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# Measurements of Recommendation Network Structure in a Package

## Tour E-commerce Platform

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**Abstract:** The economic impact of recommendation networks in an e-commerce platform is attracting increasing interests from researchers. Various indicators adopted from social network measuring are used to describe the features of products recommendation networks. However, systematic measurements are still scarce in existing studies. This paper summarized three dimensions of measurement for products recommendation network, i.e., centrality, connection and size. Furthermore, the measurements were used to examine the structures of recommendation network in a packaged tour e-commerce platform from their evenness, clustering and scale. Our study mainly contributes to the emerging literature on products recommendation networks by offering three dimensions of measurements to describe the network structure.

Keywords: measurement, recommendation network, e-commerce platform

### 1. INTRODUCTION

E-commerce Platforms build recommendation networks to help customers find the suitable products. There are many researches that have emerged in recent years investigating the economic impacts of such networks<sup>[1,2]</sup>. In these researches, many indicators in social network analysis (SNA) are used to measure recommendation networks<sup>[3]</sup>. However, there is still a scarcity of systematic measurements in extant literature to describe the characters of products recommendation networks. This paper mainly contributes to the emerging researches on recommendation networks by offering a systematic measurement to describe the network structure.

### 2. THE MEASUREMENTS OF RECOMMENDATION NETWORKS

We extracted critical indicators from the network related measurements in relevant researches and find that they can be classified into three dimensions: centrality, connection and size. Centrality refers to the importance of a node in a network. Centrality usually includes degree centrality, closeness centrality, betweenness centrality, eigenvector centrality and PageRank centrality. Connection is defined as the relational status between different products. Assortative mixing and clustering coefficient were introduced by researchers to measure connection status of products within recommendation networks. Size is defined as the total number of nodes in a network and directly determines how complex the structure of this network.

According to the dimensions mentioned above, three corresponding features of recommendation network can be described: evenness, clustering and scale. Evenness indicates the distribution status of resource among nodes in a network. Clustering measures the connection status between nodes and illustrates the speed at which the traffic could spread in a network. Scale means the size of networks.

We choose a set of indicators from each dimension that we have summarized to measure the corresponding features of recommendation networks consisting of homogeneous products. The evenness of recommendation network is measured by the variance in PageRank value (PRVar) across products in a destination market (centrality dimension). The clustering of entire recommendation network in a destination market is measured by the average clustering coefficient of all products (AvgCC) in this market (connection dimension). The scale of

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recommendation network in a destination market is the total number of products in the network (size dimension).

### 3. RECOMMENDATION NETWORK STRUCTURE ON TUNIUI.COM

We chose a famous package tour e-commerce platform — tuniu.com as our research context. 12 outbound destination markets on June 1st, 2018 was selected for our research. Recommendation networks were built by using Gephi, an open-source network analysis and visualization software written in Java, after removing duplicate and irrelevant products in raw data. Measurement indicators were also calculated by using the built-in algorithms in Gephi. As illustrated in Table 1, high unevenness, high clustering and small scale are identified three critical features to measure tuniu.com's production recommendation networks.

**Table 1. The recommendation networks of each markets on tuniu.com**

<i>Area</i>	<i>Australia and New Zealand</i>	<i>Cambodia</i>	<i>Europe</i>	<i>Hong Kong</i>	<i>Singapore</i>	<i>Thailand</i>
PRVar	$2.76 \times 10^{-9}$	$9.19 \times 10^{-10}$	$1.12 \times 10^{-8}$	$3.36 \times 10^{-8}$	$6.51 \times 10^{-9}$	$2.18 \times 10^{-7}$
AvgCC	0.49	0.22	0.53	0.52	0.43	0.36
Scale	459	198	2417	1091	455	1867
<i>Area</i>	<i>Indonesia</i>	<i>Japan</i>	<i>Malaysia</i>	<i>Middle East and Africa</i>	<i>United States</i>	<i>Vietnam</i>
PRVar	$4.06 \times 10^{-9}$	$7.36 \times 10^{-9}$	$3.39 \times 10^{-9}$	$1.05 \times 10^{-8}$	$3.25 \times 10^{-8}$	$2.97 \times 10^{-9}$
AvgCC	0.29	0.41	0.28	0.41	0.42	0.34
Scale	646	801	197	1031	580	558

### 4. DISCUSSION AND CONTRIBUTIONS

Many researches investigating the economic impacts of recommendation networks have emerged in recent years, while there is still a scarcity of systematic measurement of recommendation networks. We summarized three measurement dimensions that are used to describe the features of recommendation networks, i.e., centrality, connection and size, and examined the structures of recommendation network in a packaged tour e-commerce platform from their evenness, clustering and scale. This study makes contributions primarily to the emerging literature on recommendation networks by offering three dimensions of measurements to describe the network structure while there is still a scarcity of systematic network measurements. Moreover, based on the three dimensions, our works offer an example of measuring recommendation networks from their evenness, clustering and scale on an e-commerce platform. Our works enlighten subsequent researches by offering a systematic measurement for recommendation networks on a package tour e-commerce platform.

### ACKNOWLEDGEMENT

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