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Social Specialization of Space: Clustering Households on the French Riviera

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ABSTRACT

The aim of this paper is to estimate the extent of social specialization of residential space within the French Riviera metropolitan area. Unlike classical approaches, where social groups are pre-defined through given characteristics of households, our approach determines clusters of households inductively. Socio-demographic characteristics of households are thus measured through 16 different indicators. Clustering is then carried out through the optimization of two distinct criteria. Simulated annealing, simple and multi-objective Genetic Algorithm were adapted for this purpose and has produced pertinent results.

Categories and Subject Descriptors
H.2.8 [Information Systems]: Database Applications—Data Mining, Spatial databases and GIS; I.5.3 [Pattern Recognition]: Clustering; J.4 [Computer Applications]: Social and Behavioral Sciences—Sociology

Keywords
NSGA-II, Simulated Annealing, Metropolitan Areas

1. INTRODUCTION

Social specialization of residential space within an urban area is the concentration of households according to some characteristics like social status, demographic characteristics, ethnicity, etc. in different urban subspaces. Understanding the logics of social specialization is of course crucial in order to define policies like urban planning or housing.

Geographers have traditionally used two approaches in order to study social specialization of urban space. The first is to pre-select social groups defined along lines of social status, ethnicity and position in the life cycle. Spatial concentration of these groups is later analyzed in order to detect eventual segregation patterns within the city. The second approach aims at characterizing the content of the resident population of neighborhoods without targeting a specific social group but by taking into account the whole population and all descriptors of households at the same time. Unlike these classical approaches, we want to both determine spatial concentration of specific groups of population in the urban space and to take into account all descriptors of households at the same time. This poses the problem of clustering households according to two conflicting criteria: maximum homogeneity of human content and maximum spatial difference within the metropolitan area. Classical clustering can not be directly applied due to optimization of two conflicting criteria. This is the reason why we adapt an evolutionary and a simulated annealing algorithm and apply them to a data set of households of the French Riviera extracted from the CERTU Household Mobility Survey of 2008.

2. OUR FRAMEWORK

Given a set of \( n \) households \( I = \{x_1, \ldots, x_j, \ldots, x_n\} \) where \( x_j = \{x_{j1}, \ldots, x_{jk}\} \) represents the \( j \)-th household, and each \( x_{ji} \) represents its \( i \)-th feature value. We name \( w_i \) the weight associated with the \( i \)-th attribute and \( coem_j \) the weight corresponding to the \( j \)-th household in the sample.

In this paper we consider the clustering based on medoids: each cluster \( C_{C_{1..k}} \) is defined by a center \( m_i \in I \). One common measure used for clustering is the intra-cluster distance between medoids and items and can be defined as:

\[
Intra(C) = \sum_{i=1}^{k} \frac{\sum_{x_{ij} \in C_{i}} \sum_{x_{lj} \in C_{L}} w_i \times coem_j \times d(m_i, x_{lj})}{\# I},
\]

where \( d \in [0, 1] \) represents the distance between two items weighted by \( w_i \). Moreover, \( \# I = \sum_{j=1}^{n} \sum_{x_{ij} \in C_{i}} coem_j \). In the following the cardinality of a subset \( A \subseteq I \) will be the sum of the \( coem \) of the items it contains, i.e. \( \# A = \sum_{x_{ij} \in A} coem_j \).

However, the minimization of equation 1 is not sufficient to determine clusters of households that are spatially opposed within the metropolitan area. In order to ensure that socio-demographic differences among clusters also correspond to
respond to the medoids of the cluster. The neighborhood of
choosing
s
NBLOOP
with other strategies, we perform 400000 evaluation by
s
medoids in
SA, a state is a vector of
different clusters identified within the metropolitan population
weighted average of Duncan and Duncan index over the dif-
fraction that should move in order to spread it evenly within the
spatial difference in sectors of residence, we create a new
criteria based on dissimilarity index by Duncan and Dun-
formations are normally identified. However, only PF17 identifies
low social status. Particular profiles with higher DI are de-
respectively. Extreme solutions on the Pareto front are less
intra-cluster distances and maximizing Weighted
minimizing intra-cluster distances and maximizing Weighted
produced results seem in
social status of the average clus-
tected by PF12 and PF48: couples of retirees of low social
the produced results seem in
good agreement with expert knowledge of the social struc-
from a spatial point of view. The produced results seem in
in terms of social morphology of the metropolitan area.

Figure 1: Results

Figure 1(a) Results for clustering with a double optimization scope:
minimizing intra-cluster distances and maximizing Weighted
Dissimilarity Index seems to us the only way to empirically
determine which categories of population are most opposed
from a spatial point of view. The produced results seem in
agreement with expert knowledge of the social structure of the French Riviera. For the geographer, the task is
now to project clustering results in geographic space in or-
to see what the ID values of the different clusters mean
in terms of social morphology of the metropolitan area.

5. CONCLUSION AND FUTURE WORK

For understanding social specialization on the French Riviera, we have adapted an NSGA-II algorithm and proposed a framework for clustering with a double optimization scope: minimizing intra-cluster distances and maximizing Weighted Dissimilarity Index seems to us the only way to empirically determine which categories of population are most opposed from a spatial point of view. The produced results seem in good agreement with expert knowledge of the social structure of the French Riviera. For the geographer, the task is now to project clustering results in geographic space in order to see what the ID values of the different clusters mean in terms of social morphology of the metropolitan area.

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7. REFERENCES