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Journal of Mathematics and System Science

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Examples for Application of Gravitational Model in the Investigation of Spatial Structure

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Abstract: In this paper the authors wish to introduce an application of the gravitational model through two concrete examples. In their investigation the gravitational model was transformed to analyze the spatial structure of Europe, and the impact of accessibility in Hungary. In this analysis not only the size of gravitational forces but their direction can also be measured. Displacements were illustrated by a bi-dimensional regression, which gives a new perspective to the investigation of spatial structure.

Key words: Gravitational model, bi-dimensional regression, accessibility, spatial structure, Europe, Hungary.

1. Introduction

The overall goal of modelling is to simplify reality, actual processes and interactions and on the basis of the obtained data to draw conclusions and make forecasts. Models based on gravitational analogy are the tools of spatial interactions of classical regional analyses. They were first applied in the 19th century [2, 19, 21, 3, 31, 4, 11, etc]

The application of the geographical gravity is confirmed by the theory of experience according to which (just as in time) the things that are closer to each other in space are more related than distant things. This is called the "first law of geography" [25].

There are two basic areas of the application of gravitational models based on physical analogy: the spatial flow analysis [7, 16], and the demarcation of catchment areas [15, 17]. The potential models based on gravitational analogy are the most important groups of accessible models. In general, it can be stated that they are accessible approaches according to which models show potential benefits of the region compared to other regions where the benefits are quantified [20].

The use of accessible models in transport-geographical studies is very common. However, when models are used, it is not entirely clear what is actually modelled; because of their complexity their interpretations may be difficult [13]. It should be stressed that accessibility has no universally accepted definition; in empirical studies different methodological background indicators are used [9, 10, 29, 30].The gravitational theory is a theory of contact, which examines the territorial interaction between two or more points in a similar way as correlations are analysed in the law of gravitation in physics. According to Dusek [5]. despite the analogy, there are significant differences between gravitational models used by social sciences and the law of gravitation used in physics. It is worth bearing in mind that "the gravitational model is not based on the gravitational law". It is a fundamental statement based on the experience of undeniable statistical character that takes into consideration spatial phenomena. According to this statement, phenomena interact with each other. The phenomena, which are closer to each other in space, are more related than distant phenomena [5 p. 45.].

There are a number of differences between the law and the model. In this study, we wish to highlight a new point of view. As a consequence of the spatial

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Geometrical Langlands Ramifications and Differential Operators Classification by Coherent *D*-Modules in Field Theory

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Abstract: Spaces of equivalence modulo a relation of congruence are constructed on field solutions to establish a theory of the universe that includes the theory QFT (Quantum Field theory), the SUSY (Super-symmetry theory) and HST (heterotic string theory) using the sheaves correspondence of differential operators of the field equations and sheaves of coherent $D-$Modules [1]. The above mentioned correspondence use a Zuckerman functor that is a factor of the universal functor of derived sheaves of Harish-Chandra to the Langlands geometrical program in mirror symmetry [2, 3]. The obtained development includes complexes of $D-$modules of infinite dimension, generalizing for this way, the BRST-cohomology in this context. With it, the class of the integrable systems is extended in mathematical physics and the possibility of obtaining a general theory of integral transforms for the space – time (integral operator cohomology [4]), and with it the measurement of many of their observables [5]. Also tends a bridge to complete a classification of the differential operators for the different field equations using on the base of Verma modules that are classification spaces of $SO(1,n+1)$, where elements of the Lie algebra $\mathfrak{sl}(1,n+1)$, are differential operators, of the equations in mathematical physics [1]. The cosmological problem that exists is to reduce the number of field equations that are resoluble under the same gauge field (Verma modules) and to extend the gauge solutions to other fields using the topological groups symmetries that define their interactions. This extension can be given by a global Langlands correspondence between the Hecke sheaves category on an adequate moduli stack and the holomorphic ${}^{L}G-$bundles category with a special connection (Deligne connection). The corresponding $D-$modules may be viewed as sheaves of conformal blocks (or co-invariants) (images under a version of the Penrose transform [1, 6]) naturally arising in the framework of conformal field theory.

Keywords: Langlands correspondence, Hecke sheaves category, moduli stacks, Verma modules, generalized D-modules, Verma module extensions

1. Introduction

Some results obtained in the moduli framework of the space-time [2] and their tacked carpet for the spectral resolution

$$\mathbb{P}^3 \to \ldots \to \mathbb{P}^{1+4d} \to \mathbb{P}^{2+4d} \to \mathbb{P}^{3+4d} \to \mathbb{P}^{3+4d} \to 0$$

, from the level of moduli space $\mathscr{M}(\mathbb{P}^3,0)$, given in the corollary [2], let us in clear that the geometrical Langlands program needs be ramified in the context of the coherent $D-$ modules that can be mapped in the order of the invariance and holomorphicity through a $D-$ modules transform between categories of induced G-invariants $D-$ modules. These categories can be visualized as categories of $\mathfrak{T}-$ modules that can help to find a similar description of the Langlands correspondence for connections with irregular singularities [7]. This shape a moduli space whose equivalences are the given by the isomorphism between coherent $D-$ modules that are $D_{\mathbb{F}}-$

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Georgian Social Insurance Fund Management Problems and Probabilistic and Statistical Analysis of Fund Capital Management

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Abstract: A mathematical model of management of a social insurance fund with exponential insurance reimburse and financing determined social programs is represented and analyzed; A probability density function and fund's functioning probabilistic characteristics are obtained, that makes it possible to determine the sufficiency of fund capital at all levels of its management. With the help of conclusion it is possible for particular period of time determine in insurance fund change of cash flow movement speed, on what basis in determined from state tax revenues assigns acceptance necessity and capacity.

Keywords: Insurance reimburse, probability distribution fund capital, probability of insolvency

1. Introduction

Social protection and social insurance of the populations is the main activity of the government. Georgia as ex SSR country had social problems during market economy transition period.

Absence of experience in management of social problems made Georgia experimental polygon. Until 1995 social protection system was implemented by identifies health priority programs. In 1996 was made the first step towards social insurance financing mechanisms setting into motion. However, this mechanism proved to be weak because of rapidly increasing unemployment, made powerless social insurance and financial base of the state budget. Since 2003, health insurance companies have stopped functioning and new structure was created - State United Social Insurance Fund, the source of the formation - social insurance taxes, was included in the treasury similar as net taxes of other subjects, i.e. This tax still was an intermediate category, despite its targeting approach. During 2003-2004 social insurance taxes couldn't be sat in it's the framework and failed to fulfill purposeful function, so in 2005 was abolished social insurance tax and established social tax, which was accumulated in the budget. In the existing mechanisms conditions to meet a minimum living standards was impossible during any fiscal year. [1]

One of the reasons, along with various other reasons, was incorrect management of the Fund, in particular the formation of an incorrect assessment of the sources and the inappropriate use of resources. Existing social tax till 2008 by its purpose should have been spend on social sphere funding, but however, despite this principle high level protection it was obscure for employees what kind of social protection can they receive from state social fund, at the same time it helped to increase the salary fund shadow scale.

The only way for implementation social function by

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Consistent Criteria for checking Hypotheses

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Abstract: This paper we study a consistent criterion for checking Hypotheses. Given definition of consistent criterion for checking hypotheses for family probability measures which were defined by Z. Zerakidze (see 5). We prove the necessary and sufficient conditions are obtained for the existence of consistent criteria of hypotheses. For example we clearly build of a consistent criteria for checking hypotheses.

Keywords: Consistent criterion, orthogonal, separable, hypotheses.

1. Introduction

Let (E, S) be a measurable (selection) space with given family of probability measures $\{\mu_i,\ i \in I\}$.

We us resell other definitions [1-6]

Definition 1. The family of probability measures $\{\mu_i,\ i \in I\}$ is called orthogonal if $i \neq j$ μ_i and μ_j are orthogonal for each $i \neq j$.

Definition 2. The family of probability measures $\{\mu_i,\ i \in I\}$ is called weakly separable if there exists a family of S - measurable sets $\{X_i,\ i \in I\}$ such that relations

$$\mu_i(X_j) = \begin{cases} 1, & if \quad i = j \\ 0, & if \quad i \neq j \end{cases}$$

are fulfilled

Definition 3. The family of probability measures $\{\mu_i,\ i \in I\}$ is called strongly separable if there exists a disjoint family of $S-$ measurable sets $\{\mu_i,\ i \in I\}$ such that the relations $(\forall i)(i \in I \Rightarrow \mu_i(X_i) = 1,\ \forall i \in I)$ are fulfilled.

Remark 1. From strongly separable there follows weakly separable and from weakly separable there follows orthogonal, but not vice versa. (see 3,4)

Example 1. Let $E = [0,1]X[0,1]$. S be Borel σ -algebra of parts of E. Take the S – measurable sets

$$X_i = \{0 \le x \le 1,\ y = i,\ i \in [0,1]\}$$

and assume that l_i are linear Lebesgue probability measures on X_i. That the family $\{l_i, i \in [0,1]\}$ is strongly separable.

Example 2. Let $E = [0,1]X[0,1]$ S be a Borel σ -algebra of parts of E. Take the S – measurable sets.

$$X_i = \begin{cases} 0 \le x \le 1,\ y = i,\ i \in [0,1] \\ x = i-2,\ 0 \le y \le 1,\ i \in [2,3] \end{cases}$$

Let l_i be linear lebesgue measures on X_i Then a family of probability measures $\{l_i, i \in [0,1] \cup [2,3]\}$ is weakly separable, but not strongly separable.

Example 3. Let $E = [0,1]X[0,1]$. S be a Boral $\sigma-$ algebra of parts of E. Take the S – measurable sets.

$$X_i = \{0 \le x \le 1,\ i \in (0,1]$$

and

$$X_i = [0,1] \times [0,1]$$

Assume that l_i, $i \in (0,1]$ are linear Lebesgue measures on X_i, $i \in (0,1]$ and l_0 is plane lebesgue measure on X_0. Then a family of probability measures $\{l_i, i \in [0,1]\}$ is orthogonal, but not weakly separable.

Let H be sets hypotheses and $\beta(\mathrm{H})$ is σ–algebra witch contains of all finite subsets H.

Definition 4. The family of probability measures $\{\mu_H, H \in \mathrm{H}\}$ will be said to admit a consistent

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Holistic Discourse in the Network Cognitive Modeling

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Abstract: The purpose of this paper is to pose a new question to speed-up mutual understanding among team members or/and group of experts when communicating over the Internet in forms of virtual collaboration, electronic brainstorming, network strategic conversation, etc. We have previously proposed an approach that the convergent control mechanism based on the fundamental principles of thermodynamic and inverse problem solution method, as well as various artificial intelligence techniques, be incorporated into the communicative process. This paper shows a further development of the approach in terms of applying The Fuzzy Tychonoff Theorem along with quantum techniques provide to reach a high level of holistic discourse which is achieved not only through the application of fundamental principles of compactness of the topological space, but also utilizing quantum entanglement and complementarity principles for discourse structuring in a special way. The approach is implemented as the Responsibility Thinking System (RTS) tested in the course of finding the decisions of the real life issues.

Keywords: Cognitive modeling, convergence, decision-making, discourse, network, inverse task solution, quantum principals, topological space.

1. Introduction

Corporate teams or/and groups of experts are interested in accelerating group decision-making process. However, in telecommunication network they cannot reach mutual understanding instantly. The process involves too many messages to pursue successful interactions between participants. Typically, they face the necessity to discuss for a long interval of time such structural elements of decision-making process, as goals and other constituent factors of the strategic planning.

Currently, for creating the corporate strategy, experts usually exploit such methods as Analytic Hierarchy Process (AHP), SWOT, Genetic Algorithms (GA), Cognitive Modeling (CM), Virtual Collaboration (VC), Strategic Conversation (SC), Data-Mining, Situation Analysis, etc. It usually takes 3 – 4 months to create corporate strategy, but this interval of time is to be reduced up to a few days or hours.

For corporate team building, the author also exploits the above-mentioned methods, but numerous unmeasured characteristics of the team participants, such as trust, emotion, thought, expectation, intention, conflict, responsibility, etc., pose a certain threat to restrict a possibility to attain a higher level of rapport. In computer network, these restrictions become even more stringent.

To accelerate the speed of attaining the rapport it is essential to apply the CM method [1, 2]. Cognitive Modeling supports mutual interactions in the information space, which is characterized by ill-define, fuzzy, non-metric, qualitative factors. However, the CM does not guarantee the completeness (integrity, comprehensiveness) of decision problem representation; it does not create sufficient confidence among participants of the discourse. In this respect it would be reasonable to introduce the concept of the *Holistic Discourse* (HD) as a Discourse with topmost level of the completeness.

The network decision-making process leads us to

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Mathematical Modeling in Social Network Analysis: Using TOPSIS to Find Node Influences in a Social Network

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Abstract: In a social network analysis the output provided includes many measures and metrics. For each of these measures and metric, the output provides the ability to obtain a rank ordering of the nodes in terms of these measures. We might use this information in decision making concerning disrupting or deceiving a given network. All is fine when all the measures indicate the same node as the key or influential node. What happens when the measures indicate different key nodes? Our goal in this paper is to explore two methodologies to identify the key players or nodes in a given network. We apply TOPSIS to analyze these outputs to find the most influential nodes as a function of the decision makers' inputs as a process to consider both subjective and objectives inputs through pairwise comparison matrices. We illustrate our results using two common networks from the literature: the Kite network and the Information flow network from Knoke and Wood. We discuss some basic sensitivity analysis can may be applied to the methods. We find the use of TOPSIS as a flexible method to weight the criterion based upon the decision makers' inputs or the topology of the network.

Keywords: Social network analysis, multi-attribute decision making, Analytical hierarchy process (AHP), weighted criterion, TOPSIS, node influence

Nomenclature

$(x_{ij})_{m\,x\,n}$	Matrix of values for alternatives by criterion
$(r_{ij})_{m\,x\,n}$	Matrix of normalized values for alternatives by criterion
$(t_{ij})_{m\,x\,n}$	Matrix of weighted normalized values for alternatives by criterion
A_w	Worst solution in the column
A_b	Best solution in the column
d_{ib}	L2 distance between the target and best solution
d_{iw}	L2 distance between the target and worst solution
s_{iw}	Ratio similarity to the ideal worst solution
s_{ib}	Ratio similarity to the ideal best solution
C	Final ranking

1. Introduction to Social Network Analysis

Social network analysis (SNA) is the methodical analysis of social networks in general and dark networks in particular [1, 2]. Social network analysis is a collection of theories and methods that assumes that the behavior of actors (individuals, groups, organizations, etc.) is profoundly affected by their ties to others and the networks in which they are embedded. Rather than viewing actors as automatons unaffected by those around them, SNA assumes that interaction patterns affect what actors say, do, and believe. Networks contain *nodes* (representing individual actors or entities within the network) and *edges and arcs* (representing relationships between the individuals, such as friendship, kinship, organizational position, sexual relationships, communications, tweets, Facebook friendships, etc.). These networks are often depicted in two formats: graphically or as a matrix. We might call the graph a social network diagram, where nodes are represented as *points* or *circles* and *arcs* are

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