Brief Report
Volume 15:01, 2024

Business and Economics Journal

ISSN: 2151-6219

Open Access

Laplacian on Fractals in Techno-Econophysics

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Abstract

Ever concluded whereas fractal fluctuations exhibit quantum-like chaos. Then provided a configurative description of a repeating units [from gather (unit) to transform (emergent unit)] of four conservation laws& forces in fractal organization of nature. To be proofed that Fibonacci sequence performed through Laplacian matrix normalization which techno-econophysics realm assumed as financial innovation.

Keywords: Fractal fluctuations • Emergent unit • Laplace transform • Techno-Econophysics • Fibonacci sequence

Introduction

Fractals are the latest development in statistics [1]. The larger scale fluctuation consists of smaller scale fluctuation identical in shape to the larger scale. Fractal systems extend over many scales and so cannot be characterized by a single characteristic average number. Ever stated, the Gaussian distribution will not be applicable for description of fractal data sets.

Fractal fluctuations exhibit quantum-like chaos. Free quantum gauge theory is equivalent to the assumption about the log-normal walks of assets prices [2]. This allows us to map the theory of capital market onto the theory of quantized gauge field interacted with a money flow field.

Gauge theory of arbitrage & repeating units

In finance, arbitrage pricing theory is a multi-factor model for asset pricing which relates various macro-economic risk variables to the pricing of financial assets, proposed by economist Stephen Ross in 1976. Arbitrage is an investment strategy wherein investors simultaneously buy and sell security in different markets to take advantage of a price difference and generate a profit.

There are three type of arbitrage

- Pure arbitrage
- Merger arbitrage
- Convertible arbitrage

In general case of Gauge Theory of Arbitrage [2] the consideration maps the capital markets onto Quantum Electro Dynamics, I.e quantum system of particles with positive (securities) and negative ("debts") charge which interact with each other through electromagnetic field (gauge field of arbitrage). Entering positive charges and leaving negative ones screen up the profitable fluctuation and restore the equilibrium in the region where there is no arbitrage opportunity any more.

Further, a General Systems model of Universe is presented, based on a fractal algorithm. The table depicts distinction between structural terms: unit-pair-group-emergent unit & dynamic terms: gather-repeat-share-transform.

Laplacian matrix on fractals

Laplacian matrix is a discrete analog of the Laplacian operator in multivariable calculus and serves a similar purpose by measuring to what extent a graph [associated to function] differs at one vertex from it values of nearby vertices, whereas the Laplace operator or Laplacian is a differential operator given by divergence of the gradient of a scalar function on Euclidian space. Between Laplacian matrix and Laplace operator defined a "directed graph" where introduced an edge probability matrix.

The matrix equation where L is laplacian matrix is:

L = D–A; D is "Degree matrix" & A is "Adjacency matrix".

Let us distinguish "simple graph/undirected graph" and "directed graph".

For "simple graph", the element of Laplacian matrix here tried to be related to structural terms unit-pair-group-emergent unit and

We saw a series of number consisting dimension of Euclid (Figure 1).

For "directed graph" can be adopt stochastic or random walk matrix because it includes probability matrix.

The random walk normalized Laplacian matrix equation is

$L^{RW} = I – D+A$ where I is identity matrix (Figure 2).

For share of group/field and larger integers than dimension 3 tried to describe how Laplace transform & Fibonacci sequence performed in fractals which are real.

A "directed graph" is defined in the matrix of Laplacian operator and the Laplacian matrix of a directed graph generally are non-symmetric thus needed adjacency matrix to turn directed graph to simple graph in which symmetrical Laplacian normalized matrix for it random walk type.

It solve the problem of repeating units to complex systems as well where

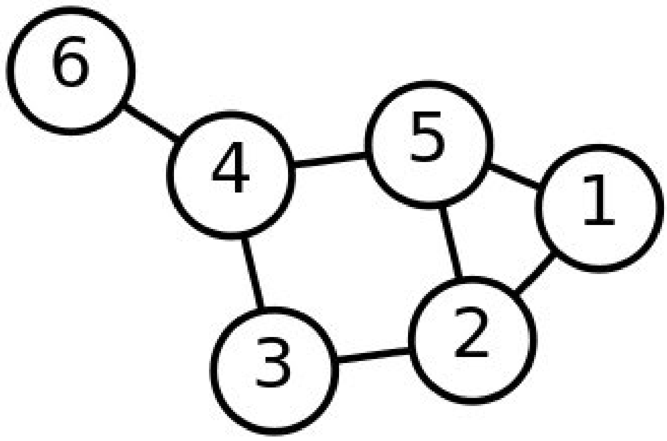

Figure 1. Laplacian matrix of directed graph.

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Received: 01 January, 2024, Manuscript No. bej-24-124219; **Editor Assigned:** 03 January, 2024, PreQC No. P-124219; **Reviewed:** 15 January, 2024, QC No. Q-124219; **Revised:** 22 January, 2024, Manuscript No. R-124219; **Published:** 29 January, 2024, DOI: 10.37421/2151-6219.2024.15.470

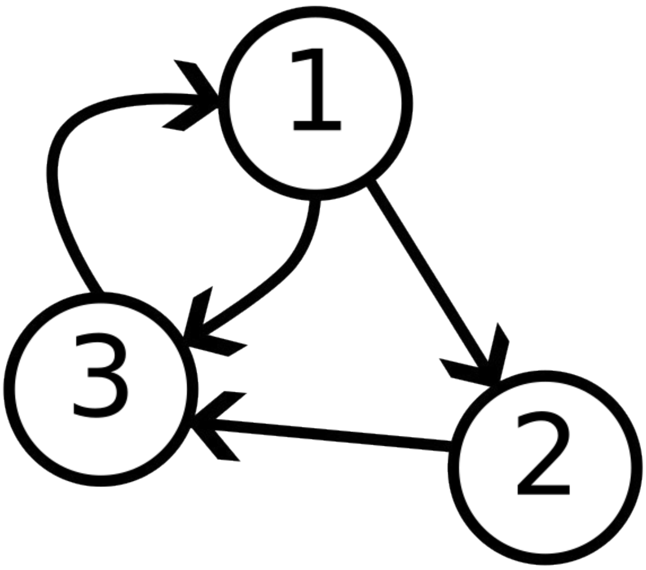

Figure 2. Laplacian matrix of directed graph.

in the study of normalized Laplacian matrices of fractal trees [3] described how various structural properties affect the dynamical processes. About Fibonacci sequence in which each numer is the sum of preceding ones off course inclusively accounted for the Laplacian matrix is always at least integer & real as it perform fractals and Laplace transform is an integral transform that convert a function [or graph] of real variable to a function of complex variable.

Description

Fractals in techno-econophysics

Let F be a set of contraction maps in a post critical finite fractal. There is defined μ called a self-similar measure in K, where K any given self-similar set [4,5]. Described any measure between correlation which measure the amount of variation in one variable that can be expressed by other variables and probability as a measure of the likelihood of an event occurring. For Laplacian matrix, to represent a random switching directed graph G, ever allocated an edge probability matrix P.

In hedge mechanism of assets management, techno-econophysics considered in the financial innovation point of view.

Conclusion

Can be concluded whereas Laplacian fractals also performed in techno-econophysics. More precisely, fractal algorithm considering structural & dynamic properties can be approached through complex systems through probability & correlation measures.

Acknowledgement

None.

Conflict of Interest

None.

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How to cite this article: Maksoed, Widastra Hidajatullah. "Laplacian on Fractals in Techno-Econophysics." *Bus Econ J* 15 (2024): 470.