

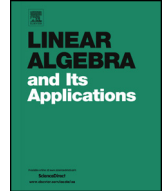


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On maximum Estrada indices of bipartite graphs with some given parameters ☆



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ABSTRACT

The Estrada index of a graph G is defined as $EE(G) = \sum_{i=1}^n e^{\lambda_i}$, where $\lambda_1, \lambda_2, \dots, \lambda_n$ are the eigenvalues of the adjacency matrix of G . In this paper, we characterize the unique bipartite graph with maximum Estrada index among bipartite graphs with given matching number and given vertex-connectivity, edge-connectivity, respectively.

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1. Introduction

Let G be a simple graph on n vertices. The eigenvalues of G are the eigenvalues of its adjacency matrix, which are denoted by $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n$. The Estrada index of G , put forward by Estrada [7], is defined as

$$EE(G) = \sum_{i=1}^n e^{\lambda_i}.$$

The Estrada index has multiple applications in a large variety of problems, for example, it has been successfully employed to quantify the degree of folding of long-chain molecules, especially proteins [8–10], and it is a useful tool to measure the centrality of complex (reaction, metabolic, communication, social, etc.) networks [11,12]. There is also a connection between the Estrada index and the extended atomic branching of molecules [13]. Besides these applications, the Estrada index has also been extensively studied in mathematics, see [16,18,20–22]. Ilić and Stevanović [16] obtained the unique tree with minimum Estrada index among the set of trees with a given maximum degree. Zhang, Zhou and Li [20] determined the unique tree with maximum Estrada indices among the set of trees with a given matching number. In [4], Du and Zhou characterized the unique unicyclic graph with maximum Estrada index. Wang et al. [19] determined the unique graph with maximum Estrada index among bicyclic graphs with fixed order, and Zhu et al. [23] determined the unique graph with maximum Estrada index among tricyclic graphs with fixed order. More mathematical properties on the Estrada index can be founded in [14].

A graph is bipartite if its vertex set can be partitioned into two subsets X and Y so that every edge has one end in X and the other end in Y . We denote a bipartite graph G with bipartition (X, Y) by $G[X, Y]$. If $G[X, Y]$ is simple and every vertex in X is joined to every vertex in Y , then G is called a complete bipartite graph. Up to isomorphism, there is a unique complete bipartite graph with parts of sizes m and n , denoted $K_{m,n}$. For an edge subset A of the complement of G , we use $G + A$ to denote the graph obtained from G by adding the edges in A .

A matching in a graph is a set of pairwise nonadjacent edges. If M is a matching, the two ends of each edge of M are said to be matched under M , and each vertex incident with an edge of M is said to be covered by M . A maximum matching is one which covers as many vertices as possible. The number of edges in a maximum matching of a graph G is called the matching number of G and denoted by $\alpha'(G)$. Let $\mathcal{M}_{n,p}$ be the set of bipartite graphs on n vertices with $\alpha'(G) = p$.

A cut vertex (edge) of a graph is a vertex (edge) whose removal increases the number of components of the graph. A (An) vertex (edge) cut of a graph is a set of vertices (edges) whose removal disconnects the graph. The connectivity (edge-connectivity) of a graph G is defined as

$$\kappa(G) = \min\{|S| : S \text{ is a vertex cut of } G\}, \quad \kappa'(G) = \min\{|S| : S \text{ is an edge cut of } G\}.$$

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