AGGLOMERATION STRUCTURE OF ETHNIC RESTAURANTS AND THE EFFECT OF ACCEPTANCE IN THE U.S.

by

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ABSTRACT

As the attention of ethnic restaurants grow from consumers, researchers have questioned the proper assessment of identifying ethnic restaurant consumer demand and where ethnic restaurants should locate accordingly. For this reason, past literature has focused on demographic features to answer these questions. However, unlike non-ethnic restaurant demand, ethnic restaurant demand cannot be fully explained by demographics since the demand for ethnic restaurants consist of two major groups, which are non-ethnic and ethnic consumers. The two consumer groups differ in location, which ethnic consumers are clustered while other non-ethnic consumers are spread across the geographical plain. The two consumer groups also differ in acceptance which ethnic consumers have a pre-established notion of the ethnic restaurant theme while non-ethnic consumers require acceptance to consume. This study proposes that since ethnic restaurants have these differences ethnic restaurants show difference in clustering patterns. More specifically this study attempts to identify whether higher acceptance from non-ethnic consumers allow ethnic restaurants to expand to other non-ethnic consumer regions while ethnic restaurants are mostly clustered in ethnic communities. In addition, the study further investigates whether ethnic restaurant clustering patterns differ by its restaurant price segment. The empirical results of this study show that acceptance of ethnic food, general restaurant opinion, and country of origin plays a crucial role in ethnic restaurants to diffuse to non-ethnic consumers while ethnic restaurants agglomerate near ethnic communities. However, higher price restaurants were found cluster stronger than lower price restaurants to reduce search cost for consumers which confirms previous studies. Finally, this study found that acceptance of food and general restaurant opinion from non-ethnic consumers affects ethnic restaurants in the ethnic community to diffuse but acceptance of country of origin showed ethnic restaurants in ethnic communities to cluster which suggest that cultural aspects allow ethnic restaurants to cluster stronger in ethnic communities.

Keywords: Restaurant agglomeration; Ethnic restaurants; Restaurant segment

CHAPTER 1. INTRODUCTION

The term *ethnic restaurant* in the U.S. is commonly defined as a restaurant that serves uncommon cuisines to the regional consumers (Leung, 2010). For this reason, ethnic restaurants have been considered small businesses that focus on minorities with limited demand (Ram *et al.*, 2000). However, beginning in the early 21st century, the demand for ethnic restaurants increased at a surprising rate across the world (Roseman, 2006; Lee *et al.*, 2014). In particular, U.S. ethnic restaurants showed staggering growth from 2002 to 2012. According to the U.S. census bureau, ethnic restaurant establishments have increased by 45%, while the total number of all restaurants increased by 19% during this period. Following the increase in numbers, ethnic restaurant sales increased by a 98%, while the total sales of all restaurants increased by 57% between the same years. The reports show a trend in rapid growth in the establishment and sales of ethnic restaurants, where roughly 40% of all restaurants in the U.S. were ethnic restaurants in 2012. Interestingly, non-mainstream ethnic specialty restaurants have increased by 66%, which is larger than any mainstream ethnic restaurant (Italian, Mexican, and Chinese) growth. The census data support the argument presented by several researchers that there is a shift in demand from non-ethnic consumers to more diversified ethnic cuisines within the U.S., while non-ethnic restaurants have also attempted to create ethnic menus for their restaurants to adapt to the increase in demand (Ebster & Guist, 2005; Josiam & Monteiro, 2004; Lee *et al.*, 2014; Roseman, 2006).

As consumer interest increases for ethnic restaurants, the majority of ethnic restaurant research studies has attempted to identify the characteristics that promote the ethnic dining behaviors of non-ethnic consumers (e.g. Qu, 1997; Jang *et al.*, 2009; Ha & Jang, 2010). Some studies have investigated each individual ethnic theme (Jang *et al.*, 2012; Qu, 1997), while others have attempted to identify the themes as a collective to compare ethnic restaurant consumer behaviors across ethnic restaurant themes (Ha & Jang, 2010). Studies have shown that not only does the acceptance and perception of non-ethnic consumers affect the attributes of ethnic food, service, and the atmosphere, which are the building blocks of restaurant hospitality, but they are also affected by political, social, and cultural perceptions of an ethnic restaurant's country of origin (Jang *et al.*, 2009; Ling, 2012; Liu, 2015). The perception of an ethnic restaurant from a

non-ethnic group has also been known to differ based on the ethnic restaurant's theme, and some ethnic restaurants have a higher acceptance than others (Jang & Ha, 2009). In addition, the acceptance of an ethnic restaurant theme changes over time (Roseman, 2006; Jang & Ha, 2009). Studies have also shown that the authenticity of an ethnic restaurant based on the food, ambience, and culture affects consumer satisfaction and purchasing intention (Jang et al., 2011; Tsai & Lu, 2012; Sukalakamala & Boyce, 2007; Lu & Lu, 2015). The motivation for conducting studies on ethnic restaurant authenticity is driven by the inevitable evolution of ethnic restaurants, as ethnic restaurants tend to change their menus over the years to adapt to mainstream, non-ethnic consumers (Lu & Fine, 1995).

For ethnic restaurant owners, understanding the current acceptance of non-ethnic consumers can be crucial when choosing a location because acceptance affects demand in terms of the frequency and the likelihood of consumers visiting ethnic restaurants (Rosemann, 2006; Jang & Ha, 2009). Theoretically, a firm's decision to select a location near a competitor or in a different area than the same type of business has been known to be affected by the structure of demand (Hotelling, 1929; Anderson *et al.*, 1997). Thus, unlike non-ethnic restaurants, each ethnic restaurant theme may vary in agglomeration intensity because all ethnic restaurants themes have different levels of acceptance, which affect differences in demand in a given space. However, although location selection is one of the most significant factors in a restaurant's success (Pillsbury, 1987; Prayag *et al.*, 2012; Tzeng *et al.*, 2002), very little is known regarding how ethnic restaurants strategically choose their locations based on consumer demand. Studies related to ethnic restaurant locations have focused on immigration patterns or demographics to explain the number of restaurants within a certain region. For example, the most recent research study related to ethnic locations and demand was conducted by Yang *et al.* (2017), who focused on the number of ethnic restaurants and demographic variables, such as population density, income, education, and gender for Mexican, Italian, and Asian restaurants in the U.S. The findings of the research showed that ethnic demographics affect the major ethnic cuisines, which is in contrast to Zelinsky's (1985) results. However, despite the uncertainty of ethnic restaurants' demand for non-ethnic consumers, there has been no attempt to identify how non-ethnic consumers' perceptions and acceptance levels affect the decision to be located near the competition or in a different area, which can be vital in understanding the current ethnic restaurant spatial structure because acceptance can alter a region's non-ethnic consumer demand

regardless of the demographics, such as population density. For instance, suppose region A has *x* population density with a low acceptance of a Korean restaurant but a high acceptance of a Mexican restaurant, while region B has the same population density with a high acceptance of Korean food and a low acceptance of Mexican food. The result of the agglomeration pattern would differ between these regions because the demand would be different based on the likelihood of the non-ethnic regional consumers to visit the Korean and the Mexican restaurants.

Similar to the demand from non-ethnic consumers, an ethnic restaurant's demand in its own ethnic community is also significant and is unevenly distributed over space. Ethnic communities are known to cluster within a region due to available labor for immigrants and shared values (Ram *et al.*, 2000). The concentration of one nation's population implies that an optimal region for a location for an ethnic restaurant theme exists when acceptance from non-ethnic consumers is low or does not exist (Kaplan, 1998). That is, when demand is not evenly distributed, an equilibrium exists for firms to agglomerate within a region where demand is the highest despite intense competition. In contrast, if the demand is evenly distributed and competition is intense, firms will tend to diffuse from each other to maximize profit and to avoid price competition (D'Aspremont *et al.*, 1979; Saxenian, 1990). Moreover, if all other factors are considered equal, consumers choose the closest businesses because traveling to a location is considered a cost in addition to the product's price (Fetter, 1924). These assumptions would imply that ethnic restaurants will diffuse from each other as demand becomes more acceptable to non-ethnic consumers. That is, when acceptance increases from non-ethnic groups for a specific ethnic restaurant theme, demand increases over the regional space, and the distribution of demand becomes more evenly distributed, which leads to diffusion.

Another important factor to consider when investigating restaurant clustering patterns is the possibility of differences in the price range, which represent differences in the quality of the food and service (Knutson *et al.*, 1996). Each price range represents a restaurant segment, which the National Restaurant Association (NRA) acknowledges as a quick service restaurant (QSR), casual dining restaurant, up-scale dining restaurant, and fine dining restaurant with prices increasing respectively. The segments differ based on occasion and purpose, and visiting higher priced restaurants is based on emotional enjoyment rather than utilitarian aspects, such as time or price sensitivity (Auty, 1992). For this reason, higher priced restaurants tend to agglomerate stronger than lower priced restaurants to signal an assurance of quality (Jung & Jang, 2018). In

contrast, firms diffuse from each other when price competition is intense and demand is fixed (Anderson *et al.*, 1997). Thus, an ethnic restaurant is in a position to choose whether to cluster among similar ethnic restaurant themes to increase demand or to choose a location in a different area from its competitors to fully exploit its demand. However, for higher priced ethnic restaurants to agglomerate, an assurance of quality from non-ethnic consumers can only exist if there is acceptance. Without acceptance, higher priced ethnic restaurants have little to no benefit to agglomerate and therefore diffuse further than the lower priced ethnic restaurants. This suggests an interaction effect between the restaurant segment and acceptance on ethnic restaurant agglomeration.

In sum, this study attempts to extend the existing literature by identifying the demand factors that affect ethnic restaurants' location pattern by examining how non-ethnic consumers' acceptance affects ethnic restaurants to expand while ethnic consumers' uneven demand causes the location to cluster to function as an incubator for ethnic restaurants to grow. The study also contributes to consumer behavior in ethnic restaurants by questioning whether acceptance from non-ethnic consumers affects ethnic restaurants' expansion by empirically testing whether non-ethnic consumers' acceptance creates motivation for ethnic restaurants to diffuse. Finally, an aim was to identify how different proportions of hedonic and utilitarian aspects of the ethnic restaurant segment, which can be represented by price range, can affect ethnic restaurants' agglomeration differently than traditionally believed. The study contributes to previous restaurant literature theory by suggesting how the interaction effect of acceptance and restaurant segments can affect ethnic restaurants for which the demand consists of non-ethnic consumer and ethnic consumer groups.

From a methodological perspective, two relatively recent methods applied in the hospitality field were combined to test the research questions. Rather than distributing surveys, which could lead to sample bias, a sentimental analysis was conducted using text mining by using Twitter tweets to identify consumers' acceptance of each ethnic restaurant theme in terms of food, restaurant opinion in general, and country of origin (COO). The data were used to rank acceptance by the highest order and were then implemented in a negative binominal regression model (NB) to test how acceptance affects ethnic restaurants' clustering patterns. In addition, each ethnic restaurant theme was investigated using *Ripley's k-function*, which evaluates

agglomeration in comparison with other ethnic restaurants by state and by city to identify the different patterns of ethnic restaurant agglomeration/diffusion.

CHAPTER 2. LITERATURE REVIEW

2.1 General restaurant location selection factors and demand based on demographics

Restaurant location is known to be one of the most significant factors that determine the success of a restaurant (Pillsbury, 1987; Prayag *et al.*, 2012; Tzeng *et al.*, 2002). However, determining which location is most optimal is not driven by a single factor. Tzeng *et al.* (2002) argued that restaurant location decisions are determined based on external and internal factors. External factors are factors that the restaurant cannot control, which is the given situation of each location. Internal factors are factors that the restaurant can control that affect location selection. Tzeng *et al.* (2002) explicitly stated that:

> External factors include economic, transportation, competition, commercial area and environment, while internal factors include personal background of the manager (such as age), idea of management, level of education, decision making preference, and management system.

More specifically, economic factors include rent cost and transportation cost; transportation factors include convenience of a mass transportation system, parking capacity, and pedestrian volume; competition factors include the number of competitors and the intensity of completion; commercial area factors include the size of the commercial area and the extent of public facilities; and environment factors include the convenience of garbage disposal and sewage capacity. Using the analytic hierarchy process (AHP), the study showed that all transportation factors, which are convenience of a mass transportation system, parking capacity, and pedestrian volume, and rent cost were the most significant factors when selecting locations. The study aim was to explain how important external factors influence restaurant locations as well as to determine the importance of how consumers consider the cost of distance.

The study conducted by Tzeng *et al.* (2002) only focused on the supply side of internal and external factors. Moreover, pedestrian volume alone cannot be a sufficient variable to explain the demand factors when choosing a restaurant's location because only using pedestrian volume would be based on the assumption that all pedestrians are homogenous to the restaurant type. Bojanic and Shea (1997) argued that there are multiple segments of demand that should be considered to optimize restaurant location selection. They tested this hypothesis by comparing

the differences in dining behaviors between suburban consumers and urban consumers. The results showed a difference in demographics as well as different constructs in overall satisfaction. Suburban consumers considered quality of service, employee friendliness, and value for price the most significant factors in predicting satisfaction. For urban consumers, timeliness of service, quality of food, and value for price were considered predictors of satisfaction. The study supports the suggestion that demand specifications are not equally distributed over space and should be considered when choosing the optimal location. Jang and Ha (2009) also supported the importance of the demand factors for location selection. They found that advertising the convenience of a store location increases store image, which affects consumer satisfaction.

As a comprehensive concept based on external and internal factors, location clustering and diffusion have been study topics in the restaurant research field (Pillsbury, 1987; Prayag *et al.*, 2012). Pillsbury (1987) found that traditional location controls socioeconomic and consumer factors in restaurant location clustering. The aim of the study was to identify clustering patters by using the city of Atlanta with 2,000 restaurant observations. Although the method used to identify such patterns was based on qualitative and personal judgment, several interesting points were mentioned in the paper. For external factors, restaurants were found to have a tendency to cluster within the central business district (CBD) as a traditional location control factor. Such clustering was claimed to be due to high density and low personal mobility consumer groups, which was the demographic information used in the study. In addition, the study showed that a large portion of restaurants in the CBD were in shopping centers. Income had also an effect on restaurant location as an external factor, and the study showed that Chinese restaurants were often located in low-income, blue-collar neighborhoods. For the internal factors, it was stated that ethnic restaurant types also affect clustering patterns of restaurant locations. Special ethnic restaurants were also found to agglomerate around immigration communities, while American cuisine restaurants tended to cluster around the CBD. The difference in the restaurant theme was also claimed to affect restaurant locations, which represents internal factors. Limited service restaurants were mostly located near major traffic areas around the CBD, while higher priced full-service restaurants were located within the CBD. Non-franchise “mom and pop” full-service restaurants were found to be located outside of the CBD, while franchise restaurants were mostly scattered around the city. The type of food was also suggested to affect location

clustering, where pizza was found to be scattered around the entire city with no clustering effects. In sum, for the internal factors, restaurant ethnicity, restaurant segment (full/limited), franchise/non-franchise, and type of food affect location selection. For the external factors, CBD, income of the consumer group, and consumer group ethnicity affect restaurant selection.

2.2 Endogenous agglomeration and supply side agglomeration

Marshall (1890) explained two possible causes for firms to agglomerate: exogenous externality and endogenous externality. Exogenous externalities is defined as the benefits a firm gains by geographically locating next to a beneficial physical infrastructures (McCann & Folta, 2008), such as restaurants clustering near parks or theaters. The benefits are specifically due to only physical infrastructures and do not include benefits from clustering with other firms. Marshall (1890) argued that external infrastructures such as transportation nodes or natural resources were the most significant reason why firms were observed to agglomerate with each other. However, unlike Marshall's (1890) argument, Ellison and Glaeser's (1999) empirical results found that only 20 percent of all firm agglomeration were found to be exogenous externalities. The more dominant agglomeration was endogenous externality agglomeration which was similar firms to agglomerating with each other. Though Marshall (1890) did not claim this was the dominant factor for agglomeration, the article mentioned four benefits from such agglomeration type: (1) product specialization; (2) skilled labor force; (3) technology spillover; and (4) heighten demand through reduction of consumer search cost. As an extension, Mccann and Folta (2009) further classified these advantages into two groups which they claimed that product specialization, skilled labor force, and technology spillover as supply side agglomeration while heighten demand through reduction of search cost as demand side agglomeration.

As an extension to Marshall's (1890) theory, Hoover (1936) accounted for inter-sectoral clustering among different types of firms to explain why different firms agglomerated in a specific location. Hoover (1936) classified agglomeration as *internal returns to scale*, *localization economics*, and *urbanization economics*. Internal returns to scale type agglomeration is defined as firms choosing to cluster within a specific location due to labor specialization, which increases productivity. Localization economics is defined as firms benefiting by being locating close to other firms that produce similar products. Finally,

urbanization economics is defined as an incentive to cluster around firms that are different in terms of firm sector (Jacobs, 1969). This general classification by Hoover (1936) was applied in later research in the hospitality field. The findings of Porter (1998) support the *localization economics* effect by explaining that tourism businesses cluster where restaurants, hotels, and tourist attractions interact with each other. Pillsbury's (1987) findings support the *internal returns to scale* by observing that restaurants with similar segments agglomerate within a specific location.

An extensive record of empirical research on the supply side of agglomeration across diverse industries exists. One stream of literature that has been extensively studied is firm agglomeration due to knowledge spillovers by innovative producers when firms are geographically located in close proximity (Acs et al., 1994; Anselin et al., 1997; Audretsch & Feldman, 1996; Jaffe et al., 1993). Analogous to these studies, another stream of literature concentrates on how knowledge can pass on to other close regions across borders which creates firms to cluster. The importance of these interactions between regions allows firms to share knowledge which creates innovative products due to the spillover effect (Coe & Helpman, 1995; Grossman & Helpman, 1991, Breschi et al., 2001). The objective of these studies were to determine how the economic activities can shape agglomeration externalities and can support innovation.

However, whether it is more beneficial to agglomerate with similar firms or complementary firms is an ongoing debate. Glaeser *et al*. (1992) claimed that the specialization or localization of similar firms is linked when there is a pool of skilled labor, co-location of suppliers and customers, and technology spillovers among firms in the same industry, which can provide returns to scale in final production as well as greater productivity and growth (Lucas, 1993; Romer, 1990). In contrast, Jacobs (1969) argued that the advantages of diverse externalities or urban economies when knowledge is exchanged through different types of firms that are complementary industries and economic agents. Duranton and Puga (2000) argued that the complementary knowledge exchange would generate greater returns due to new economic knowledge and providing opportunities to innovation, which would foster growth. The argument implies that innovation occurs when the local economy has a greater diversity in economic activity. However, empirical evidence does not offer conclusive results for this argument, which shows that innovation-oriented policies may not create agglomerated regions. Keller (1998)

argued that if technology and intellectual properties were considered as public goods that could be freely passed on to other firms, knowledge spillover would not be locally bounded which would allow innovation to move freely even across other regions. From this perspective, not only local R&D but also other economies' R&D efforts could determine local innovation.

Nevertheless, in some cases, it is assumed that the entire foreign pool of knowledge is not transmittable. Caborer-Borras and Serrano-Domingo (2007) found innovative technology spillover would only occur within a close trade-based regional range when studying how higher education and public administrations affect regional innovation spillovers within the Spanish regions. Caborer-Borras and Serrano-Domingo (2007) further argued that the effects of higher education and public administrations only required a minimum level of regional development to improve the effectiveness of R&D policies. Therefore, R&D policies should be considered with other policies focused on the improvement of socio-economic and structural determinants to enhance regional innovative performance.

In addition to agglomeration, some researchers of geological studies have claimed that the deterioration of agglomeration may lead to diffusion due to supply force. Shaver and Flyer (2000) found that firms that excel in technology, labor, training programs, suppliers, and distributors suffer losses from agglomeration, while weaker firms gain by agglomerating near superior firms when a spillover effect exists. Diffusion of an endogenous agglomeration may also occur as the clustered region is matures. Pouder and St. John (1996) claimed that clusters erode over time and eventually limit firms' innovative capabilities and performance. This implies that the benefits of clustering change over time, and thus firms begin to diffuse as the cluster becomes more competitive and less innovative (Audretsch & Feldman, 1996; Grove, 1987; Klepper & Miller, 1995; Meleki, 1985). Stuart and Sorenson (2003) found supporting results in the biotechnology industry, where early start-up firms agglomerated and then began to diffuse as the industry evolved.

2.3 Agglomeration by demand and agglomeration studies in hospitality

Among Marshall's (1890) reasoning of benefits for firms to agglomerate, reduce search cost has been the essential purpose for hospitality industries to agglomerate. Previous studies related to agglomeration in the service industries have argued that low technology firms, such as restaurants, lodging, and retail, benefit more from heightened demand and reduced search costs

rather than knowledge spillovers or skilled labor availability (Canina *et al.*, 2005; Mccann & Folta, 2009). The reasoning of such possibilities is driven by the fact that heighten demand will attract more consumers then the total amount of demand driven alone (Kalnins and Chung, 2004), while the assumption of these studies was argued by Stigler (1961) which explained that search cost benefits occur when both buyers and sellers are identified for heighted demand. Stahl (1982) further explained that firms derive greater benefits from agglomeration when products require high search costs and visual inspections. Fisher and Harrington (1996) further theoretically proved that the demand factor for firm collocating to each other occurs when firms are more heterogenous in products that are homogenous in terms of superiority. Kalnins and Chung (2004) argued that this could explain the existence of food courts and auto malls. However, several empirical studies have also shown that similar industry firm agglomeration by demand can be beneficial when a superior firm exist in a heterogenous product environment. Kalnins and Chung (2004) found that low-resourced hotel firms tend to agglomerate predominant hotel firms to exploit the spillover effects of demand. Ingram and Baum (1997) empirically found that unbranded hotels had lower failure rates when chain hotels were adjacent. Chung and Kalnins (2001) further found that unbranded hotels to have higher revenues when their locations were near national brand hotel agglomerated locations. These effects were initially stated by Shaver and Flyer (2000) who have argued that demand spillover may occur when one firm has a superiority over another, and demand is ample enough to spillover to other inferior firms. In a more recent study, Liu *et al*. (2018) empirical results showed that restaurants in regions with higher volume in electronic word of mouth (eWOM) had an inverted U-shape in terms of agglomeration. Liu et al. (2018) argued that higher agglomeration makes the area more attractive which increases the possibility to fulfill consumer needs.

For ethnic restaurants, Zukin's (1995) survey, which sampled restaurants that mainly dealt with immigrants working in ethnic restaurants may suggest that agglomeration is mostly due to the demand factor as well rather than technology or specialized skilled labor spillover. The study was based on 20 questions for both owners and employees, covering national origins, hiring arrangements, work conditions of the organization, and sources of investment capital. The 35 respondents in the sample came from 17 different countries in North Africa, the Middle East, Asia, Scandinavia, the Caribbean, North America, and Latin America. The common ground for all these countries was the growing number of service jobs in relation to industrial and

agricultural employment. Few of the respondents had industrial skills and experience. The main reason for choosing a restaurant job was that working in an ethnic restaurant provided the fastest way to earn money, and one participant explained that the work "didn't require too much knowledge about anything." Hiring patterns in ethnic restaurants suggested that cultural experience was necessary to prepare the cuisine, but this experience could be achieved by a learning process and could be obtained thorough group membership. Most immigrant cooks received on-the-job training in food preparation, while most employees with chef responsibilities had some prior training. In addition, they read cooking magazines and attended trade shows in search of new ideas. The qualitative study findings indicated that supply forces, which include labor specialization or technology advancement, are relatively less important than the demand forces of non-ethnic group acceptance for ethnic restaurants to agglomerate or to expand. That is, only the chef requires a specialization to operate the business, while other employees are trained.

Although similar firm agglomeration or collocating to each other creates greater competition among firms (Saxenian, 1990), this does not necessarily result in firm diffusion. Using a set of assumptions, Hotelling (1929) provided a Nash equilibrium solution, where two firms agglomerate despite price competition. The assumptions included a linear market and bounded, evenly distributed demand, duopoly competition, constant marginal cost production, no fixed cost, homogenous products, linear transportation cost, and perfect inelastic demand. The study results imply that agglomeration between two firms occurs despite price competition. Extensions to this research, which include the attempt to relax the assumptions of Hoteling (1929), have shown various results. By relaxing the assumption of evenly distributed consumers, Anderson *et al.* (1997) found an equilibrium where firms locate closer to each other with lower prices using a log-concave consumer function. They argued that if demand or distance diminishes in a non-linear function, firms tend to agglomerate within the optimal location. The solution that Anderson *et al.* (1997) presented can be applied to ethnic restaurants at an early stage, where the demand only exists within a clustered region, while the non-linear function of demand is created due to a low acceptance of the ethnic restaurant theme outside the ethnic community. Since there is no demand or very little outside the ethnic group, the curve of the concavity is much steeper than well-accepted food by the non-ethnic group. This theory

implies that without acceptance from non-ethnic groups, diffusion would not occur despite higher competition.

The theoretical proof of Anderson *et al.* (1997) also explains the importance of demand, and potential consumer demographics have been found to be important factors in understanding ethnic restaurant clusters. Zelinsky (1985) was one of the first to study how demographics affect ethnic restaurants. Although the empirical results were analyzed by comparing descriptive information, the paper showed two main interesting results. One result showed population density to be an important factor in identifying the number of restaurants, which was consistent across all ethnic themes. The other result showed that the population density of the ethnic consumers had no relationship with ethnic restaurant clusters. Zelinsky (1985) argued that this might indicate that non-ethnic consumers are willing to try new foods because ethnic restaurants were found to be dispersed and not in ethnic communities. However, the second study by Zelinsky (1985) contradicted the findings of Yang *et al.* (2017), and U.S. census data by zip code were used that consisted of population density, median age, median income, college education percentage, male percentage, owner occupied housing units, renter occupied housing units, urban rural taxonomy, hotel density, and ethnic percentage divided by white, black, Asian, and Mexican. The census data were used to identify clustering patterns of ethnic restaurants. The same results as Zelinsky (1985) were found for population density, but a higher percentage of Asian and Mexican populations was linked to more ethnic restaurants in the region. In sum, the findings of previous studies suggest that dominate force for hospitality industries is demand and that competition does not necessarily conclude to diffusion. Table 1 summarizes the literature on agglomeration.

Table 1

Selected literature on Agglomeration

Author	Result/Implications
Marshall (1890)	Reasons for similar firms to agglomerate can divided by exogenous agglomeration and endogenous agglomeration, where most agglomerations are based on exogenous agglomeration.
Hotelling (1929)	Under the assumption of linear market and bounded, evenly distributed demand, duopoly competition, constant marginal cost production, no fixed cost, homogenous products, linear transportation cost, and perfect inelastic demand two firms find a Nash equilibrium agglomerated in the center.
Hoover (1936)	Agglomeration can be classified by *internal returns to scale*, *localization economics*, and *urbanization economics*. Internal returns to scale are firms choosing to cluster within a specific location due to labor specialization which increases productivity. Localization economics are defined as firms benefiting by locating close to other firms that produce similar products. Urbanization economics are defined as an incentive to cluster around firms that are different in terms of firms' sector.
Stigler (1961)	Search cost benefits occur when both buyers and sellers require identification for heighted demand.
Jacobs (1969)	greater return to new economic knowledge and facilitating innovation are achieved when different types of firms that are complementary industries and economic agents exchange complementary knowledge.

CONT Table 1
Selected literature on Agglomeration

Stahl (1982)	Firms achieve greater benefits by agglomeration when products require high search costs and visual inspections
Zelinsky (1985)	Population density was found to be an important factor in identifying the number of ethnic restaurants while ethnic communities had no relationship with ethnic restaurant clusters.
Pillsbury (1987)	Special ethnic restaurants were agglomerated around immigration communities while American cuisine restaurants clustered around the central business district.
Glaeser *et al*. (1992)	Specialization or localization of similar firms were linked when there exists a pool of skilled labor, co-location of suppliers and customers, and technology spillovers among firms in the same industry, which provide returns to scale in final production
Pouder and St. John (1996)	First mover advantage in the clustered area erodes over time as outside competitors gain strength in population which agglomeration economies start to diffuse.
Anderson *et al.* (1997)	When demand or distance diminishes in a non-linear function, firms will agglomerate within the optimal location
Ellison and Glaeser (1999)	80 percent of all firm clusters could not be explained by exogenous externalities.
Shaver and Flyer (2000)	Firms that excel in technology, labor, training programs, suppliers, or distributors experience losses from agglomeration, while weaker firms gain by agglomerating near superior firms when there is a spillover effect.

CONT Table 1
Selected literature on Agglomeration

Caborer-Borras and Serrano-Domingo (2007)	When resources can only be acquired by proximity, improvement of socio-economic and structural determinants of regional affect innovative performance
Mccann and Folta (2009)	Marshall's (1890) can be re-classified into supply side agglomeration and demand side agglomeration where demand side agglomeration occurs in low technology related firms
Prayag *et al.* (2012)	Restaurants were more clustered in the central business district when comparing to outside the central business district.
Yang *et al.* (2017)	Population density, median age, median income, college education percentage, renter occupied housing units, urban rural taxonomy, hotel density, and ethnic percentage by white, black, Asian, and Mexican affect ethnic restaurant density

2.4 Acceptance of ethnic foods and neophobia

The term ethnic food and ethnic restaurants has been defined in many ways. The Food Marketing Institute (1998) defines ethnic food as certain foods that a racial or national favor. Utami (2004) defines ethnic food as a cuisine of the minority immigrants in a multi-cultural environment which defines ethnic food to be regional specific. Kwon (2015) argued that the definition of ethnic foods can be defined in a narrow and broader sense. In a narrow sense, the narrow approach definition represents foods that originate from a heritage or culture of an ethnic group that shares knowledge of an ingredient in the cuisine. In a broader sense, ethnic food was defined as a cuisine that is culturally and socially accepted by other consumers that are not within the ethnic group.

As for Ethnic restaurants, Turgeon and Pastinelli (2002, p.252) refers ethnic restaurants as a restaurant that consists of signboards or publicity that clearly states that it promises to a certain regional or national cuisine unique to the resided country location. In Olsen et al. (2000)

research which studied the dining out behavior in the United Kingdom, ethnic restaurants were defined as all restaurants that were non-British restaurants. Sriwongrat (2008) had also defined ethnic foods in this manner which the study considered all non-New Zealand food as ethnic restaurants, which were Chinese, Greek, Italian, Japanese, Thai, Mexican, and Spanish when studying influential factors of upscale ethnic food dining selection.

One primary reason for ethnic restaurant consumption is to seek new food experiences and flavor combinations. Most ethnic cuisines are transferred to other regions by introducing unique flavors from spices that the transferred region is unfamiliar with, which Danhi and Slatkin (2009) argued is the "essence" of an ethnic food. Ethnic restaurants differ from non-ethnic restaurants in terms of the importance of the acceptance of the food (Roseman, 2006). It is important to note that acceptance refers to the perception of an ethnic food or restaurant from a consumer group comprised of non-ethnic consumers, which carries uncertainty regarding the ethnic theme. The differences between the non-ethnic consumer group and ethnic consumer group familiarity of a foreign dish can lead non-ethnic consumer group to psychologically fear of trying the foreign dish, also known as neophobia (Tuorilla et al., 2001; Hursti et al., 2002). First identified by Pliner and Hobden (1992), the personality trait of food neophobia was defined to measure the reluctance to eat novel foods. It is known to influence the willingness to try new foods and thereby how new foods are accepted (Lähteenmäki & Arvola, 2001). This fear of trying new food which is reflected by avoiding unfamiliar types of foods or spices is driven by the psychological resistance to change. Neophobic behavior is especially found to be observed in the consumption of ethnic food (Barrena & Sanchez, 2012), which can be altered through education or living within regions that have more diversity in terms of culture (Flight et al., 2003)

A person's diversification in dietary and eating habits are developed in the early stages in life which is dominantly based on the parent cultural eating tendencies (Bril *et al.*, 2001). Verbeke and Lopez (2005) study supports this notion by finding children to be more acceptable to new foods (more neophilic) than adults 55 years and older, who are more neophobic. It has also been found that exposure to flavors, both through prenatally and breastmilk feeding, influences the child's flavor preferences later in life (Mennela et al., 2001). Lumeng and Cardinal (2007) also supports the notion which the study found young children to remember a flavor better if the flavor recalls positive memories about the time it was consumed, which they

argued that the purpose of the ability to describe a flavor is possibly to make future references to repeat consumption. This can increase one's preference for a certain food since repeated exposure is known to affect preference as well (Liem & DeGraaf, 2004).

Due to the limited unfamiliarity of ethnic restaurants, the acceptance of ethnic restaurants is not only based on the dishes but also based on social perceptions of the nation and culture and political perceptions. This is consistent with Tversky and Kahneman's (1974) heuristic availability in which a relevant event can be a source to alter a person's perception of an object. For example, Liu (2015) explained that political affairs degraded the image of Chinese restaurants between 1882 and 1904 when the Chinese Exclusion Act was passed. Liu (2015) claims that this racial discrimination and misperception of Chinese culture hindered Chinese restaurant expansion for three decades as there were merely 14 Chinese restaurants that existed in the United states. However, as public relations improved, a dramatic increase in Chinese restaurants was observed with an increase of 117 Chinese restaurants within a decade (Ling, 2012). By 1915, 118 Chinese restaurants were located in Chicago, and only five were in Chinatown, which explains how Chinese restaurants expanded to non-ethnic consumers. The history of Chinese restaurants and the political relationship is an example showing that the acceptance of an ethnic food changes based on the perceived social status of the country of origin.

2.5 Diffusion in ethnic restaurants due to differences in acceptance

Although a neophobic behavior towards ethnic foods is embedded in the early years of childhood development, neophobic behaviors of non-ethnic consumers are not constant and can change over time. Hwang and Lin (2010) empirically showed that an increase in familiarity reduces neophobic behavior, which is an example of additional information reducing neophobic behavior. Techniques such as adding familiar flavors, appearances, presentations, and preparation methods were found to reduce neophobic behavior towards novel Asian food. Jang and Kim (2015) found visual information, verbal information, and cultural familiarity to be effective in reducing perceived risk and in increasing acceptance of ethnic restaurants.

Furthermore, acceptance differs based on ethnic restaurant themes, which might suggest a multi-stage for ethnic restaurant location based on the degree of acceptance. Sloan (2001)

classified four ethnic restaurant development stages in the U.S.: exotic (e.g., Ethiopian), narrow (e.g., Vietnamese), expanding (e.g., Thai), and mainstream (e.g., Italian and Chinese), which indicates that the acceptance of ethnic restaurants can vary over time. Roseman (2006) suggested that ethnic restaurants have an ordinal value of acceptance from the non-ethnic group of ethnic restaurants. The study showed that the acceptance of an ethnic restaurant within the U.S. varies by type, and the order of acceptance is Italian, Mexican, Chinese/Asian, German, French, Greek, Indian, and Caribbean restaurants. Roseman (2006) also claimed that a difference in acceptance affects the likelihood of visiting an ethnic restaurant, which was supported by a correlation between the likelihood of visiting an ethnic restaurant and acceptance. Jang *et al.* (2009) studied the acceptance of Asian food for each ethnic restaurant theme based on attributes. The attributes that were observed were tasty, edible, quality, fresh, digestible, looks pleasing, clean, aromatic, healthy, attractive, nutritionally balanced, colorful, has a strong vegetable component, inexpensive, unique, traditional, neat, spicy, light, and exotic. Using the importance-performance analysis (IPA), it was found that all Asian ethnic restaurant themes had different attributes that affected the acceptance of the ethnic restaurant theme. For instance, Chinese restaurants were perceived as economic, while Indian restaurants were perceived as colorful, spicy, and exotic. The findings of the Jang *et al.* (2009) showed that each ethnic restaurant theme differs in acceptance even in countries that are adjacent to each other. Other studies on acceptance have shown that constructs of acceptance affect consumer purchase intentions. Ha and Jang (2010) found that the perceived quality of atmospherics affects satisfaction and loyalty to Korean restaurants. Liu and Jang (2009) found that food taste and service reliability are key success drivers for Chinese restaurants. Sukalakamala and Boyce (2007) found that consumers with higher incomes and graduate degrees were more open to trying Thai restaurants. Table 2 summarizes the literature on ethnic restaurant acceptance. These findings suggest that non-ethnic groups are capable of changing their perceptions of an ethnic restaurant, which implies an increase in acceptance that increases demand and therefore allows the ethnic restaurant type to diffuse from within the ethnic community to reduce competition. Therefore, the following hypothesis is proposed:

Hypothesis 1: The acceptance of a non-ethnic group will have a positive effect on ethnic restaurant diffusion.

2.5.1 Food acceptance and diffusion

Food acceptance is best classified as a hypothetical construct. The acceptance of food has been referred to by terms such as hedonic tone, liking/disliking, food preference, and pleasantness/unpleasantness (MacFie & Meiselman, 2012). These terms reflect the operational measures of the construct, which is a phenomenological experience best categorized as a feeling, emotion, or mood with a defining pleasant or unpleasant character. Because it is a subjective construct, the measurement of food acceptance relies on the use of psychometric, psychophysical, and/or behavioral methods.

MacFie and Meiselman (2012) developed a schematic model of the sensory basis of food acceptance, which the process moves from physical to sensory, perceptual, and hedonic levels. In terms of physicochemical level, neurochemical and neuroelectric event occur in the peripheral nervous system when receptor organs for sensory system are activated by digesting food that creates energy. MacFie and Meiselman (2012) mentions psychophysical transformation occurs at this stage, which sensors are activated such as how long and how strong the experience will pursue based on the quality of the intake. These information by the sensors are passed through the nervous system which interacts with diverse channels of the body.

The next stage is “processing” which information by the sensors is transformed to recognizable characteristics of the food based on past memory or previous experiences. It is in this stage where flavor or texture are defined. Following these sensory information, perception of the food memory triggers the hedonic tone of pleasant or unpleasant perceptions which is subject to diverse factors that do not relate to the stimulus itself. MacFie and Meiselman (2012) states the diverse factors are such as previous experience, culture, expectations, and current status of hunger or thirst.

Finally, as for the last stage, the hedonic tone based on the perception of the dish transfers to food acceptance which results in verbal or written expression which takes part in individual consumption that affects the market region collectively.

Table 2

Selected literature on Acceptance of ethnic restaurants

Author	Result/Implications
Roseman (2006)	Ethnic restaurants have an ordinal value of acceptance from the non-ethnic group of ethnic restaurants.
Sukalakamala and Boyce (2007)	Consumers with higher income and graduate degrees were more open to try Thai restaurants.
Jang *et al.*, (2009)	Using importance-performance analysis (IPA), Asian ethnic restaurant themes had different attributes that affected acceptance to the ethnic restaurant theme.
Liu and Jang (2009)	Taste and service reliability are key success drivers for Chinese restaurants.
Ha and Jang (2010)	Perceived quality of atmospherics affected satisfaction and loyalty to Korean restaurants.
Ha and Jang (2010)	While American consumers valued Korean restaurants as utilitarian aspects greater than hedonic values, familiarity level with Korean restaurants moderated the hedonic aspects more effectively.
Hwang and Lin (2010)	Adding familiar flavors, appearance, presentation, and preparation removes barriers in trying new ethnic foods while nutrition information moderates the impact of familiarity on consumers' nutrition attitudes toward Asian menus.
Clemes and Sriwongrat (2013).	Up-scale ethnic restaurants were influenced by dining experience, social status, service quality, food quality, and value for money.

CONT Table 2

Selected literature on Acceptance of ethnic restaurants

Roseman *et al.* (2013)	Willingness to purchase ethnic food is provoked by attitudes toward feelings of familiarity, comfort, and healthfulness.
Jang and Kim (2015)	found visual, verbal information, cultural familiarity to be effective in reducing perceived risk and increasing acceptance in trying ethnic restaurants.
Lu *et al.* (2015)	Authenticity perception is critical in determining brand equity while brand equity has a significant impact on consumers' brand choice intention in ethnic restaurants.
Marinkovic *et al.* (2015)	Quality of food and price were the two most significant factors that determine which ethnic restaurant to visit while interior was the most significant factor for ethnic restaurant image

2.5.1.1 Sensation vs. perception of food

As mentioned in 2.5.1, the receptor systems convert physical, chemical, and thermal energy into biochemical and physiological events within the nervous system which results to specific sensations such as taste or texture that leads to perception. The difference relationship between sensation and perception regarding food was mentioned in Reid (1785) which claimed that perception is sense produced by nature while sensation is the feeling that is incorporated with perception. Titchener (1909) further argued the duality of sensation and perception by suggesting that sensation is the analytical experience while perception is the synthetic component which has become the core difference in defining sensation and perception.

Although early views of the relationship between sensation and perception held that perception could only occur in the presence of sensation, in the mid-1960s, Gibson (1966) argued that perception could occur without sensation. This was defined as conscious awareness of sense data, but not in the absence of information. The argument was supported by stating

that human senses are not only passive but also active perceptual systems that attempt to interact with its surroundings to identify information (Gibson, 1966). The differences between sensation and perception and between passive and active perception can be observed in the different approaches to the assessment of the role of the human senses in feeding behaviors. Though a substantial amount of research has been done regarding passive perception based on feeding behaviors conducted by psychophysical studies, a substantial amount of studies has shown the effect of active perception based on using actual foods to identify food acceptance.

MacFie and Meiselman (2012) mentions that to identify perception, testing sensory dimension such as its effect of length, degree, and quality have been measured by standardizing sensory and psychophysical methods. However, challenges have been met in identifying sensory due to subjects being untrained regarding the precise definition to sensory related lexicons (Richardson & Zucco, 1989; Desor & Beauchamp, 1974) or psychological concept miss match among subjects (O'Mahony, 1991; O'Mahony et al., 1990; Ishii & O'Mahony, 1987, 1990). MacFie and Meiselman (2012) provides an example of the sensory response miss match by using an orange as an example which could be responded as "fruity" or "citrusy" which are the same sensation but with different labels. Thus, standardization of sensory has been an ongoing issue in the research field which modern techniques use statistical methods to allow untrained subjects to identify their own definition of sensors (Williams & Langron, 1984; Steenkamp & van Trijp, 1988).

2.5.1.2 The perception of ethnic food

Ethnic groups vary, often widely, based on the cultural context of the foods and diets. According to Guerrero *et al.* (2008), when defining a "traditional food product," non-ethnic consumers identify a certain taste using sensory parameters. This is because an evaluation of the sensory attributes of foods is an easy and effective way to distinguish the authenticity of such products as well as the culture related to them. The recognition of flavor is a direct link to flavor and memory. Varadachari (2002) argued that consumers often have difficulty describing new foods and flavors because they must rely on memory and experience to do so, so they have not tasted the product before. Food selection is often based on memory, though consumers are often unaware of such factors in their decisions. The consumption of products leads to an implicit knowledge of the specific foods eaten, thus influencing what is eaten (Mojet & Koster,

2005). In particular, Jang *et al.* (2010) found that attributes such as quality, freshness, digestible, healthy, attractive, nutritional balance, and spicy differ among Asian ethnic restaurants. This variance in the acceptance of food creates a difference in demand depending on the ethnic restaurant theme even in the same region, which allows for different agglomeration patterns based on ethnic restaurant theme. Therefore, the following hypothesis is proposed:

Hypothesis 1-1: Ethnic restaurant themes that have higher food acceptance will diffuse more than ethnic restaurant themes with lower food acceptance.

2.5.2 Ethnic restaurant physical environment acceptance and diffusion

Consumers' reactions to the physical environment are more related to emotional states than cognitive perceptions, particularly in a hedonic consumption situation (Donovan & Rossiter, 1982; Turley & Milliman, 2000). In service-related consumption situations, servicescape has been accepted as an important determinant of customer psychology and behavior when a service is consumed primarily for hedonic reasons and when customers spend moderate to long times in the service delivery setting (Wakefield & Blodgett, 1994). The origins of servicescape date back to Mehrabian and Russell (1974), who first introduced a theoretical model for the impact of the environment on human behavior. The model is divided into three parts: environmental stimuli, emotional states, and approach or avoidance responses. The environment creates an emotional response in individuals, which in turn elicits either an approach or an avoidance behavior. The model has received consistent support from empirical studies with different settings, such as retail outlets, shopping malls, and hotels (Baker & Cameron, 1996; Donovan & Rossiter, 1982; Sayed *et al.*, 2003).

The model claims that the environment generates an emotional state in an individual that can be characterized as one of three emotional states: pleasure, arousal, and dominance. In addition, the three emotional states are mediated by approach or avoidance behaviors in a broad range of environments. Pleasure refers to the extent to which individuals feel good, happy, pleased, or joyful in a situation, whereas arousal is the degree to which individuals feel stimulated, excited, or active (Bigné et al., 2005). Dominance is defined as the extent to which a person feels influential, in control, or important. However, studies that tested the model have found that the pleasure and arousal dimensions underlie any affective responses to any

environments, whereas dominance did not have a significant effect on approach or avoidance behaviors (Russell & Pratt, 1980; Ward & Russell, 1981). The essential assumption regarding environmental psychology is that consumers emotion affects actions (Donovan & Rossiter, 1982; Mehrabian & Russell, 1974). Furthermore, environmental factors that trigger approach and avoidance behaviors are consisted of different set of emotions which are incorporated with positive and negative responses.

Among the environmental psychology theories, the M-R model proposes that emotions such as pleasantness/unpleasantness and arousal/no arousal influence the responses of individuals to their environments. For instance, the model was used to examine whether emotions influenced purchasing behavior in retail stores, and pleasantness increased the time shoppers spent in the stores and the amount of money they spent (Baker *et al.*, 1992; Donovan & Rossiter, 1982; Donovan *et al.*, 1994). Within restaurant research, six dimensions of the physical environment have been considered potentially important factors to consumer perceptions of a restaurant.

Facility aesthetics refer to architectural design, along with interior design and décor, all of which contribute to the attractiveness of the dining environment (Wakefield & Blodgett, 1994). For instance, consumers are exposed to the interior setting of the dining hall of an fine dining restaurants due to the long hours spent which would affect the experience and attitude about the restaurant. Consumers are also affected by the color schemes of the dining area which provoke different emotions (Bellizzi & Hite, 1992; Crowley, 1993; Gorn, Chattopadhyay, Yi, & Dahl, 1997; Mikellides, 1990). Ryu and Jang (2007) mentioned other possible aspects of interior design which were furniture, paintings/pictures, flowers which may affect the perception of quality of the dining experience which results in pleasure and arousal for consumers.

Lighting is another physical environment that affect consumers emotions which can stimuli upscale restaurant consumers (Hopkinson et al., 1966; Kumari & Venkatramaiah, 1974; Kurtich & Eakin, 1993; Ryu and Jang, 2007). For instance, depending on the light settings, warm and comfortable light setting may give the impression that the restaurant is high priced while bright lighting may represent quick and lower price restaurants. This is supported by Hopkinson et al. (1966) which found that the degree of comfort was associated with lower light setting and brighter light levels associated with less comfort. Kumari and Venkatramaiah (1974) also found the direct relationship between illumination physiological arousal. Lighting has also been found

alter consumers perception of the quality of a space, awareness of physical, emotional, and psychological aspects of the space (Kurtich & Eakin, 1993).

Ambience has also been known to affect consumers emotions. The term "Ambience" refers to this type of responses which is a nonvisual and subconscious effect to intangible background characteristics. Ryu and Jang (2007) mentioned that previous research has shown that atmospheric music increase sales (Areni & Kim, 1993; Mattila & Wirtz, 2001; Milliman, 1986; North & Hargreaves, 1998; Yalch & Spangenberg, 1993), influence purchase intentions (Baker et al., 1992; North & Hargreaves, 1998), increase satisfaction and relaxation (Oakes, 2003), increase or decrease time spent in the store (Milliman, 1986; North & Hargreaves, 1998; Yalch & Spangenberg, 1993, Hui, Dube, & Chebat, 1997), influence dining speed (Milliman, 1986), and affect customers' perceptions of stores (Hui et al., 1997; Mattila & Wirtz, 2001; North & Hargreaves, 1998; Yalch & Spangenberg, 1993). In addition, the influence of pleasant scents as a powerful tool to increase sales has gained much attention from retail businesses (Bone & Ellen, 1999; Hirsch, 1995; Lin, 2004; Mattila & Wirtz, 2001). Ambient scents have also been known influence consumer emotion (Bone & Ellen, 1999; Hirsch, 1995) while certain temperatures were found to provoke negative emotions.

How infrastructures are arranged have been known to affect attitudes to restaurants. This is also known as "layout" which can also affect hedonic or pleasure needs (Wakefield & Blodgett, 1994). The direct effects of layout are quality perception and excitement level while indirect effects affect revisit intention (Wakefield & Blodgett, 1994). Within the restaurant research Ryu and Jang (2007) found that dining equipment such as silverware, glassware, linen, flatware, table decoration affects influence customers' quality perception in up-scale dinning settings.

Finally, employees, who are deeply related to the social environment in terms of service setting which include the employees' appearance (professional appearance and attractiveness) and the number of employees (Ryu & Jang, 2005) have been suggested to also affect consumer emotions in the restaurant setting (Ryu & Jang, 2007). Baker et al. (1992) studied the effects of social cues such as number and friendliness of employees and found that the more social cues present in the store environment affected higher customer arousal. Tombs and McColl-Kennedy (2003) also argued that employees are related to the desired social density, which influences customers' affective and cognitive responses as well as repurchase intentions.

These physical dimensions of a restaurant setting varies by its segment. For example, Ryu and Jang (2007) found that physical environments affect consumers' pleasure and arousal perceptions of a restaurant, which leads to behavioral intention only based on facility aesthetics, ambience, and employees in up-scale restaurants. More importantly, the physical environment affects whether the consumer perceives the restaurant to be an ethnic restaurant. Jang *et al.* (2010) attempted to identify the factors of ethnic restaurant acceptance, and the study showed that cleanness, aroma, light, exoticness, and neat were significant environmental factors in ethnic restaurant acceptance. Furthermore, these traits vary by ethnic restaurant, which affects the acceptance of the ethnic restaurant in addition to the ethnic food. If general restaurant acceptance incorporates ambience and service, which affects ethnic restaurant demand based on purchase intention, a higher acceptance of an ethnic restaurant theme from non-ethnic consumers would expand to regions where non-ethnic consumers exist. This would allow higher accepted ethnic restaurants to avoid competition. Thus, the following hypothesis is proposed:
Hypothesis 1-2: Ethnic restaurant themes with a higher acceptance are more likely to diffuse than ethnic restaurants with a lower acceptance.

2.5.3 Cultural familiarity of the origin of ethnic restaurants

The study of Country of Origin (COO) primarily focuses on determining the effects of consumers' perceptions of the respective countries based on their rating of the quality of the product and the choice processes (Thakor & Kohli, 1996). In terms of its importance, Ahmed and d'Astous (1996) conducted a study to determine how consumers react to a multidimensional formulation of COO, which included Country of Design (COD) and Country of Assembly (COA). The study showed that in the presence of origin cues, such as brand name, quality, and other product attributes, COD explained the largest proportion of common variance when measuring perceived quality, followed by COA and brand name. More interestingly, COD and COA cues were found to have a stronger impact than brand name on consumers' evaluations of quality and purchase value. Elliott and Cameron (1992) studied COO and consumers' perceptions of product quality and concluded that COO is a surrogate indicator of product quality. Their findings showed that though the quality and the price of products were more significant choice determinants for respondents than COO, consumer perceptions of quality differed based on product category when COO was the variation factor.

The effect of COO influences consumer evaluations of foreign products broadly in two dimensions: perception of quality and purchase value of the product (O'Cass & Lim, 2002). However, country image is normally defined as "the general perception of consumers for the quality of products made in the given country" (Han, 1989), and COO cues have been found to have a stronger impact on quality perception than judgments related to purchase value (d'Astous & Ahmed, 1999). Bandyopadhyay and Banerjee (2002) also supported this notion, where the impact of price information, which relates to purchase value, was considered more often for local products than in the case of foreign products. They also found that attributes of products, such as variety, reliability, after sales service, store image, and ad image, also played important roles in evaluating the quality of COO.

A country's stereotyped image also affects consumers' product evaluation process and is activated automatically by COO cues (Liu & Johnson, 2005). The diagnostic role of identity plays a major role in evaluating products. Consumers favor the accessible brand identity more than the global identity when identity is in the diagnostic form (Zhang & Khare, 2009). Batra *et al.* (2000) conducted a study to measure the non-localness perception of a global brand among consumers who belonged to economically developed countries to determine "how and why consumers in developing markets choose between older, local brands and newer, non-local brands." The perceived non-localness of brand origin led to a positive brand attitude when admiration for the Economically Developed Country (EDC) increased.

In practice, researchers use COO as a summary construct when the product evaluations are consistent with the image or reputation of the COO in producing or supplying a type of good and service (Pecotich & Ward, 2007). The COO effect can be evaluated by analyzing the perceptions affecting consumer evaluations of special product attributes, general product attributes, and general country attributes (Parameswaran & Pisharodi, 1994). The effect of COO can be product-specific, and it may operate on a wide variety of products when the country enjoys high and widespread consumer confidence in the quality of its goods. One popular framework used to study cross-culture research is the four-dimensional framework developed by Hofstede (2001). The four "classic" dimensions originally proposed were uncertainty avoidance, individualism, masculinity, and power distance. Among the four dimensions, uncertainty avoidance is found to be the most relevant to innovative behavior (Steenkamp *et al.*, 1999; Tellis *et al.*, 2003) and has been extensively studied. Uncertainty avoidance indicates the extent to

which a society tolerates uncertainty and ambiguity and the extent to which a culture programs its members to feel either uncomfortable or comfortable in unstructured situations. A country's high uncertainty avoidance hinders consumer innovativeness (Steenkamp *et al.*, 1999), which negatively affects a new product's takeoff probability (Tellis *et al.*, 2003). Uncertainty avoidance may also affect foreign susceptibility. Citizens of countries low in uncertainty avoidance experience less alienation from what occurs in the world, have greater tolerance of foreigners' opinions, accept people from other races as neighbors more easily, tolerate immigrants better, and show a more open-minded mentality in search for information than citizens of countries high in uncertainty avoidance (Hofstede, 2001). The relationship between uncertainty avoidance and foreign product quality is less clear, though it could be argued that if the new product has taken off in countries high in uncertainty avoidance, this could represent a stronger quality signal, given that they are more conservative than countries low in uncertainty avoidance. Cultural similarities of two countries tend to have lower uncertainty because people communicate more easily when they share a common cultural background (Ganesh *et al.*, 1997; Kumar & Krishnan, 2002; Rogers, 1995; Takada & Jain, 1991). In sum, past research has shown that the opinion of foreign countries' products varies by country and affects purchasing intention. This means that COO can affect demand for ethnic restaurants as well, where a high acceptance of COO would increase demand and would allow ethnic restaurants to expand to non-ethnic consumers and avoid competition in ethnic communities. Therefore, the following hypothesis is proposed: *Hypothesis 1-3: Ethnic restaurant themes that are more culturally familiar to non-ethnic consumers will diffuse more than ethnic restaurants that are culturally unfamiliar.*

2.6 Endogenous agglomeration due to price segment

For restaurants, price determines the restaurant segment, and consumers expect higher quality and services as prices increase. Restaurant segments have been known to differ in utilitarian value and hedonic value. Utilitarian consumer behavior can be described as a functional or task-related standpoint which may be viewed as efficiency or work (Babin et al., 1994; Batra & Ahtola, 1990). On the other hand, hedonic consumer behavior is defined as seeking "fun, fantasy, arousal, sensory stimulation, and enjoyment," as described by Hirschman and Holbrook (1982). Within the restaurant research, different restaurant segments have been known to consist of different weights for utilitarian and hedonic values which aids the consumer

when deciding which restaurant they desire to dine out based on utility maximization. Hanzaee and Rezaeyeh (2013) found that utilitarian value showed a stronger influence on purchase intentions than hedonic value for quick service restaurants. Ha and Jang (2013) identified the main attributes of restaurant segments, and they concluded that casual restaurants and fine dining restaurants value emotion values, which can be interpreted as hedonic values. The results of Crowley et al. (1992) support that higher end restaurants were influenced by hedonic value. Past research within this field imply order in hedonic and utilitarian value, where quick service restaurants (hereafter, QSRs) have the least hedonic value, followed by casual dining restaurants (hereafter, casual) and then fine dining restaurants with the most hedonic value.

In terms of restaurant location and demand, the restaurant distance from consumers can also be considered a utilitarian value since traveling is activity that incorporates cost. In such case, a consumer's utilitarian value to utility will decrease as the location the restaurant becomes further away from the consumer. However, the weights of utility by distance may be moderated by the type of restaurant segments. More specially, consumers might consider the cost of distance differently depending on whether the restaurant is a quick service, casual, up-scale, or fine dining. This might be due to the difference of the hedonic component of each restaurant segment that allows consumers' willingness to travel longer distance for higher end restaurants than low end restaurants (Jung & Jang, 2018). In terms of a geographical agglomeration perspective, previous literature would imply that low end restaurants would need to locate nearest to the consumer demand since cost of distance increases at a higher rate than high end restaurants while high end restaurants will tend to agglomerate in a certain location to benefit for consumer search cost by representing higher quality of a region. However, this might not be the case for ethnic restaurants because a search cost reduction can only occur when acceptance exists. That is, a consumer with a low acceptance of an ethnic restaurant theme would not choose a higher-end ethnic restaurant even if the ethnic restaurant is agglomerated to convey excellence and quality. This suggests that the acceptance of characteristics comes before quality, which is analogous to the findings of Bandyopadhyay and Banerjee (2002) in their research on the acceptance of COO. For restaurants, hedonic quality can only be appreciated when acceptance exists. Therefore, the following hypotheses are proposed:

Hypothesis 2: Higher priced ethnic restaurant themes will agglomerate stronger than lower priced restaurants only when acceptance is high for the ethnic restaurant theme.
Hypothesis 2-1: Higher priced ethnic restaurant themes will agglomerate stronger than lower priced restaurants only when the acceptance of food is high for the ethnic restaurant theme.
Hypothesis 2-2: Higher priced ethnic restaurant themes will agglomerate stronger than lower priced restaurants only when the acceptance of general restaurant opinion is high for the ethnic restaurant theme.
Hypothesis 2-3: Higher priced ethnic restaurant themes will agglomerate stronger than lower priced restaurants only when the acceptance of country of origin is high for the ethnic restaurant theme.

2.7 Agglomeration in early stage of ethnic restaurants due to immigration in U.S. and an uneven supply force of labor and an uneven ethnic group demand

Of the numerous explanations regarding how ethnic restaurants first form within the U.S., immigration has been cited as a primary cause (Josiam & Moneiro, 2004; Roseman, 2006). The U.S. in general has a strong heritage of accepting immigrants with the exception of certain periods, such as after the terrorist attacks on September. 11, 2001 (Martin & Midgley, 2003). Martin and Midgley (2003) explained that there have been four major waves of immigration in American history.

The first wave was prior to 1820 when English immigrants comprised 60 percent of the population in 1790. However, citizens of several European nations also immigrated to America, including Scotland, Germany, France, and Spain. These immigrants moved to the U.S. due to religious, political, and economic reasons. Following the European immigrants were African slaves who traveled and worked under harsh conditions. The second wave, which was between 1820 to 1860, was due to the Industrial Revolution in Europe. During this era, many immigrants from Europe came to the U.S. due to job loss caused by efficient machinery. Over five million German, British, and Irish people immigrated to the U.S. during this period. The third wave was from 1880 to 1914, when over 20 million southern and eastern Europeans arrived in the U.S. In addition to the European population, several thousand Chinese, Japanese, and other Asian laborers settled in the western states and accepted jobs in the mines or railroad buildings. By 1910, the foreign-born population consisted of 14 percent, and 24 percent of this population

comprised the workforce. In major cities, such as New York, Chicago, and Detroit, over half of foreign-born immigrants comprised the total workforce. From 1915 to 1964, the outbreak of World War 1 and 2 ceased European immigration. However, extensive immigration from Mexico and the western hemisphere during the 1940s and 1950s increased. The fourth wave was from 1965 to the present, and the preference for immigrant labor has shifted from national origin to special skilled labor. Less than 20 percent of U.S. immigrants are Europeans, whereas in the 1970s, Italians were the dominant population. In the 1980s, Congress granted more visas to the western hemisphere, which led Mexico to be the dominant immigration population to the present. Beginning in the 1990s, the U.S. began to resemble the diverse country it is today. East Asian immigration increased, with South Korea being the dominant immigrant population in seven states. In the 2000s, immigrants from India were dominant in three states.

The single most significant factor involved when immigrants decide where to settle is the condition of the labor market (Bartel, 1989). Ethnic immigration tends to cluster in distinct regions and neighborhoods, which is known as the "neighborhood effect" (Kaplan, 1998). Immigrants are most likely to group in a certain location due to shared values, a lack of their own resources, and contributions among group members without reciprocity (Portes & Sensenbrenner, 1993). Portes and Sensenbrenner (1993) explained that shared values and enforceable trust are significant factors in financial activities among ethnic groups, which are also known as social capital. Kalnins and Chung (2006) supported this argument by finding that hotel entrepreneurs who are immigrants agglomerate within a location. The results of the study also show that social capital is a vital variable for ethnic business concentration because it was found that groups that possess more resources are located outside the agglomerated community. Bartel (1989) also found that immigrants tend to agglomerate and to diffuse depending on the level of education and that higher educated immigrant groups tend to diffuse.

Kaplan (1998) classified four possibilities for the reason that ethnic businesses might benefit from clustering together:

(1) There is a need for the ethnic business to be close to its market and labor supply (Portes & Manning, 1998). The residential concentration works as a "cushion of customers" for the early stage of ethnic businesses (Auster & Aldrich, 1984). The ethnic community functions as an "incubator," providing protected markets (Alderich *et al.*, 1985).
(2) Different types of ethnic businesses cluster due to the benefit of "linkages" between the

ethnic suppliers (Kaplan, 1998). Information exchanges, credit, and other types of support are encouraged within the community (Portes & Manning, 1986; Portes & Sensenbrenner, 1993). Using an in/out put model, Wilson and Martin (1982) supported the "linkages" possibility of firm agglomeration by observing the success of the Cuban community.

(3) The development of several pivotal ethnic businesses creates conditions for other ethnic businesses to cluster around the location. Aldrich *et al.* (1985) found that Asian shops in Asian neighborhoods increased local demand high enough for other Asian shops to enter the local area. The increased size of the market allowed other types of businesses to be established around the Asian shops as well.

(4) Different types of ethnic businesses cluster to represent the cultural aspect of the ethnic group. This generates cultural stability and stronger cultural ties and aids the community in becoming "institutionally complete" (Breton, 1964; Min, 1993).

In an ethnic restaurant's primitive stage, Kaplan's (1998) "incubator" model is the best candidate to determine the reasons that ethnic restaurants cluster. This is due to the uneven demand distribution over space and a labor force where the major consumer group is also agglomerated in a specific location (Kaplan, 1998). The restaurant industry's labor market mobilizes immigrants and natives whose networks, both cultural and economic, influence a restaurant's style (Omholt, 2015). At this early stage of development, the non-ethnic consumer group has little or no information about the ethnic restaurant, and there is little or no demand or acceptance from non-ethnic groups (Levenstein, 1985; Lee et al., 2014). In such a situation, it is best for all early stage ethnic restaurants to be located within the ethnic community, where ethnic restaurants can utilize the "cushion of customers," which indicates that the primary consumers are the ethnic group of the ethnic restaurant. Because ethnic groups are clustered in one location, there is a lump in demand within the ethnic cluster group's location. Therefore, the following hypothesis is proposed:

Hypothesis 3 Ethnic restaurant themes in ethnic communities will agglomerate stronger than in non-ethnic communities.

2.8 Effects of endogenous agglomeration for ethnic restaurants in ethnic communities based on non-ethnic group demand

McCann and Folta (2009) argued that causes of firm agglomeration differ, and certain industries, such as retail or service industries, that require consumers to come to a certain location constitutes demand-related agglomeration. McCann and Folta (2009) claimed that demand-side agglomeration has different effects on the location as opposed to supply oriented agglomeration, where demand-side agglomeration occurs when firms are unable to attract demand on their own and the transaction cost is passed to the consumer. Cresswell and Hopkins (2008) argued that in terms of a geographical location destination consumers acknowledge it in two ways: the tangibles that the location provides and the emotional value a consumer relates to the location. Jensen (2007) argued that geographical urban branding can affect these emotional values through narrative storytelling that forms consumer perception of the city in a distinct way. Sheilds (1991) explained that the "place images" play is a powerful too which last for a long time in the consumer of the place. Jansson and Power (2010) argued such "place images" could also be used within a city by having similar stores clustered together to represent product quality and excellence. The association with the product sold in the region would then create emotions for consumers and would be reinforced by every time consumption would occur (Hede & Watne, 2013). In terms of ethnic restaurants in an early stage, urban restaurants form geographical clusters by restaurant type, which then become neighborhood institutions, such as Little Italy or Chinatown (Omholt, 2015), where non-ethnic consumer demand begins to form by information of perception. For example, according to Liu (2015), Chinese restaurants were first established for the Chinese immigrants who worked for goldmines and railroads. After the first Chinese restaurant was opened in 1849, which was called Canton Restaurant, seven restaurants were operating within two years that were located within a short distance. Despite the ethnic food selections, Anglo-American miners also enjoyed eating at these restaurants (Shaw, 1851). By the 1850s, non-Chinese miners began to try exotic Chinese food, and the Chinese restaurants also expanded their menus to non-Chinese dishes (Ayers, 1922). To also fulfill the needs of the non-Chinese group. Chinese restaurants began to sell mutton chops and grilled steak and served coffee, which were considered as British foods. This example and past literature suggest that non-ethnic consumers develop acceptance of an ethnic restaurant theme in stages, which differ from non-ethnic restaurants in menu and atmosphere and cultural, social, and political aspects

(Sukalakamala & Boyce, 2007). More importantly, the initial point where non-ethnic consumers develop ethnic restaurant perceptions is influenced by the ethnic communities with ethnic restaurant themes. Therefore, the following hypotheses are proposed:

Hypothesis 4: Ethnic restaurant themes in ethnic communities will expand when acceptance from non-ethnic consumers is high.
Hypothesis 4-1: Ethnic restaurant themes in ethnic communities will expand when acceptance of food from non-ethnic consumers is high.
Hypothesis 4-2: Ethnic restaurant themes in ethnic communities will expand when acceptance of general ethnic restaurant themes from non-ethnic consumers is high.
Hypothesis 4-3: Ethnic restaurant themes in ethnic communities will expand when acceptance of ethnic COO from non-ethnic consumers is high.

CHAPTER 3. METHODOLOGY

3.1 Sample and data

The data on restaurant locations and the ethnic type were obtained through the Yelp database. The available states with restaurant listings were North Carolina, Pennsylvania, Ohio, Arizona, and Nevada, with 9,200 restaurants recorded. The Yelp database contains information regarding longitude and latitude coordinates of the restaurant location, price range, and type of ethnic restaurant. The neighborhood non-English speaking percentage for a representation of the ethnic group and median income level were collected through the U.S. census data by zip code. For acceptance variables, tweets from Twitter Application Programming Interface (API) using a keyword filter over a 30-day period were used. The list of keywords contained words that included the ethnic restaurant theme followed by the word "food" for food acceptance, the ethnic restaurant theme as the restaurant acceptance in general, and the countries' ethnicities for country of origin. For example, for Italian restaurants, "Italian food" was used as the keyword for ethnic food acceptance, "Italian restaurants" was used for restaurant opinions in general, and "Italian people" / "Italians" / "Italy" were used to identify country of origin. For ethnic restaurant theme, Italian, Mexican, Chinese, Thai, Vietnamese, Indian, Middle Eastern, French, Korean, Japanese, and Greek ethnic restaurants were used to identify the rank of acceptance.

3.2 Variables

For the independent variables of acceptance, which were food acceptance (*FOOD*), restaurant general acceptance (*REST*), and acceptance of country of origin (*COO*), a sentiment analysis using text mining was performed to identify each perception based on Twitter tweets. The objective of using text mining and a sentiment analysis was to identify insights from electronic messages that are based on text (Gruzd et al., 2011). The process used to identify the magnitude and opinion of whether a tweet was positive or negative was mainly a three-step process. For the data to be used to identify opinions, a preprocess was first conducted to eliminate URLs, stop words, punctuation, hash tags, and usernames. The process is necessary to transform natural language into structured data that can measure opinions (Weiss et al., 2010). After the preprocess was complete, word frequency of positive, neutral, or negative words were

automatically counted by a lexicon dictionary with a pool of positive and negative words (Gruzd et al., 2011). Hu and Liu's (2004) positive/negative word list (https://www.cs.uic.edu/~liub/FBS/sentiment-analysis.html#lexicon) was used, which incorporates approximately 6800 words of positive and negative English opinion words or sentiment words. The final process involved a subtraction of the total positive from the negative words to determine whether the tweet was negative, neutral, or positive. For example, "I love Italian food" consists of one positive word with no negative word, which the sentiment analysis would determine as +1 for the opinion of the tweet.

Other independent variables were defined in the following manner for each ethnic restaurant observation. Intensity of ethnic group (*NON-ENGLISH*) was calculated by the percentage of non-English speaking people by each zip code. *PRICE* was the price range for each ethnic restaurant listed in the Yelp dataset, where $PRICE = \{1 = \$1 \sim \$10, 2 = \$10 \sim \$20, 3 = \$20 \sim \$30, 4 = \$30 \text{ and above}\}$. *MEDIANINCOME* represented the median household income by zip code. *MALEPERCENTAGE* was the male percentage by zip code for each restaurant observation.

To identify the intensity of agglomeration, an index *SAME* was created for the dependent variable for each ethnic type. The agglomeration index suggested by He and Pan (2009) was adopted, where the dependent variable ($SAME_{i,x}$) is the percentage of restaurant agglomeration for each restaurant within x-miles over the total amount of restaurants in the city divided by the total amount of restaurants in each segment, which is denoted as:

$\forall \text{x} - \text{miles} = \{0.2, 0.4, 0.6\ 0.8, 1, 1.2, 1.4, 1.6\ 1.8, 2\}$

$$SAME_{i,x} = \frac{N_{s,x}/N_x}{N_{i,c}/N_c}$$

where $N_{i,x}$ is the number of restaurants in the same price range *s* in *x-miles*; N_x is the total number of restaurants in *x-miles*; N_{ic} is the total number of restaurants in the same price range within the whole city; and N_c is the total number of restaurants in the city. If $SAME_{ix}$ is greater than one, then restaurant *i* in *x*-miles indicates a relatively high agglomeration for restaurants in the same price range. The advantage of using the index is that it controls for the different number of restaurants by segments. This is achieved by incorporating $N_{i,c}/N_c$ in the index, which is vital for empirically testing differences in restaurant segments because up-scale restaurants are

substantially lower in number compared to the number of casual restaurants and limited service restaurants.

3.3 Model with Ripley's K-function

Ripley's K-function, which was proposed by Ripley (1976), explains the spatial distribution of a set of points using an average number of neighbors within a circle of a given radius (Marcon and Puech, 2003). The K-function can be denoted as:

$$K(t) = \lambda^{-1}E\{\#\ of\ points\ of\ Type\ i\ within\ a\ distance\ \leq t\ of\ a\ random\ event\}$$

where λ is the density (number per unit area) of points (Dixon, 2002).

The *K*(t) is estimated by:

$$\widehat{K}(t) = \hat{\lambda}^{-1}\sum_{i}\sum_{i\neq j} w(l_i l_j)^{-1}\frac{I(d_{ij} < t)}{N}$$

where $I(d_{ij} < t)$ is the distance between the *i*th and *j*th points (d_{ij}) under *t* distance and $w(l_i l_j)$ is the weighted function for the edge correction, $\hat{\lambda} = {}^{N}/_{A}$, where *N* is the observed number of points and *A* is the area of the whole region (Dixon, 2002). The function is then compared with a random distribution with the same number of plots and density using the Monte Carlo simulation. There was a total of 1000 simulations for this research. A *bivariate K-function* was also implemented, which is denoted as:

$$K_{ij}(t) = \lambda_j^{-1}E\{\#\ of\ points\ of\ Type\ i\ falling\ at\ a\ distance \leq t\ from\ an\ arbitray\ Type\ j\ point\}$$

where λ

$$I_{lk}(t) = \begin{cases} 1 \text{ if } d_{lk} \leq t \\ 0 \text{ if } d_{lk} > t \end{cases}$$

$$\widehat{K}_{ij}(t) = \left(\hat{\lambda}_i\hat{\lambda}_j A\right)^{-1}\sum_{l=1}^{n_1}\sum_{k=1}^{n_2} I_{lk}(t)$$

The model was used to identify agglomeration for each ethnicity agglomeration by ethnic type by total available states, each individual state, and each city with more than 1000 ethnic restaurants.

3.4 Model with agglomeration index

Picone et al. (2001) claimed that agglomeration reflects a complex set of variables that lead to human settlements. When research is conducted on a city scale, the agglomeration of firms will reveal population density. Therefore, comparing different segments is more important than observing a single segment because any single segment will show some degree of clustering. Because the data for the dependent variable consisted of zero values and was left constraint, OLS estimators can be significantly biased. Therefore, the negative binominal model (NB) was used, which overcomes the issue of the overdispersion problem that creates under bias estimates when the conventional Poisson distribution is used in identifying the number of firms (Yang *et al.*, 2017). Because this model also included zip code-based demographics, as in the case of Yang et al. (2017), to identify a non-negative dependent variable, a likelihood of a region having the ethnic restaurant agglomeration index ($SAME_i$) in a zip code *i* is:

$$f(SAME_i) = \frac{e^{-\lambda_i}{\lambda_i}^{AI_i}}{AI_i!}$$

The conditional expectations of $SAME_i$ and λ_i are specified as a log-linear function with the set of dependent variables x_i as:

$$\ln\mathrm{E}(SAME_i|x_i) = \ln(\lambda_i) = {x'}_i\beta$$

The model was estimated using a maximum likelihood estimation using the log-likelihood function:

$$\ln L = -\sum_i \lambda_i + \sum_i SAME_i {x'}_i\beta - \sum_i \ln(AI_i!)$$

Thus, the regression to identify the relationship between agglomeration and different segments based on ethnic restaurant is expressed as the following equation:

Model

$$SAME_i = \beta_0 + \beta_1 \text{PRICE} + \beta_2 \text{FOOD} + \beta_3 \text{RESTAURANT} + \beta_4 \text{COO} + \beta_5 \text{FOOD} * \text{PRICE} + \beta_6 \text{RESTAURANT} * \text{PRICE} + \beta_7 \text{COO} * \text{PRICE} + \beta_8 \text{POPULATION} + \beta_9 \text{MALEPERCENT} + \beta_{10} \text{MEANINCOME} + \beta_{11} \text{NONENGLISH} + \beta_{12} \text{RESTAURANT} * \text{NONENGLISH} + \beta_{13} \text{FOOD} * \text{NONENGLISH} + \beta_{14} \text{COO} * \text{NONENGLISH} + \varepsilon$$

CHAPTER 4. RESULTS

4.1. Results for sentimental analysis

Figure 1 shows an example of Italian restaurant sentimental analysis distribution of food. As shown in the example, the sentimental analyses show positive skewness with an average negative review. This is consistent with opinions of ethnic food. As a collective result, table 3 shows the descriptive results for all sentiment analyses. Tsugawa and Ohsaki (2015) found that tweets are more likely to be retweeted or to be read by others when the tweet is negative, which might be a reason that negative words were used to draw attention. When comparing frequencies on Twitter, Italian, Mexican, and Chinese were the three most mentioned foods among all ethnic foods. However, the frequency of the ethnic food mentioned did not follow the rank of food perception. As shown in table 4, the top two ranked for perception of ethnic food were Chinese and Mexican, while Italian restaurants were third from the last. The results also differ from Rosemann (2006), who found that Italian restaurants have the highest acceptance. The contrasting difference can be interpreted as a shift in opinion of ethnic food because an ethnic restaurant has become common to non-ethnic groups since the 2006 study.

The results also differ from Park *et al.* (2016) when the sentimental analysis for ethnic restaurants in general was used. However, a direct comparison is difficult because this study was conducted during a different time period. As shown in figure 2 and table 3, all average sentiments were negative with a positive skewness distribution. In terms of frequency, similar results show across all ethnic type regarding ethnic food perception. Italian, Mexican, and Chinese had the most frequency. For the ranks shown in table 4, for restaurant sentiment, Mexican and Chinese were the top 2 with the rank switched. However, the results of the perception of ethnic restaurants differed from the perception of ethnic foods. For example, Thai food was found to be the lowest among all restaurants with its ranking being the 4^{th} in food. French restaurants were higher in rank, placing 5^{th}, compared to food perception, which was 8^{th} in the ethnic restaurant food list. The difference in ranks support Ha and Jang's (2010) claim that restaurants are evaluated for more than simply the perception of the food.

For COO, the results showed few positive average sentimental comments, which were for Middle eastern, French, Mexican, and Korean food. However, most of the ethnic COO had an

average negative opinion, as shown in the example of the Italian COO in figure 3. As shown in table 4, French, Greek, and Indian had the most sentiment comments in terms of frequency. In terms of rank, COO had the least consistency from the general opinion about ethnic restaurant types. The discrepancy shows that the non-ethnic group considered different values regarding opinions of nationality as opposed to opinions of food and restaurants in general.

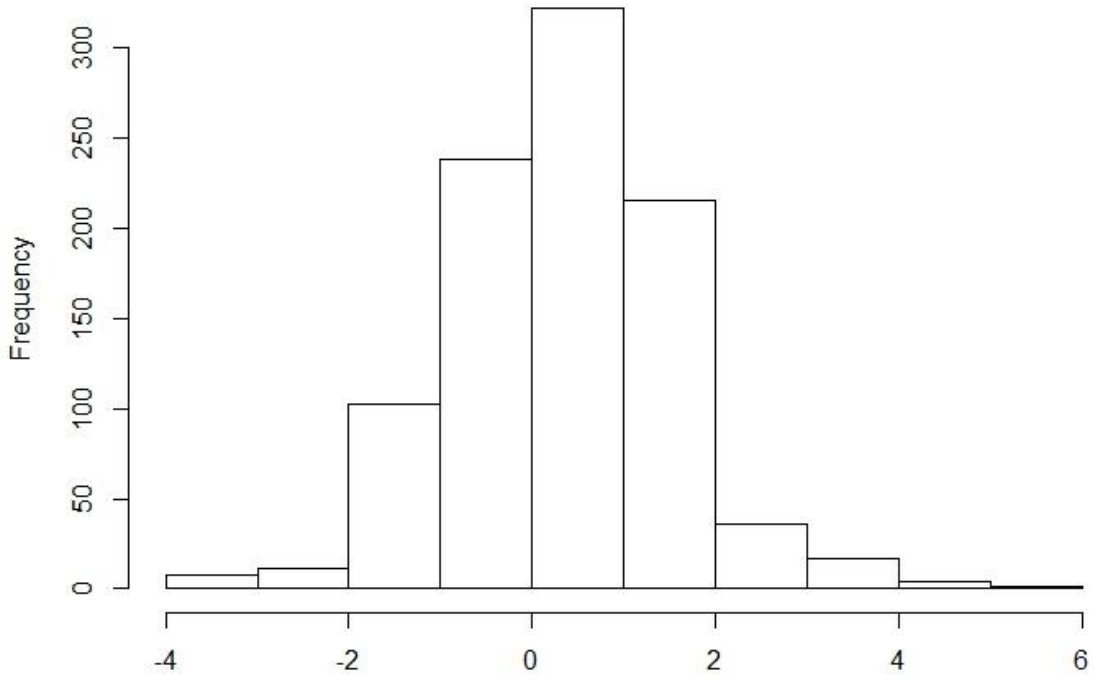


Figure 1

Sentimental analysis distribution for Italian food

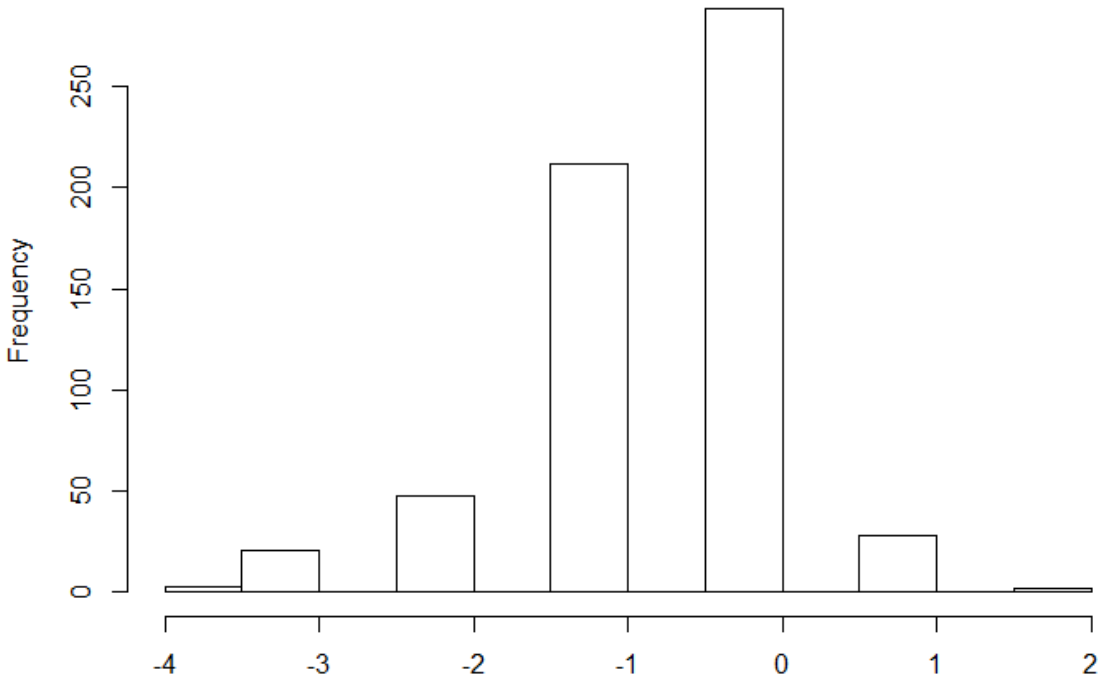


Figure 2

Sentimental analysis distribution for Italian restaurant general opinion

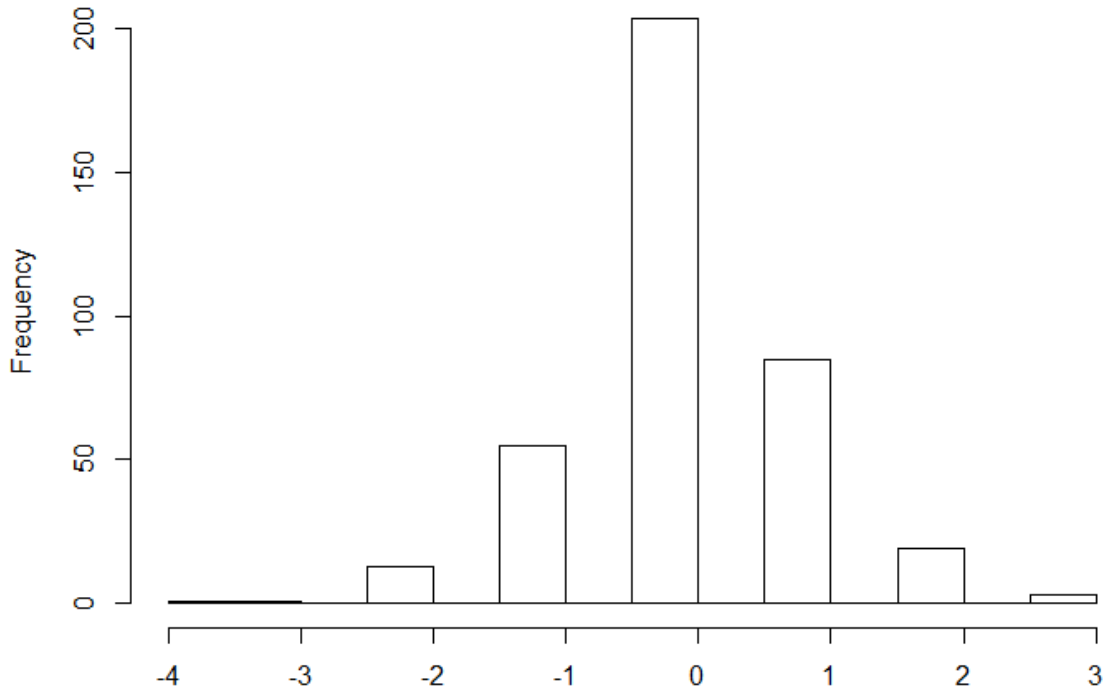


Figure 3

Sentimental analysis distribution for Italian country of origin

Table 3

Sentiment Analysis descriptive results

	Food			*Restaurant*			*COO*		
	μ	σ	*Freq.*	μ	σ	*Freq.*	μ	σ	*Freq.*
American	-0.104	0.083	6731	-0.317	0.113	520	0.136	0.085	8669
Italian	-0.974	0.212	2388	-1.118	0.255	314	-0.232	0.236	177
Mexican	-0.075	0.212	4141	-0.685	0.283	365	0.131	0.217	352
Chinese	-0.388	0.209	4292	-0.617	0.254	392	-0.215	0.204	874
Thai	-0.493	0.214	1765	-1.170	0.236	106	-0.571	0.259	63
Japanese	-0.731	0.228	1732	-0.863	0.282	131	-0.423	0.233	511
Korean	-0.785	0.229	1216	-0.753	0.269	93	0.158	0.241	215
Indian	-0.812	0.213	2982	-0.936	0.243	236	-0.182	0.204	1070
Greek	-1.060	0.249	618	-0.917	0.349	60	-0.375	0.204	1149
Middle eastern	-0.565	0.262	131	-1.133	0.357	15	0.520	0.343	25
French	-0.894	0.216	1787	-0.790	0.262	157	0.122	0.203	5000
Vietnamese	-1.008	0.246	355	-0.770	0.305	61	-0.215	0.255	339

Table 4

Order of sentiment by ethnic restaurants

No.	*Food*	*Restaurant*	*COO*
1	Mexican	Chinese	Middle eastern
2	Chinese	Mexican	Korean
3	Thai	Korean	Mexican
4	Middle eastern	Vietnamese	French
5	Japanese	French	Indian
6	Korean	Japanese	Chinese
7	Indian	Greek	Vietnamese
8	French	Indian	Italian
9	Italian	Italian	Greek
10	Vietnamese	Middle eastern	Japanese
11	Greek	Thai	Thai

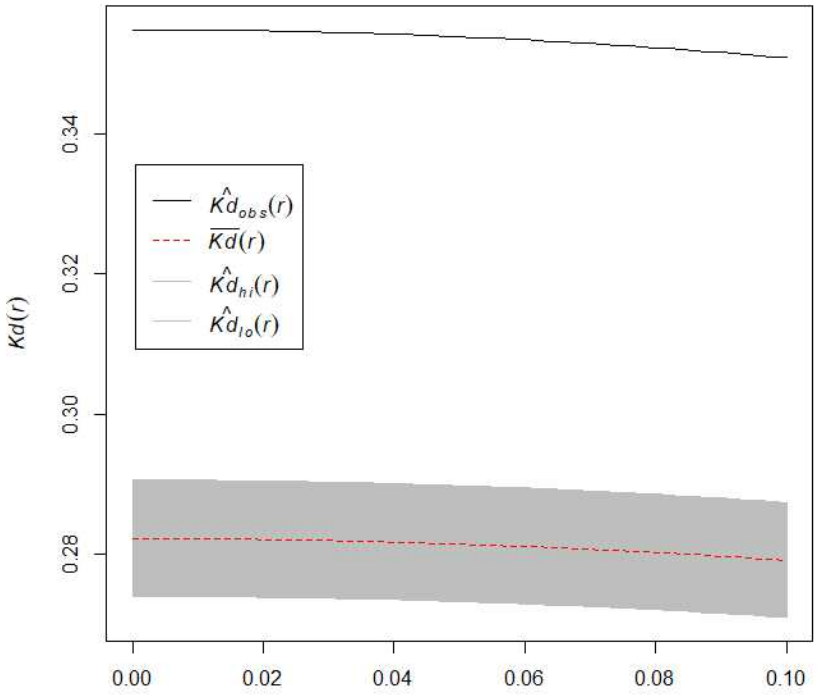
4.2 Agglomeration by ethnic restaurant type

Some researchers have explicitly questioned the correct scale at which agglomeration occur (Mori & Smith, 2015). Based on a concentration analysis in the U.S. performed at different geographical levels (from zip codes to states), Rosenthal and Strange (2001) concluded that agglomeration plays out differently at each geographical level. Arribas-Bel *et al.* (2015) examined the link between small employment districts and city level measures of urban externalities. They concluded that smaller units generate higher levels of agglomeration predictability in patterns because cities are internally heterogeneous with employment highly concentrated in their central parts and people of different income levels located in different areas. The same can apply to ethnic restaurants, where the population of the ethnic concentration may affect the total number of ethnic restaurants as well as the percentage. Cottineau et al. (2018) also found city level agglomeration to be the relevant unit to observe agglomeration economies as well as internal inequalities. The national level of agglomeration/diffusion is a representation of the general clustering patterns of each ethnic restaurant. If the ethnic restaurant is agglomerated, this means that the ethnic restaurant is more agglomerated in a specific state than when compared to other ethnic restaurants.

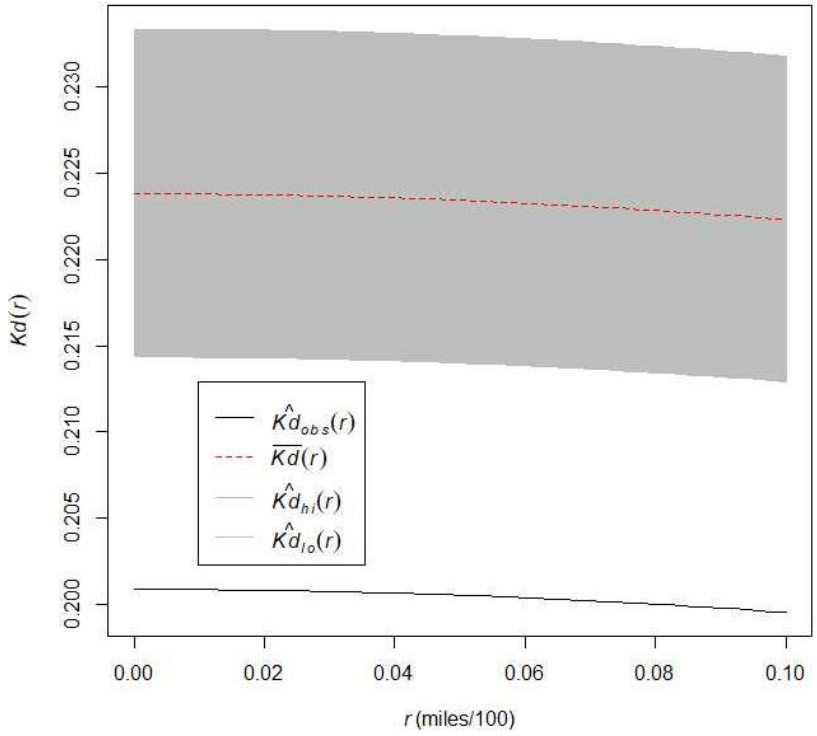
4.2.1. Agglomeration using total sample

As an example of ethnic restaurant agglomeration by state level, as shown in figure 4, which illustrates the Ripley's K-function of a radius from 0 to 10 miles, there is consistency with migration patterns among ethnic groups. The agglomeration pattern in figure 4 shows that the Chinese population is more dispersed across the U.S. compared to the Mexican population. This is because the Hispanic migration population is mostly located in the Western part of the U.S. This is supported by table 5, which is the comprehensive table for all agglomeration/diffusion patterns for each ethnic restaurant type. Arizona and Nevada, which are states in the western part of the U.S., show a large population percentage in the Mexican population, whereas the Chinese population is more consistent in its population percentage across all state samples. The findings are consistent for all other ethnic restaurants, where state level agglomeration shows patterns of migration and a higher proportion of the population of the ethnic group shows stronger agglomerations in restaurants. Appendix B indicates that Italian, Chinese, and Indian restaurants

have spread across the U.S. states, while Mexican, Korean, and Japanese restaurants are more agglomerated in specific states. This is because Mexican, Korean, and Japanese immigrants have been known to cluster in groups in fewer states. In contrast, Italian, Chinese, and Indian citizens have immigrated across the U.S. uniformly.



<Mexican Restaurants>

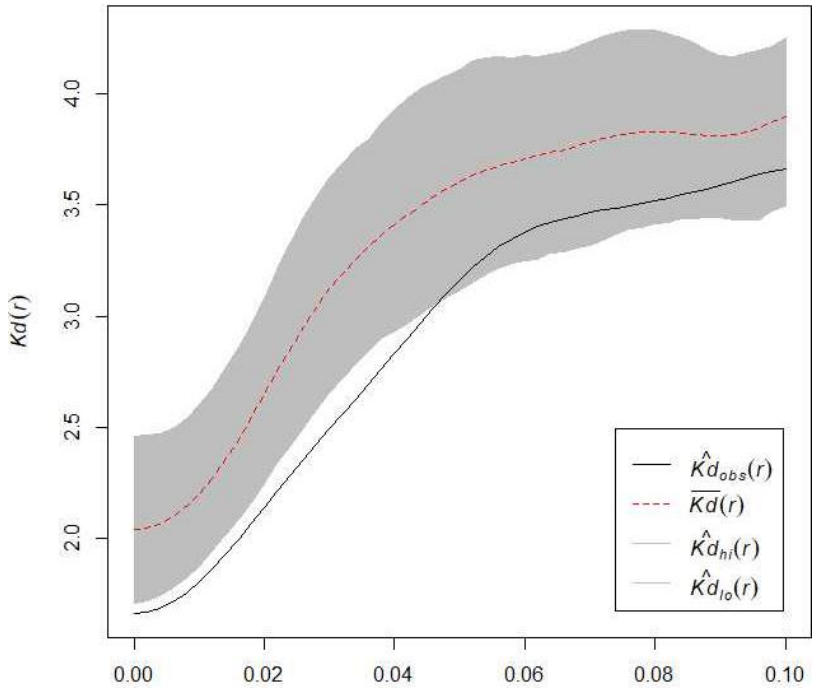


<Chinese Restaurants>

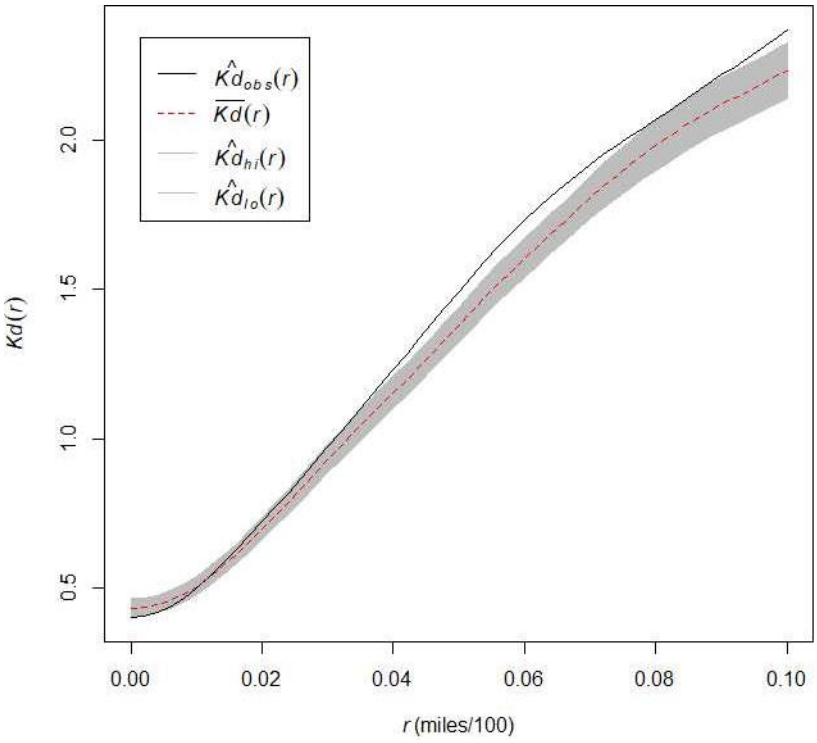
Figure 4. Comparison between Chinese and Mexican restaurant agglomeration pattern by total US

4.2.2. Agglomeration pattern by state

Figure 5 shows an example of a comparison between agglomeration patterns of Italian restaurants in Pennsylvania and agglomeration patterns of Mexican restaurants in Arizona. The example shows that at a state level, not only the population percentage but also the ethnic restaurant type and the number of restaurants is crucial to understanding ethnic restaurant agglomeration. For Italian restaurants, ethnic group population affected the diffusion process, with Pennsylvania having the highest population of Italians, indicating diffusion across all miles. However, for Mexican restaurants, population seemed to affect the agglomeration process, with Arizona having the most ethnic population of Mexicans showing agglomeration. The difference between Italian restaurants and Mexican restaurants' location clustering shows heterogenous clustering patterns based on ethnic group population, which emphasizes that the ethnic type is important whether the ethnic restaurant clusters or diffuses. This is consistent over all ethnic type restaurants, and table 5 shows the three ethnic restaurants that have the highest numbers (Italian, Mexican, and Chinese), showing diffusion compared to other ethnic restaurants that have fewer restaurants by state. Aside from the ethnic restaurants that have high numbers, most of the ethnic restaurants with a lower number of restaurants had a consistency to agglomerate across all states with several ethnic types, showing no agglomeration but also no diffusion.



< Italian restaurant – Pennsylvania >

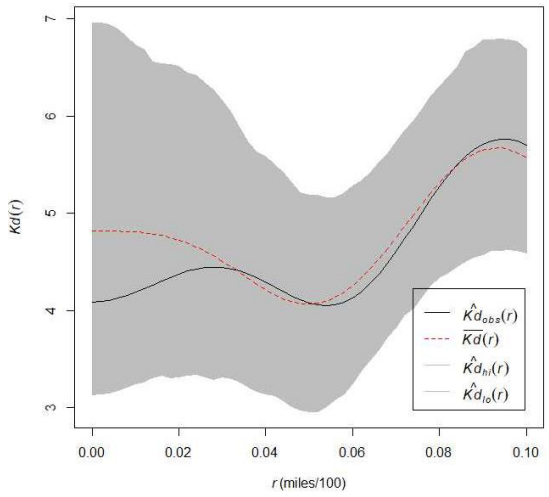


<Mexican restaurant – Arizona>

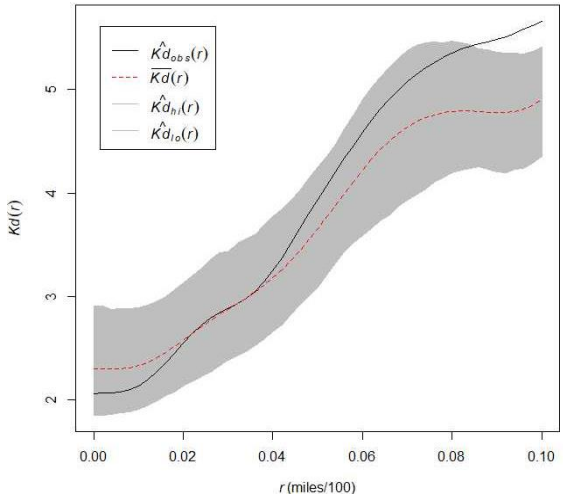
Figure 5. Comparison between Italian and Mexican restaurant agglomeration pattern by state

4.2.3. Agglomeration pattern by city

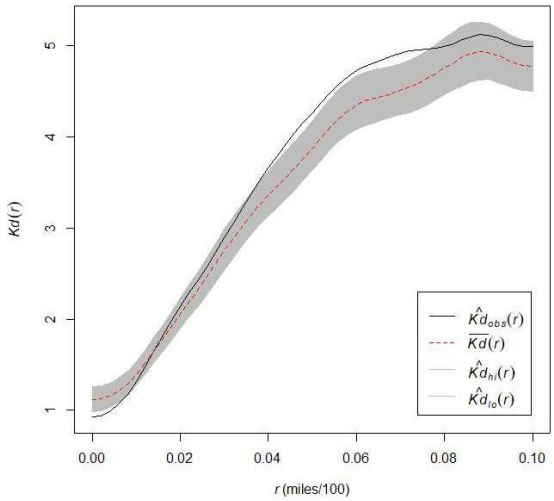
When ethnic restaurants were observed at the city level, a greater heterogenous pattern of agglomeration for each ethnic restaurant was observed. Table 5 shows the three largest ethnic restaurants (Italian, Mexican, and Chinese) that differ by city. The largest difference can be found in Mexican restaurants, for which Cleveland and Charlotte showed agglomeration or no agglomeration, while Las Vegas and Phoenix showed diffusion as the radius of agglomeration increased, as shown in figure 6. Las Vegas showed the largest difference compared to its state agglomeration pattern in which many ethnic restaurants showed diffusion as the radius increased, as indicated in figure 7. It is important to note that Las Vegas may differ from other cities because it is a tourist region, which may cause ethnic restaurants to show different agglomeration patterns due to a sufficient demand for certain ethnic restaurants, such as French restaurants. Thus, most ethnic restaurants showed diffusion except for Korean, Japanese, and Greek restaurants. The difference in the ethnic restaurant pattern by city indicates that the population of the ethnic group is not sufficient in explaining ethnic restaurant agglomeration patterns. Thus, the motivation for investigating non-ethnic group demographics and perceptions as well as ethnic restaurant quality, which can be represented as a price range, is justified when observing city level ethnic restaurant agglomeration. That is, the findings of the *k*-function show that individual factors of ethnic restaurants are more significant at a city level agglomeration than a U.S. level ethnic restaurant agglomeration/diffusion or a state level ethnic restaurant agglomeration/diffusion. This is reasonable to assume because restaurants are influenced by the demand of the city (Jekanowski & Binkley, 2001).



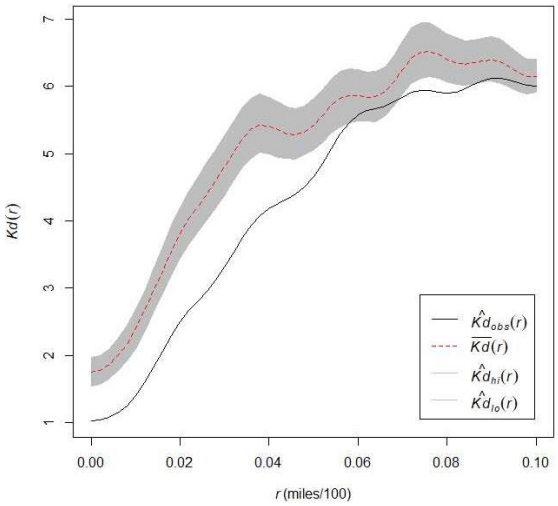
< Mexican restaurant – Cleveland >



< Mexican restaurant – Charlotte >

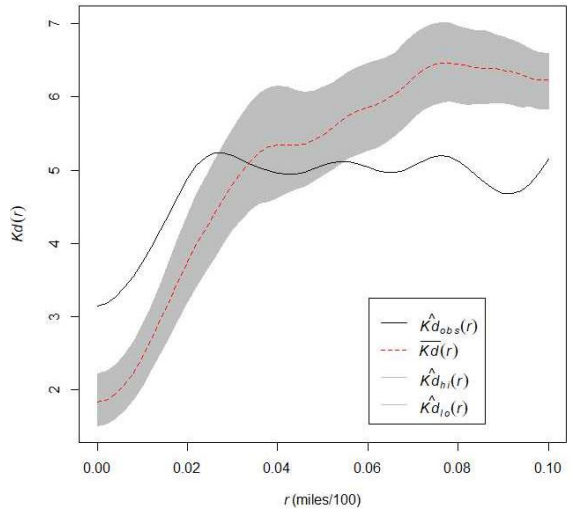


< Mexican restaurant – Phoenix >

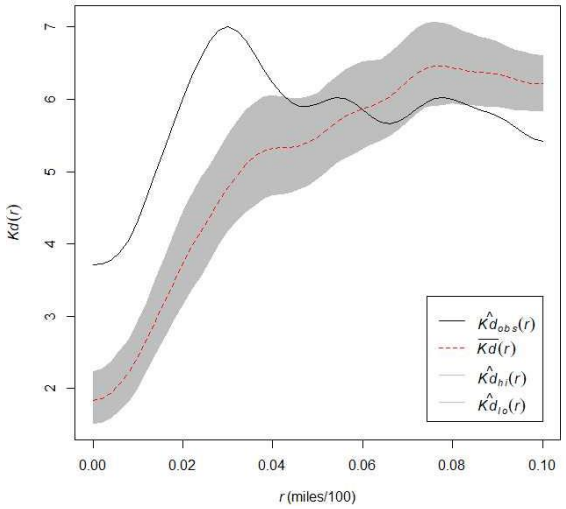


< Mexican restaurant – Las Vegas >

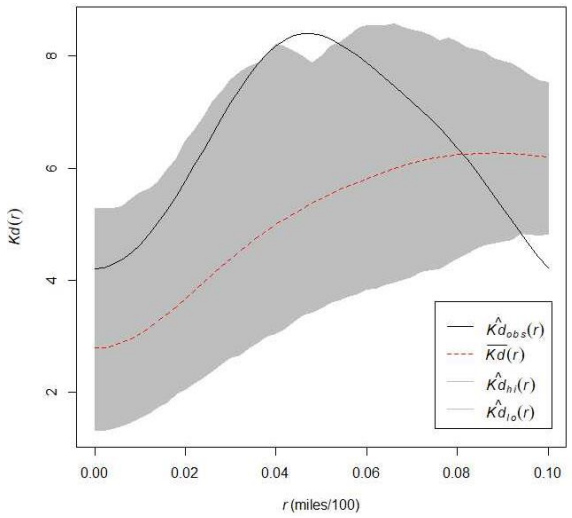
Figure 6. Comparison between Mexican restaurant agglomeration pattern by city



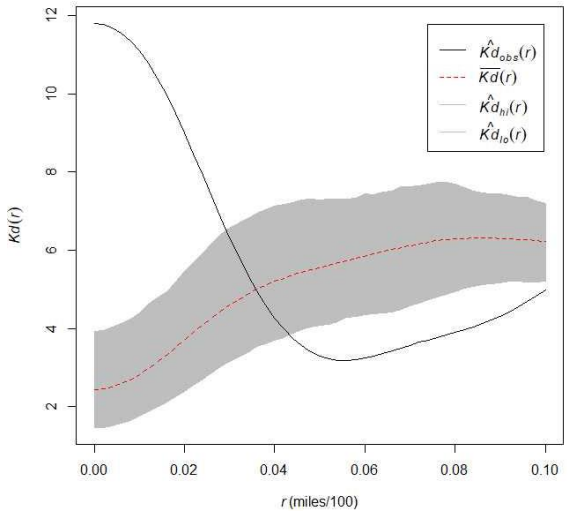
< Italian restaurant>



< Chinese restaurant>



<Middle eastern restaurant>



<French restaurant>

Figure 7. Las Vegas ethnic restaurant diffusion by ethnic menu

Table 5

Agglomeration pattern by Total states, States, and City

	Italian	*Mexican*	*Chinese*	*Thai*	*Vietnamese*	*Indian*	*Middle Eastern*	*French*	*Korean*	*Japanese*	*Greek*	*GDP*
All States	**D**	**A**	**D**	**N**	**A**	**D**	**N**	**N**	**A**	**A**	**N**	
						State level agglomeration						
North Carolina	**N/D**	**N**	**D**	**N**	**A**	**A**	**A**	**A**	**A**	**N**	**N**	**449**
Pennsylvania	**D**	**N**	**D**	**A**	**N**	**A**	**A**	**A**	**N**	**N**	**N**	**652**
Ohio	**N**	**D**	**D**	**N**	**A**	**A**	**A**	**A**	**A**	**A**	**N**	**552**
Arizona	**A/D**	**N/A**	**D**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**267**
Nevada	**A/D**	**D**	**A/D**	**N/A**	**A**	**A**	**N**	**A**	**A**	**A**	**N**	**128**
Population (NC)	**297,951** (3.06%)	**514,829** (5.28%)	**39,659** (0.41%)		**30,168** (0.31%)	**65,056** (0.67%)	**33,276** (0.34%)	**196,927** (2.02%)	**20,751** (0.21%)	**5,877** (0.06%)	**27,665** (0.28%)	
Population (PA)	**1,548,246** (12.13%)	**137,793** (1.08%)	**95,713** (0.75%)		**43,399** (0.34%)	**109,453** (0.86%)	**63,127** (0.49%)	**238,902** (1.87%)	**39,875** (0.31%)	**7,109** (0.06%)	**63,809** (0.50%)	
Population (OH)	**744,755** (6.44%)	**189,389** (1.64%)	**51,103** (0.44%)		**14,363** (0.12%)	**69,286** (0.60%)	**76,990** (0.67%)	**287,526** (2.49%)	**15,785** (0.14%)	**10,541** (0.09%)	**53,434** (0.46%)	
Population (AZ)	**283,349** (4.32%)	**1,784,013** (27.19%)	**37,970** (0.58%)		**25,649** (0.39%)	**39,488** (0.60%)	**33,060** (0.50%)	**194,116** (2.96%)	**15,602** (0.24%)	**10,029** (0.15%)	**22,087** (0.34%)	
Population (NV)	**170,282** (6.17%)	**580,008** (21.00%)	**33,929** (1.23%)		**11,648** (0.42%)	**10,495** (0.38%)	**14,130** (0.51%)	**76,214** (2.76%)	**14,172** (0.51%)	**10,211** (0.37%)	**11,767** (0.43%)	
(NC) # of restaurants	**195**	**292**	**177**	**29**	**33**	**46**	**14**	**15**	**7**	**93**	**61**	
(PA) # of restaurants	**315**	**145**	**159**	**48**	**9**	**41**	**35**	**19**	**8**	**49**	**37**	
(OH) # of restaurants	**308**	**258**	**209**	**39**	**14**	**42**	**56**	**15**	**9**	**72**	**40**	
(AZ) # of restaurants	**717**	**1378**	**507**	**133**	**85**	**107**	**69**	**49**	**25**	**225**	**153**	
(NV) # of restaurants	**403**	**761**	**367**	**107**	**67**	**52**	**29**	**56**	**71**	**300**	**37**	

CONT Table 5

Agglomeration pattern by Total states, States, and City

	Italian	*Mexican*	*Chinese*	*Thai*	*Vietnamese*	*Indian*	*Middle Eastern*	*French*	*Korean*	*Japanese*	*Greek*	*GDP*
Charlotte	**N/D**	**N/A**	**D**	**N**	**A**	**A/D**	**N**	**A**	**N**	**N/D**	**N**	**140**
Pittsburgh	**N**	**N/D**	**N/D**	**N**	**N**	**A**	**N**	**A**	**N**	**N/D**	**N/A**	**147**
Cleveland	**A**	**N**	**D**	**N**	**A**	**N**	**N**	**N**	**A**	**A**	**N**	**131**
Phoenix	**A**	**D**	**D**	**A**	**N**	**A/D**	**N**	**A**	**N**	**N**	**A**	**231**
Las Vegas	**A/D**	**D**	**A/D**	**N/A**	**A**	**A/D**	**N/D**	**A/D**	**A**	**A**	**N**	**111**
Population Charlotte	**27,237** (3.52%)	**42,655** (5.51%)	**5,737** (0.74%)		**8,047** (1.04%)	**16,088** (2.08%)	**4,834** (0.62%)	**13,928** (1.80%)	**2,685** (0.35%)	**421** (0.05%)	**4,463** (0.58%)	
Population Pittsburgh	**40,006** (13.07%)	**1,235** (0.40%)	**5,831** (1.91%)		**774** (0.25%)	**3,941** (1.29%)	**2,740** (0.90%)	**5,089** (1.66%)	**1,534** (0.50%)	**765** (0.25%)	**1,697** (0.55%)	
Population Cleveland	**17,815** (4.54%)	**4,385** (1.12%)	**2,453** (0.63%)		**553** (0.14%)	**1,346** (0.34%)	**4,377** (1.12%)	**4,161** (1.06%)	**390** (0.10%)	**144** (0.04%)	**1,260** (0.32%)	
Population Phoenix	**60,115** (4.03%)	**556,776** (37.35%)	**7,997** (0.54%)		**7,160** (0.48%)	**14,191** (0.95%)	**9,801** (0.66%)	**34,692** (2.33%)	**2,733** (0.18%)	**1,452** (0.10%)	**4,686** (0.31%)	
Population Las Vegas	**37,826** (6.33%)	**147,360** (24.67%)	**4,860** (0.81%)		**1,526** (0.26%)	**1,669** (0.28%)	**2,764** (0.46%)	**14,756** (2.47%)	**3,415** (0.57%)	**2,212** (0.37%)	**2,377** (0.40%)	
# of rest Charlotte	**104**	**183**	**111**	**16**	**28**	**36**	**13**	**13**	**6**	**59**	**43**	
# of rest Pittsburgh	**177**	**99**	**98**	**41**	**8**	**29**	**29**	**16**	**7**	**34**	**21**	
# of rest Cleveland	**80**	**58**	**71**	**15**	**8**	**15**	**26**	**11**	**4**	**22**	**10**	
# of rest Phoenix	**234**	**583**	**181**	**37**	**25**	**30**	**26**	**17**	**3**	**63**	**57**	
# of rest Las Vegas	**327**	**632**	**312**	**95**	**65**	**51**	**24**	**54**	**66**	**261**	**30**	

"A" = Agglomeration, "D" = Diffusion, "N" = No agglomeration or diffusion, "A/D" = Shift from agglomeration to diffusion, "N/D" = Shift from no agglomeration or diffusion to diffusion, "N/A" = Shift from no agglomeration or diffusion to agglomeratio

4.3. Price by ethnic restaurants

A descriptive analysis showed distinct differences in ethnic food price ranges. Table 6 shows that French restaurants had the highest percentage above $40 at 31% among the total ethnic restaurants, while Japanese restaurants had the second largest percentage above the $40 mark, which was 29%, followed by Italian restaurants as the third-largest with 26% of the share of this market in the data. The results were also consistent across each ethnic restaurant, where the order of highest percentage for $30 and above were French, Japanese, and Italian. The results imply a possible relationship between the country of origin's GDP and ethnic restaurant price range, where the top 10 highest GDP nations consist of 93% of $30 and above restaurants and 91% of $40 and above restaurants. In contrast, Thai, Vietnamese, Indian, Middle Eastern, and Korean restaurants had close to 0% and above the $40 mark, while most of the restaurants were below the $20 mark. Finally, in terms of distribution, French restaurants had the widest distribution in terms of price range, followed by Italian and Japanese, respectively. When combining the results of table 1, differences between the tourist regions and non-tourist regions were observed for agglomeration. The tourist city Las Vegas showed a stronger diffusion in French and Italian, which are higher priced restaurants as opposed to non-tourist cities. However, Japanese restaurants showed agglomeration in Las Vegas, while other cities showed diffusion except for Cleveland. The difference in agglomeration explains that the suppliers' price and number of restaurants are not sufficient in explaining the current ethnic restaurants' agglomeration patterns, and thus demand-related perception and demographics are required to understand the total effect.

Table 6

Price by ethnic restaurants

	Frequency by price				*Percentage by price*				*Percentage by ethnic restaurants*				
	Price1	*Price2*	*Price3*	*Price4*	*Price1*	*Price2*	*Price3*	*Price4*	*Price1*	*Price2*	*Price3*	*Price4*	Total
Italian	475	1446	145	15	11%	31%	55%	26%	23%	69%	7%	1%	2081
Mexican	1944	1055	13	4	46%	23%	5%	7%	64%	35%	0%	0%	3016
Chinese	955	568	14	3	22%	12%	5%	5%	62%	37%	1%	0%	1540
Thai	92	288	3	0	2%	6%	1%	0%	24%	75%	1%	0%	383
Viet	154	60	0	0	4%	1%	0%	0%	72%	28%	0%	0%	214
Indian	73	245	1	0	2%	5%	0%	0%	23%	77%	0%	0%	319
Middle	95	117	2	0	2%	3%	1%	0%	44%	55%	1%	0%	214
French	18	81	48	18	0%	2%	18%	31%	11%	49%	29%	11%	165
Korean	23	116	0	0	1%	3%	0%	0%	17%	83%	0%	0%	139
Japanese	187	538	39	17	4%	12%	15%	29%	24%	69%	5%	2%	781
Greek	233	114	0	1	5%	2%	0%	2%	67%	33%	0%	0%	348
Total	4249	4628	265	58									9200

4.4 Descriptive analysis for ethnic restaurant clustering

Table 7 shows the descriptive information for the agglomeration index from a 0 to 2-mile radius, the price for each restaurant, the rank of acceptance of ethnic food, ethnic restaurant, and ethnic COO, the interaction effects of each perception and price, population by zip code, male percentage by zip code, non-English-speaking percentage for identifying ethnic group location, and income by zip code. For the agglomeration index, the results show a decrease in agglomeration as the radius was increased. This indicates that all ethnic restaurants show some degree of agglomeration. More interestingly, the largest decrease was observed between 0.2 to 0.4 miles, which explains that ethnic restaurants are generally strongly agglomerated in a small region. The sample showed an average of 40,000 people by zip code with a mean income of 80,000 dollars. However, both population and income showed a high standard deviation of 170,000 and 290,000, which indicates a large deviation in population and income. For the non-English-speaking population, the average was 9.6 percent by zip code with a high standard deviation of 7.81 percent. For all acceptance except for COO, the mean was slightly higher than the average if each ethnic restaurant had the same amount of number of restaurants. This indicates that marginally, there were higher accepted ethnic restaurants than lower accepted ethnic restaurants. Finally, for price segments, the average price range was 1.58, which is slightly lower than the average price range of 2 if all ethnic restaurant price segments were identical in terms of numbers. This indicates that there were more ethnic restaurants below the $20-dollar range than above it.

Table 7

Descriptive analysis for regression

Variables	*Mean*	*Std.Dev*	*Frequency*
SAME(0.2mile)	4.37	8.08	9200
SAME(0.4mile)	3.13	5.31	9200
SAME(0.6mile)	2.61	4.38	9200
SAME(0.8mile)	2.28	3.74	9200
SAME(1.0mile)	2.05	3.40	9200
SAME(1.2mile)	1.88	3.19	9200
SAME(1.4mile)	1.69	2.33	9200
SAME(1.6mile)	1.53	1.93	9200
SAME(1.8mile)	1.41	1.72	9200
SAME(2.0mile)	1.33	1.60	9200
PRICE	1.58	0.58	9200
FOOD	6.53	3.54	9200
RESTAURANT	6.17	3.45	9200
COO	5.10	2.75	9200
PRICEFOOD	9.73	5.95	9200
PRICEREST	7.66	5.80	9200
PRICECOO	7.66	4.91	9200
POPULATION	0.04	0.17	9200
MALEPERCENTAGE	0.49	0.05	9196
NON-ENGLISH	9.12	7.81	9196
MEDIANINCOME	0.08	0.29	9196

4.5 Comparing American restaurants with each ethnic restaurant and difference between small and big city populations

Prior to the results for the hypotheses, two additional dimensions regarding ethnic restaurants were investigated. First, for validity purpose, this study investigated whether there were differences between ethnic restaurants and American restaurants. Using chow (1960) test, table 8 results showed that American restaurants were different in agglomeration patterns as opposed to all ethnic restaurants across all mile radiuses which indicate that all ethnic type restaurants differed in agglomeration as opposed to American restaurants.

Second, the study has also investigated whether ethnic restaurants perception was also different by population. Table 9 shows differences between agglomeration patterns for perceptions of ethnic food, restaurant, and country of origin. The coefficient results of *DummyFOOD* and *DummyRESTAURANT* show higher populated regions to be more agglomerated when perception of ethnic food and restaurant were higher. However, the coefficient of *DummyCOO* indicate that larger cities were more diffused when perception of COO was higher. The difference in the perceptions might indicate that for larger population cities, perception of food and restaurant lead to more regional ethnic grouping behavior to represent the ethnicity such as China town or little Italy. On the other hand, smaller populated regions fail to have enough additional amount of demand by agglomerating as an ethnic group while the loss from competition is larger than the benefits of agglomeration surplus demand. However, when COO is largely accepted, ethnic restaurants that are in large populated regions will have the benefit to avoid competition and still have enough demand since the cultural aspect is fulfilled.

Table 8

Chow test comparison across all ethnic restaurants by miles using American restaurants as default

Miles / *F-values*	*SAME (0.2mile)*	*SAME (0.4mile)*	*SAME (0.6mile)*	*SAME (0.8mile)*	*SAME (1.0mile)*	*SAME (1.2mile)*	*SAME (1.4mile)*	*SAME (1.6mile)*	*SAME (1.8mile)*	*SAME (2.0mile)*
Comparison between ethnic restaurant agglomeration and American restaurants										
Italian	1520.22 ($p < .000$)	860.27 ($p < .000$)	705.03 ($p < .000$)	601.67 ($p < .000$)	517.16 ($p < .000$)	470.99 ($p < .000$)	415.94 ($p < .000$)	365.93 ($p < .000$)	332.70 ($p < .000$)	306.05 ($p < .000$)
Mexican	871.10 ($p < .000$)	581.38 ($p < .000$)	467.24 ($p < .000$)	429.62 ($p < .000$)	379.85 ($p < .000$)	342.58 ($p < .000$)	300.97 ($p < .000$)	306.63 ($p < .000$)	295.71 ($p < .000$)	289.89 ($p < .000$)
Chinese	2133.64 ($p < .000$)	1297.10 ($p < .000$)	1079.97 ($p < .000$)	860.88 ($p < .000$)	745.01 ($p < .000$)	646.48 ($p < .000$)	535.60 ($p < .000$)	441.27 ($p < .000$)	393.13 ($p < .000$)	356.19 ($p < .000$)
Thai	3853.34 ($p < .000$)	2565.07 ($p < .000$)	2074.50 ($p < .000$)	1730.24 ($p < .000$)	1513.60 ($p < .000$)	1298.45 ($p < .000$)	1109.39 ($p < .000$)	986.22 ($p < .000$)	790.74 ($p < .000$)	718.44 ($p < .000$)
Vietnamese	3463.15 ($p < .000$)	2650.37 ($p < .000$)	2609.74 ($p < .000$)	2817.57 ($p < .000$)	2720.08 ($p < .000$)	2884.41 ($p < .000$)	3073.72 ($p < .000$)	2851.09 ($p < .000$)	2652.00 ($p < .000$)	2388.84 ($p < .000$)
Indian	3129.23 ($p < .000$)	2044.72 ($p < .000$)	1569.76 ($p < .000$)	1598.20 ($p < .000$)	1608.43 ($p < .000$)	1585.62 ($p < .000$)	1550.62 ($p < .000$)	1536.09 ($p < .000$)	1520.70 ($p < .000$)	1413.44 ($p < .000$)
Middle Eastern	2168.48 ($p < .000$)	1409.29 ($p < .000$)	1079.16 ($p < .000$)	780.44 ($p < .000$)	763.38 ($p < .000$)	777.20 ($p < .000$)	911.21 ($p < .000$)	971.96 ($p < .000$)	954.75 ($p < .000$)	910.10 ($p < .000$)
French	2779.89 ($p < .000$)	2425.51 ($p < .000$)	1941.60 ($p < .000$)	1762.39 ($p < .000$)	1680.79 ($p < .000$)	1588.20 ($p < .000$)	853.73 ($p < .000$)	760.68 ($p < .000$)	625.71 ($p < .000$)	517.14 ($p < .000$)
Korean	2129.51 ($p < .000$)	1753.78 ($p < .000$)	1732.66 ($p < .000$)	1494.76 ($p < .000$)	1344.40 ($p < .000$)	1193.23 ($p < .000$)	1161.84 ($p < .000$)	1428.68 ($p < .000$)	1320.29 ($p < .000$)	1327.51 ($p < .000$)
Japanese	2011.41 ($p < .000$)	1255.10 ($p < .000$)	998.68 ($p < .000$)	804.79 ($p < .000$)	706.62 ($p < .000$)	613.15 ($p < .000$)	522.81 ($p < .000$)	490.63 ($p < .000$)	435.44 ($p < .000$)	406.74 ($p < .000$)
Greek	3156.88 ($p < .000$)	2106.76 ($p < .000$)	1763.15 ($p < .000$)	2009.18 ($p < .000$)	1754.48 ($p < .000$)	1540.13 ($p < .000$)	1295.45 ($p < .000$)	1069.53 ($p < .000$)	918.70 ($p < .000$)	791.51 ($p < .000$)
Comparison between small cities and large cities for ethnic restaurant agglomeration										
Small vs. Large cities	2.92 ($p < .002$)	2.01 ($p < .002$)	2.31 ($p < .002$)	1.40 ($p < .191$)	1.51 ($p < .146$)	1.57 ($p < .127$)	1.59 ($p < .123$)	1.86 ($p < .062$)	1.60 ($p < 0.12$)	1.60 ($p < .12$)

All nominal values listed are *F-values* with the degree of freedom of 5 for "Comparison between ethnic restaurant agglomeration and American restaurants" and degree of freedom of 8 for "Comparison between small cities and large cities for ethnic restaurant agglomeration"

Table 9

Results using agglomeration index low population/ high population regions

Dependent / Independent	*SAME(0.2mile)*	*SAME(0.4mile)*	*SAME(0.6mile)*	*SAME(0.8mile)*	*SAME(1.0mile)*	*SAME(1.2mile)*
(Intercept)	3.00***	3.54***	3.81***	3.71***	3.71***	3.56***
	(.141)	(.170)	(.188)	(.202)	(.213)	(.223)
MALEPERCENTAGE	-2.89***	-4.60***	-5.42***	-5.76***	-6.14***	-6.18***
	(.282)	(.340)	(.377)	(.405)	(.429)	(.448)
MEDIANINCOME	-2.89***	-2.68***	-2.54***	-1.51**	-1.05*	-.815
	(.368)	(.437)	(.483)	(.517)	(.054)	(.566)
FOOD	-.105***	-.079***	-.062***	-.059***	-.063***	-.063***
	(.003)	(.004)	(.004)	(.005)	(.005)	(.005)
RESTAURANT	-.015***	-.022***	-.025***	-.016**	.006	.014*
	(.003)	(.004)	(.004)	(.005)	(.005)	(.005)
COO	.095***	.076***	.061***	.057***	.048***	.047***
	(.004)	(.004)	(.005)	(.005)	(.005)	(.006)
PRICE	.011***	.062***	.008	.010	.025	.032*
	(.012)	(.015)	(.016)	(.018)	(.018)	(.019)
Non-English	.012***	.015***	.020***	.022***	.020***	.021***
	(.001)	(.002)	(.002)	(.002)	(.002)	(.002)
PDummy	-.362	-.956**	-1.98***	-1.21***	-1.19**	-1.38***
	(.001)	(.297)	(.002)	(.350)	(.370)	(.386)
PDummyMALE-PERCENTAGE	1.00*	2.48***	3.10***	3.06***	2.95***	3.54***
	(.494)	(.588)	(.644)	(.695)	(.736)	(.768)
PDummyMEDIAN-INCOME	-3.35***	-3.10***	-3.23***	-2.38**	-1.87*	-2.04*
	(.662)	(.783)	(.860)	(.914)	(.959)	(1.00)
PDummyFOOD	-.003	.022***	.026***	.022***	.019**	.013*
	(.004)	(.005)	(.006)	(.006)	(.007)	(.007)
PDummyRESTAURNT	.050***	.031***	.031***	.026***	.037***	.040***
	(.005)	(.005)	(.006)	(.007)	(.007)	(.007)
PDummyCOO	.004	-.027***	-.045***	-.036***	-.047***	-.045***
	(.005)	(.006)	(.006)	(.007)	(.007)	(.008)
PDummyPRICE	-.065***	-.052*	-.003	-.009	-.020	-.060*
	(.018)	(.022)	(.024)	(.026)	(.027)	(.028)
PDummyNon-English	-.007***	-.010***	-.014***	-.015***	-.011***	-.014***
	(.002)	(.002)	(.002)	(.003)	(.003)	(.003)

CONT Table 9

Results using agglomeration index low population/ high population regions

Dependent / Independent	*SAME(1.4mile)*	*SAME(1.6mile)*	*SAME(1.8mile)*	*SAME(2.0mile)*
(Intercept)	3.23***	2.88***	2.48***	1.95***
	(.232)	(.244)	(.254)	(.262)
MALEPERCENTAGE	-5.75***	-5.36***	-4.86***	-4.06***
	(.466)	(.490)	(.509)	(.523)
MEDIANINCOME	-1.26*	-1.09*	-.942	-.539
	(.597)	(.627)	(.653)	(.676)
FOOD	-.052***	-.050***	-.044***	-.041***
	(.006)	(.006)	(.006)	(.006)
RESTAURANT	.017**	.031***	.037***	.042***
	(.006)	(.006)	(.006)	(.007)
COO	.038***	.032***	.031***	.033***
	(.006)	(.006)	(.006)	(.007)
PRICE	.042*	.043*	.050*	.045*
	(.020)	(.021)	(.022)	(.023)
Non-English	.021***	.019***	.017***	.016***
	(.002)	(.002)	(.002)	(.002)
PDummy	-1.56***	-1.44***	-1.30**	-.873*
	(.407)	(.428)	(.443)	(.456)
PDummyMALE-PERCENTAGE	3.75***	3.42***	3.22***	2.38**
	(.810)	(.850)	(.881)	(.905)
PDummyMEDIAN-INCOME	-.743	-.752	-1.16	-1.88
	(1.06)	(1.11)	(1.16)	(1.20)
PDummyFOOD	.010	-.008	-.008	-.014
	(.008)	(.008)	(.008)	(.009)
PDummyRESTAURNT	.031***	.040***	.034***	.034***
	(.008)	(.008)	(.009)	(.009)
PDummyCOO	-.037***	-.028***	-.020*	-.013
	(.008)	(.008)	(.009)	(.009)
PDummyPRICE	-.061*	-.053*	-.070*	-.063*
	(.030)	(.031)	(.033)	(.034)
PDummyNon-English	-.016***	-.013***	-.012***	-.012***
	(.003)	(.003)	(.003)	(.003)

PDummyFOOD is the interaction of population dummy variable and ***FOOD***; ***PDummyCOO*** is the interaction of population dummy variable and ***COO***; ***PDummyREST*** is the interaction of population dummy variable and ***RESTAURANT***; ***PDummy*** is the dummy variable where high population regions are 1 and 0 zero elsewhere

4.6. Results between ethnic restaurant agglomeration and perception, price, and demographics of non-ethnic and ethnic groups

Table 10 presents the results of identifying how non-ethnic group perceptions of ethnic food, ethnic restaurants, and ethnic COO affect ethnic restaurant agglomeration, how ethnic group clusters affect ethnic restaurant agglomeration, and how ethnic restaurant price affects ethnic restaurant agglomeration. The results of the demographics for ethnic restaurants showed that ethnic restaurants are positive and significant for agglomeration, which peaked at 1.4 miles. The results indicated that ethnic restaurants are more clustered in locations that have higher populations, which confirms Yang *et al.*'s (2017) results. However, for income, the results showed a negative and significant coefficient. The results may be explained by ethnic communities with lower income regions having more ethnic restaurants.

For acceptance, all types of acceptance showed a negative and significant coefficient, which confirms that a higher acceptance of non-ethnic consumers motivates ethnic restaurant themes to diffuse and to expand to non-ethnic consumer regions to avoid competition. Therefore, hypotheses 1-1, 1-2, and 1-3 are confirmed. Among the types of acceptance, COO provided the best explanation for clustering patterns among all perceptions across all radiuses, with a negative coefficient of 0.926 being the strongest point at 0.4 miles. The results indicated that although ethnic restaurant acceptance includes many components to consider, COO is the strongest variable for an ethnic restaurant to diffuse from its similar competitors.

For price, the study showed that higher prices diffuse from each other. The results differ from Jung and Jang (2018), who found that higher prices were more agglomerated in the CBD. The findings might suggest that most ethnic restaurants are not located in the CBD for cities. More importantly, the results indicated that the loss of competition due to higher prices is more significant than gains of reducing search cost. However, for the interaction effect between price and acceptance, the results showed the interaction effect of food, general acceptance of the ethnic restaurant theme, and COO with price to have a positive and significant value, which peaked at a 0.8 mile, 0.2 mile, and 0.2 mile, respectively. Thus, ethnic restaurants that have a higher food acceptance from non-ethnic groups with higher prices tend to agglomerate with similar restaurants. This implies a conditional factor on ethnic restaurant clustering, which suggests that higher priced ethnic restaurants can send positive signals of quality assurance to non-ethnic

groups by agglomerating with same ethnic theme only when the acceptance is high from non-ethnic consumers. Therefore, hypotheses 2-1, 2-2, and 2-3 were confirmed.

For ethnic restaurants in ethnic communities, the results showed that ethnic restaurants cluster more strongly in ethnic communities than in non-ethnic communities because the variable *NON-ENGLISH* was a positive and significant variable, which peaked at the 0.2-mile radius. The results confirmed that ethnic consumers were clustered, which generates an uneven demand. Therefore, hypothesis 3 was accepted. More importantly, the results from the interaction effects of acceptance varied by each construct. When acceptance of food is low, ethnic restaurants tend to agglomerate together across all radiuses, with a 0.2-mile radius having the most impact. The results indicated that when ethnic restaurants are not able to receive enough demand from non-ethnic groups, they tend to be located close to each other in optimal locations from their ethnic communities. Thus, hypothesis 4-1 is accepted. However, for the effect of the agglomeration/diffusion process and the restaurant general opinion in ethnic communities, the results are more complex. Although diffusion occurs when the general opinion of the ethnic restaurant is higher in a radius from 0.2 to 0.6 miles, ethnic restaurants agglomerate from 1.4 to 2.0 miles as the acceptance of the general ethnic restaurants is higher. The result may explain that although ethnic restaurant diffusion occurs when there is a higher acceptance of the restaurant in a local group, ethnic restaurants are still bound to a certain location in which they are agglomerated together. Thus, hypothesis 4-2 is partially accepted. For the effect of COO on ethnic restaurant agglomeration in ethnic communities, it was found that ethnic restaurants that were more agglomerated when there was a higher acceptance of the ethnic COO existed, and the effect lasted for a 1.8-mile radius. The results suggested that ethnic restaurant themes that have a high acceptance in COO tend to agglomerate more strongly to represent the cultural aspect of authenticity. Thus, hypothesis 4-3 was rejected.

Table 10

Results using agglomeration index for sentimental analysis and price

Dependent / *Independent*	*SAME(0.2mile)*	*SAME(0.4mile)*	*SAME(0.6mile)*	*SAME(0.8mile)*	*SAME(1.0mile)*	*SAME(1.2mile)*
(Intercept)	2.58***	2.35***	2.21***	2.04***	1.85***	1.68***
	(.102)	(.103)	(.102)	(.102)	(.102)	(.103)
POPULATION	2.07***	2.02**	2.85***	3.20***	3.47***	3.63***
	(.596)	(.615)	(.617)	(.616)	(.616)	(.620)
MALEPERCENTAGE	-.491*	-.645***	-.857***	-1.01***	-1.00***	-.883***
	(.191)	(.194)	(.192)	(.191)	(.190)	(.193)
MEDIANINCOME	-1.95***	-2.44***	-2.46***	-1.79***	-1.40***	-1.34**
	(.401)	(.418)	(.422)	(.421)	(.421)	(.425)
FOOD	-.513***	-.563***	-.472***	-.523***	-.475***	-.389***
	(.081)	(.083)	(.084)	(.083)	(.083)	(.084)
RESTAURANT	-.525*	-.307***	-.301***	-.152*	-.109*	-.159*
	(.088)	(.091)	(.091)	(.092)	(.916)	(.092)
COO	-.094***	-.926***	-.854***	-.845***	-.841***	-.796***
	(.076)	(.078)	(.078)	(.078)	(.078)	(.078)
PRICE	-.447***	-.452***	-.450***	-.440***	-.425***	-.430***
	(.028)	(.030)	(.299)	(.030)	(.030)	(.031)
PRICEFOOD	.228***	.244***	.233***	.263***	.257***	.230***
	(.040)	(.041)	(.041)	(.041)	(.041)	(.041)
PRICEREST	.175**	.100*	.096*	.030	.013	.006
	(.047)	(.049)	(.049)	(.049)	(.049)	(.050)
PRICECOO	.726***	.709***	.653***	.653***	.674***	.661***
	(.043)	(.045)	(.045)	(.045)	(.045)	(.045)
NON-ENGLISH	.034***	.026***	.023**	.020***	.018***	.015***
	(.001)	(.003)	(.003)	(.003)	(.003)	(.003)
NON-ENGLISHFOOD	-.031***	-.021***	-.022***	-.018***	-.021***	-.021***
	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)
NON-ENGLISHREST	-.013***	-.015***	-.013***	-.010**	-.002	.003
	(.003)	(.003)	(.003)	(.003)	(.003)	(.004)
NON-ENGLISHCOO	.000***	.006*	.009**	.009**	.006*	.005*
	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)

CONT Table 10

Results using agglomeration index for sentimental analysis and price

Dependent / *Independent*	*SAME(1.4mile)*	*SAME(1.6mile)*	*SAME(1.8mile)*	*SAME(2.0mile)*
(Intercept)	1.43***	1.24***	1.08***	.952***
	(.102)	(.100)	(.100)	(.101)
POPULATION	2.75***	2.18***	1.96**	1.78**
	(.610)	(.601)	(.597)	(.599)
MALEPERCENTAGE	-.727***	-.681***	-.604**	-.561**
	(.190)	(.186)	(.185)	(.186)
MEDIANINCOME	-1.21**	-.102*	-.972*	-.837*
	(.419)	(.412)	(.411)	(.413)
FOOD	-.307***	-.246**	-.164*	-.123
	(.082)	(.081)	(.080)	(.085)
RESTAURANT	-.088	-.029	-.030	-.053
	(.091)	(.090)	(.088)	(.089)
COO	-.820***	-.786***	-.773***	-.690***
	(.077)	(.075)	(.074)	(.074)
PRICEFOOD	.211***	.195***	.182***	.172***
	(.040)	(.040)	(.039)	(.039)
PRICEREST	-.036	-.060	-.071	-.040
	(.049)	(.048)	(.048)	(.048)
PRICECOO	.662***	.644***	.649***	.606***
	(.044)	(.043)	(.042)	(.043)
NON-ENGLISH	.011***	.008**	.006*	.006*
	(.003)	(.003)	(.003)	(.003)
NON-ENGLISHFOOD	-.020***	-.015***	-.017***	-.017***
	(.003)	(.003)	(.003)	(.003)
NON-ENGLISHREST	.007*	.009*	.014***	.015***
	(.003)	(.003)	(.003)	(.003)
NON-ENGLISHCOO	.006*	.005*	.003	.001
	(.003)	(.003)	(.003)	(.003)

PRICE is the nominal value that ranges from 1 to 5 where each value ranges from 1 to 10 dollars; ***FOOD*** is the ordinal sentimental value between ethnic restaurants for food; ***COO*** is the ordinal sentimental value between ethnic restaurants for country of origin; ***RESTAURANT*** is the ordinal sentimental value among ethnic restaurant for opinions about restaurants; ***PRICEFOOD*** is the interaction of ***PRICE*** and ***FOOD***; ***PRICECOO*** is the interaction of ***PRICE*** and ***COO***; ***PRICEREST*** is the interaction of ***PRICE*** and ***RESTAURANT***; ***POPULATION*** is the population for each zip code by millions; ***MALEPERCENTAGE*** is the male percentage for each zip code; ***NON-ENGLISH*** is the percentage of population that do not speak English; ***MEDIANINCOME*** is the median income for each zip code by millions.

CHAPTER 5. CONCLUSION

As the public's interest has grown for ethnic restaurants, previous studies have attempted to identify determinant factors that affect ethnic restaurant locations. However, why ethnic restaurants agglomerate and what causes them to diffuse from each other have received less attention. Understanding ethnic restaurant agglomeration and diffusion is consisted of a complex structure which requires comprehensive knowledge in the history of immigration, acceptance of non-ethnic consumers in terms of food, general opinion of the ethnic restaurant theme and culture, restaurant location theory in agglomeration and diffusion, and general restaurant demand based on demographics. From a theoretical viewpoint, this study attempted to connect ethnic restaurant location based on the theory of competition/cooperation and consumer perception. More specifically, this study attempted to theorized that ethnic restaurant agglomeration patterns shift from agglomeration to diffuse by non-ethnic consumers' perception based on the theory of Marshall's (1890) benefits of endogenous agglomeration by demand and competition by agglomeration.

In terms of the theoretical justification for ethnic restaurant perception affecting ethnic restaurant agglomeration/diffusion, this study has utilized two aspects of non-ethnic consumer perceptions. First, perception varies by each ethnic restaurant theme. And second, each perception factor contributes to purchase intention, which implies that perception constructs would affect non-ethnic consumer consumption that in turn would affect ethnic restaurant demand. For perception, this study utilized previously established ethnic restaurant perception constructs which were perception of food, perception of ethnic restaurant theme, and perception of COO. The empirical results of this study confirm that higher acceptance from non-ethnic consumers is a driving force for ethnic restaurants to expand to non-ethnic consumer locations. The findings are consistent with the theory that firms diffuse to avoid competition when demand is spread more evenly (Anderson *et al.*, 1997), which in this case occurs when acceptance from non-ethnic consumers increases. More interestingly, the findings of this study showed that acceptance of ethnic food, ethnic restaurants in general, and COO had different influences on ethnic restaurant expansion. Among the three acceptances, acceptance of COO had the strongest contribution to ethnic restaurant diffusion, followed by acceptance of food and acceptance of the

ethnic restaurant in general, respectively. The results confirmed previous consumer behavior research results that non-ethnic consumers dine at ethnic restaurants to experience the culture of the ethnic theme, and social and cultural aspects motivate ethnic restaurants to expand to non-ethnic consumers.

On the other hand, first-generation immigrants tend to form ethnic communities due to the labor force, shared values, and no language barriers. In terms of location patterns, this suggests that consumers that consume at their own ethnic restaurant are clustered in a geographical area. Under this condition, it is theorized that ethnic restaurants are first formed in ethnic communities, which provides the ethnic restaurant with a guaranteed consumer group that understands the food, ambience, and culture of the theme. These ethnic communities act as "incubators" for ethnic restaurants to first be established in a foreign country, and they serve authentic food at the initial stage. The geographical clustered demand causes ethnic restaurants to agglomerate near these regions because regions outside the ethnic communities would have little to no demand. That is, the demand curve would be highly concaved, causing an optimal location to exist (Anderson *et al.*, 1997). Thus, ethnic communities would agglomerate strongly despite fierce competition. The results of this study confirmed this notion by showing that communities with a higher proportion of an ethnic group have stronger agglomeration in ethnic restaurants. This supports Yang *et al.*'s (2017) results while contradicting Zelinsky (1985), who found that ethnic communities have more ethnic restaurants than non-ethnic communities. The findings also confirmed that unevenly distributed demand clusters that are formed by ethnic communities create optimal locations for ethnic restaurants to cluster because ethnic groups already have an established acceptance of their own food.

The study results also extend previous literature in ethnic restaurant clustering patterns in ethnic communities by identifying how non-ethnic consumer acceptance affects ethnic restaurant clustering patterns in ethnic communities. If ethnic restaurants will cluster in ethnic communities despite fierce competition when acceptance from non-ethnic consumers is low, this would imply that higher accepted ethnic restaurant themes in the ethnic community would be more dispersed because higher acceptance from non-ethnic consumers would mean that non-ethnic consumers also visit these restaurants as well. That is, ethnic restaurants with a higher acceptance would be able to diffuse because demand is also generated from outside the community, which allows ethnic restaurants to avoid competition. From a spatial theoretical

point of view, this means that the demand curve is less concave as acceptance increases, which leads to diffusion among ethnic restaurants. However, the results of this study only partially support the theory that ethnic restaurants in ethnic communities are more diffused only when acceptance from non-ethnic consumers of food is high. That is, ethnic restaurants in ethnic communities diffusing from each other was not identified for COO or general restaurant opinions, which were found to agglomerate stronger when acceptance from non-ethnic consumers was high. The findings may imply that higher COO and higher acceptance of an ethnic restaurant theme benefit local ethnic communities by creating additional demand from non-ethnic consumers entering ethnic communities to consume and experience the cultural aspect as well.

Finally, the study also extends previous literature on restaurant agglomeration and restaurant price segments. The results of this study showed that in contrast to the conventional assumption that higher priced restaurants cluster more strongly, higher priced restaurants were found to diffuse, which means that clustering does not increase the quality assurance of a location for ethnic restaurants. This implies that higher priced ethnic restaurant clustering does not have enough force to generate a larger demand by agglomerating together, which may explain why the demand from non-ethnic consumers is sparse compared to mainstream, non-ethnic restaurants. Therefore, competition is a more important factor for higher priced restaurants when choosing a location, which makes higher ethnic restaurant price segments diffuse away from each other. This notion was further supported by observing higher accepted ethnic restaurant themes to agglomerate more strongly than lower accepted ethnic restaurants across the acceptance of food, ethnic restaurant opinion in general, and COO.

For ethnic restaurant practitioners, the results suggest that the question of whether these restaurants agglomerate together or diffuse from each other is determined based on acceptance from non-ethnic consumers, whether the ethnic restaurant is in an ethnic community, and which price segment the ethnic restaurant is placed in. As shown in table 7, when acceptance of ethnic food, general acceptance of an ethnic restaurant theme, or COO is unknown, the niche market strategy to be located away from competitors in a non-ethnic community can be a risky strategy. The current geographical structure of ethnic restaurants showed that a low acceptance of food, low general opinion of the restaurant theme, or low COO causes them to cluster more strongly than higher accepted restaurant themes. However, the results also suggested that the

agglomeration pattern differs by price segment, where up-scale and fine dining practitioners will cluster under the condition that acceptance is high to reduce consumer search cost. In terms of agglomeration patterns in ethnic communities, table 11 shows that ethnic practitioners cluster around ethnic regions when acceptance is low. However, when ethnic restaurants have a high acceptance, ethnic restaurants in ethnic communities differ in agglomeration and diffusion, and current markets show agglomeration if acceptance of cultural aspects is high rather than if the acceptance of food is high. In sum, if acceptance is low, the best practice for an ethnic restaurant is to be located with similar ethnic themes in the ethnic community to earn demand from the ethnic community despite competition, which would be higher in these regions. As acceptance from non-ethnic consumers increases, being locating away from the ethnic group is possible, and it is best to diffuse from similar ethnic restaurants when COO is high, and the price segment is low.

Table 11

Practices for ethnic restaurant agglomeration and diffusion by acceptance

	Acceptance of food, opinion of ethnic restaurant theme, and country of origin		
Price Segment		Low	High
	QSR	Agglomeration	Diffusion
	Fine dining	Agglomeration	Agglomeration
	Acceptance of food		
Ethnic community		Low	High
	Inside ethnic community	Agglomeration	Diffusion
	Outside ethnic community	Agglomeration	Diffusion
Ethnic community	Acceptance of opinion of ethnic restaurant theme and country of origin		
		Low	High
	Inside ethnic community	Agglomeration	Agglomeration
	Outside ethnic community	Agglomeration	Diffusion

This study is not free from limitations, and further studies are required to conclude the findings. First, the dataset did not include the largest cities in the U.S., such as Chicago and New York, though it can be speculated that similar results would emerge with only the difference of higher agglomeration estimates because population density would be the primary difference. This is because the relationship between agglomeration patterns and acceptance would still apply in such cities despite a higher population. Second, a lag effect of the acceptance of ethnic

restaurant agglomeration may exist because ethnic restaurants expand to non-ethnic consumers as their demand increases. There is a possibility that the acceptance of ethnic restaurants may change faster than the response from ethnic restaurants. Thus, identifying how each ethnic restaurant cluster changes over time would verify how acceptance affects ethnic restaurant clustering over a temporal period. However, as shown in the U.S. census, ethnic restaurants increase at a rapid rate to the response of increase in demand. Therefore, the general theory that acceptance would allow ethnic restaurants to expand away from ethnic communities should still hold because agglomeration patterns would change over time due to acceptance. Finally, the authenticity of the ethnic restaurant was not captured by this research due to the absence of such information, although there is a large body of literature on ethnic restaurants. The authenticity of a restaurant may affect the intensity of agglomeration among similar ethnic restaurants because authentic restaurant food and ambience have been shown to alter consumers' purchase intention (Jang *et al.*, 2011), which would in turn affect demand. Based on this study, the expected outcome of whether authenticity would affect agglomeration or diffusion is difficult to predict because search cost reduction would affect authentic restaurant agglomeration, while an increase in purchase intention from non-ethnic consumers would also allow for diffusion to avoid competition. However, for non-authentic ethnic restaurants, diffusion is predicted because non-ethnic consumer acceptance would be high, which would lead to diffusion, while a reduction in the search cost of authenticity would not be required. Nevertheless, the results would still be governed by the theory presented, for which the outcome of agglomeration or diffusion would be determined based on which force would be stronger.

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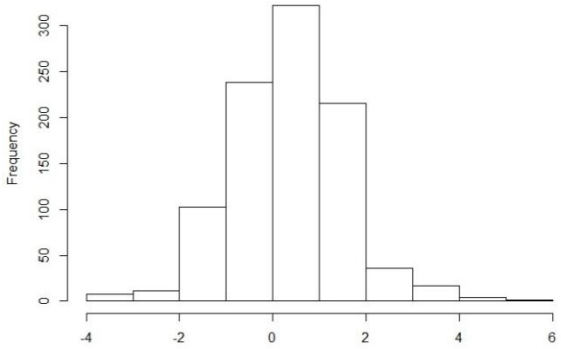
APPENDIX A. SENTIMENTAL ANALYSIS

A.1. Sentimental analysis using ethnic food



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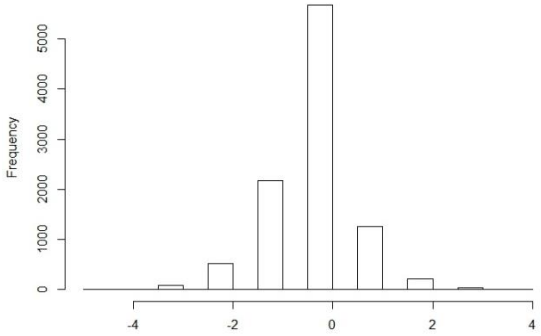

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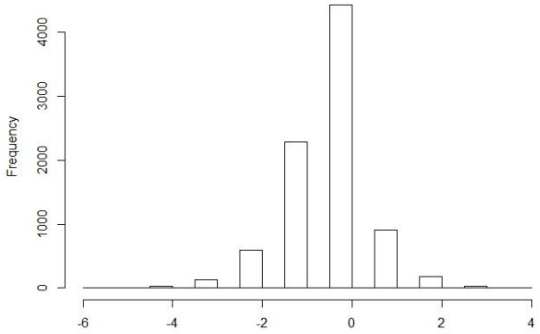

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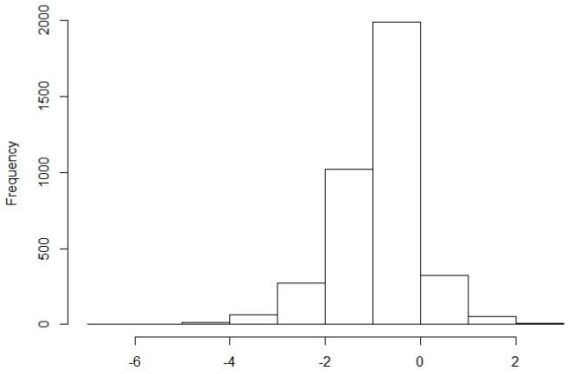

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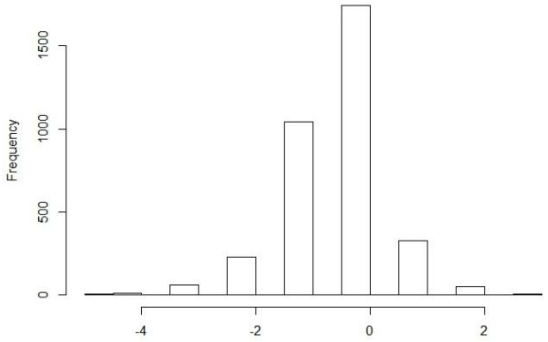

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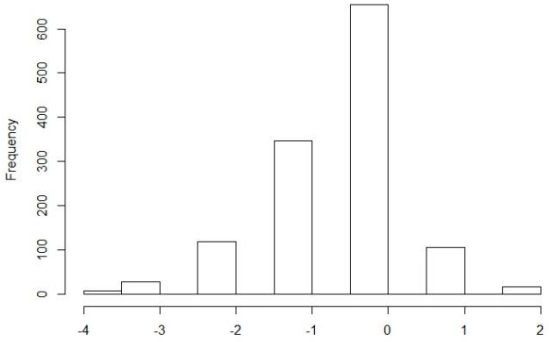

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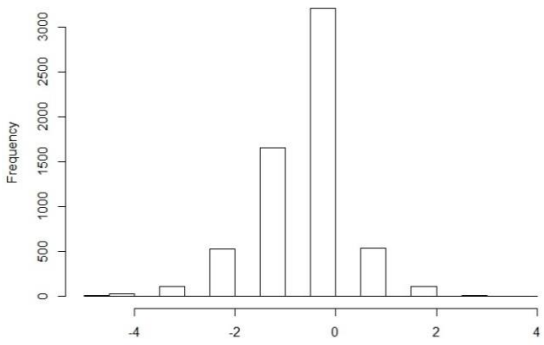

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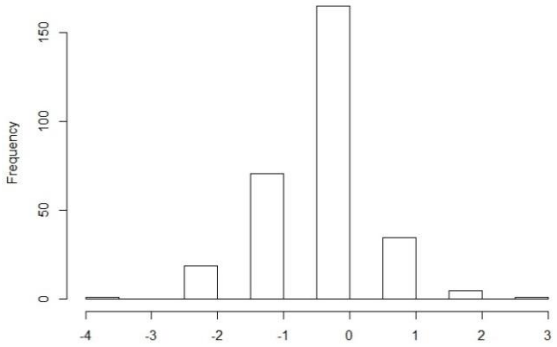

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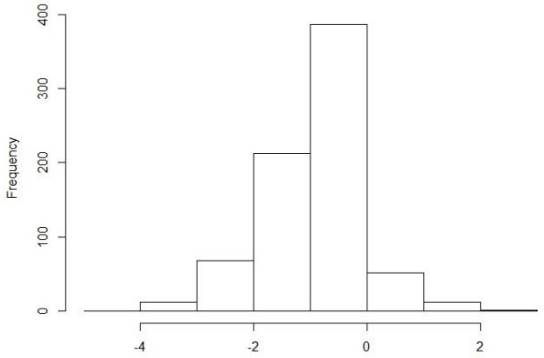

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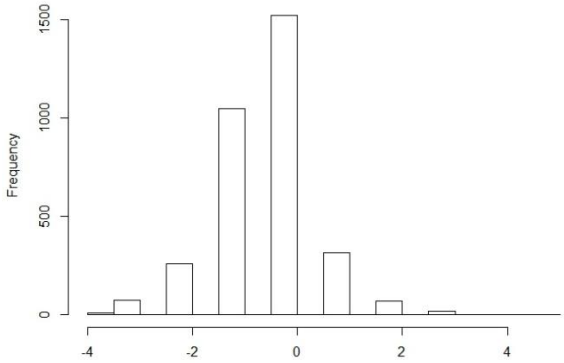

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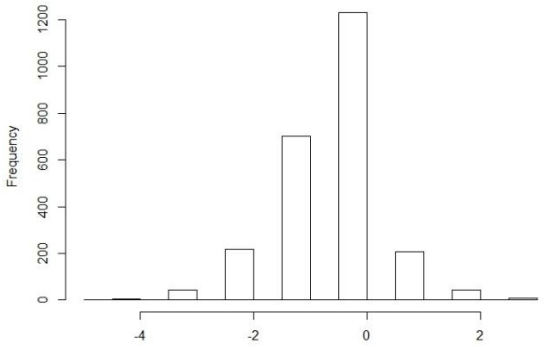

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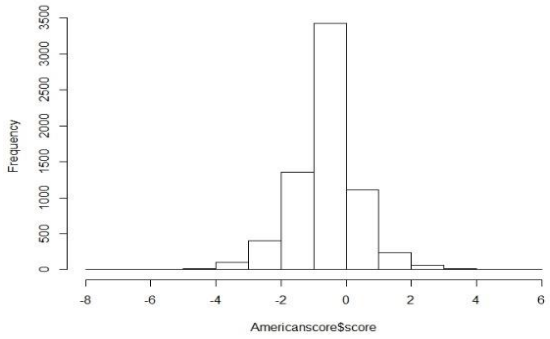

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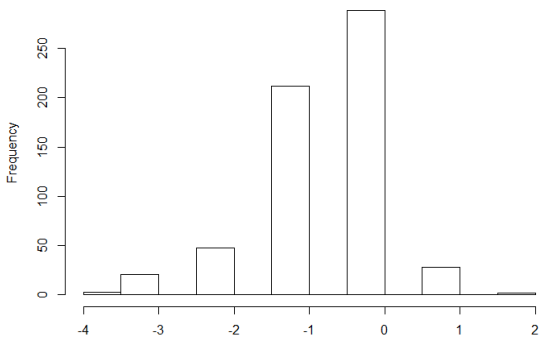
A.2. Sentimental analysis for Restaurant



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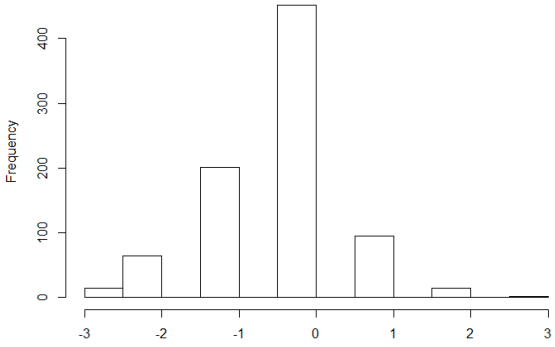

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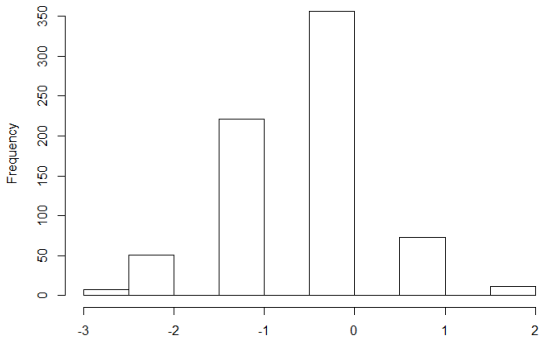

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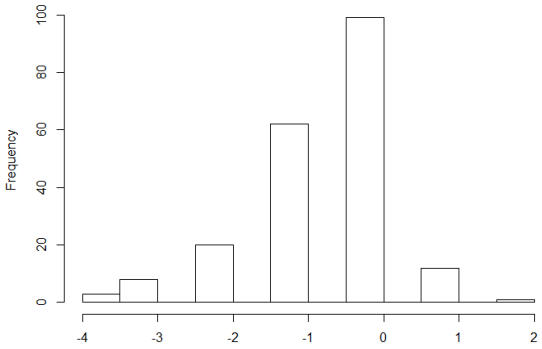

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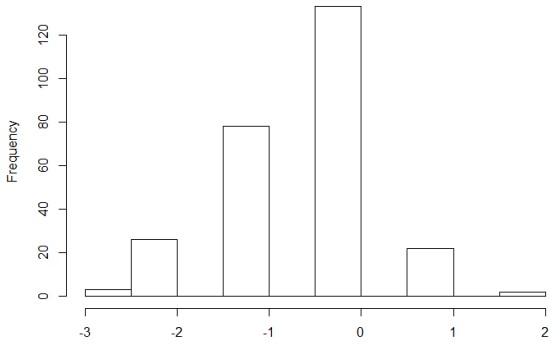

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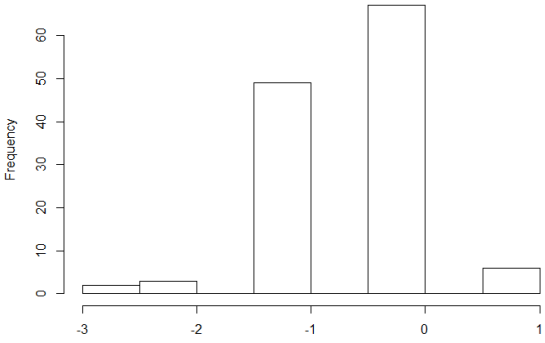

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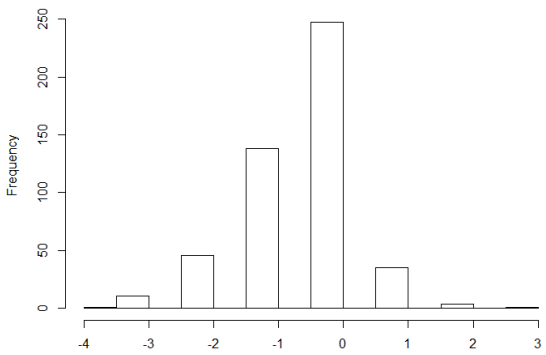

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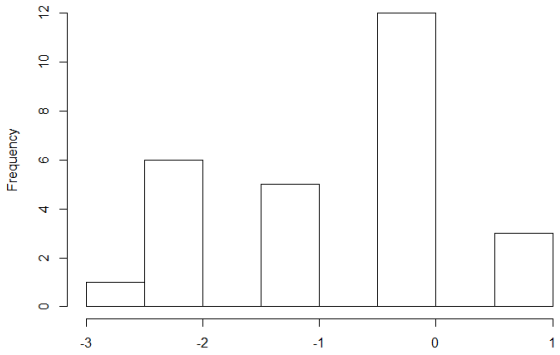

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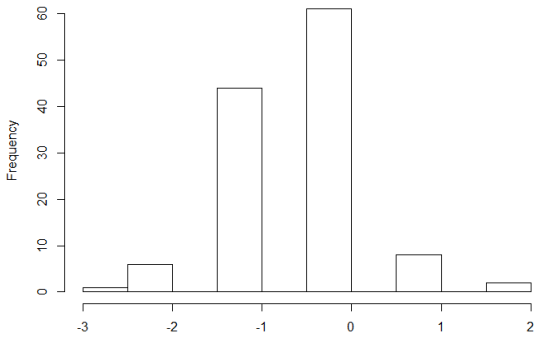

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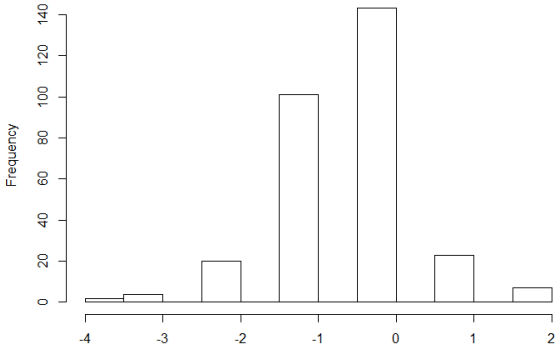

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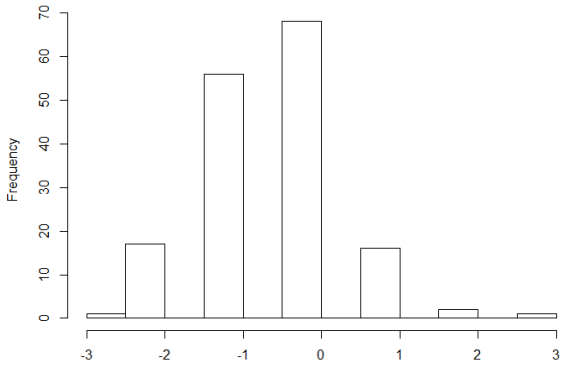

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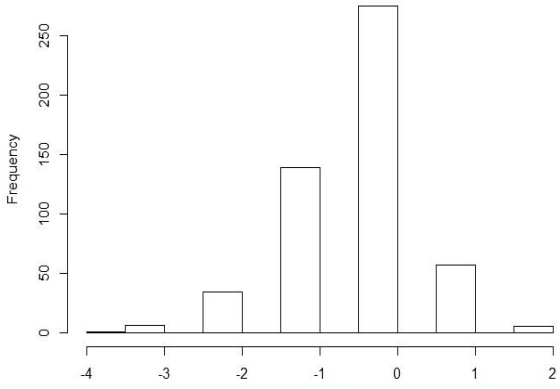
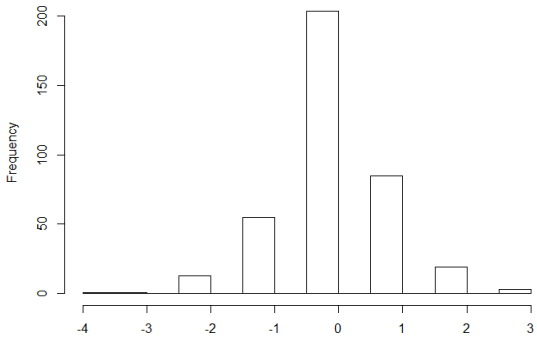


<American restaurant>

A.3. Sentimental analysis by Country of Origin (COO)



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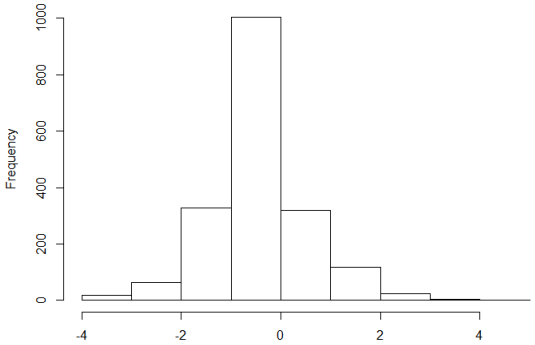

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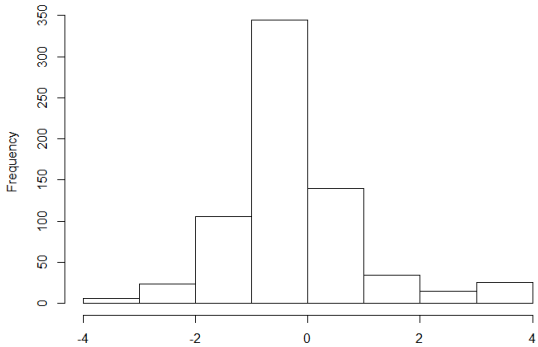

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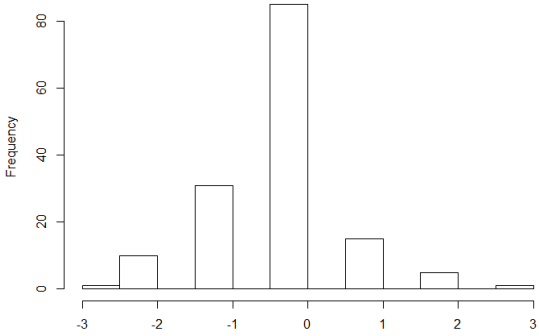

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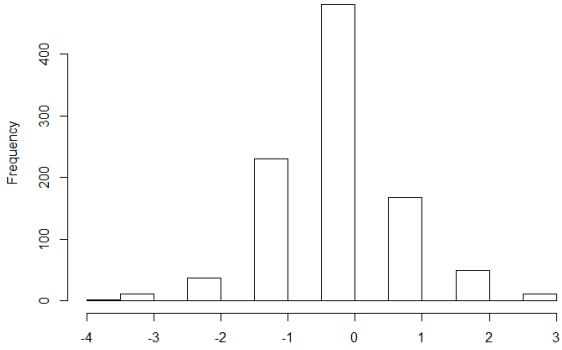

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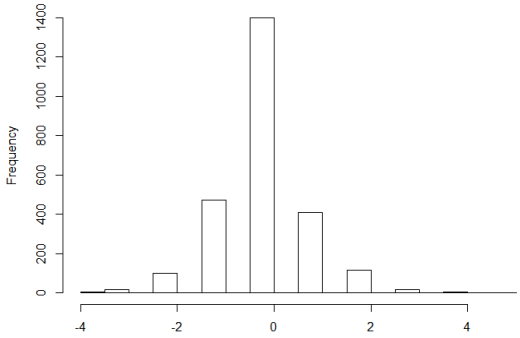

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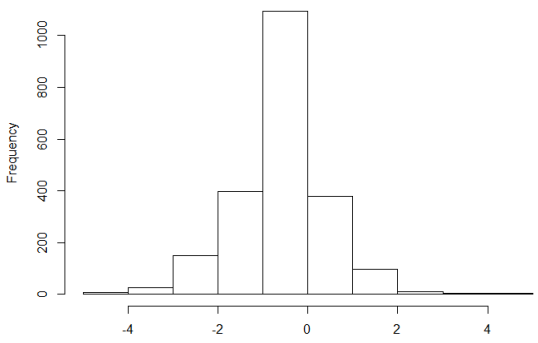

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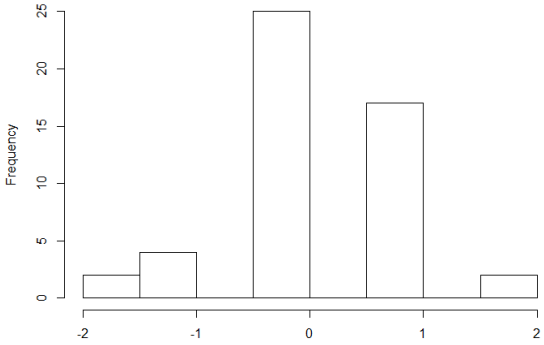

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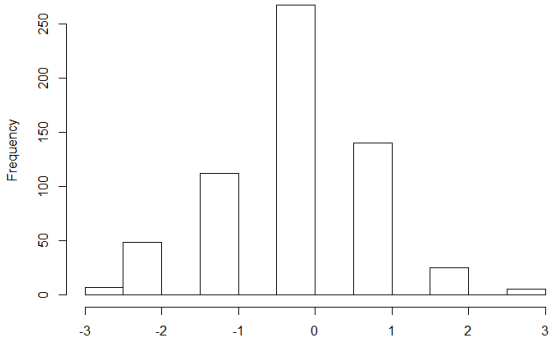

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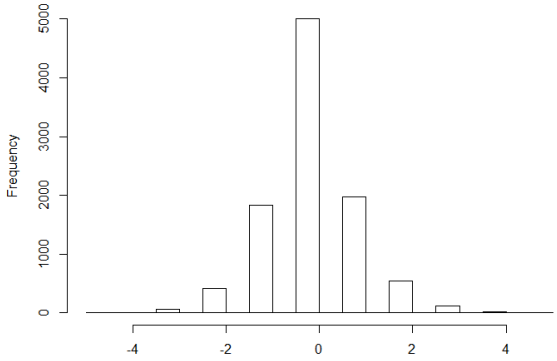

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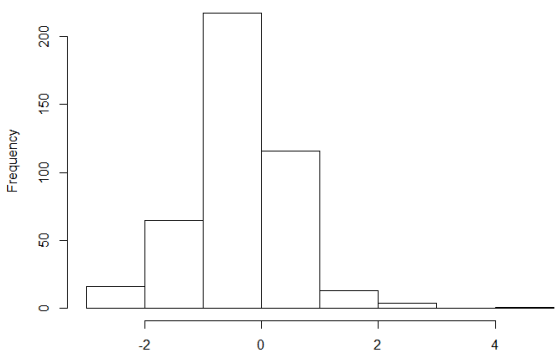

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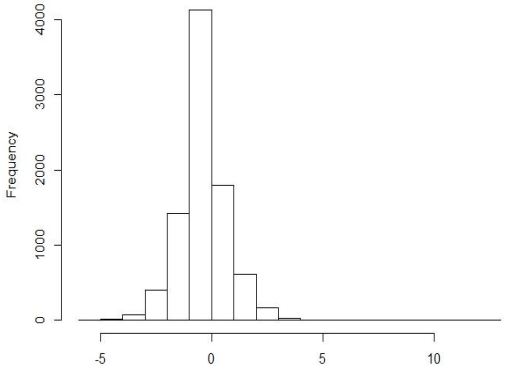
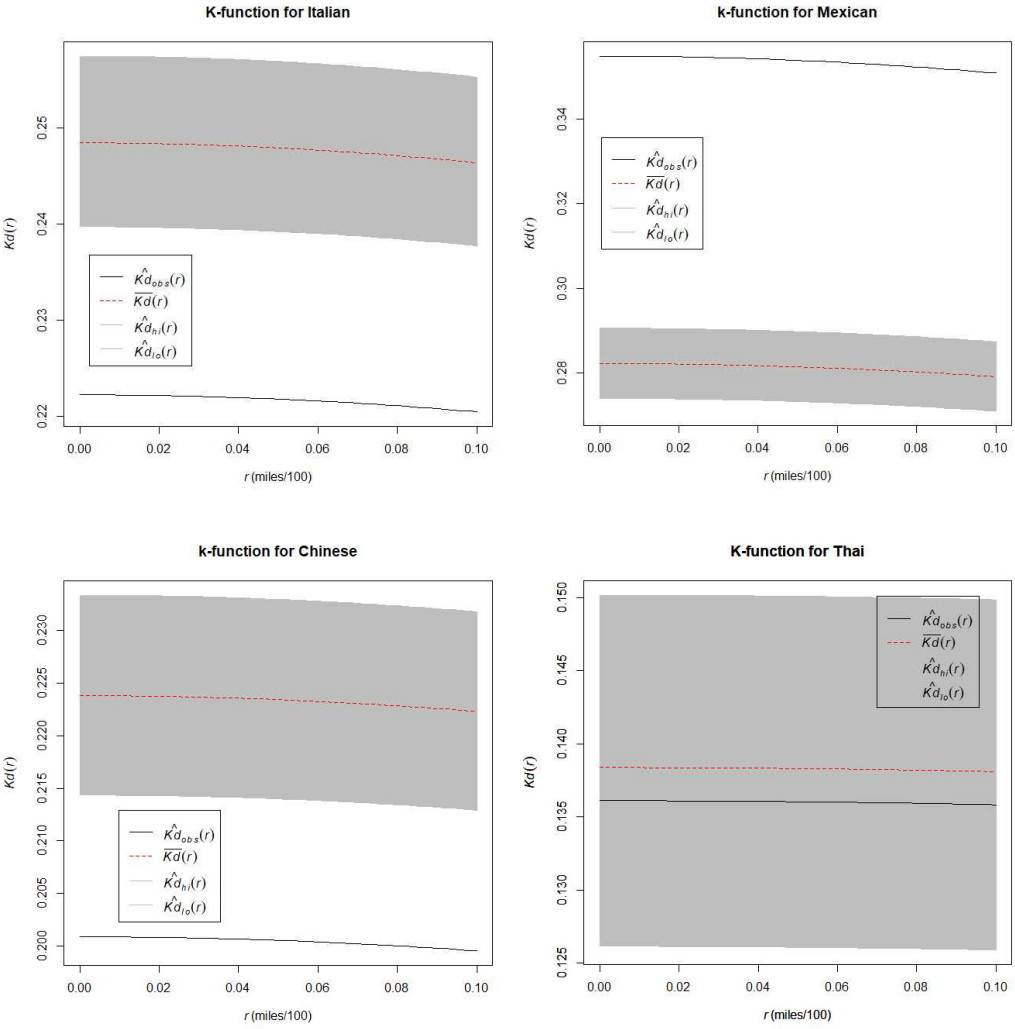
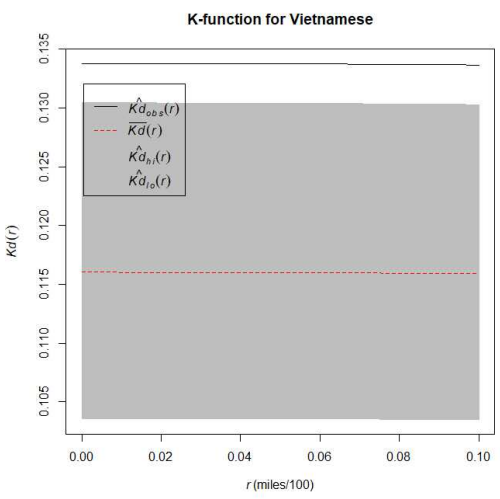


<American COO>

APPENDIX B. RIPLEY'S K AGGLOMERATION

B.1. Agglomeration pattern using total US sample




K-function for Vietnamese
Kd(r)
r (miles/100)
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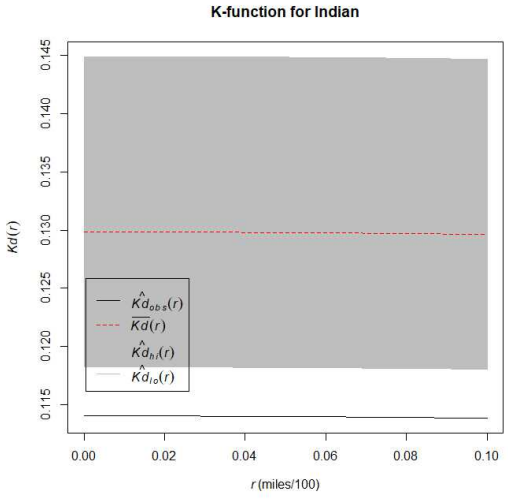
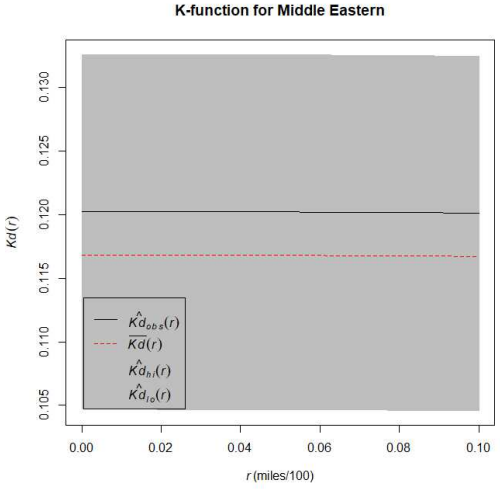
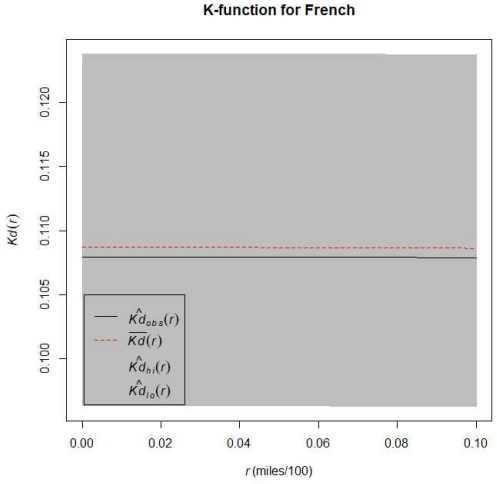
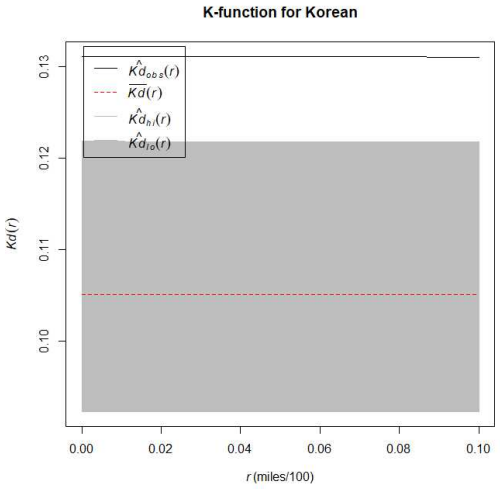
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$


K-function for Indian
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$


K-function for Middle Eastern
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$


K-function for French
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$


K-function for Korean
Kd(r)
r (miles/100)
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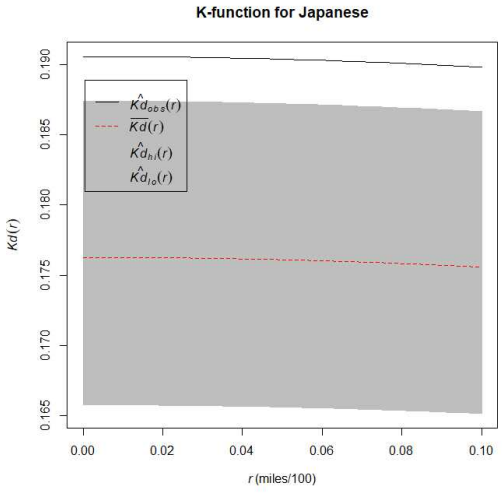
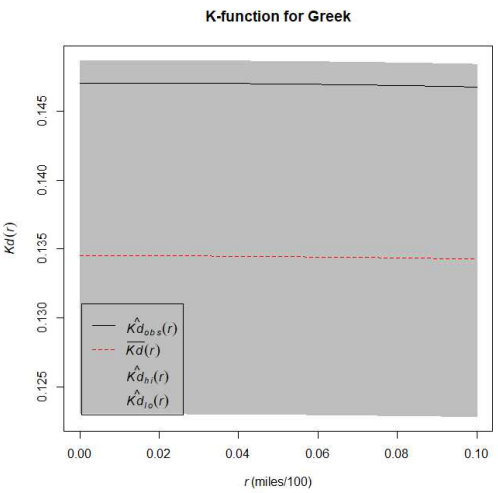
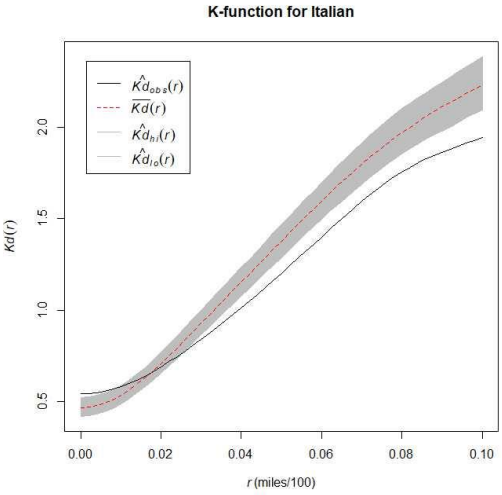
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

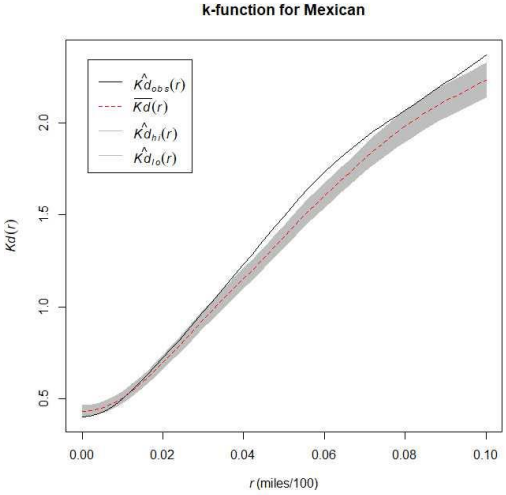

K-function for Japanese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

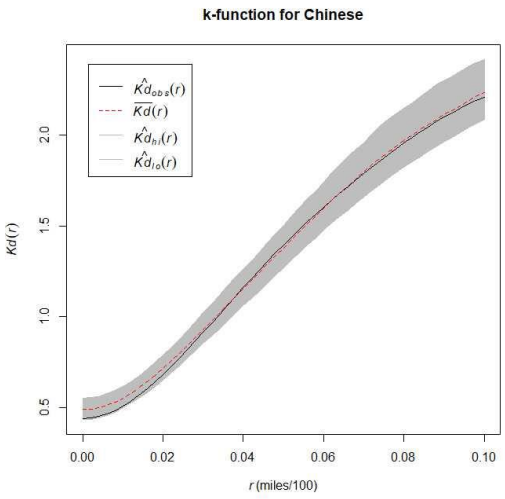


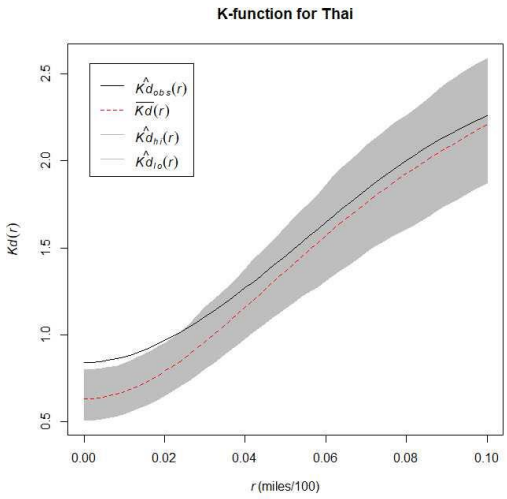
B.2. Agglomeration pattern using states that have over 1000 ethnic restaurants

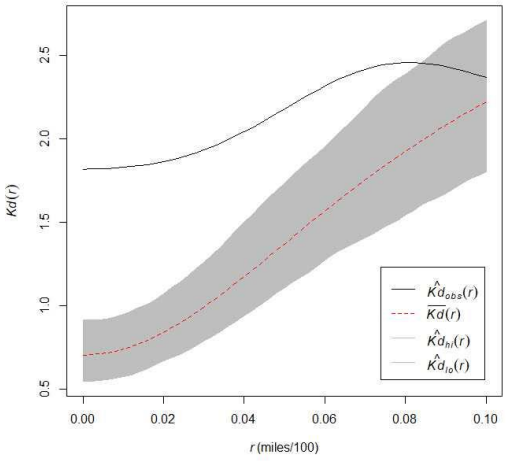
B.2.1 Arizona

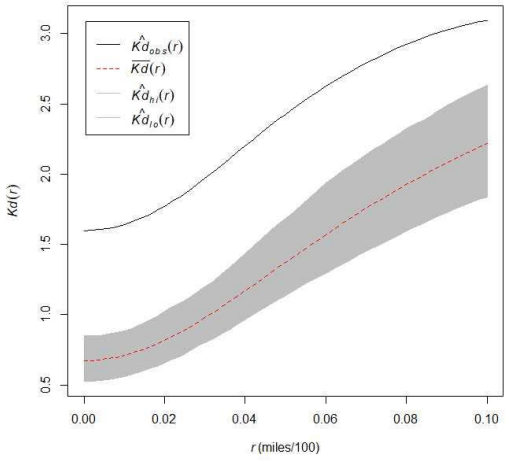


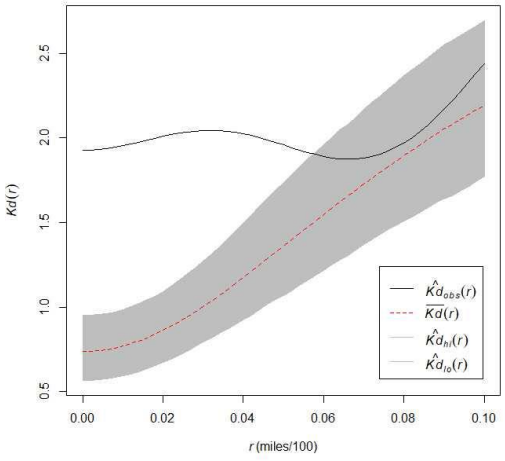


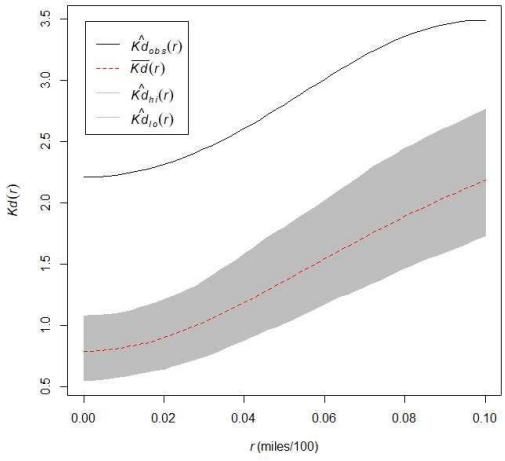

k-function for Chinese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

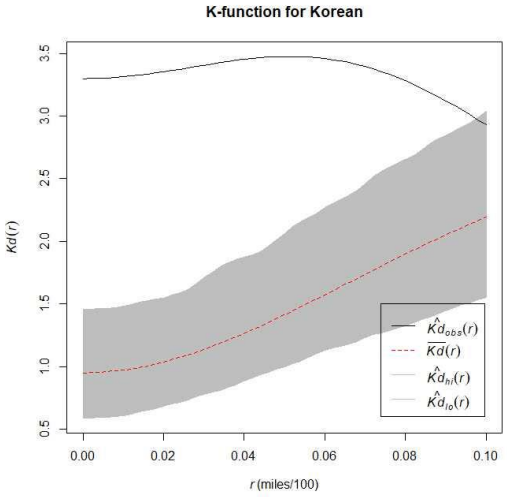

K-function for Thai
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

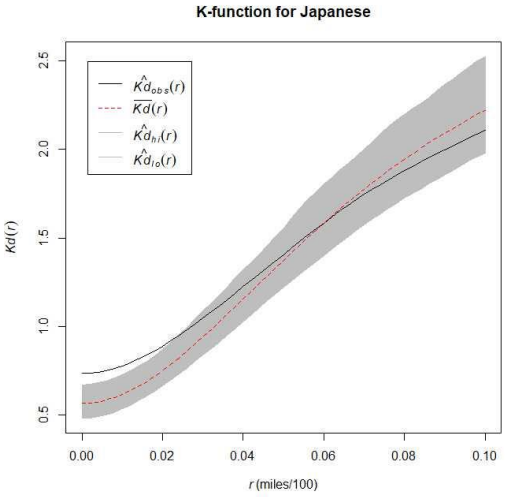

K-function for Vietnamese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

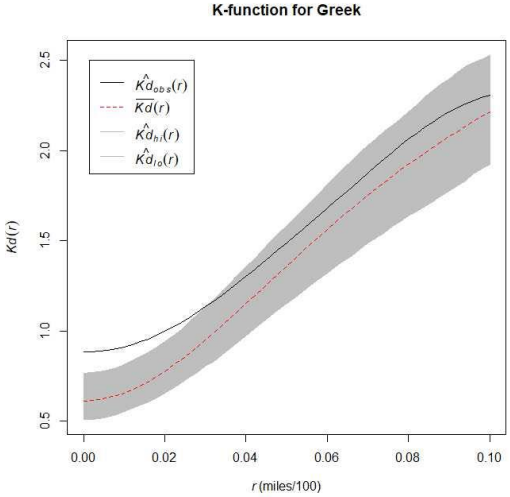

K-function for Indian
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)


K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

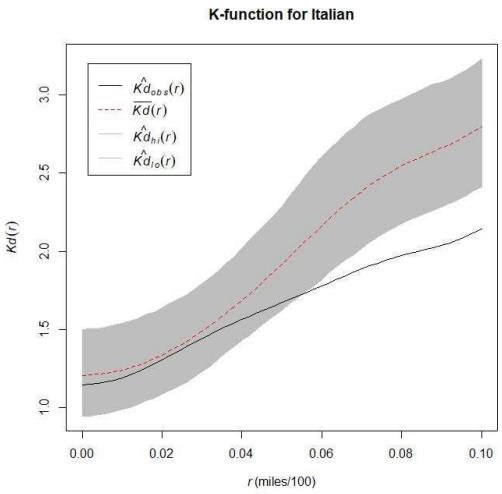

K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

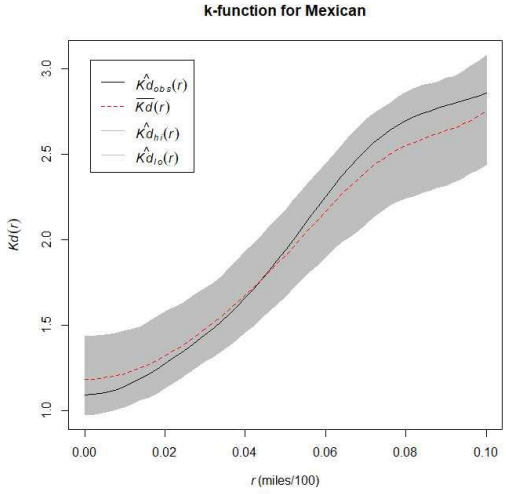

K-function for Korean
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

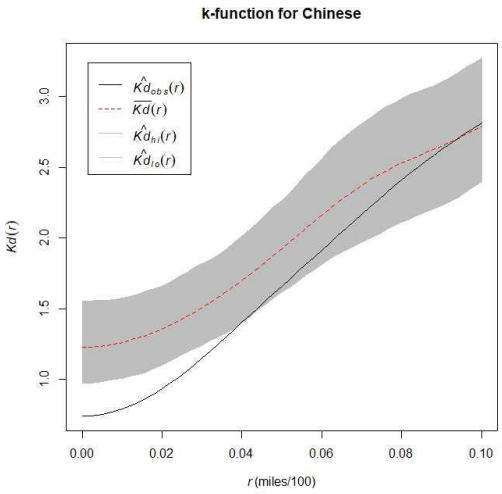

K-function for Japanese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

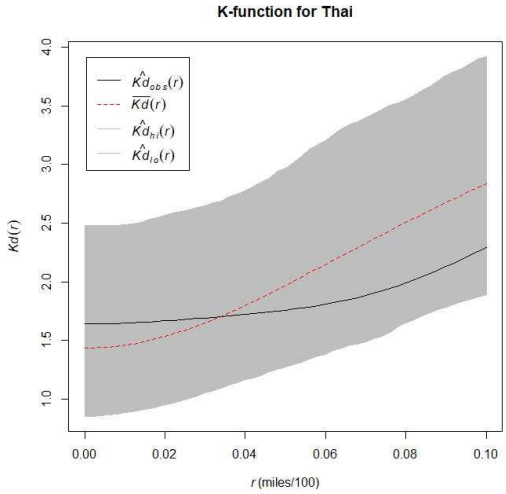

K-function for Greek
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

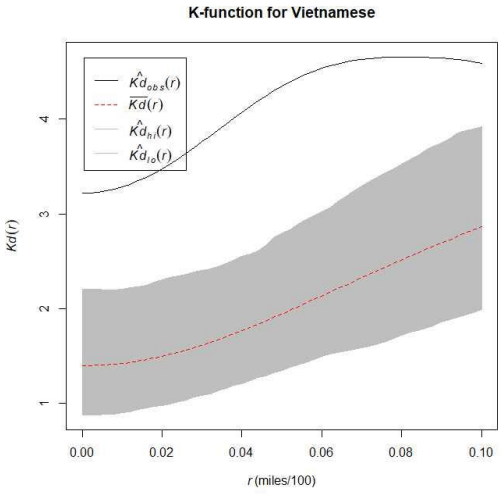
B.2.2 North Carolina

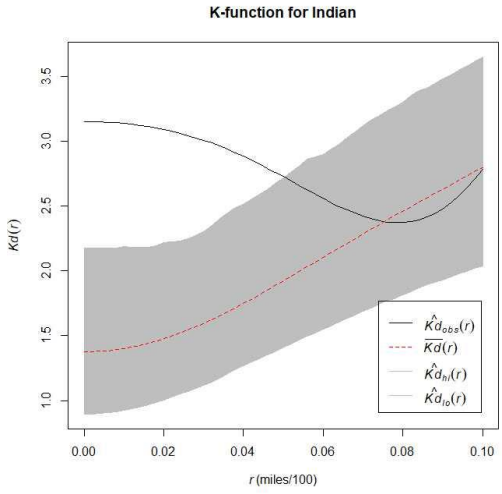


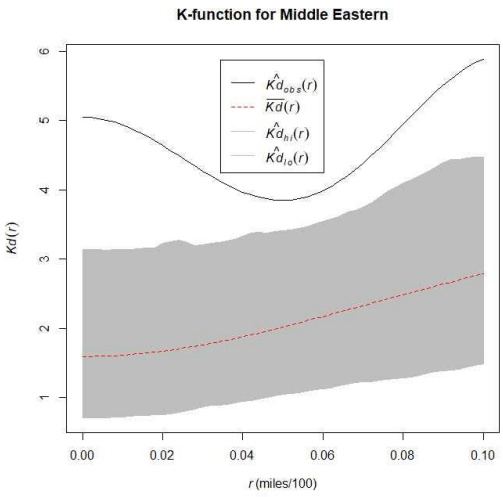


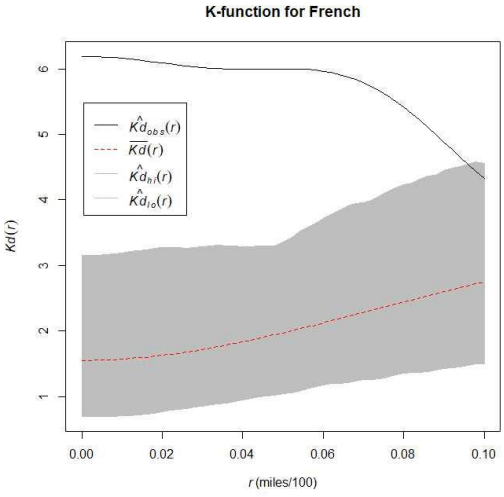


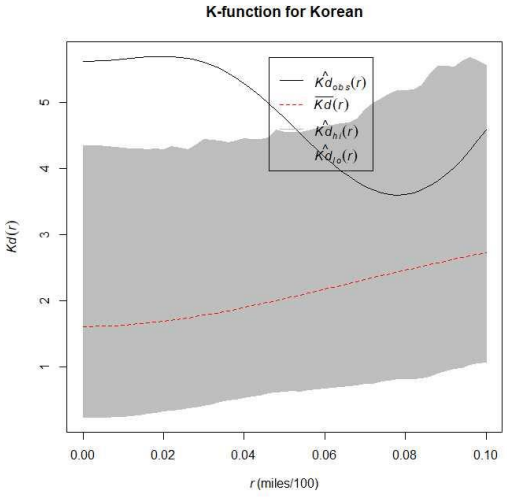


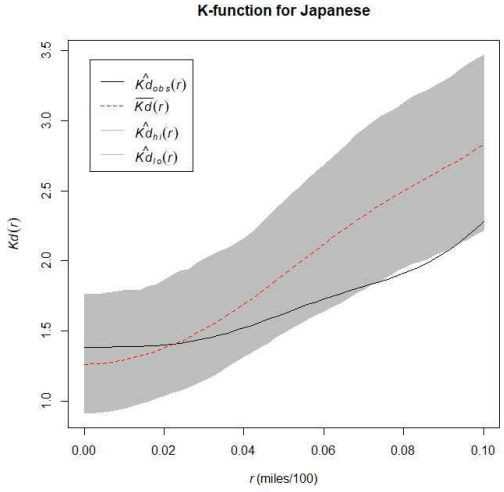


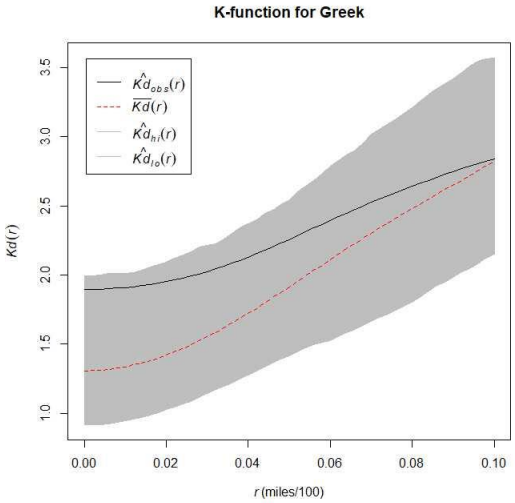



K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

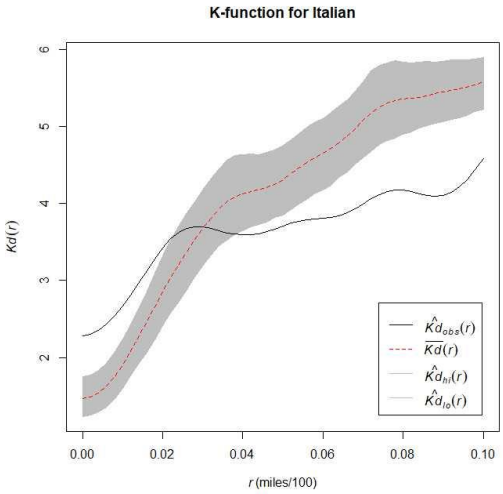

K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

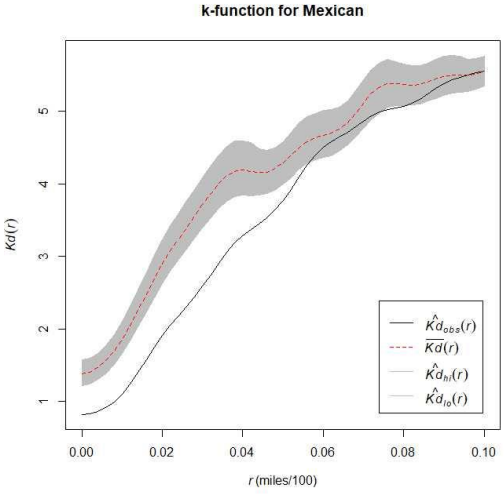

K-function for Korean
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

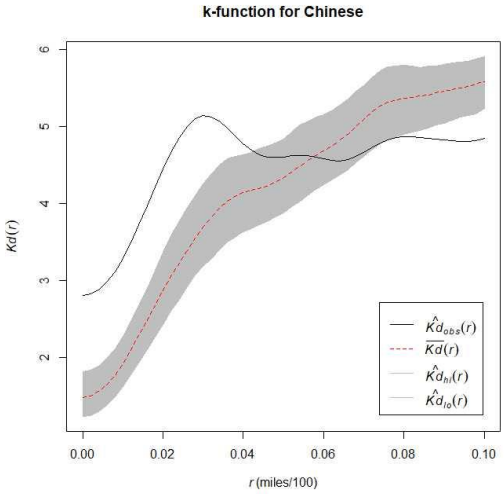

K-function for Japanese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

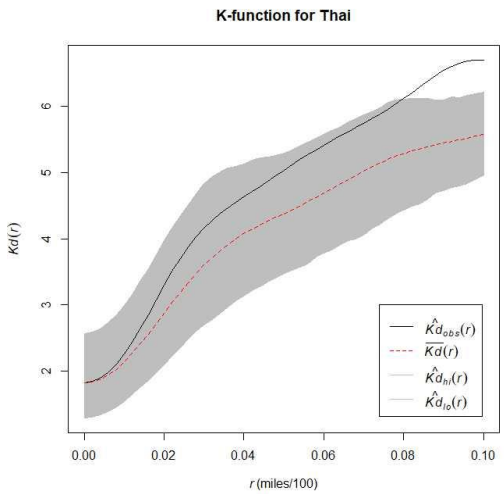

K-function for Greek
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

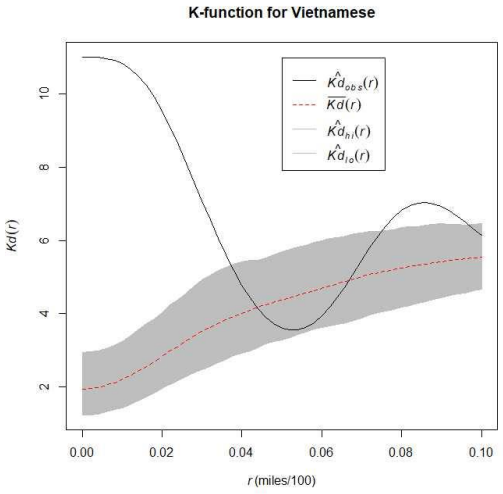
B.2.3 Nevada

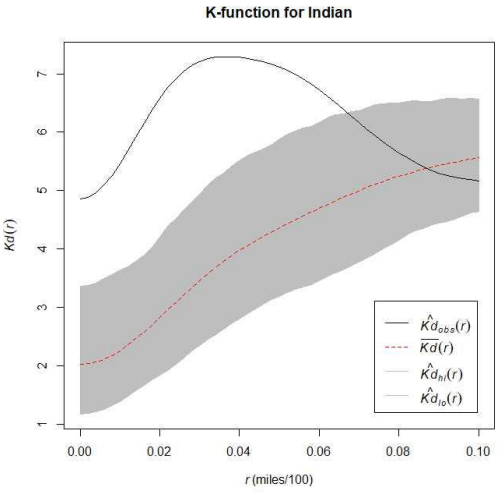

K-function for Italian
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

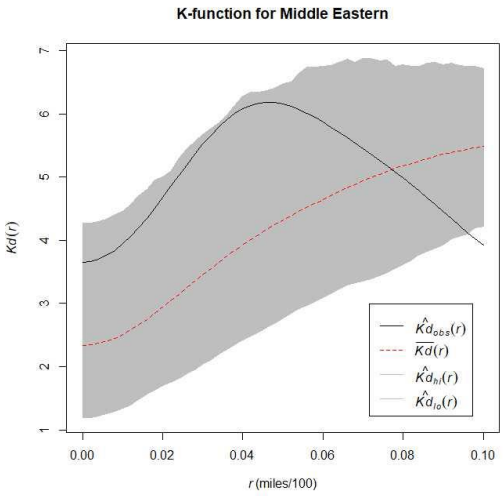

k-function for Mexican
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

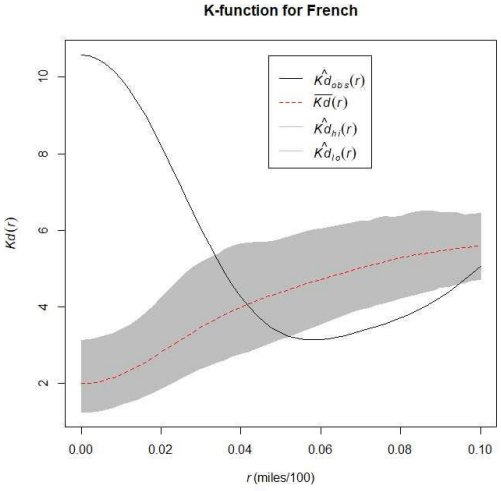

k-function for Chinese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

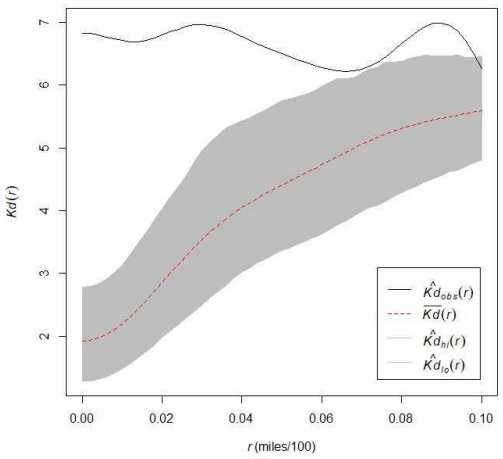

K-function for Thai
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

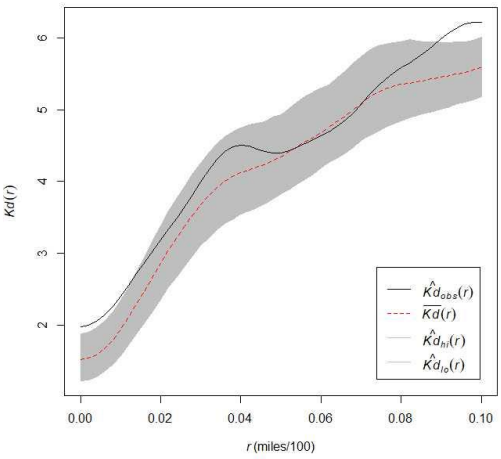

K-function for Vietnamese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

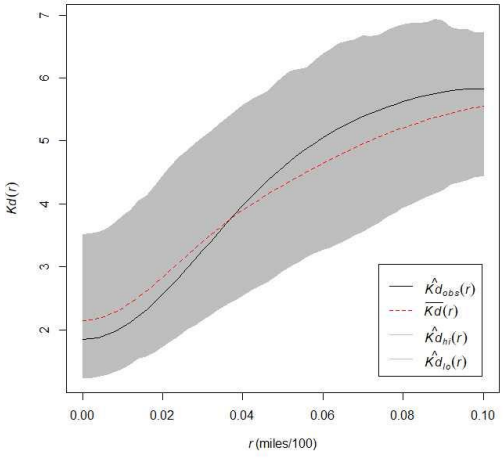

K-function for Indian
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$


K-function for Middle Eastern
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

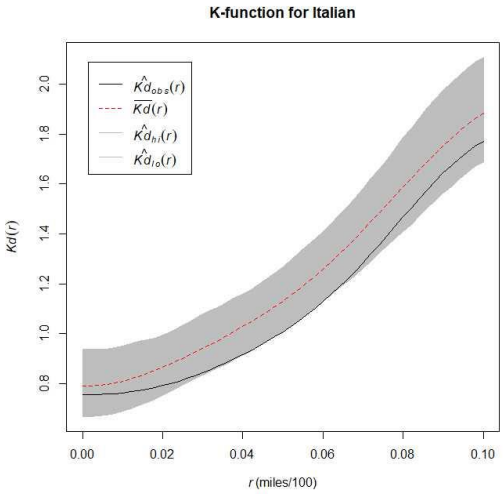

K-function for French
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

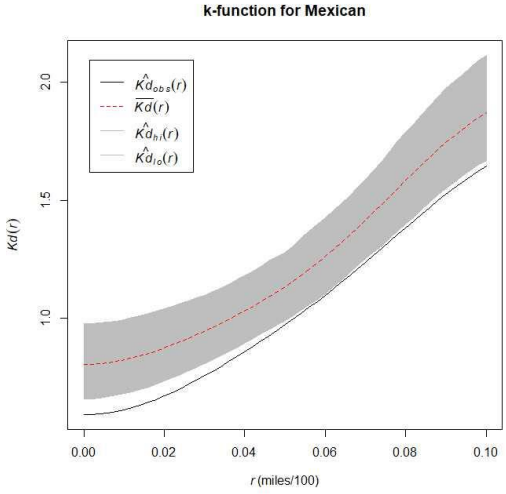

K-function for Korean
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

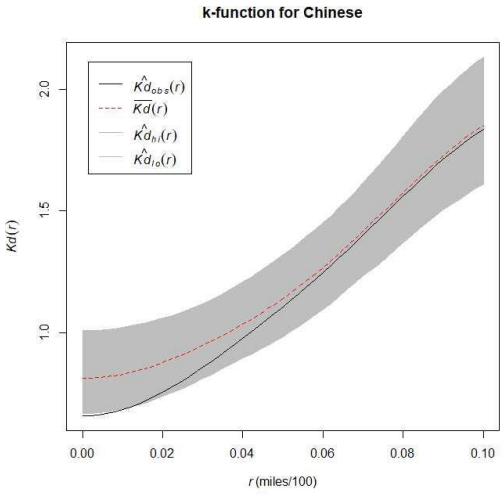

K-function for Japanese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

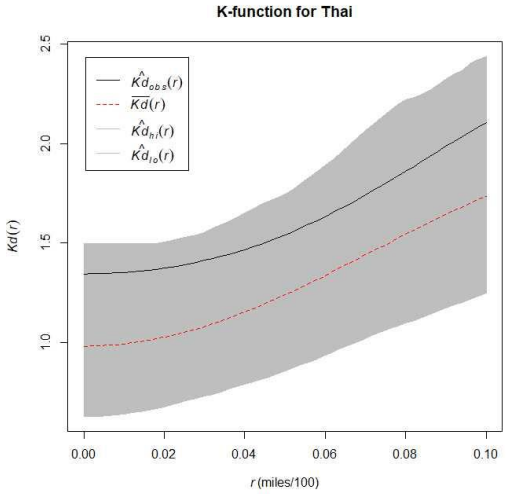

K-function for Greek
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

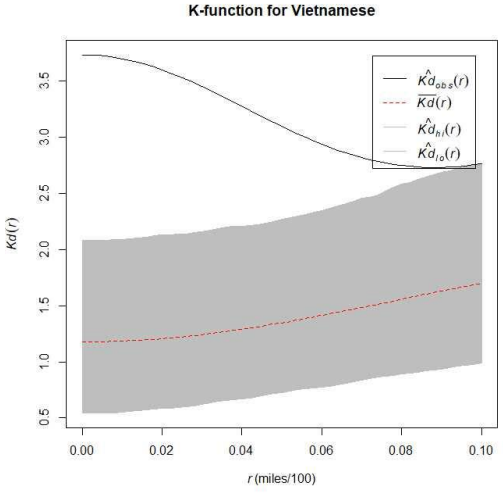
B.2.4 Ohio

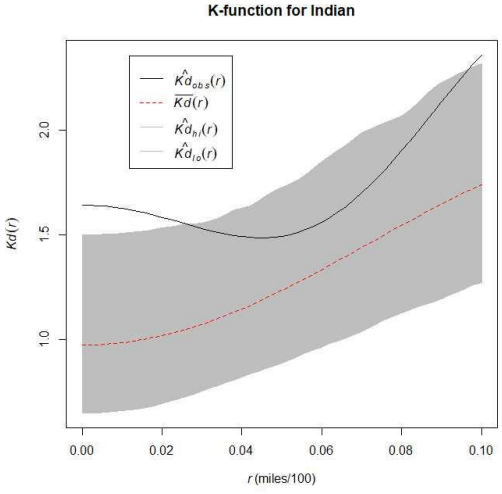

K-function for Italian
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

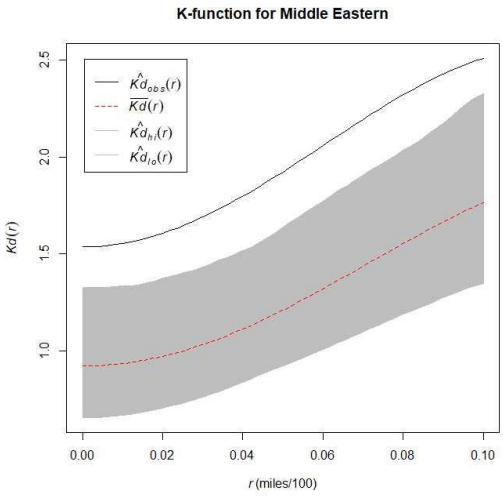

k-function for Mexican
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

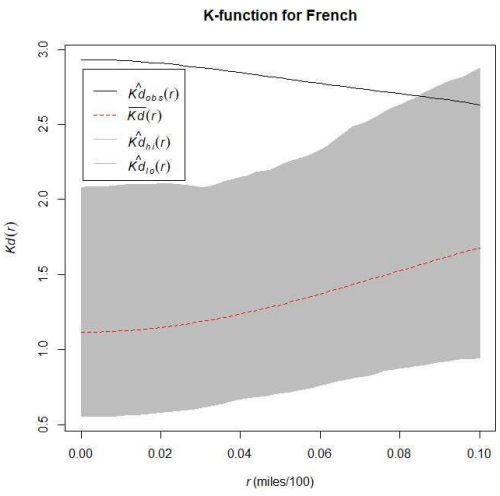

k-function for Chinese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

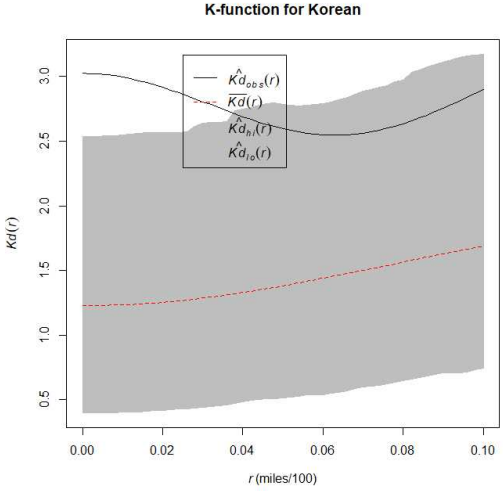

K-function for Thai
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

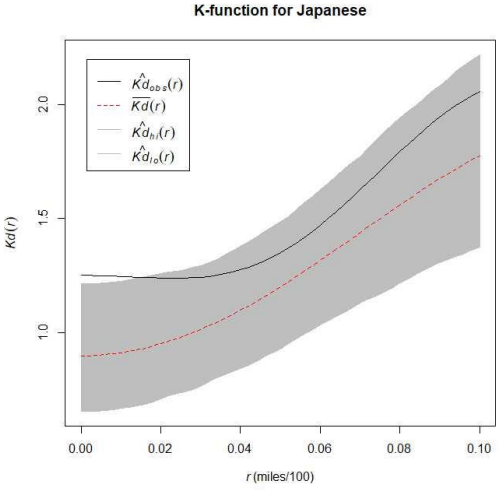

K-function for Vietnamese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

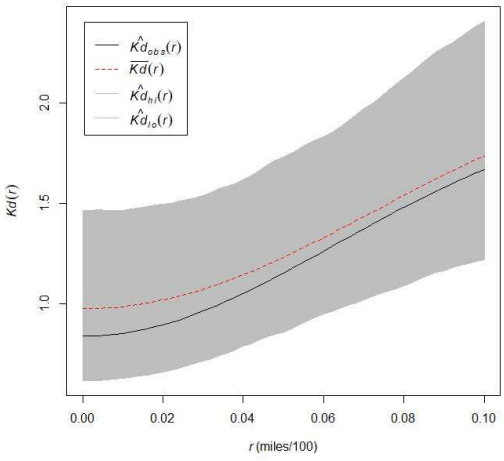

K-function for Indian
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)


K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

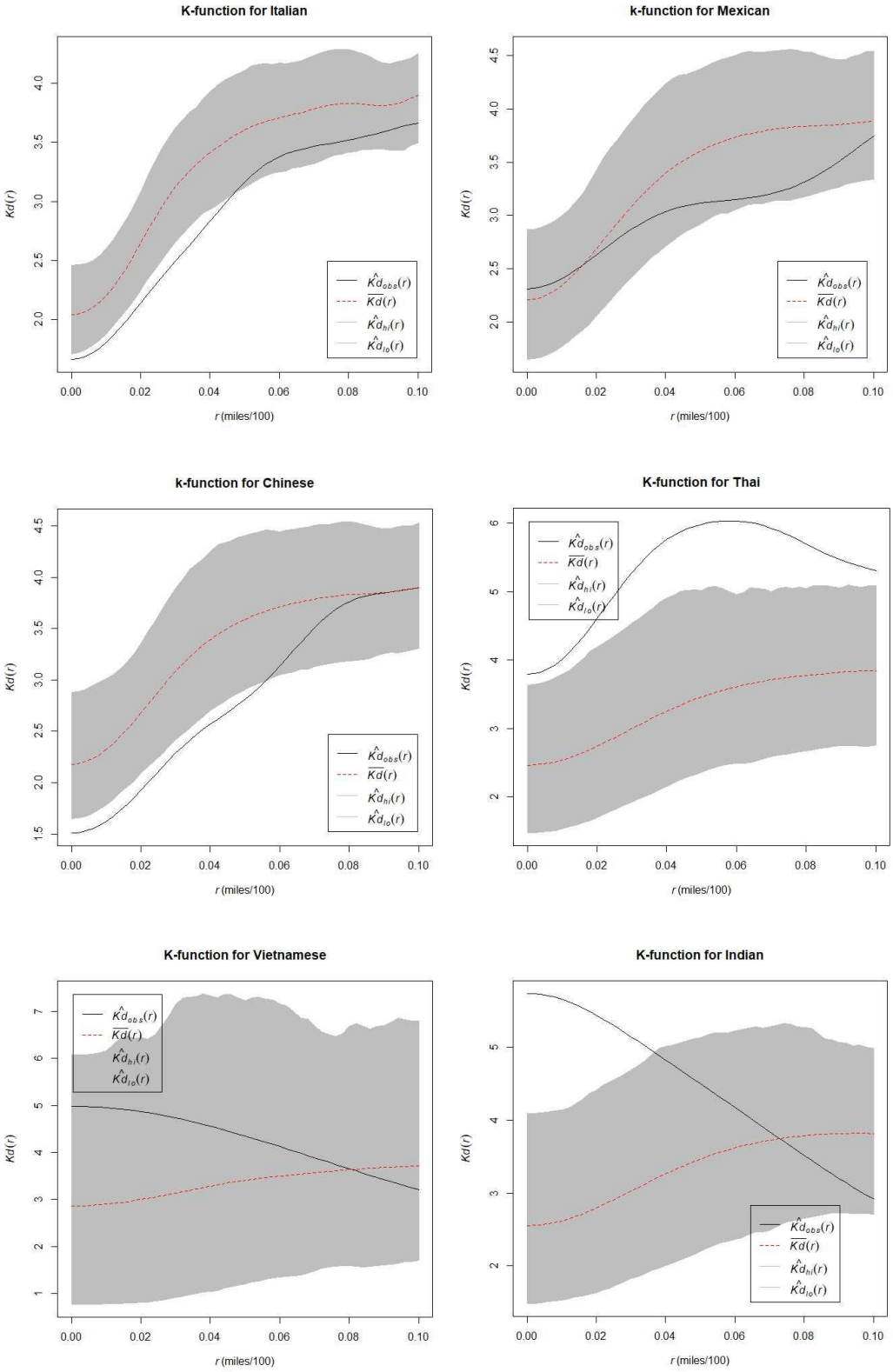

K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

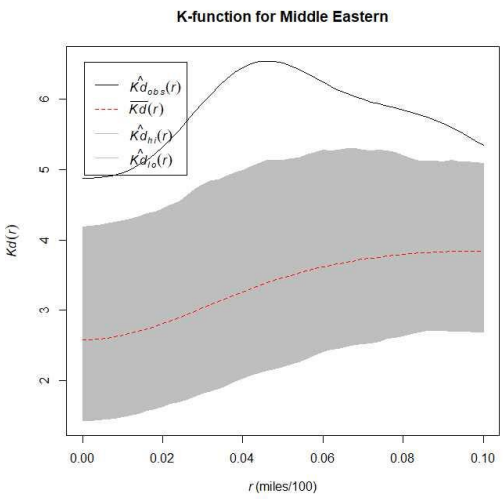

K-function for Korean
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

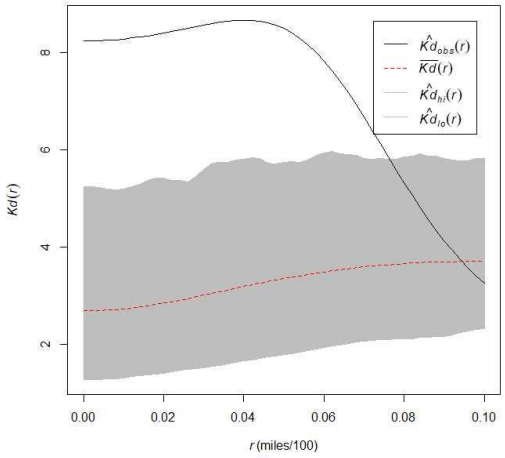

K-function for Japanese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

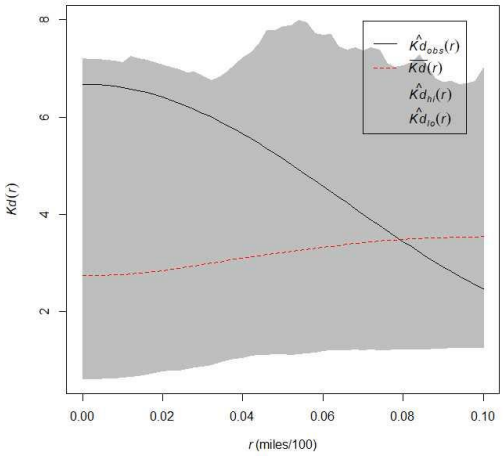

K-function for Greek
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

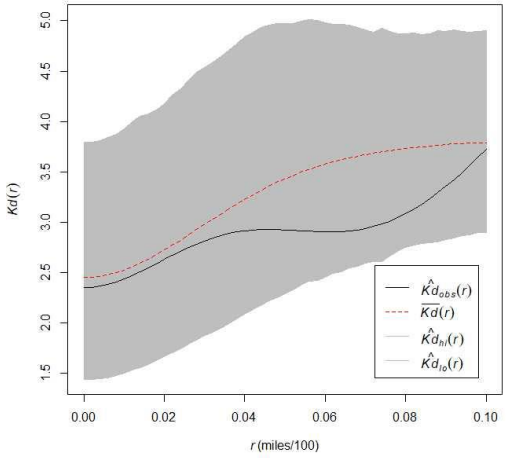
B.2.5 Pennsylvania

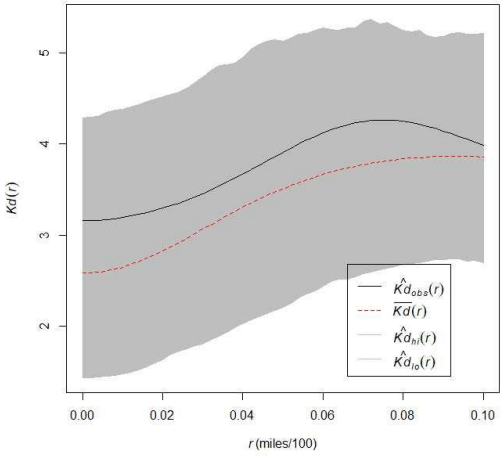



K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)


K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

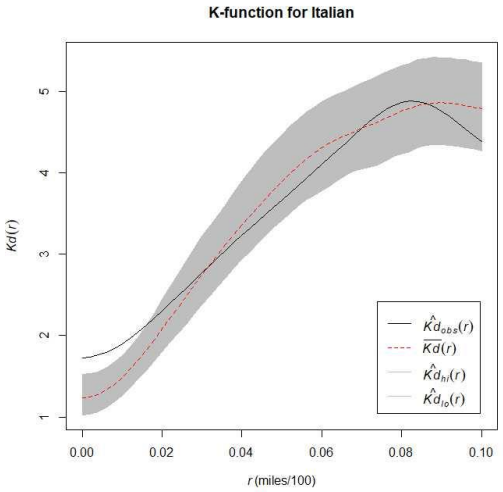

K-function for Korean
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

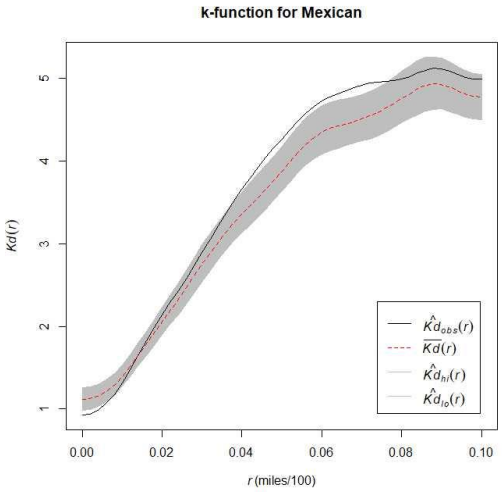

K-function for Japanese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

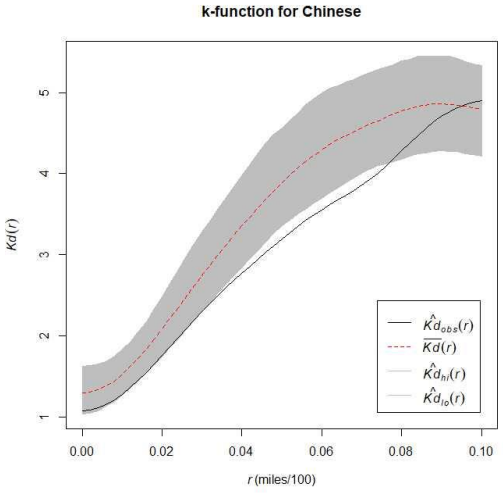

K-function for Greek
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

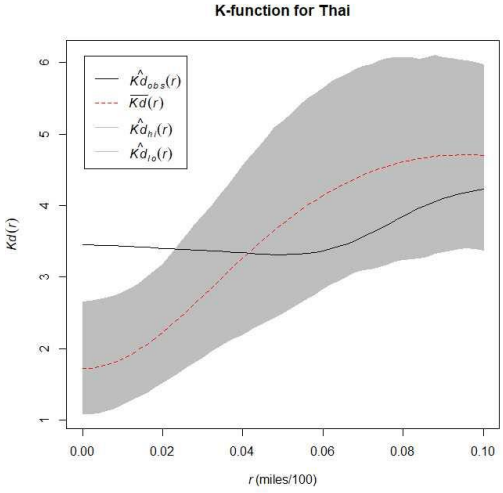
B.3. US cities that have more than 1000 restaurants in the sample

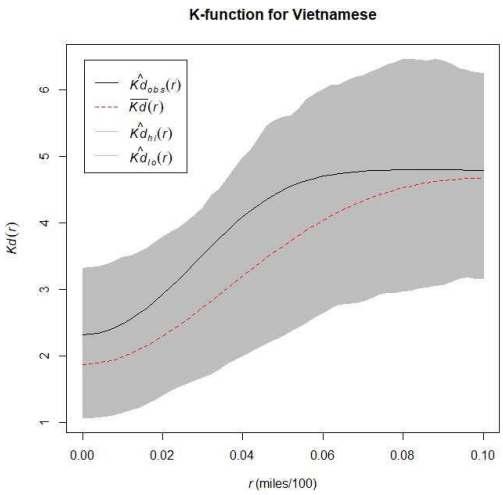
B.3.1 Phoenix

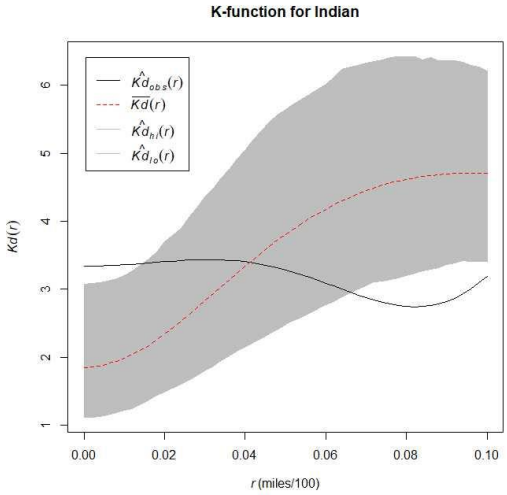


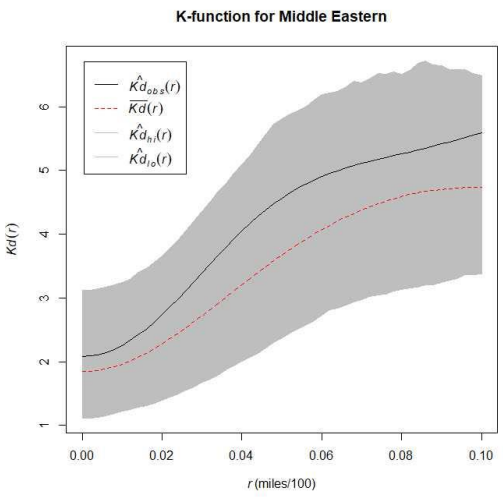


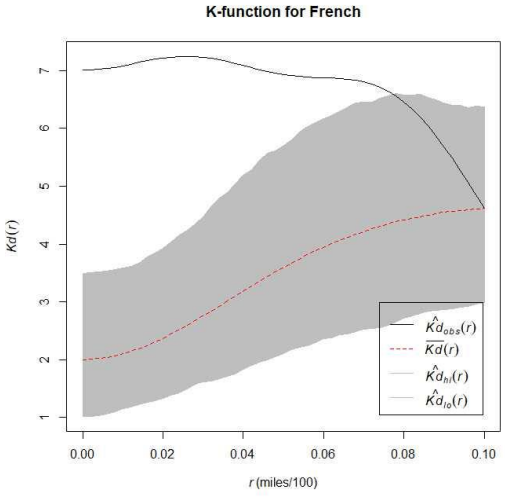


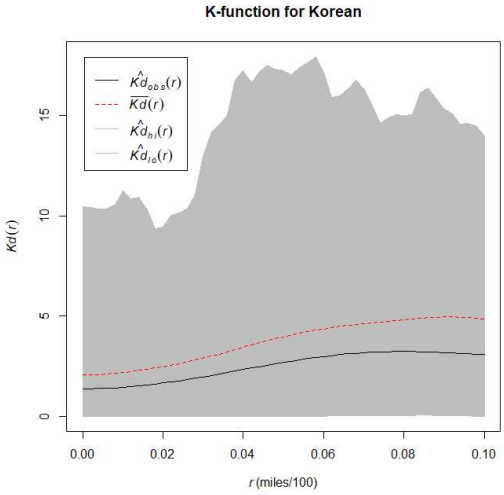


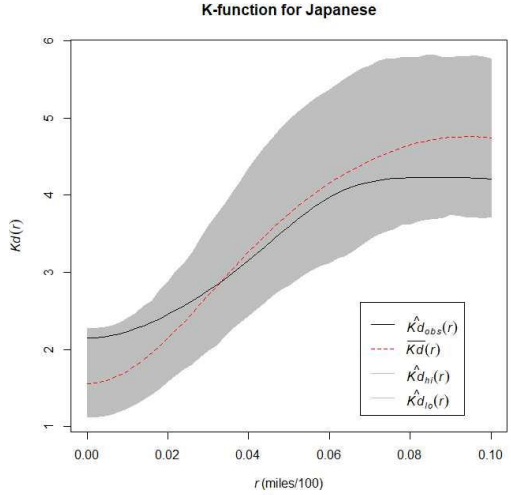


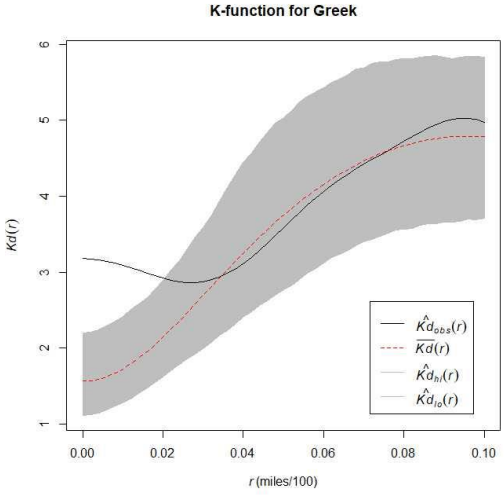



K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

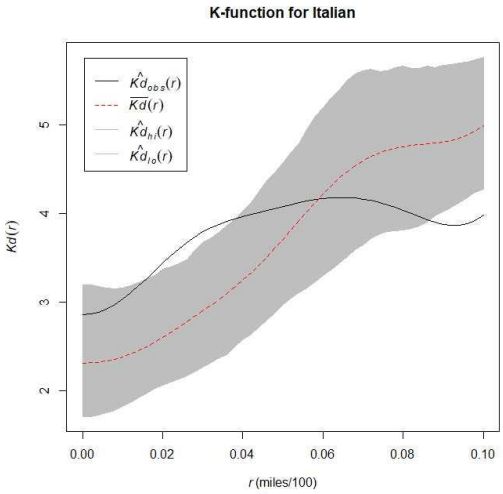

K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

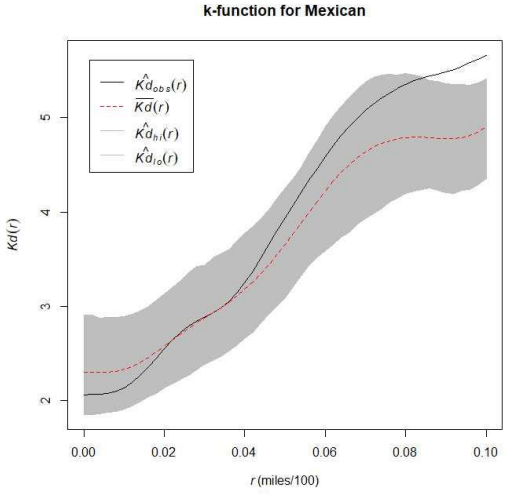

K-function for Korean
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

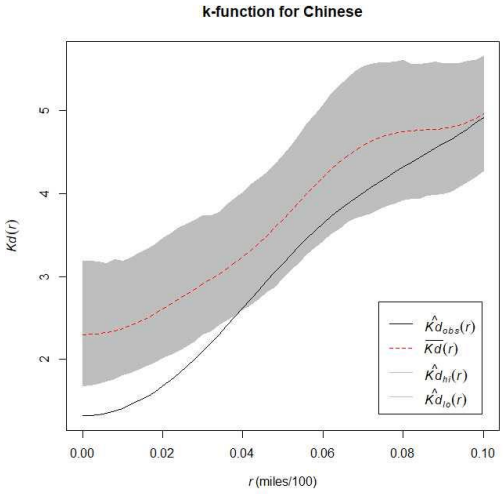

K-function for Japanese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

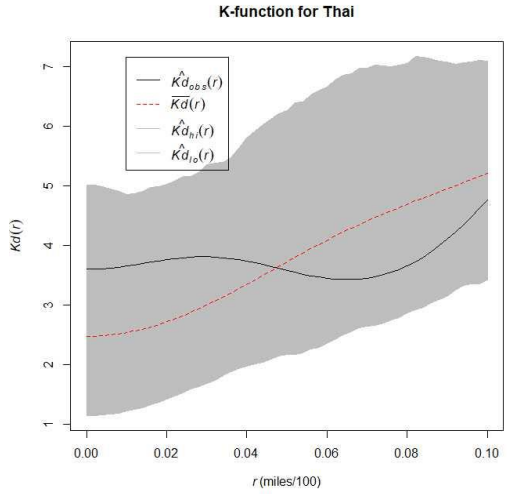

K-function for Greek
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

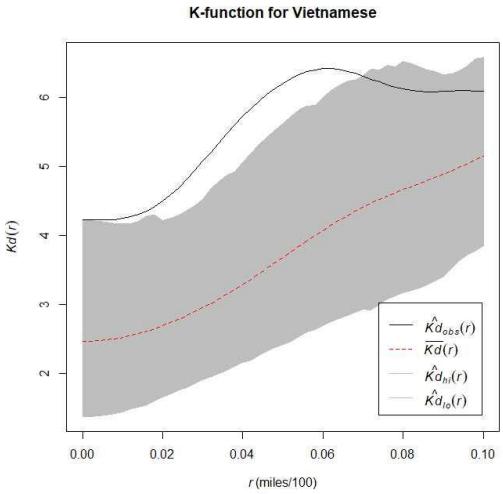
B.3.2 Charlottes

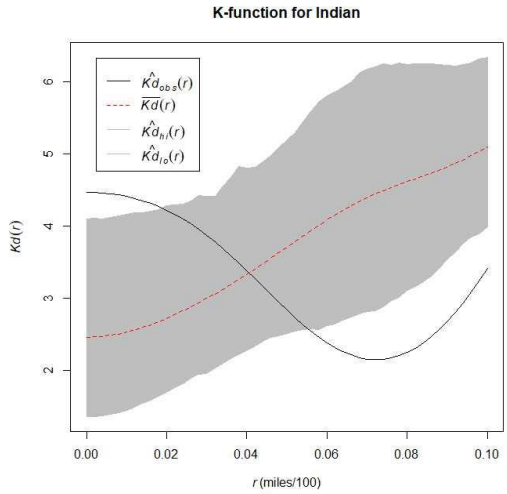


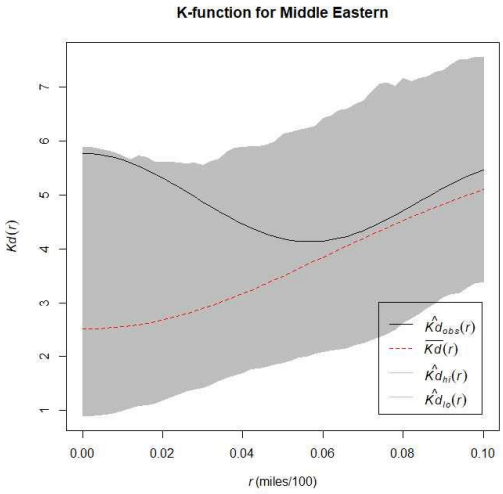


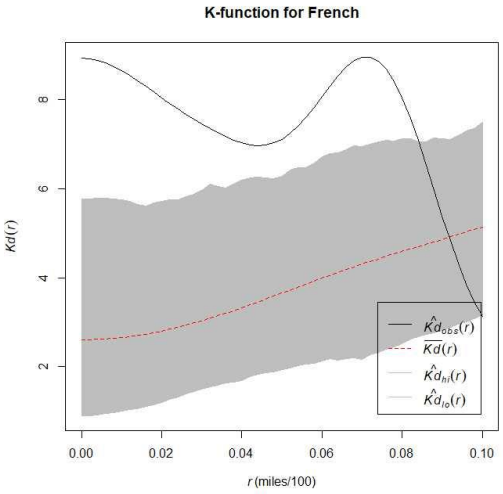


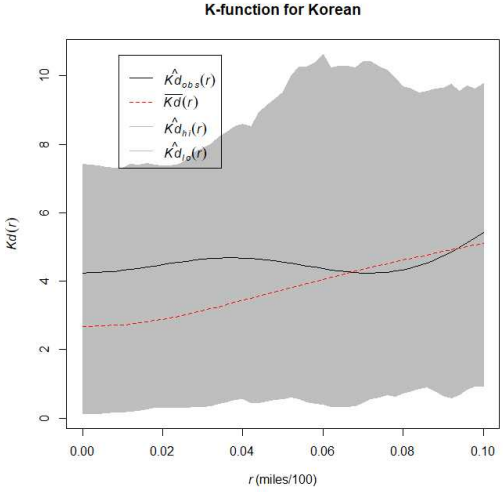


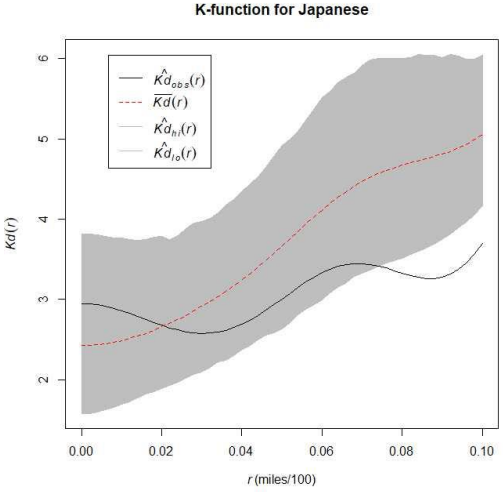


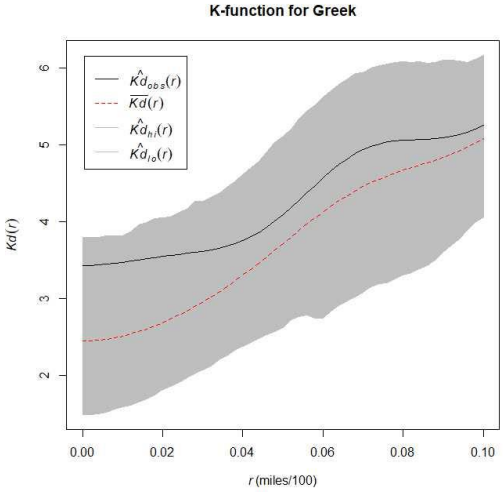



K-function for Middle Eastern
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

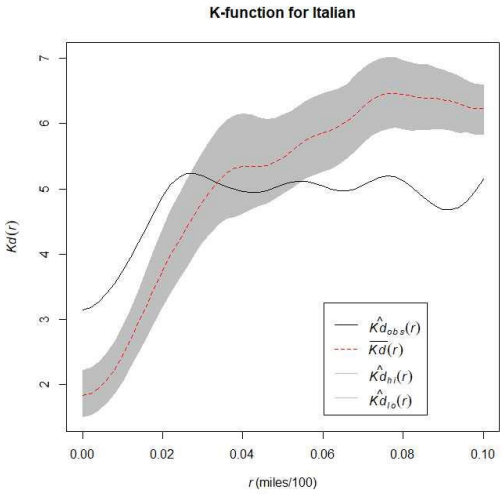

K-function for French
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

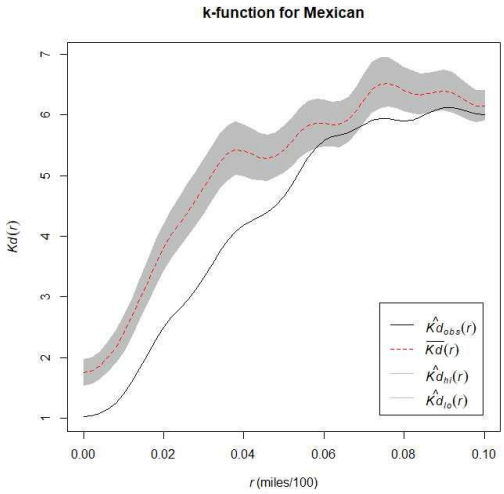

K-function for Korean
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

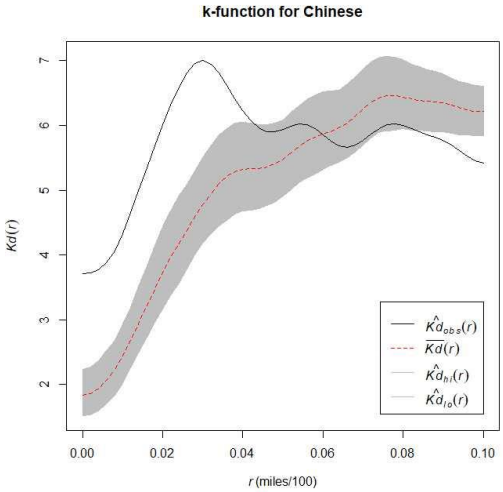

K-function for Japanese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

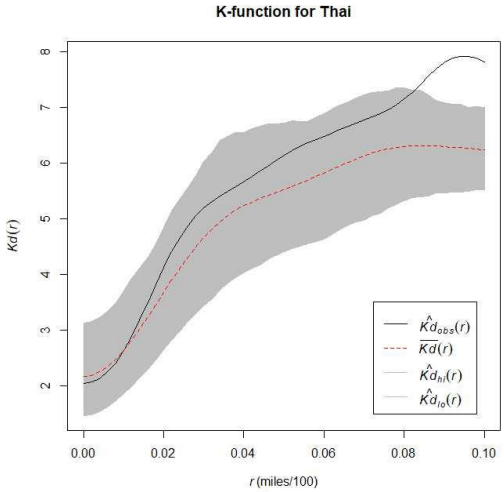

K-function for Greek
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

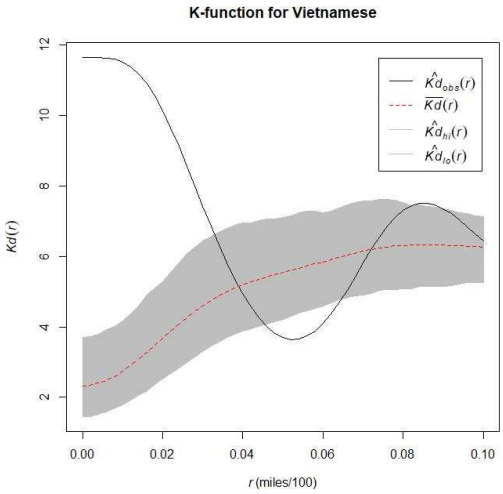
B.3.3 Las Vegas

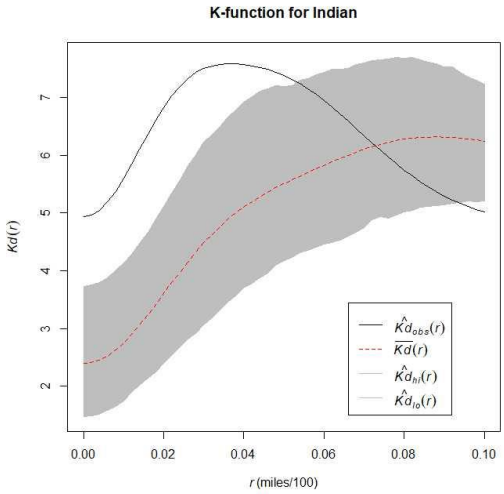


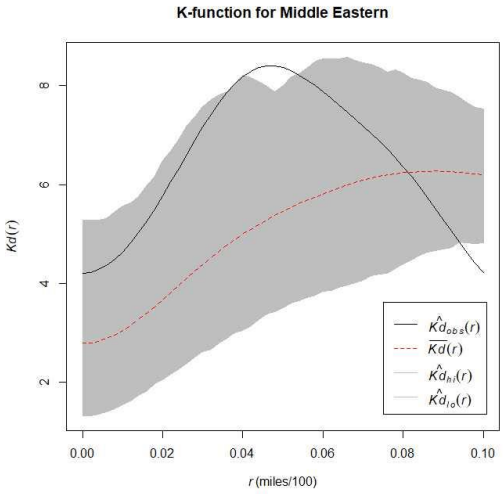


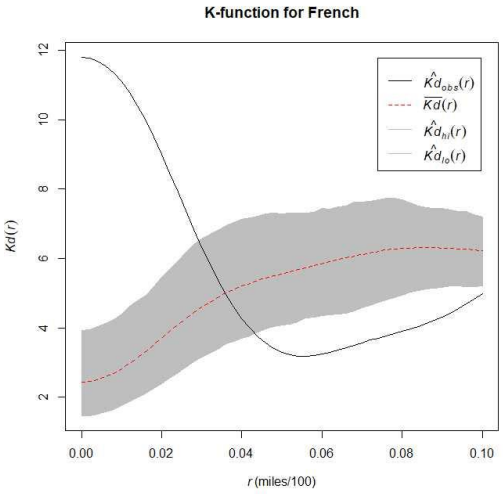


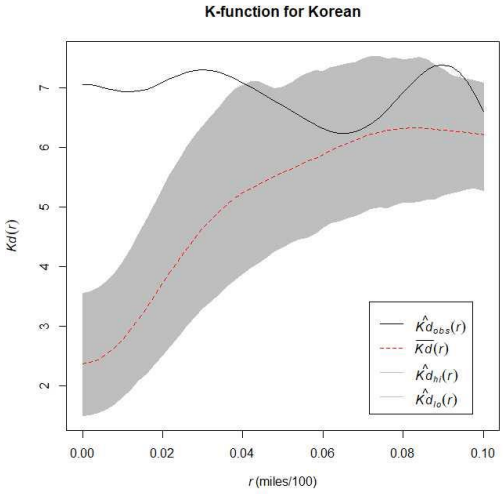


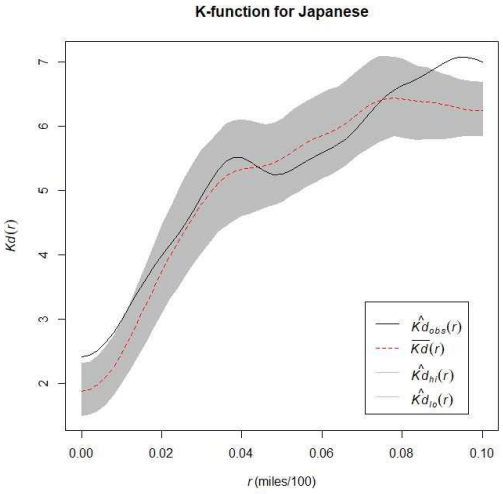


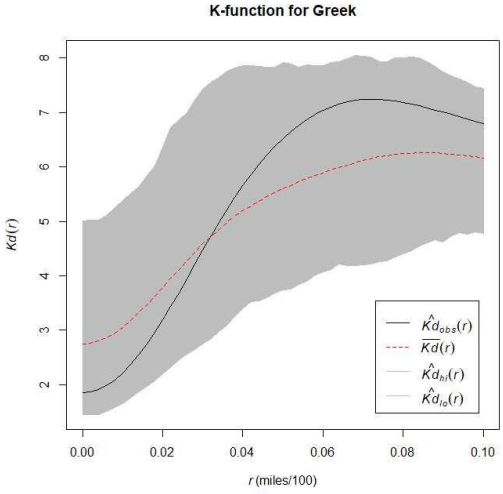



K-function for Middle Eastern
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

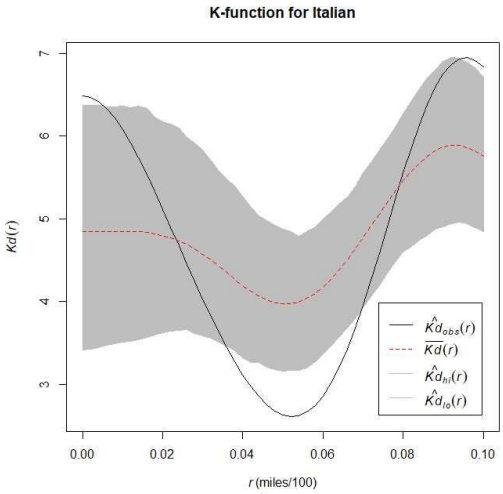

K-function for French
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

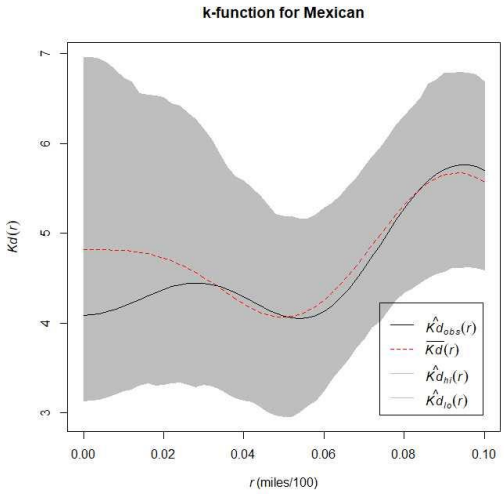

K-function for Korean
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

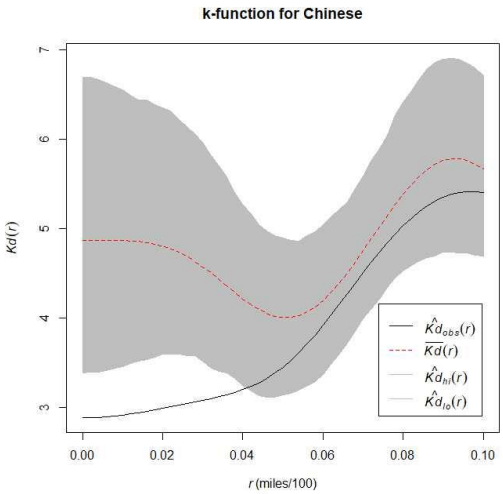

K-function for Japanese
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

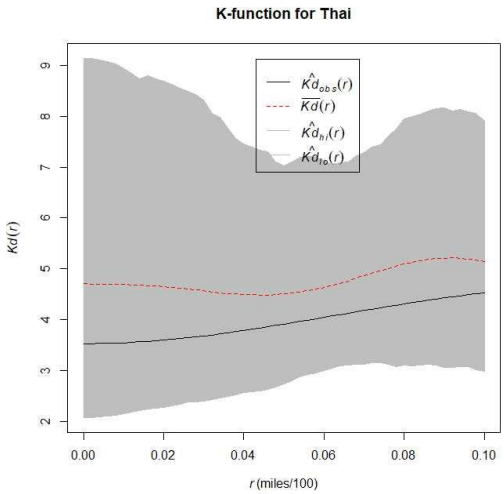

K-function for Greek
Kd(r)
r (miles/100)
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$

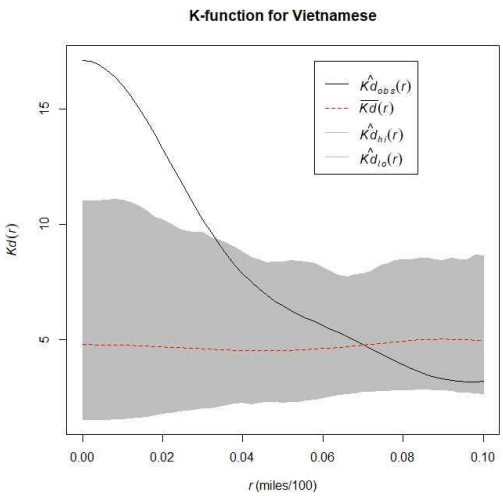
B.3.4 Cleveland

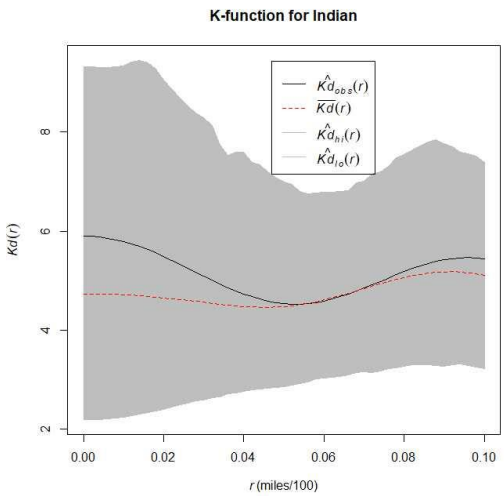


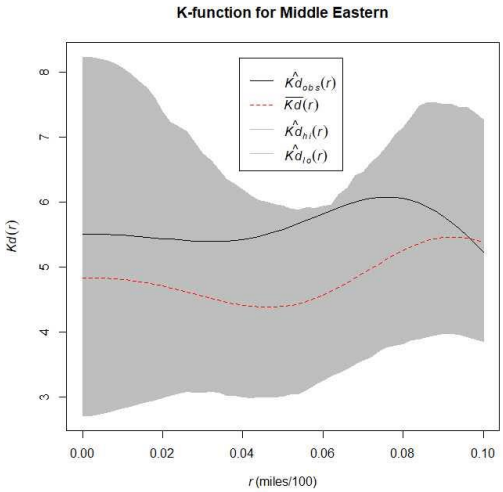


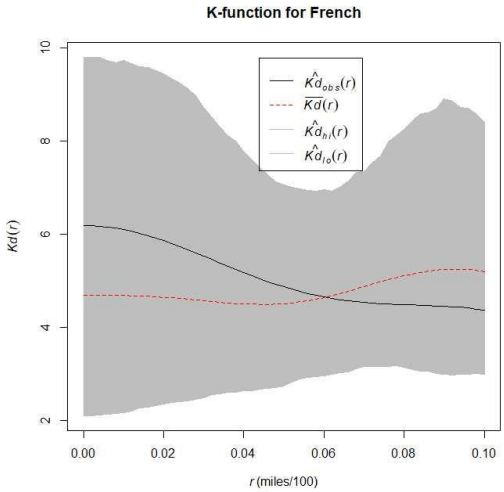


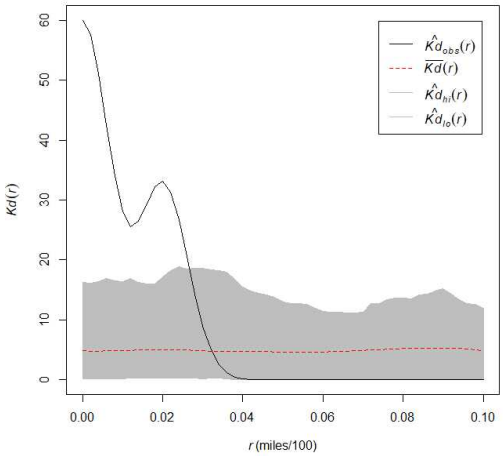


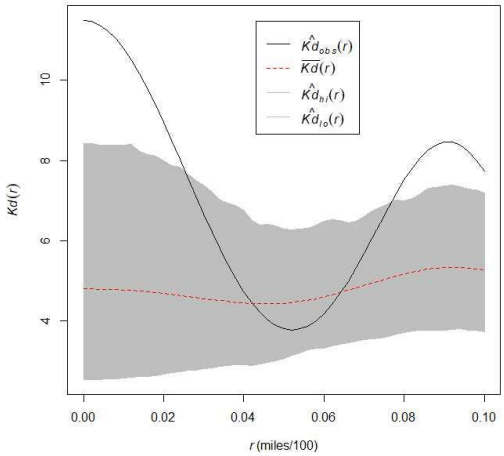


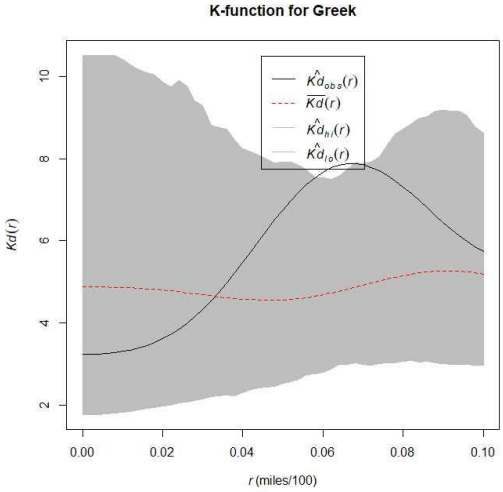



K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

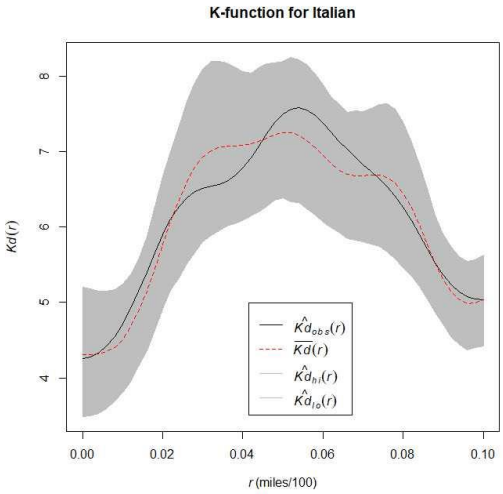

K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

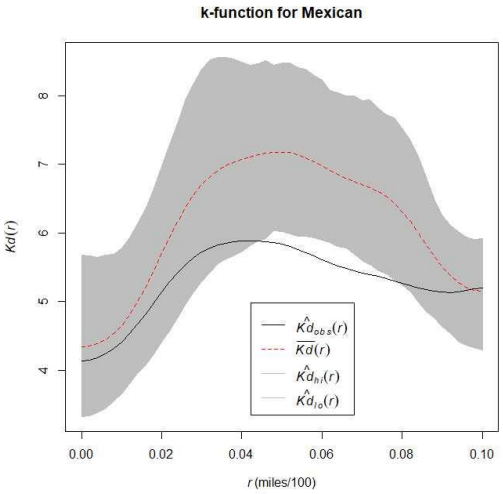

K-function for Korean
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

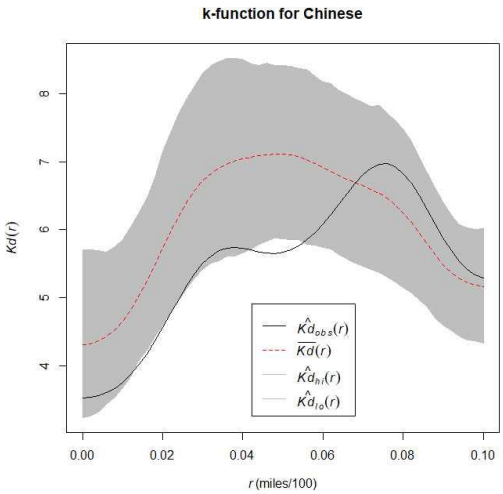

K-function for Japanese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

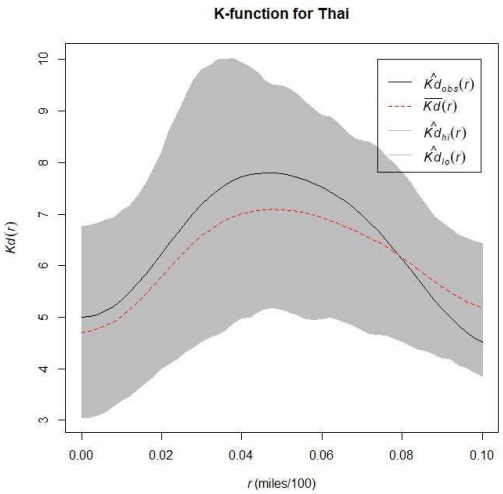

K-function for Greek
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)

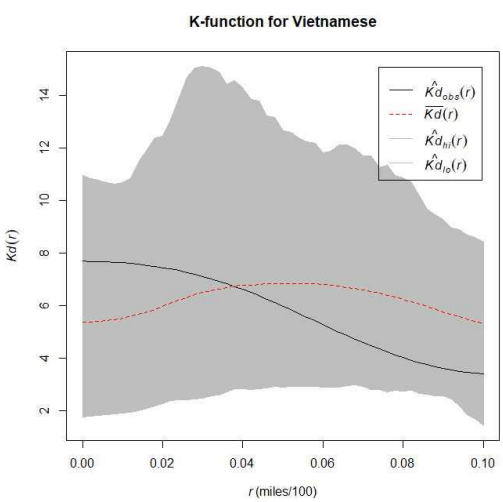
B.3.5 Pittsburg

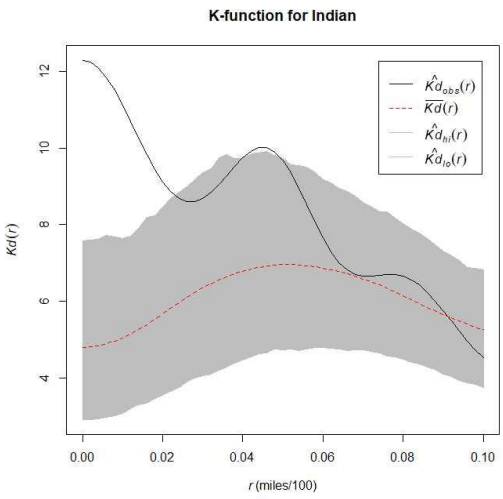


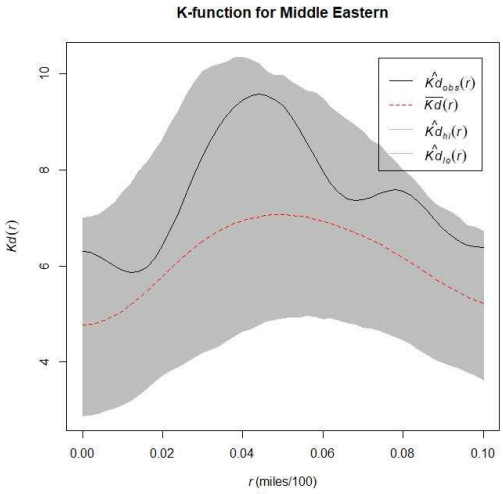


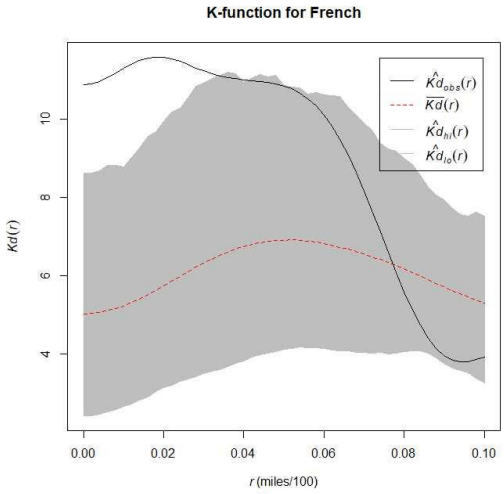


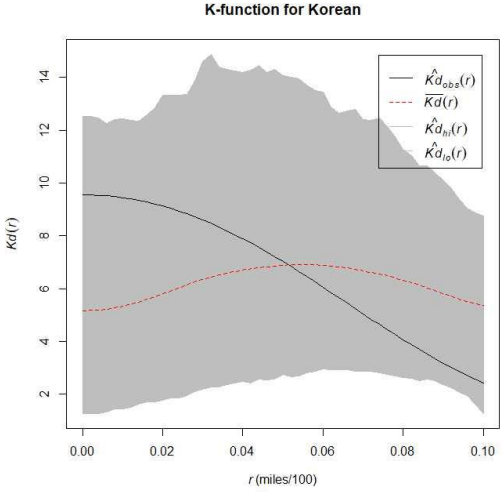


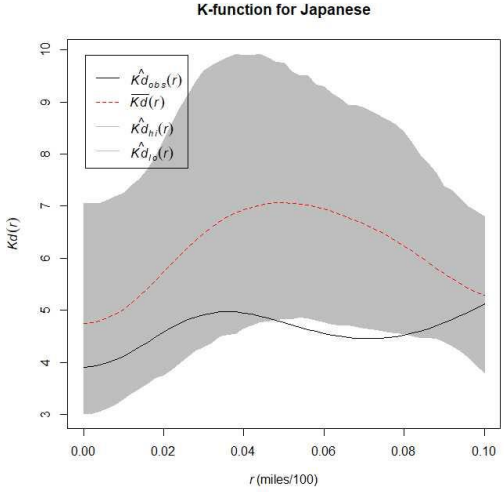





K-function for Middle Eastern
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)


K-function for French
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)


K-function for Korean
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)


K-function for Japanese
$\hat{Kd}_{obs}(r)$
$\overline{Kd}(r)$
$\hat{Kd}_{hi}(r)$
$\hat{Kd}_{lo}(r)$
Kd(r)
r (miles/100)