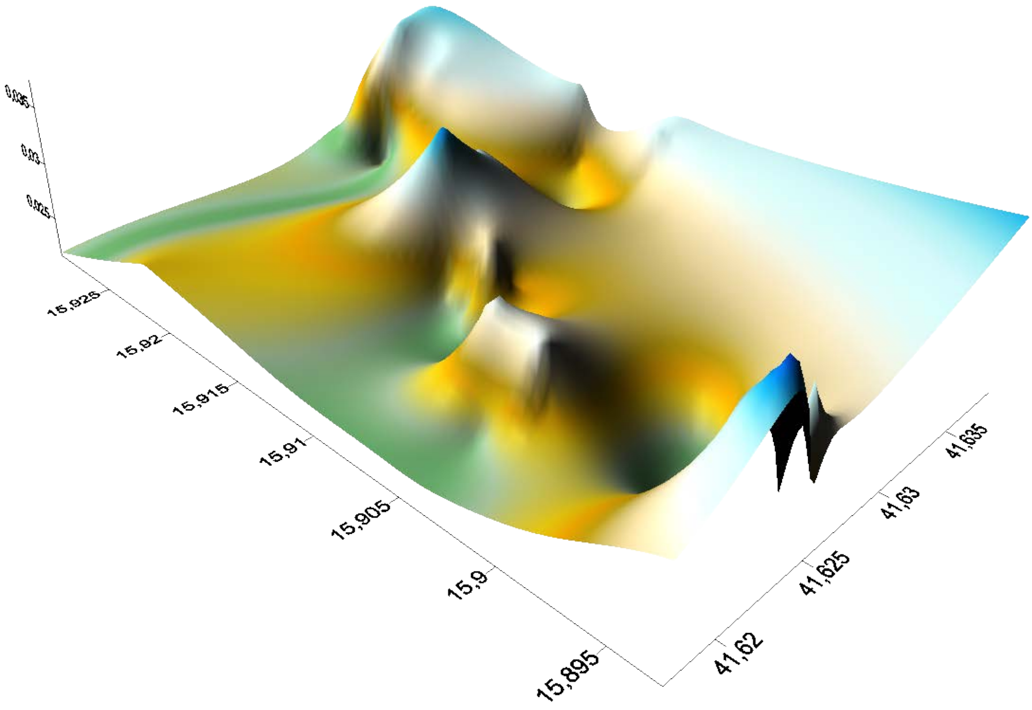

Figure 2 – Application of Kriging Technique to Capitalization Rates distribution in 3D

Latitude	Longitude	Risk Premium
41,635158	15,926511	0,014419355
41,626708	15,910572	0,0138
41,625225	15,894042	0,005235294
41,634506	15,925442	0,00664
41,626228	15,909142	0,017
41,634367	15,906406	0,014189189
41,630492	15,914108	0,015307692
41,631097	15,915117	0,017
41,624836	15,89415	0,018516129
41,623061	15,894728	0,0196
41,623389	15,895006	0,0122
41,627489	15,913278	0,0235
41,626414	15,894761	0,014
41,621958	15,902267	0,020307692
41,638567	15,915069	0,022230769
41,617294	15,921453	0,012466667
41,621828	15,902125	0,014
41,630856	15,915911	0,011333333
41,625825	15,909961	0,010571429
41,626058	15,911586	0,0112
41,634378	15,926897	0,01
41,637069	15,909747	0,0118
41,637747	15,914419	0,01225
41,636058	15,922931	0,018
41,620464	15,903836	0,009
41,634614	15,912581	0,010571429
41,623578	15,906444	0,011666667
41,626728	15,909994	0,015
41,625369	15,893653	0,021
41,634978	15,92925	0,007272727
41,62445	15,907675	0,0056
41,637236	15,909689	0,01664
41,626992	15,908831	0,010571429
41,623544	15,896792	0,005391304
41,626094	15,896222	0,014
41,623047	15,90585	0,015823232
41,636233	15,925986	0,01783871
41,625464	15,896761	0,005913043
41,625353	15,895069	0,016
41,624836	15,8927	0,011514286
41,623703	15,89325	0,0227

Table 2 – Risk Premium Determination

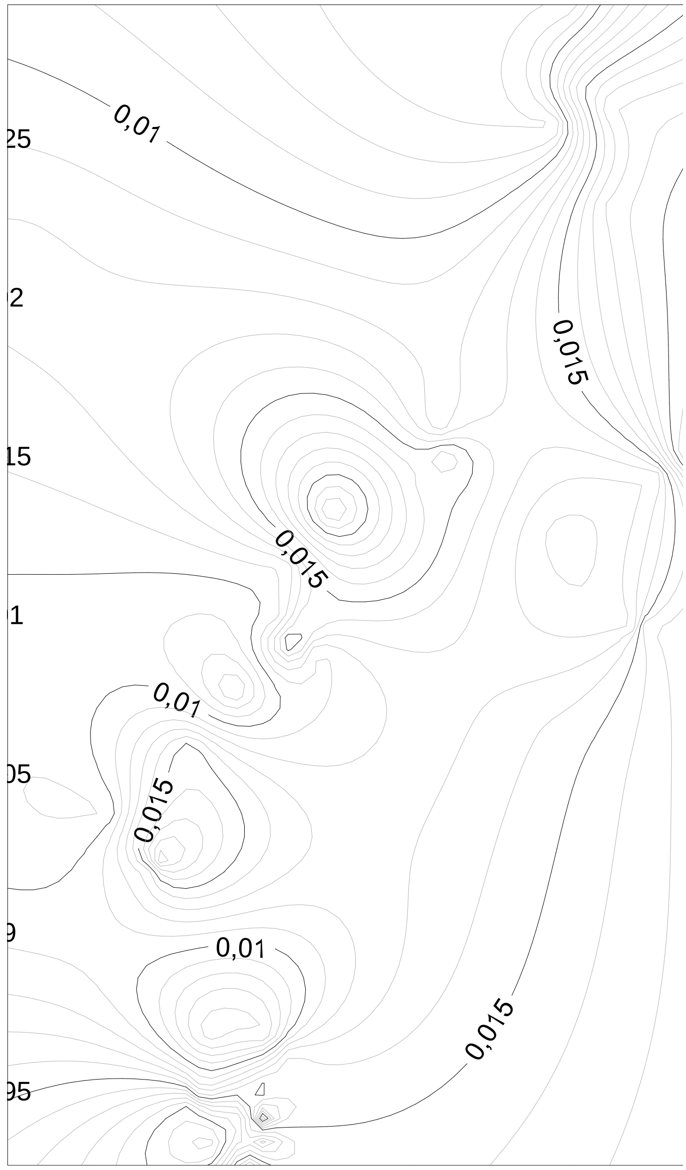

Figure 3 – Application of Kriging Technique to Risk Premium distribution: Risk Premium Map

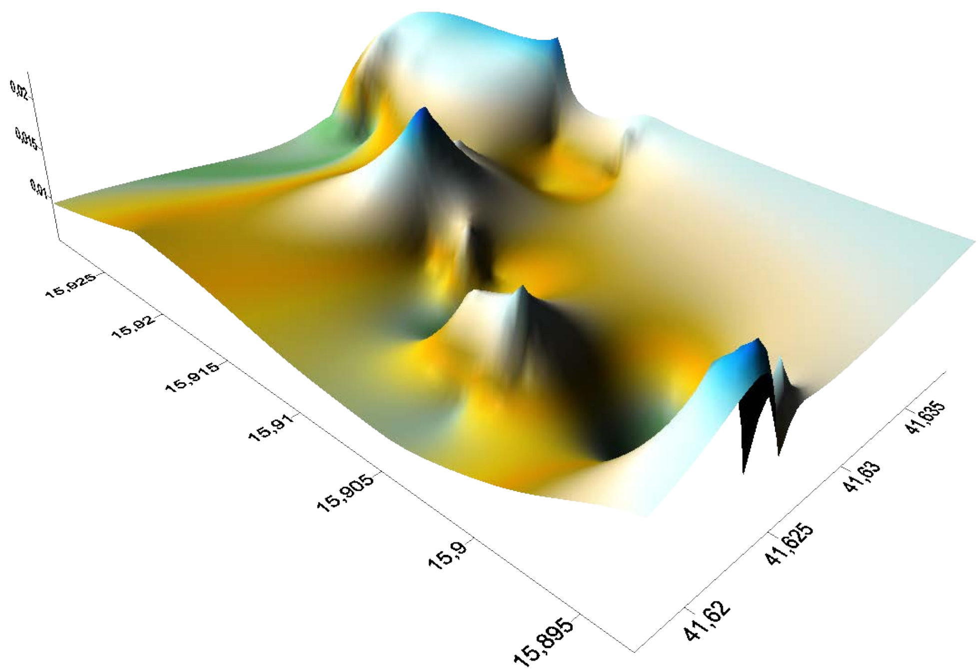

Figure 4 – Application of Kriging Technique to Risk Premium distribution in 3D