

Preface

... the enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious and there is no rational explanation for it.

Eugene Paul Wigner (Nobel Prize in Physics, 1963).¹

The Harary index of a graph has been independently introduced by two research groups, one in Zagreb (Croatia) and other in Bucharest (Romania), at the Symposium held in honour of Professor Frank Harary at the University of Saskatchewan, Saskatoon, Canada from September 12 to 14, 1991. This symposium was organized to celebrate the 70th birthday of Harary. The term *Harary index* was given by the Zagreb Group [1], a member of which is one of the present authors (NT), and denoted by H , while the Bucharest Group called this index as the *reciprocal distance sum index* and denoted it RDSUM [2]. However, the term Harary index nowadays is generally accepted for this molecular descriptor [3, 4].

The Harary index of a graph G is defined [1, 2] as

$$H(G) = \sum_{u,v \in V(G)} \frac{1}{d_G(u,v)}$$

where $d_G(u,v)$ denotes the distance of two vertices u, v in G and the summation goes over all unordered pairs of vertices of G .

Since its first introduction in 1991, the Harary index has attracted much attention of chemical and mathematical researchers, especially those focussing on graph theory, from all over the world. Nowadays many interesting results on Harary index have been reported in literature [3, 4]. These results range from theoretical ones such as the extremal graphs with respect to Harary index, the relation between Harary index and other topological indices of graphs and some properties of Harary

¹ These lines are taken from his article: The unreasonable effectiveness of mathematics in the natural sciences, *Comm. Pure Appl. Math.* 13 (1960) 1–14.

index, and so on, to applied ones, including its applications in pure graph theory or in mathematical chemistry. Very recently, an interesting variant of Harary index of a graph G , which is named as additively weighted Harary index, has been introduced [5]. For a graph G , the additively weighted Harary index is defined [5] as follows:

$$H_A(G) = \sum_{\{u,v\} \subseteq V(G)} \frac{d_G(u) + d_G(v)}{d_G(u,v)}$$

Moreover some mathematical results have been obtained in several recent papers (e.g., [6, 7]).

In this book we will report some properties and applications of Harary index as well as some mathematical results of additively weighted Harary index. Furthermore, in the last chapter we will propose some interesting open problems on the Harary index of graphs.

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Suwon
Zagreb

Kexiang Xu
Kinkar Ch. Das
Nenad Trinajstić

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Xu, K.; Das, K.C.; Trinajstić, N.

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