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# Study on A New Definition of Degree of Grey Incidence

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## ABSTRACT

**Based on the definition of degree of grey incidence, which put forward by Professor Ju-Long Deng, a new definition of absolute degree of grey incidence is given in this paper. And a simplified method to calculate the new absolute degree of grey incidence is put forward and proved. The properties of the new definition of absolute degree of grey incidence are studied. Compared with the original definition, the new definition has many advantages such as (1) satisfies the properties of symmetry, (2) the order of grey incidences remain stable, and (3)with smaller amount of computation, etc.**


***Keywords: Absolute degree of grey incidence, Definition, Properties.***

## 1. Introduction

In the year of 1982, grey systems theory was brought forward by Professor Deng from China. It was a new theory and method applicable to the study of unascertained problems with few data and/or poor information. Grey systems theory works on unascertained systems with partially known and partially unknown information by drawing out valuable information by generating and developing the partially known information. It can describe correctly and monitor effectively the systemic operational behavior[1]. Grey incidence analysis is one of the major content of grey systems theory [2,3].

The fundamental idea of the grey incidence analysis is that the closeness of a relation is judged based on the similarity level of the geometrical patterns of sequence curves[4,5]. The more similar the curves are, the higher degree of incidence between sequences are; and, vice versa. Grey incidence analysis can be applied to cases of various sample sizes and distributions with small amount of computation. And, in general, the application of the grey incidence analysis does not result in situations of disagreement between quantitative analysis and qualitative analysis[6,7].

Based on the definition of degree of grey incidence which put forward by Professor Ju-Long Deng[4,5].

$$\gamma(X_0, X_i) = \frac{1}{n}\sum_{k=1}^{n}\gamma_{0i}(k) \qquad (1)$$

where

$$\gamma_{0i}(k) = \gamma(x_0(k), x_i(k)) = \frac{\min\limits_i \min\limits_k |x_0(k) - x_i(k)| + \zeta \max\limits_i \max\limits_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \zeta \max\limits_i \max\limits_k |x_0(k) - x_i(k)|}$$

a new definition of degree of grey incidence is given as follows

$$\varepsilon_{0i} = \varepsilon(X_0, X_i) = \frac{1 + |s_0| + |s_i|}{1 + |s_0| + |s_i| + |s_0 - s_i|} \qquad (2)$$

where: $s_0 = \int_1^n (X_0 - x_0(1))dt$

$$s_i = \int_1^n (X_i - x_i(1))dt$$

$$s_0 - s_i = \int_1^n [(X_0 - x_0(1)) - (X_i - x_i(1))]dt .$$

A simplified method to calculate the new absolute degree of grey incidence is put forward and proved. The properties of the new definition of absolute degree of grey incidence are studied. Compared with the original definition, the new definition has many advantages such as (1) satisfies the properties of symmetry, (2) the order of grey incidences remain stable and (3) with smaller amount of computation, etc.

## 2. The Definition of Absolute Degree of Grey Incidence

**Proposition 2.1** Assume that

$$X_i = (x_i(1), x_i(2), \cdots, x_i(n)) \qquad (3)$$

stands for a behavioral sequence of data, and that the zigzagged line

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