Bayesian Network-based GF-City Metropolitan Zone Modelling: an Approach Based on Location Quotient Resource Impulse Response Principle

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Abstract. Based on the evolution phenomenon and law of "location quotient", this paper has studied the mapping relationship between image recognition of GF-City metropolitan area and the impulse response of local industrial resources. Based on the "location quotient" method, the level of local industry specialization in Foshan city was analysed, with the aid of VAR model. With the help of economic logic reasoning method, the VAR regression equation model improved design pattern analysis method was extracted in terms of the typical local industry semantics; a Bayesian network-based VAR model GF-City metropolitan area local industrial resources was constructed together with the impulse response network model. Based on the image recognition evaluation experiment of GF-City metropolitan area, the network combined Bayesian scoring function and search algorithm to carry out learning reasoning, and thus divided into local industrial grammar sub-network, image vocabulary sub-network and mapping relationship sub-network by modularization. According to the trend of node and conditional probability distribution, the image lexical structure and morphological organization characteristics were analysed, and the impulsive local industry resource impulse response knowledge rules were subsequently mined and characterized. Consequently, an example analysis proved the validity and applicability of the modelling method for the knowledge acquisition of the “location quotient” resource impulse response, so as to further analyse and perfect the rapid development of Foshan City with the drive of “GF-City metropolitan area” in the background of GHM Greater Bay Area.

1. Introduction
Global Greater Bay Area and the city metropolitan area have been built into the most dynamic regions of the global economy, featuring the global highland for innovation and development, the world-renowned high-quality living areas and metropolitan areas, in terms of world cultural exchanges, and deepening demonstrations of various countries and regions. The coordinated development of the global Greater Bay Area and the city metropolitan area will also promote the GHM Global Bay Area and the same city metropolitan area to become technological innovation cooperation zones in terms of world-class efficient resource allocation mechanism service centre.

Based on the evolution phenomenon and law of "location quotient", this paper studies the mapping relationship between image recognition of GF-City metropolitan area and the impulse response of local industrial resources.
2. Literatures

Some scholars have advocated the definition of the bay and the metropolitan area as a set of process area systems. Various types of institutions use certain system management systems, in order to achieve regional interests, and are also restricted by the local regional social, political and cultural environment. These participating organizations include regional enterprises, research institutes, educational and training institutions, regional efficient resource allocation mechanisms, regional governments and other intermediary organizations. The regional local environment includes regional local cultural atmosphere, regional infrastructure environment, and regional institutional environment (David Doloreux, 2008; Steve Dionne, 2008). Some scholars have studied the method of regional aggregation in the bay and the metropolitan area, the current debate on the research methods and the challenges ahead. The method of clustering systems in the Greater Bay Area and the metropolitan area is often applied in a rather static manner, more as an inspiration rather than a consistent theory (Asheim, 2016).

Some scholars have found the main challenge facing current and future research in the RIS approach is how to become a more theoretical, dynamic perspective of the RIS approach, dealing with new development paths and transforming RIS and thus proposed a three-helix structure that innovates the regional clusters of the same city. It is believed that the core of the metropolitan area is the knowledge production activities carried out by the school-enterprise cooperation, regional industrial structure, geographical distribution and bay. The synergy between the regional academic traditions constitutes a key force in the Greater Bay Area and the regional metropolitan area aggregation system (Asheim, 2016; Yucong You & Luxia Yi, 2017; 2018).

Through analysis, Yucong You (2018) found that the spill-over effects of the private sector, universities and other public research institutions in the Bay Area have a positive impact on the efficiency of the Greater Bay Area and the metropolitan area aggregation system. In particular, the interaction between private and public sector research has increased and efficiency has increased. Luxia Yi (2017) proposed that many intermediaries participate in the Greater Bay Area and regional metropolitan area gathering systems, such as research institutions, universities, private companies, governments and public institutions, and in some developed countries and regions, regional governments adopt government macro overall R&D budget policy develops an innovation system, and the role of macro-government behaviour in science and technology exceeded 90%. Some scholars have analysed the evolution of the mainstream policy of the metropolitan area to the mainstream of public policy, examined the evolution of development experience and development theory, and transformed a large number of problems related to the Bay Area and the regional cluster system of the same city.

Some scholars have studied the issue from economic geography perspective, in terms of policy, paying special attention to the reasons for the failure of the local market, and explaining the role of local institutions in the importance and demand of regional aggregation policies in the Greater Bay Area and the metropolitan area, which is currently observed globally. The Bay Area and the metropolitan area gather policy tools and interventions to summarize, and international institutions often view it as a case of best practice (Steve Dionne, 2008; Mccann, 2013).

Yucong You and Luxia Yi (2018) evaluated the diversity of regional aggregation systems in the Greater Bay Area and the metropolitan area and their economic performance in Europe, and suggested that adjustments be made at the regional level by identifying specific arrangements for various parts of the innovation and production system. The social system of the Innovation and Production framework uses multivariate data analysis to determine the type of regional configuration resulting from the combination of scientific, technical, educational, and industrial indicators. The findings highlight the continuing heights of regional pattern diversity, especially in knowledge-intensive areas, but also indicate that the national institutional environment remains critical to shaping some regional patterns.

At present, scholars’ research on the regional clustering effect of the Bay Area and the metropolitan area is mainly focused on the study of the Bay Area and the metropolitan area of the same city. It focuses on the micro level, that is, using the elements in the enterprise (system) to analyse the micro-enterprise. The level of development in the Bay Area and the metropolitan area of the same city; but
there is less research on the behavioural Bay Area and the concentration of the same city metropolitan area within the system at the miso level; especially for the Bay Area at the regional level and the measurement of regional cluster development in the same city metropolitan area and the quantitative analysis of the regional concentration of the Bay Area and the metropolitan area are even rarer. Therefore, this paper combines the Bayesian reasoning idea with the economic logic reasoning paradigm and the new research paradigm for the Bay Area and the same city. The study of regional agglomeration effects in metropolitan areas provides new theoretical references and model references.

3. Model

3.1. Bayesian network theory

Based on probability theory and graph theory, Bayesian networks provide a solution to the problems of uncertainty and complexity in engineering. It uses conditional probability to represent the degree of influence and mutual relationship between the variables on the pair of parent nodes and child nodes in the network, and can better deal with the problem of incomplete data sets. Lam W & Bacchus F. (1994) argues that because Bayesian networks contain a joint distribution of all variables, the joint distribution of a set of variables U can be expressed in the form of conditional probabilities. Therefore, the core of Bayesian network inference problem is a kind of calculating conditional probability distribution. Its formula (1) is as follows:

$$P(L) = p(X_1, X_2, \ldots, X_n) = \prod_{j=1}^{n} p(x_j : Paj)$$

Among them, Paj represents a parent node of Xj, besides, in a Bayesian network, when a parent node gives timing Xj, then other nodes are mutually independent. Therefore, it can be seen that the process of determining the parent node by the Bayesian network actually corresponds to the process of seeking a conditional independent relationship between variables.

3.2. Bayesian Reasoning-based "GF City" and "Location Quotient " Resource Impulse Response Network Construction

According to the modular concept of directed graph of Bayesian network, this paper follows the practice of Yang C, Shieh M. (2010), based on the response prediction model to regression the support vector, with a view to achieving the design of the research object morphology, through Bayesian inference combined with VAR model and impulse response analysis to construct Bayesian network-VAR model, determine the number of network nodes from image recognition evaluation data, learn and find the best fit network with data set, and finally establish natural and intuitive, which is named "GF City" and "Location Quotient" resource impulse response network. Considering the scale of the “location quotient” sample in the “GF City” imagery economic logic cognitive model, this study combines the MDL (Minimum Description Length) jointly proposed by Glover F. (1989) and Lam W & Bacchus F. (1994), of which the search algorithm uses Bayesian network structure search based on the minimum description length scoring function to solve the Bayesian global optimal structure. The Bayesian network structure description length is expressed as formula (2).

$$Dl(R,D) = Dl1(N) + Dl2(P) + Dl3(D,R)$$

Where N is the network structure, P is the conditional probability distribution, and D is the given imagery evaluation data set. X is defined as a set of nodes in R, and each node xj(xj ∈ X) can be expressed as a local industrial semantic attribute or an image vocabulary attribute in the network, which can map and represent the "direction arc" between the nodes xj. Dl1(N) represents the structure coding length, Dl2(P) represents the conditional probability table coding length, and Dl3(D,R) represents the data set coding length. The basic principle is to find the network model that minimizes the total description length DL.

Based on the network division, the "GF City" and "location quotient" resources impulse response knowledge representation combined with the consistency of the attribute set consistency conditions, the joint probability of the whole network is decomposed into several factors, that is, R is decomposed into sub-networks that are relatively independent and whose attributes are potentially associated.
Based on the "location quotient" measurement resource impulse response, a topological structure relationship can be well identified as shown by Figure 1.

As shown in Figure 1, the directed graph nodes represent attributes in the problem domain, namely resource image vocabulary (\(V_i\)) and local industry semantics (\(L_i\)); each of the edges represents a probability dependency between the "location quotient" nodes. Assuming that each non-adjacent "location quotient" node is independent of each other, a certain "location quotient" node can be defined as an intermediate "location quotient" node, and it is associated with the "location quotient" sub-node, the "location quotient" parent node and The inter-association between the "location quotient" nodes jointly forms a sub-network with inference function. Here, the resource image vocabulary network (L) and the impulse response mapping association network (M) are divided and defined by the probability dependency relationship between the "location quotient" nodes. There is a directed graph of the probabilistic reasoning relationship between the semantics of local industry semantics, which can describe the knowledge of morphological cognition local industrial grammar, characterized as shown by formula (3) and (4) as follows.

\[
A = <L_i, Y_1>, Y_1 = \{(x_i, x_j) : x_i, x_j \in L_i\} \quad (3)
\]

\[
M = <V_i, Y_2>, Y_2 = \{(x_i, x_j) : x_i, x_j \in V_i\} \quad (4)
\]

3.3. Knowledge Acquisition of "Location Quotient" Resources Based on Bayesian Network

Based on the Bayesian network, the "GF City" and "location quotient" impulse response mapping related resource knowledge acquisition framework is shown in Figure 2. Based on the mapping of imagery relationship between imagery vocabulary and impulse response, the imagery evaluation experiment of "GF City" is carried out, and the cognitive evaluation data is obtained. Then, the Bayesian scoring function and search algorithm is used to learn and seek imagery. The mapping between vocabulary and impulse response is related to the semantic relationship between semantics. Finally, the mapping-correlation resource network model of impulse response is established by modularization, the potential image lexical association is mined, the mapping of the impulse response is extracted, and the hierarchical structure is extracted, and then the image is represented by probability distribution. The mapping of vocabulary to impulse response is associated with semantically related knowledge.
4. Conclusion
Combining Bayesian network modularization concept, this paper innovatively transforms the local industrial resource impulse response modelling problem of "GF City metropolitan area" and "location quotient" into the general probabilistic relationship of knowledge reasoning and based on the "location quotient" measurement resource impulse response. The topology relationship represents a typical relevant issue. Based on the "GF City metropolitan area" image and the local industry resource impulse response cognitive model, Bayesian scoring function and search algorithm are used to establish the "location quotient" local industrial resource impulse response network, and then the

Figure 2. Economic Logic Framework Image of "GF City" Cognition of the "Location Quotient" Resource
Probability dependence relationship is described to extract multi-dimensional "Guangzhou-Foshan City metropolitan area" "location quotient" resource impulse response knowledge. The method can be adapted to solve many uncertain problems such as "location quotient" cognition and calculation, emotional information processing, etc. The follow-up work will be experimental analysis of image vocabulary and local industry semantics, as well as different reasoning methods such as rough set and regression analysis. In terms of reliability comparison, the paper further analyses and improves the empirical analysis of the mechanism and path of the rapid development of Foshan City using the “Guangzhou-Foshan City metropolitan area” in the context of G-H-M Greater Bay Area.

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