



中国科学院空天信息创新研究院

Aerospace Information Research Institute(AIR)  
Chinese Academy of Sciences(CAS)

## 8th ACM SIGSPATIAL International Workshop on Location-based Recommendations

# Spatial Heterogeneity and Influencing Factors of Music Training Institutions in Beijing-Tianjin-Hebei Urban Agglomeration

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**October 29, 2024**

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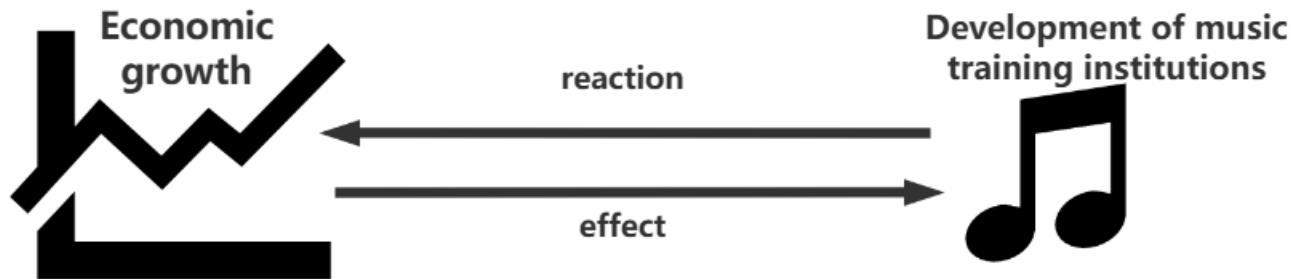
# Introduction

Under the background of The Times in which students are infiltrated with aesthetic education and their core qualities such as cultural understanding, aesthetic perception, artistic expression and creative practice are comprehensively improved, music education assumes an important responsibility, and music training institutions play an important role in it.

| 序号 | 颁布部门           | 颁布日期       | 政策名称                    | 主要内容   |
|----|----------------|------------|-------------------------|--|
| 1  | 中共中央办公厅、国务院办公厅 | 2015/9/29  | 《关于全面加强和改进学校美育工作的意见》    | 明确指出教育应以美育为核心，全面开展课堂教学与课外活动。                               |
| 2  | 中共中央办公厅、国务院办公厅 | 2020/10/15 | 《关于全面加强和改进新时代学校美育工作的意见》 | 提高学生审美和人文素养为目标，弘扬中华美育精神，把美育纳入各级各类学校人才培养全过程。                |
| 3  | 中共中央办公厅、国务院办公厅 | 2023/12/22 | 《教育部关于全面实施学校美育浸润行动的通知》  | 将美育融入教育教学活动各环节，潜移默化地彰显育人实效，实现提升审美素养、陶冶情操、温润心灵、激发创新创造活力的功能。 |
| 4  | 二十大政府工作报告      | 2022/3/25  | 《义务教育艺术课程标准(2022版)》     | 要大力推进教学改革，转变育人方式，切实提高育人质量。加大条件保障力度，保证课程有效实施。               |

# Introduction

- The higher level of economic development plays a positive role in promoting the development of music training institutions.
- It not only provides a broad market space and a solid economic foundation for music training institutions, but also plays a promoting role in upgrading software and hardware of music training institutions and enriching teaching content.

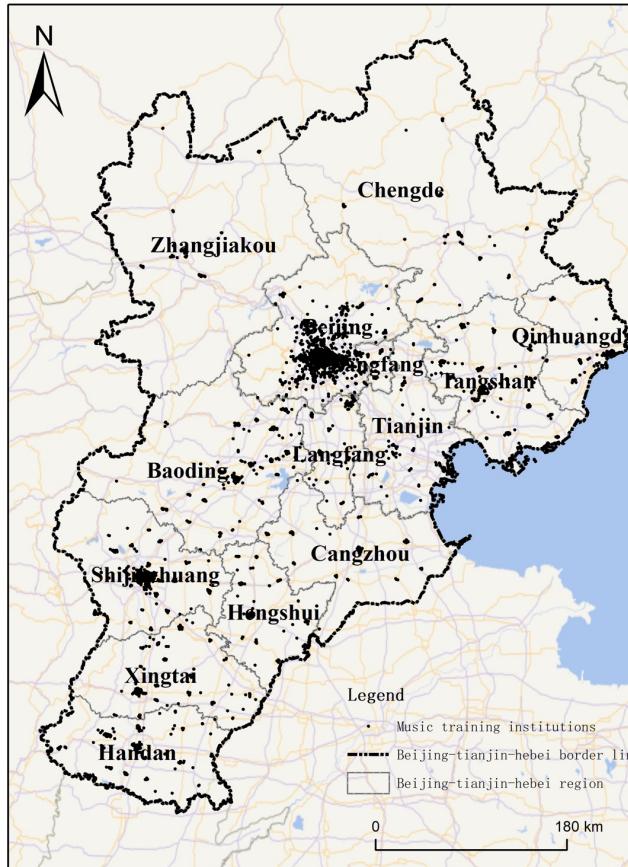


- The Beijing-Tianjin-Hebei city cluster, as a world-class city cluster in China, has a significant imbalance within the region in terms of coordinated economic development. Similarly, The development of music training institutions is also unbalanced, which is not consistent with the fairness of aesthetic education.

# Data sources and research methods

## (一) Study area overview

### Study area: Beijing, Tianjin and Hebei Province



The spatial location of the study area

# Data sources and research methods

## (二) Data sourcing and processing

- Music training institutions data: The company searched the official website of the Beijing-Tianjin-Hebei music training institutions, and eliminated them according to the business scope, taking 4041 music institutions as the research object.

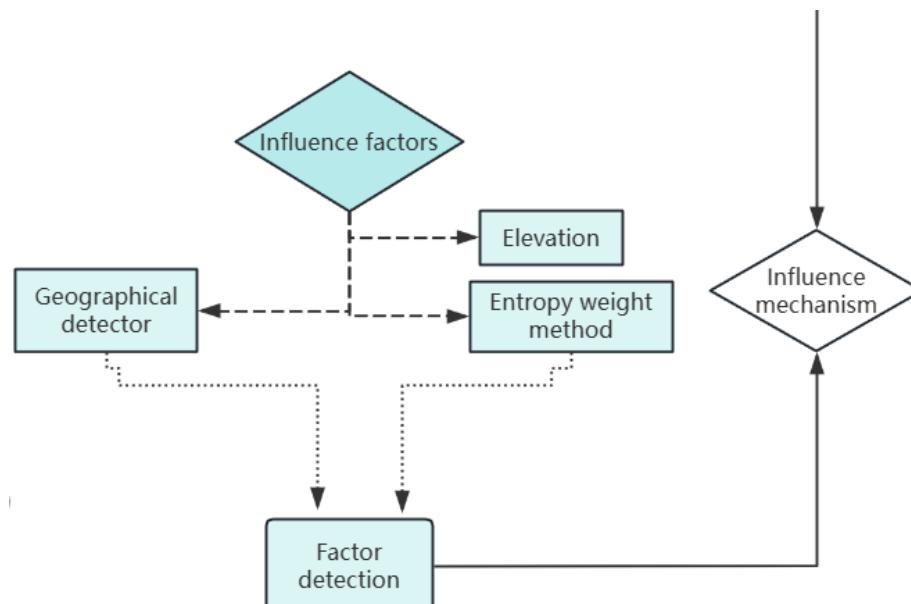
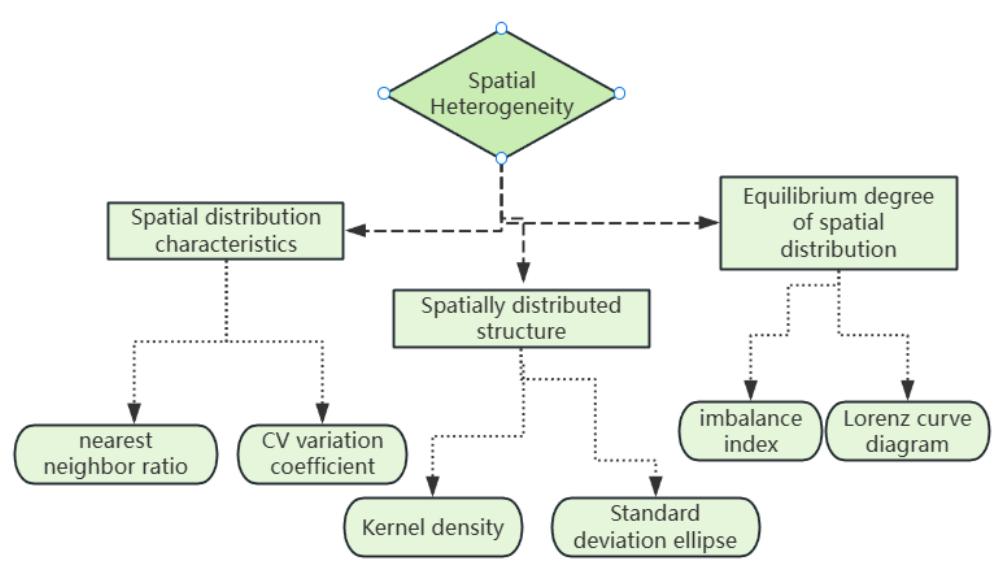
| City           | Beijing | Shijiaz<br>huang | Tangsh<br>an | Baod<br>ing | Hand<br>an | Xing<br>tai | Qinhuang<br>dao | Langfang | Hengshui | Cheng<br>de | Zhangjiak<br>ou | Tianjin | Cangz<br>hou |
|----------------|---------|------------------|--------------|-------------|------------|-------------|-----------------|----------|----------|-------------|-----------------|---------|--------------|
| Number         | 1588    | 420              | 364          | 337         | 264        | 239         | 214             | 177      | 120      | 106         | 74              | 69      | 69           |
| Proportion (%) | 39.3    | 10.4             | 8.7          | 8.3         | 6.5        | 6.2         | 5.3             | 4.4      | 3        | 2.6         | 1.8             | 1.7     | 1.7          |

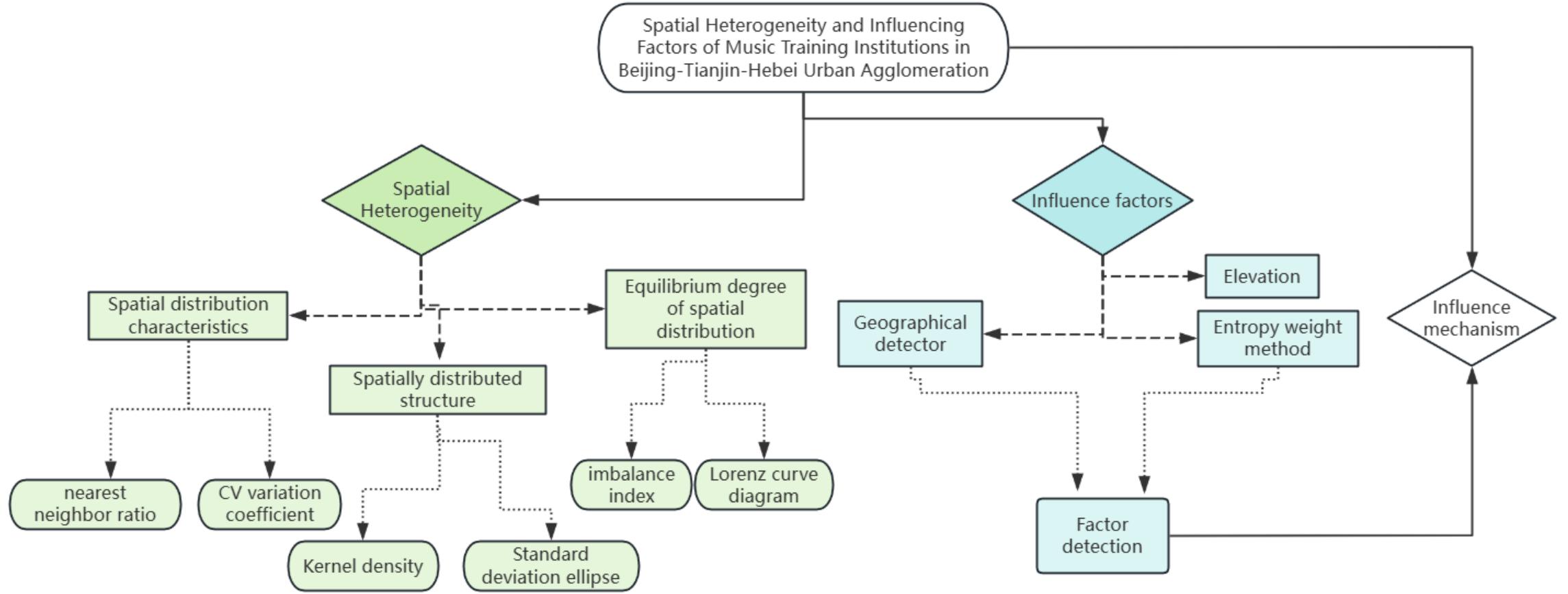
- Map data: derived from the department of natural resources standard map service web site (<http://bzdt.ch.mnr.gov.cn/index.html.>);
- Elevation data: from the geospatial data cloud DEM digital elevation data;
- The data of road network density, per capita disposable income, population with college degree or above, population density, and total capital of cultural service industry are from the national, provincial and municipal statistical yearbooks in 2022
- The number of museums, cultural palaces, libraries, schools, parks and squares comes from the official websites of provincial and municipal people's governments.

# Data sources and research methods

## (二) Research method

- Spatial distribution characteristics: nearest neighbor ratio、CV variation coefficient
- Spatially distributed structure: Kernel density、Standard deviation ellipse
- Equilibrium degree of spatial distribution: imbalance index、Lorenz curve diagram
- Influence factors: Elevation、Geographical detector、Entropy weight method



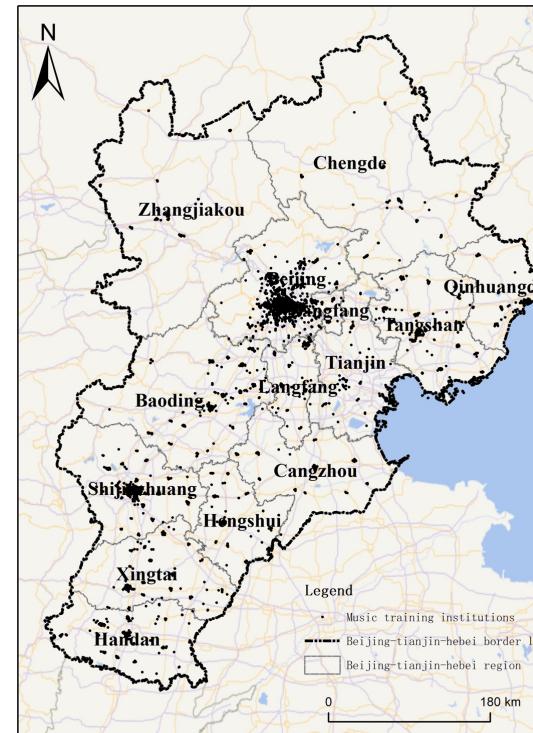


# Spatial distribution analysis

## (一) Spatial distribution characteristics

### ■ The number of music training institutions shows obvious agglomeration characteristics.

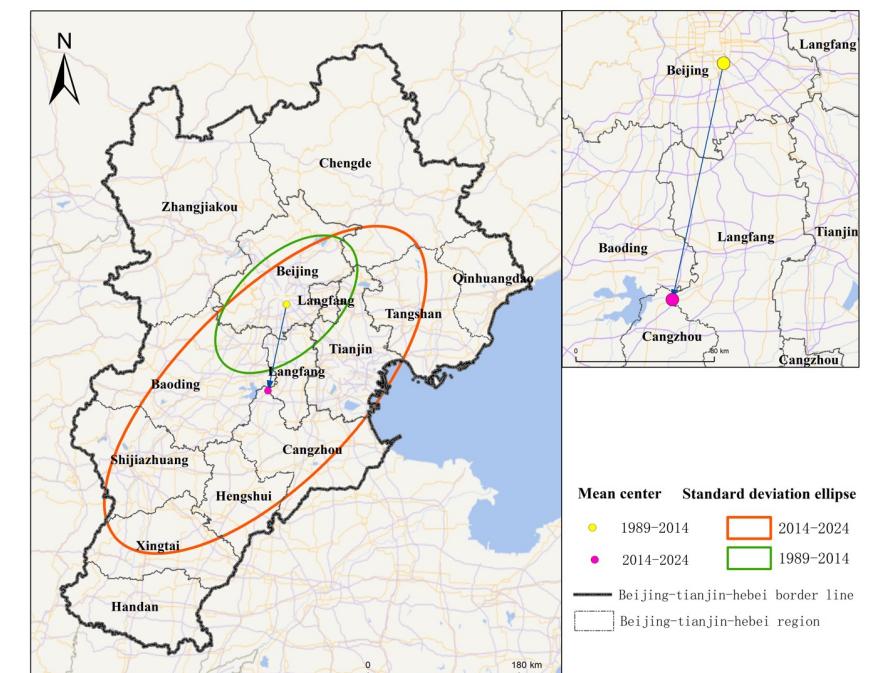
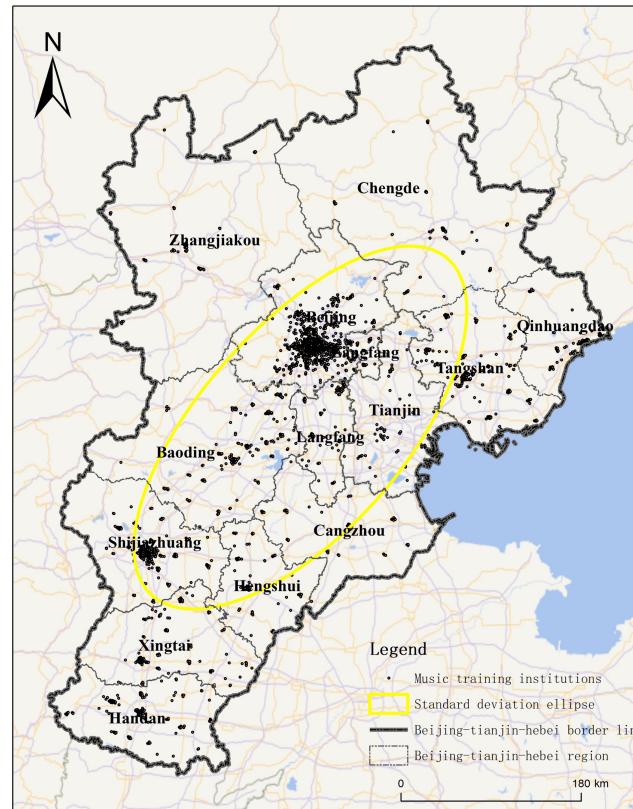
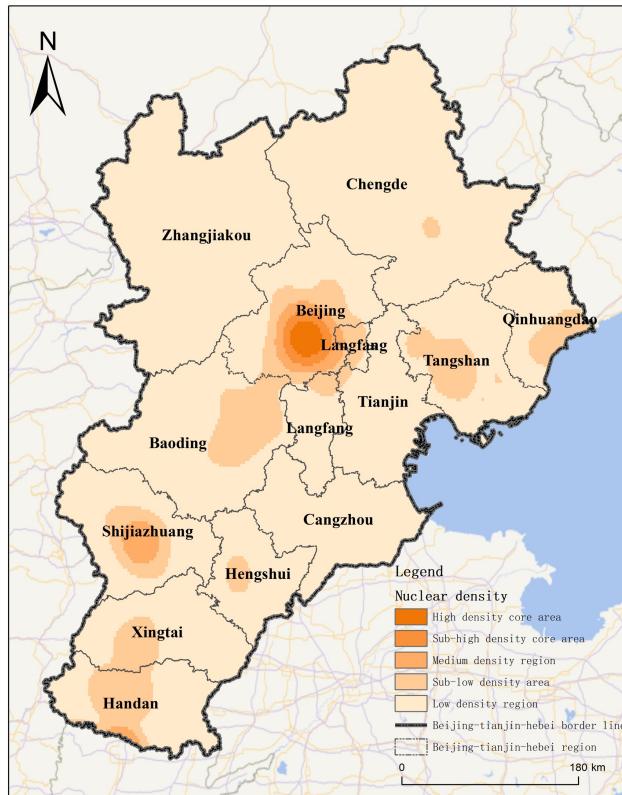
- The nearest neighbor ratio was 0.179, and the significant level was  $P < 0.01$ , indicating that the music training institutions in Beijing-Tianjin-Hebei Province showed obvious clustering distribution characteristics in space.
- CV variation coefficient=385%, which further verified the spatial agglomeration distribution trend of music training institutions in Beijing, Tianjin and Hebei.



# Spatial distribution analysis

## (二) Spatial distribution structure

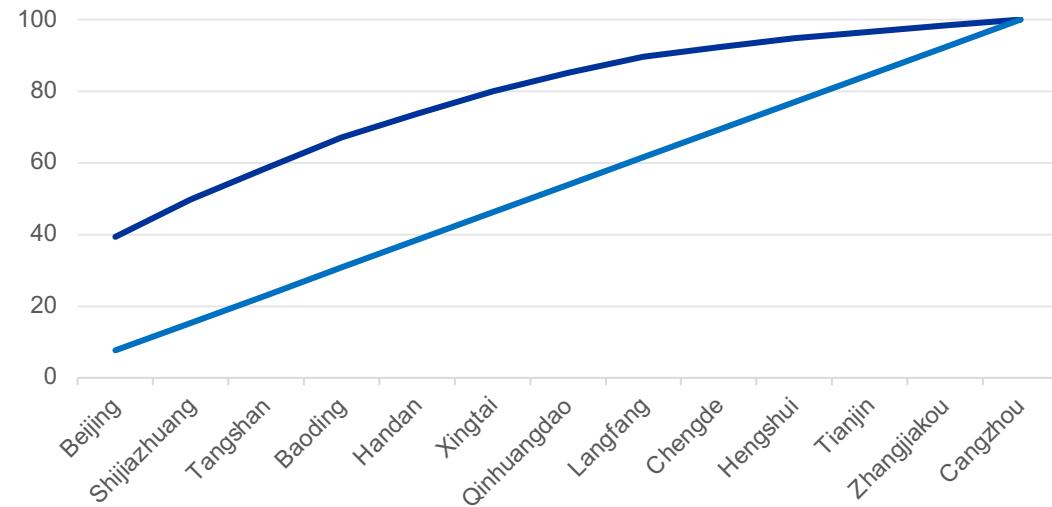
- The results of kernel density show two prominent core regions and several scattered point clusters.
- The standard deviation ellipse results show a significant "northeast-southwest" trend feature, and the expansion degree in the south-north direction is more significant than that in the east-west direction.



# Spatial distribution analysis

## (三) Equilibrium degree of spatial distribution

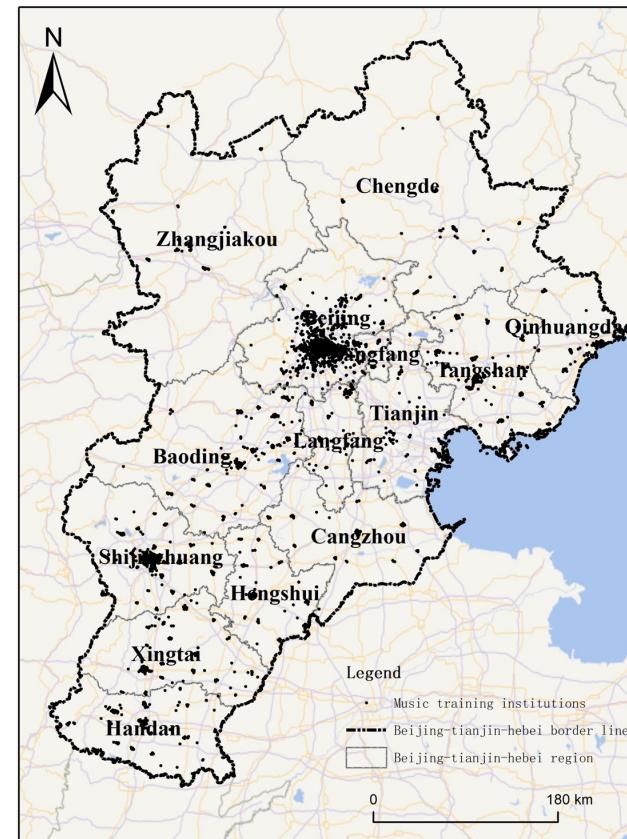
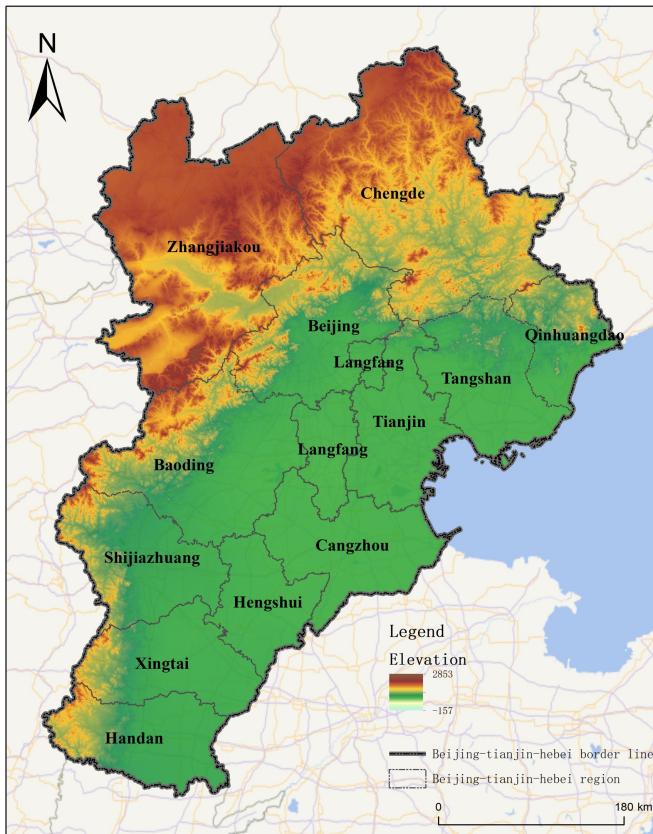
- Imbalance index results:  $S=0.458$ , indicating that there is a significant imbalance in the distribution of music training institutions in the Beijing-Tianjin-Hebei region.
- Lorenz curve results: the curve is far away from the uniform distribution line, and the curve has a convex arc, which further proves the uneven distribution of music training institutions in the Beijing-Tianjin-Hebei region.



# Influence factors

## (一) Elevation factor

- Beijing-tianjin-hebei music training institutions are greatly influenced by the terrain of Yanshan Mountains in the north and Taihang Mountains in the west, mainly concentrated in the plain area.



# Influence factors

## (二) Entropy weight method

- Index weight: the order of influence intensity from large to small is: economic development level > population factor > transportation convenience > cultural service facilities > leisure and residential places.

| Influencing factor              | Specific indicators                             | Entropy weight method |                      | Geographical detector |         |
|---------------------------------|---|-----------------------|----------------------|-----------------------|---------|
|                                 |   | Indicator weight      | Overall index weight | q Price               | p Price |
| Transportation convenience      | X1 Road network density                         | 0.150                 | 0.925                | 0.926                 | 0.004   |
|                                 | X2 Parking lot                                  | 0.776                 |                      | 0.925                 | 0.004   |
| economic development horizontal | X3 GDP per capita                               | 0.015                 | 0.963                | 0.948                 | 0.000   |
|                                 | X4 Culture and art industry cash flow           | 0.948                 |                      | 0.964                 | 0.000   |
| demographic factor              | X5 Population density                           | 0.388                 | 0.936                | 0.931                 | 0.003   |
|                                 | X6 Junior college degree or above               | 0.198                 |                      | 0.954                 | 0.000   |
|                                 | X7 Proportion of the population aged 0-14 years | 0.350                 |                      | 0.933                 | 0.003   |
| Leisure living place            | X8 Entertainment venue                          | 0.313                 | 0.817                | 0.958                 | 0.000   |
|                                 | X9 Park Plaza                                   | 0.095                 |                      | 0.371                 | 0.485   |
|                                 | X10 Mall  | 0.184                 |                      | 0.979                 | 0.000   |
| Cultural services installation  | X11 Residential area                            | 0.2252                | 0.882                | 0.980                 | 0.000   |
|                                 | X12 Library                                     | 0.3207                |                      | 0.958                 | 0.000   |
|                                 | X13 Cultural Palace                             | 0.1472                |                      | 0.977                 | 0.000   |
|                                 | X14 Museum                                      | 0.31008               |                      | 0.958                 | 0.000   |
|                                 | X15 School                                      | 0.1038                |                      | 0.545                 | 0.260   |

# Influence factors

## (三) Geographic detectord

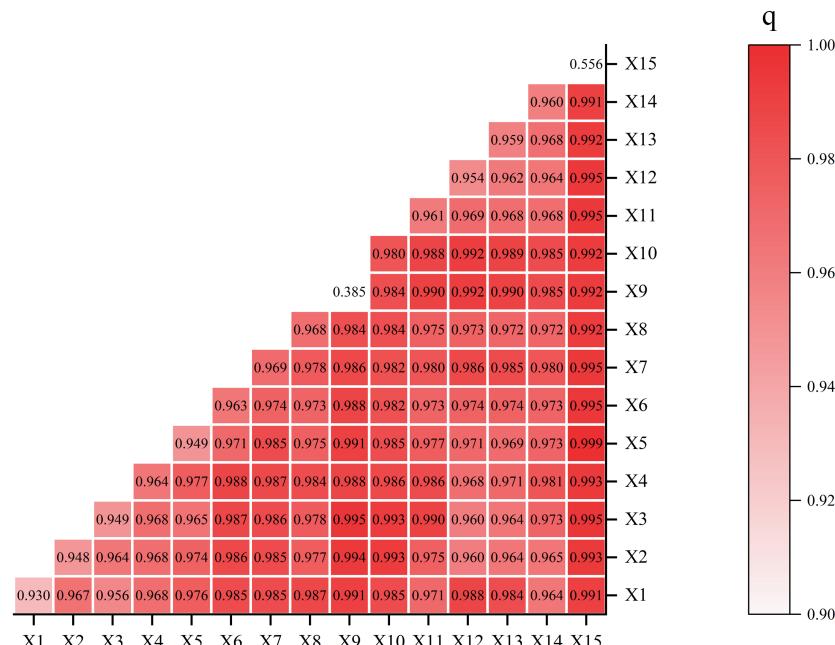
- Single factor analysis: shopping malls, residential areas, cultural palace and other places have the greatest impact on music training institutions

| Influencing factor              | Specific indicators                             | Entropy weight method |                      | Geographical detector |           |
|---------------------------------|---|-----------------------|----------------------|-----------------------|-----------|
|                                 |   | Indicator weight      | Overall index weight | $q$ Price             | $p$ Price |
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|                                 | X15 School                                      | 0.1038                |                      | 0.545                 | 0.260     |

## Influence factors

### (三) Geographic detector

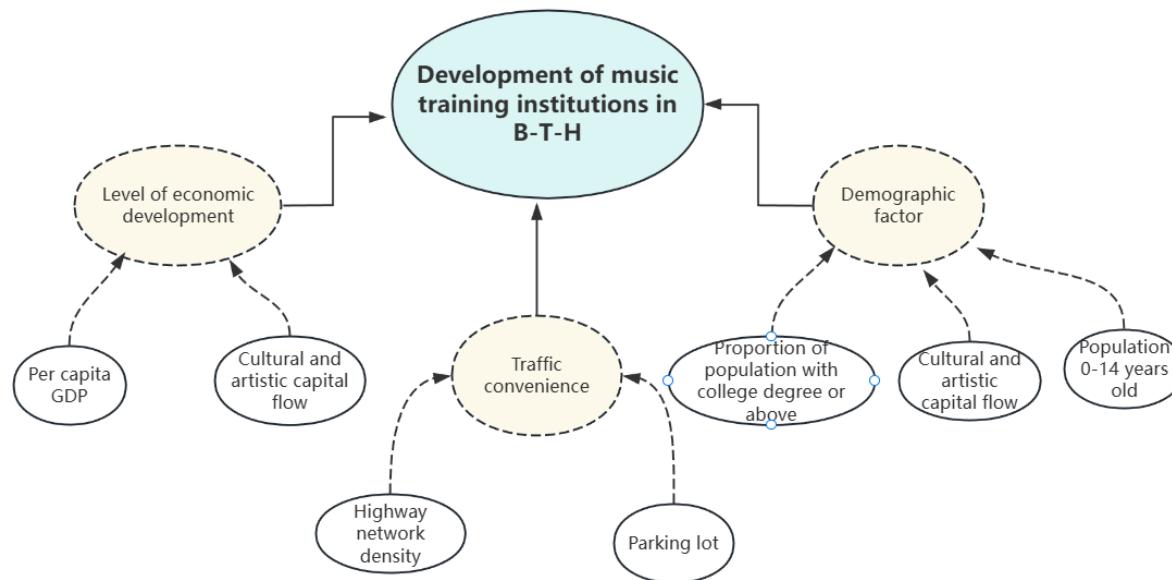
- Interaction factor analysis: per capita GDP  $\cap$  shopping malls (0.9932), shopping malls  $\cap$  libraries (0.9918), per capita GDP  $\cap$  residential areas (0.990), road network density  $\cap$  libraries (0.988),<sup>a</sup> and capital flow  $\cap$  population with junior college degree or above (0.9877)



# Discussion

## ■ Mechanism of influence

- By analyzing the pattern and mechanism of music training institutions, it is found that the spatial distribution pattern of music training institutions in Beijing-Tianjin-Hebei is the result of the general background of The Times and the joint action of various factors.



## ■ Policy suggestion

- The inclination of coordinated development policy
- Driven by coordinated economic development
- Work together to achieve high-quality development goals

# Conclusion

- Music training institutions in the Beijing-Tianjin-Hebei region generally show the spatial distribution characteristics of "scattered in the northwest and gathered in the southeast"
- In the first stage of the development of music training institutions in the Beijing-Tianjin-Hebei region, the geographical coverage of music training institutions is relatively limited, and the core of spatial distribution is concentrated in Dongcheng District of Beijing. In the second stage, the coverage of music training institutions expanded on a large scale, and the center of their spatial distribution moved to the border area of Langfang, Baoding and Cangzhou.
- The spatial layout of music training institutions in the Beijing-Tianjin-Hebei region is the result of the comprehensive effects of five factors, and the influence of each factor on the music training institutions is slightly different. In terms of the overall index weight, the influence is ranked in the order of economic development level > population factor > transportation convenience > cultural service facilities > leisure and residential places.



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Any Questions  
Welcome to Collaborate



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