國土計劃
pISSN: 1226-7147, eISSN: 2383-9171
https://doi.org/10.17208/jkpa.2021.04.56.2.138
Journal of Korea Planning Association Vol.56, No.2 (2021)
대한국토·도시계획학회지 「국토계획」 제56권 제2호 pp.138-158

Big Data-Based Analysis of Characteristics of Consumption Sales by Region and Age*
: Focused on Seoul

Lee, Su-Bin** · Son, Su-Min*** · Kim, Sun-Jeong**** · Nam, Jin*****

Abstract

The purpose of this study is to empirically analyze the characteristics of sales distribution in Seoul in 2019 by region and age using big credit card data. Prior to the analysis, similar consumption spaces were noted in all age groups, but there were age groups such as 20s, 40s, and 60s that showed characteristic spaces. In the 20s age group, consumption was observed around university districts such as Hwayang-dong, Gayang 1-dong, and Seocho 3-dong, whereas in the 40s age group, consumption was observed in Daechi 1-dong and Yongsin-dong, which are specialized in education. Finally, in the 60s age group, consumption was confirmed in large hospitals and places where living facilities were concentrated, such as Sangil-dong, Sinjeong 7-dong, and Ihwa-dong. This demonstrated that there were differences in areas where consumption occurred by age. To clearly identify and classify the regional characteristics of consumption areas by age, the main components were analyzed to correct the variables, and then a cluster analysis was conducted. Consequently, seven groups were classified as administrative districts in Seoul. A closer look at the seven clusters revealed that the elderly, the higher was the expenditure of the financial/insurance/property and medical sectors, and the young, the higher was the expenditure of the tourism/entertainment/leisure/wear sector. This identified differences in the types of businesses consumed by age. Furthermore, the results of the current situation analysis show that regional characteristics affect age-specific sales differences. A combination of local sales and commercial areas has shown that differences in population guidance facilities and business types have a greater impact on age-specific consumption than on commercial regional distributions.

Keywords Regional Characteristics, Big Data, Card Sales, Consumption Behavior by Age, Regional Consumption
주제어 지역특성, 빅데이터, 카드 매출액, 연령별 소비행태, 지역 내 소비

Ⅰ. Introduction

1. Research Background and Purpose

As Korea is entering a period of sluggish economic development, consumption has a greater impact on the regional economy of Korea than does production. According to data from the National Statistical Office, the impact of consumption has increased continuously since 2009, when profit from industry was exceeded by profit from consumption.

* The present study was supported by the Ministry of Land, Infrastructure, and Transport/Korea Agency for Infrastructure Technology Advancement (Grant Number: 21TSRD-B151228-03).
** Master's Candidate, Department of Urban Planning & Design/ Department of Smart Cities, The University of Seoul (First Author: binyi9034@uos.ac.kr)
*** Master's Candidate, Department of Smart Cities, The University of Seoul (helen0282@uos.ac.kr)
**** Master's Candidate, Department of Smart Cities, The University of Seoul (suni0574@uos.ac.kr)
***** Professor, Department of Urban Planning & Design/Department of Smart Cities, The University of Seoul (Corresponding Author, jnam@uos.ac.kr)

Accordingly, the government has announced that the virtuous circle of income-consumption-economic revitalization to facilitate consumption within the regions will be one of the key methods of economic growth, and has promoted relevant policies. The realization of specific policies requires not only national policies but also customized strategies developed by individual municipal governments to increase consumption (KRIHS, 2017; Kang and Lee, 2018).

This requires thorough understanding of the spatial distribution of consumption in cities as well as the regional characteristics that cause differences in consumption. However, few studies have been conducted on interactions between consumption and urban spaces.

Previous studies based on life cycle theory have shown that the consumption behavior differs among stages of the life cycle. However, the differences have been interpreted by focusing only on typified consumption expenditure patterns, such as housing expenses and food expenses. In addition, because previous studies were mainly based on data acquired from surveys such as household budget survey and family status surveys, the spaces in which consumption occurs have not been studied sufficiently.

Data limitations of consumption studies may be supplemented by using the credit card big data, which has started to be utilized in recent studies. Credit card big data, collected through a computer system on a real-time basis when credit card transactions take place, is valuable data that can show the overall characteristics of consumption by the civilian sector in Korea (Yoo, 2018; Kim and Kim, 2019). The data rapidly reflect the actual consumption occurring in urban spaces, and include almost no errors with regard to the measurement positions.

The present study was conducted using credit card sale big data to investigate the spatial distribution of consumption and consumption behavior of different age groups in Seoul, and to typify the differences in the consumption depending on the regional characteristics through a cluster analysis to understand the regional characteristics. The results of the present study will provide basic data of current status examination to establish a plan for managing land use and density in each region and district according to the Basic Urban Plan and the Management Plan.

2. Research Method and Flow

The temporal range of the present study is the year 2019; the spatial range and analytical units include the 424 administrative dongs of Seoul. The data utilized in the study were credit card purchases big data from Hyundai Card, wherein the amount of purchases was estimated in consideration of the utilization of credit cards of other companies. The credit card sales data provide the sum of annual purchases with reference to the gender, age, day of the week, time and business category.

Figure 1 shows the flow of the present study. First, the theory and previous studies on consumption were reviewed to discuss the research flow and the methodologies of the previous studies, describing how the present study is different from previous studies. After that, credit card sales big data of 2019 were used to investigate the spatial distribution of the amount of purchases by age in the individual administrative dongs of Seoul. Based on the analytical results of the current status, a two-stage analysis was performed. First, a factor analysis was performed to remove from the regional characteristic variables affecting the consumption; these are variables that have a low importance and thus are not combined

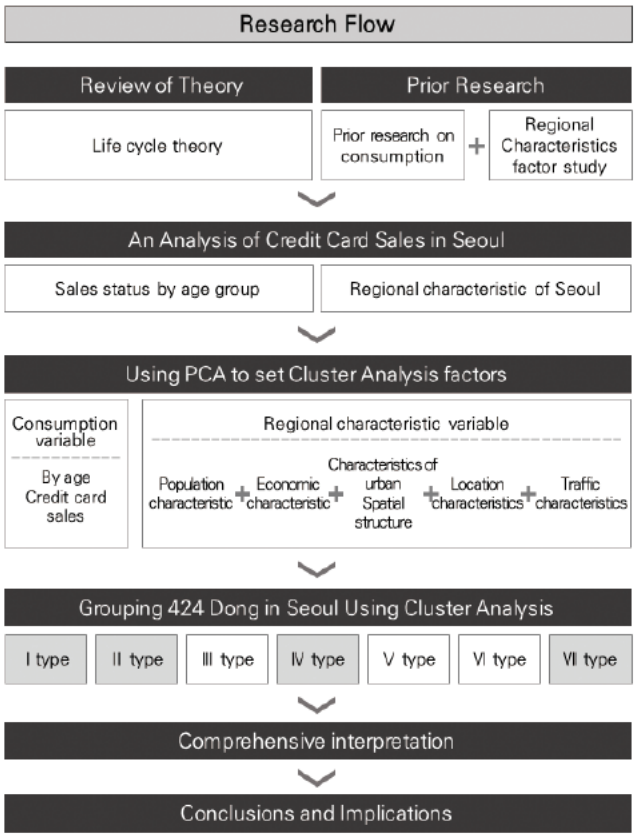

Figure 1. The flow chart of research

as a factor. In addition, principal component analysis was performed based on the eigenvalues and variances of the individual factors. Second, cluster analysis was performed with the extracted variables to typify the differences in the consumption consumption for each region, and the results were interpreted. Finally, using the conclusions of the present study, this article provides suggestions of urban policies related to consumption.

II. Review of Theory and Previous Studies

1. Review of Life Cycle Theory on Consumption

Life cycle refers to the stage-by-stage procedure of individuals, which changes along with the time flow; life cycle theory highlights the importance of recognizing and adapting to changes in each stage because the social and economic roles of individuals are dependent on the life cycle. The life cycle is divided into stages according to changes that occur in the lives of individuals or families, and the stages are generally associated not only with age, physical changes or psychological factors of individuals but also the social roles played by the individuals. Previous studies on life cycle theory have shown that the income of individuals may be dependent upon the stages in the life cycle of individuals.

The life cycle theory in the field of consumption, presented by F. Modigliani and A. Ando, is a consumption theory that suggests that people determine the currently appropriate consumption level in consideration of income throughout life. Individuals maintain a reasonable level of consumption to maximize the efficacy of consumption; the consumption expenditure is determined with reference to the resources available in life. This implies that consumption expenditure behavior of middle individuals, who have a relatively high income and thus save much, is different from that of youths and the elderly, who have relatively low income.

With the assumption that economic factors, such as the income and asset of individuals in each stage of the life cycle, change according to life cycle theory, and individuals show different consumption expenditure behaviors accordingly, the present study was conducted to investigate the regional characteristics that affect the consumption expenditure behavior of different age groups by using credit card sales big data.

2. Review of Previous Studies

As shown in Table 1, the previous studies related to the present study were reviewed from the two aspects. First, the previous studies on consumption were reviewed to analyze the differences in the credit card sales with regard to the characteristics of consumption expenditure, change of consumption patterns, and regional consumption structure. Second, the studies on regional characteristics were reviewed to set the variables related to the difference of the consumption among the regions, centered on the studies in which the regional types were classified and their characteristics were analyzed.

1) Previous Studies on Consumption

Consumption occurs in actual spaces and is directly connected with regional consumption. Since the enhancement of regional consumption may revitalize the overall regional economy without actively extending the basis for export, consumption is expected to be used as a method for revitalizing the regional economy. As the role of consumption increases, the government has prepared various policies to revitalize consumption, and there is an increasing need for study of the consumption characteristics of individual regions (Won and Chung, 2015; Kim and Seo, 2016; Kim and Yeom, 2017; Song and Park, 2017).

Kim and Yeom (2015) divided the entirety of South Korea into 7 regions, and analyzed the proportions of business categories in credit card sales in the individual regions. The results showed that Gangwon-do is focused on tourism and Jeju-do showed a high share in food and accomodations, indicating that business categories having large shares in consumption are different among regions. The Seoul Metropolitan Area accounted for more than 50% of credit card sales of the entire country.

Previous studies on consumption showed that consumption decreases from middle age to old age in a ∩-shaped curve (Kim and Kim, 2019). It was also found that eating-out and accomodations expenditures account for a higher portion in consumption by youths and the middle aged group, while food expenditures accounted for a higher portion in the consumption by the elderly (Sung, 2013; KIF, 2014; Hwang et al., 2015; HRI, 2017). These results show that the expenditure pattern is different among age groups, as

Table 1. Review of prior research

Classification	Researcher (year)	Research content
Prior research on consumption	Kim and Yeom (2017)	Proposal for continuous credit card statistics tracking survey as an auxiliary indicator for the selection and development of growth industries in the appropriate region and improvement of local government infrastructure
	Kim and Yeom (2015)	Confirmation through estimation that credit card statistics can be used for short-term prediction of real economic indicators and economic judgment
	Kim, S.J. and Kim, H.B. (2019)	Considering that the consumption expenditure of single-person households is stronger than that of multi-person households, the necessity of responding to the government's customized policies is mentioned
	Sung (2013)	For single-person households, comparing and analyzing different consumption expenditure patterns by age, identifying the characteristics of each type, mentioning the necessity of establishing appropriate welfare policies for each age
Regional characteristics factor study	Jang (2019)	Providing policy implications for preserving regional identity and industry diversity by identifying factors that affect the spread of gentrification-prone areas and industry diversity in Seoul
	Kim and Lee(2019)	Through multiple regression analysis, the factors that affect sales in alleys in Seoul are identified by dividing into commercial districts, hinterland areas, and spatial structure characteristics
	Kang and Lee (2011)	Identify the potential for improving urban creativity by examining the impact of regional characteristics of 25 autonomous districts in Seoul on urban creativity
	Kim and Yang (2013)	Identify regional characteristics that affect the inflow and outflow of population, and find out that business and workplace factors, qualitative level of cultural facilities, and expansion of transportation infrastructure affect population inflow factors

assumed by the life cycle consumption theory. This suggests that the differences of the consumption among the age groups should be considered in order to thoroughly understand the spatial distribution of consumption.

2) Studies on Regional Characteristics Factors

Since regions have multifaceted factors, the regional types should be defined more clearly to understand regional characteristics (Lee and Ji, 1998; Lee, 2002). Regional characteristics are generated by the accumulation of the changes in the activities by the residents caused by the differences of the planning factors, such as the regulation and management of land use, and the physical environment (Jang, 2019).

Kim and Lee (2019) conducted a study with local businesses that play important roles in the basic economic life of local residents to analyze the factors affecting the amount of sales, and identified that the factors are the economic level of the customers in the surrounding region and the large-scale distributors (Turan et al., 2013), which can increase the number of consumers by attracting customers. The results also showed that the amount of sales by the local businesses increased as they were distanced from a developed commercial area, suggesting that the analysis should include not only the internal characteristics of a commercial area, such as the population density and income level of the adjacent areas, but also the spatial characteristics of the surrounding region.

Kim and Yang (2013) analyzed the factors affecting the inflow and outflow of population, which are important to securing of independent financial sources of municipal governments, and found that the factors are changes in businesses, the conditions of local infrastructure, and access to mass transportation.

Kang and Lee (2011) analyzed the factors affecting urban creativity, the internal force to sustain local development, in terms of population, household, industry, economy, land and settlement environment, and reported that the number of medical centers per 10,000 population, the ratio of foreign residents, and the area of parks per person have a positive effect on the urban creativity, the medical centers having the highest impact.

Based on these previous studies, the present study was conducted with the regional characteristic factors of population, housing, industry, economy, land use, transportation, and customer attracting facilities, which were used in select-

ing the variables for analysis.

3) Differences from Previous Studies

As consumption plays an increasing role in the revitalization of overall regional economy, many studies have been conducted to investigate the characteristics of consumption in different regions. Most of the studies were conducted to investigate differences of the consumption behavior among the age groups based on the life cycle assumption and the difference of the portions of consumption items among the regions. In addition, the regional characteristics factors affecting the population inflow and outflow and urban creativity were analyzed to understand the multifaceted factors of regions. The revitalization of the overall regional economy requires studies on consumption in smaller units of the regions. However, such studies have not been conducted sufficiently.

The present study is different from the previous studies in that the regional characteristic variables that affect the amount of consumption were established in consideration of the consumption behavior of different age groups, and the regional characteristics that incur consumption were clearly typified through a cluster analysis of the variables. The credit card big data, used in the present study, are a highly useful consumption variable in modern society, which is seeking a cash-free nature, and enable the researchers to accurately investigate the consumption characteristics in different regions and business categories. The present study is different from previous studies in that the present study is an empirical study conducted by using the credit card big data, which provide comprehensive information about consumption status of individual regions.

Ⅲ. Analysis of Consumption Status

1. Description of Credit Card Sales Data

This study was conducted using the credit card sales big data of Hyundai Card, provided by SKT. The data include annual amount of purchases with reference to different genders, 10-year age groups, days of the week, time slots, and business categories in the Seoul Metropolitan Area in 2019, estimated in consideration of the utilization of the credit cards of other companies. The data consist of 30,315,084 cells and show the sales status according to the reference date, sub-regional code, large/medium/small business category, day of the week, and time slots. According to the purpose of the study, the data for the time slots were integrated with the data for one day, and the total amount of yearly sales from each region was converted to the amount of the daily sales.

The present study was conducted by using the data according to the age groups, days of the week and the business categories. For the sake of analytical convenience, the data were arranged in the units of the 424 administrative dongs of Seoul. With regard to the business category, the business category classification by the credit card company, which is closely related to the actual business categories of the private businesses, was applied instead of the standard business category classification provided by the National Statistical Office. The conventional business category codes, including 28 large categories and 198 medium categories, were rearranged to 18 business types, including eating-out, life service, education, manufacturing, accomodations, healthcare, and general merchandise, in consideration of the proportions of the business categories in the amount of sales. After confirming that all of these business types are classified as service industry, the business types were used as the business category classification in the present study.

The business categories of the highest sales identified for the weekdays and the weekends were hospital and miscellaneous sales industry, respectively. The top 3 administrative dongs in the weekday sales were Yeoksam 1-dong (13.54%), Daechi 4-dong (4.29%) and Sajik 4-dong (3.50%), and the top 3 administrative dongs in weekend sales were Yeoksam 1-dong (9.26%), Mok 1-dong (3.58%) and Sogong-dong (3.05%). This means that the consumption behavior is different between weekdays and weekends, and thus the data should analyzed separately. Therefore, the present study was conducted with the weekday data.

The data for January and February 2019 were excluded from the analysis because of the absence of sub-regional codes that happened in the early data collection stage. In addition, the amount of purchases by the teenage group was not included in the calculation of the total amount of purchases, because credit cards are not issued to youths in their teens and thus the data for teens is hardly considered as data purely from teens.

2. Consumption Sales Status in Seoul

1) Status in Entire Seoul

(1) Consumption Sales Status by Age Group

According to the amount of purchases by the age groups in Seoul, purchases by those in their forties were 33.8 trillion KRW (29.86%), the highest share, followed by those in their thirties (31.8 trillion KRW, 27.68%), fifties (24.7 trillion KRW, 21.86%), sixties (11.7 trillion KRW, 10.35%) and twenties (11.6 trillion KRW, 10.25%).

(2) Consumption Sales Distribution in Administrative Zones (Gu)

The amount of purchases by all age groups in the 25 administrative zones (gu) in Seoul was analyzed. The total amount of purchases was 113.9 trillion KRW. The top 4 administrative zones were Gangnam-gu (34.6 trillion KRW, 30.5%), Jung-gu (9.2 trillion KRW, 8.14%), Seocho-gu (8.8 trillion KRW, 7.84%) and Jongro-gu (7.3 trillion KRW, 6.48%), accounting for 53% of the total amount of purchases in Seoul. It was noted that 7 administrative zones out of the top 10 list were south of the Han River, indicating that consumption in specific regions has a large share in the total amount of purchases in Seoul.

(3) Characteristics of Administrative Dongs ranked in the top 10% in Sales

Among the 424 administrative dongs in Seoul, the administrative dongs ranked in the top 10% in sales account for 61.79% of the total amount of sales in Seoul. Therefore, the regional characteristics of the administrative dongs were investigated (see Figure 2 and Table 2).

The amount of sales was highest in Yeoksam 1-dong (13.54%), followed by Daechi 4-dong (4.29%) and Sajik 4-dong (3.50%), Sogong-dong (3.05%), Gonghang-dong (2.66%), Sinsa-dong (1.97%), Jongno 1, 2, 3, 4ga-dong (1.95%), Mok 1-dong (1.82%), Hoehyeon-dong (1.81%), and Myeong-dong (1.79%). In Yeoksam 1-dong, the amount of sales was highest in the general merchandise among the business categories. The commercial areas are around subway stations, such as Gangnam Station, Yeoksam Station, Seonreung Station and Seonjeongreung Station, where there are large-scale customer facilities including CGV, Megabox, Le Merdian Seoul, and the Gangnam Cha Medical Center.

The analysis showed that administrative dongs ranked in the top 10% in sales included at least 3 subway stations of different subway lines or double or triple subway station spheres or commercial areas with a complex transfer center,

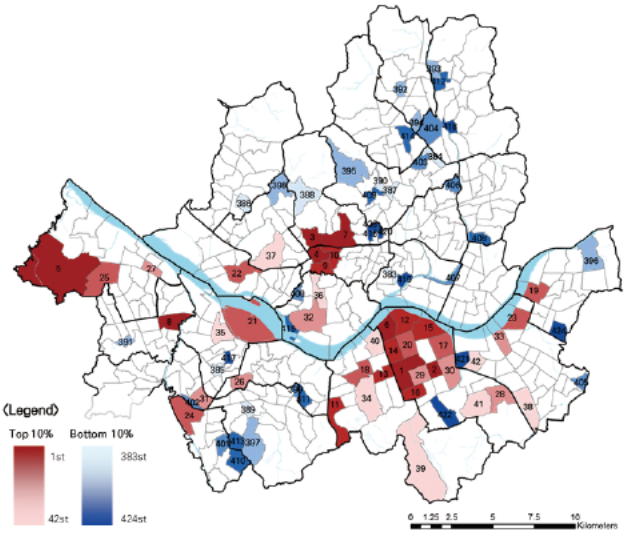

Figure 2. The present situation of the top 10% card sales area in Seoul

Table 2. Region where the top 10% card sales have occurred

Ranking	Dong name	Ranking	Dong name
1	Yeoksam 1-dong	22	Seogyo-dong
2	Daechi 4-dong	23	Pungnap 2-dong
3	Sajik-dong	24	Gasan-dong
4	Sogong-dong	25	Balsan-dong
5	Gonghang-dong	26	Sindaebang 2-dong
6	Sinsa-dong_ Gangnam-gu	27	Deungchon 1-dong
7	Jongno 1,2,3,4ga-dong	28	Suseo-dong
8	Mok-dong	29	Yeoksam 2-dong
9	Hoehyeon-dong	30	Daechi 2-dong
10	Myeong-dong	31	Guro 3-dong
11	Bangbae-dong	32	Hangangno-dong
12	Apgujeong-dong	33	Jamsil 6-dong
13	Seocho 4-dong	34	Seocho 3-dong
14	Nonhyeon 1-dong	35	Yeongdeungpo-dong
15	Cheongdam-dong	36	Namyeong-dong
16	Dogok 1-dong	37	Shinchon-dong
17	Samsung 1-dong	38	Munjeong 2-dong
18	Banpo 4-dong	39	Yangjae 2-dong
19	Cheonho 2-dong	40	Jamwon-dong
20	Nonhyeon 2-dong	41	Ilwonbon-dong
21	Yeouido-dong	42	Jamsilbon-dong

such as a bus terminal, where there are large complex facilities including department stores and hotels. In addition, the amount of sales is high in areas where specialized industrial and business facilities are concentrated.

Considering these characteristics, the analysis showed that amounts of sales are high in regions that play roles of central places in Seoul, where transportation facilities and commercial and business areas are concentrated.

(4) Characteristics of Administrative Dongs Ranked Bottom 10% in Sales

Among the 424 administrative dongs in Seoul, the amount of sales is lowest in Dunchon 1-dong, where there is no consumption area due to a reconstruction project. Most of the administrative dongs ranked in the bottom 10% in sales were regions where urban renewal projects including redevelopment and reconstruction projects were being carried out, like Dunchon 1-dong, or residential areas with small houses in hilly areas where there are extensive green areas without large shops (see Figure 2 and Table 3).

Table 3. Region where the bottom 10% card sales have occurred

Ranking	Dong name	Ranking	Dong name
383	Kumho 1-ga-dong	404	Wolgye 2-dong
384	Jangwi 3-dong	405	Macheon 1-dong
385	Singil 5-dong	406	Yimun 2-dong
386	Eungam 2-dong	407	Songjeong-dong
387	Donam 1-dong	408	Myeonmok 4-dong
388	Buam-dong	409	Donam 2-dong
389	Sinwon-dong	410	Shiheung-dong
390	Jeongneung 1-dong	411	Sadang-dong
391	Sinwol 6-dong	412	Sanggye 10-dong
392	Ssangmun 4-dong	413	Nanhyang-dong
393	Sanggye 8-dong	414	Bun 2-dong
394	Chang 3-dong	415	Ichon 2-dong
395	Jeongneung 3-dong	416	Changshin 2-dong
396	Godeok 2-dong	417	Singil 4-dong
397	Samseong-dong	418	Hagye 2-dong
398	Hong Eun 1-dong	419	Eungbong-dong
399	Cheongrim-dong	420	Sungin 1-dong
400	Hyochang-dong	421	Jamsil 7-dong
401	Siheung 4-dong	422	Gaepo 1-dong
402	Garibong-dong	423	Changshin 3-dong
403	Jangwi 1-dong	424	Dunchon 1-dong

2) Consumption Sales Status in Seoul by Age Group

With regard to the spatial background of Seoul, the amounts of purchases by age groups in the administrative dongs ranked in the top 10% were analyzed in the analytical period of 2019.

The total amount of purchases by those in their twenties was 11.6 trillion KRW; the sum of purchases in the administrative dongs ranked in the top 10% in purchases was 7 trillion KRW (66.3%). According to Figure 3 and Table 4, the top 3 administrative dongs are Yeoksam 1-dong (11.1%), Sogong-dong (4.08%) and Sinsa-dong (3.48%), and the proportion of Yeoksam 1-dong is outstanding. The administrative dongs that were ranked in the top 10% only in the amount of purchases by those in their twenties are Hwayang-dong (0.66%), Gayang 1-dong (0.53%) and Seocho 3-dong (0.48%), wherein all the three dongs include many commercial facilities located around universities, such as KonKuk University, Ewha Womans University Medical School and Seoul National University of Education. Gayang 1-dong was located in a semi-industrial district with many education and research facilities. The analysis of the amount of purchases in the three dongs by business category showed that eating-out was the business category that recorded the highest sales in all three dongs. This indicates that all three dongs reflected consumption behavior of people in their twenties, focused on consumption of food and beverages around universities.

Next, the total amount of purchases by those in their thirties was 31.8 trillion KRW, and the sum of purchases in the

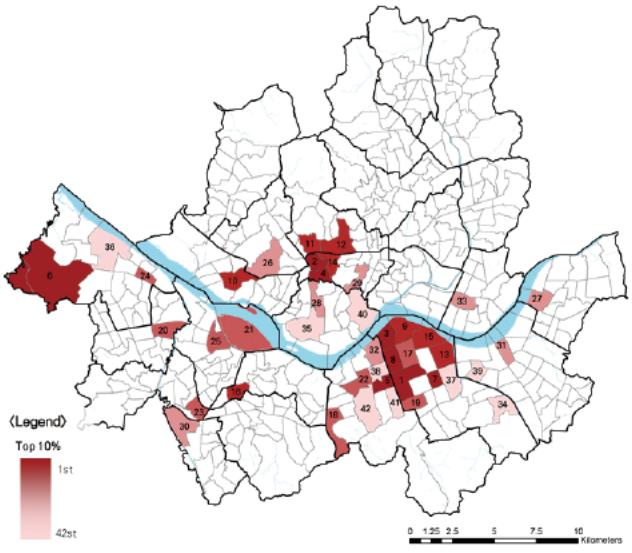

Figure 3. The present situation of 20s consumption area

Table 4. Region where 20s consumption have occurred

Ranking	Dong name	Ranking	Dong name
1	Yeoksam 1-dong	22	Banpo 4-dong
2	Sogong-dong	23	Guro 3-dong
3	Sinsa-dong_ Gangnam-gu	24	Deungchon 1-dong
4	Hoehyeon-dong	25	Yeongdeungpo-dong
5	Seocho 4-dong	26	Shinchon-dong
6	Gonghang-dong	27	Cheonho 2-dong
7	Daechi 4-dong	28	Namyeong-dong
8	Nonhyeon 1-dong	29	Jangchung-dong
9	Apgujeong-dong	30	Gasan-dong
10	Seogyo-dong	31	Jamsil 6-dong
11	Sajik-dong	32	Jamwon-dong
12	Jongno 1,2,3,4ga-dong	33	Hwayang-dong
13	Samsung 1-dong	34	Suseo-dong
14	Myeong-dong	35	Hangangno-dong
15	Cheongdam-dong	36	Gayang 1-dong
16	Sindaebang 2-dong	37	Daechi 2-dong
17	Nonhyeon 2-dong	38	Banpo 1-dong
18	Bangbae-dong	39	Jamsilbon-dong
19	Dogok 1-dong	40	Hannam-dong
20	Mok-dong	41	Seocho 2-dong
21	Yeouido-dong	42	Seocho 3-dong

administrative dongs ranked in the top 10% of purchases was 20.5 trillion KRW (65.5%). The amount of purchases by those in their thirties was 2.7 times more than the amount of purchases by those in their twenties. As shown in Figure 4 and Table 5, the top 3 administrative dongs are Yeoksam 1-dong (14.69%), Sogong-dong (4.26%) and Gonghang-dong (3.36%), and there was no administrative dong that was ranked in the top 10% only in the amount of purchases by those in their thirties.

The total amount of purchases by those in their forties was 33.8 trillion KRW, and the sum of the purchases in the administrative dongs ranked in the top 10% in sales was 21.3 trillion KRW (63%). As shown in Figure 5 and Table 6, the top 3 administrative dongs are Yeoksam 1-dong (15.8%), Daechi 4-dong (4.36%) and Sajik-dong (3.40%), and the administrative dongs that were ranked in the top 10% only in the amount of purchases by those in their forties are Daechi 1-dong (0.45%) and Yongsin-dong (0.44%). Daechi

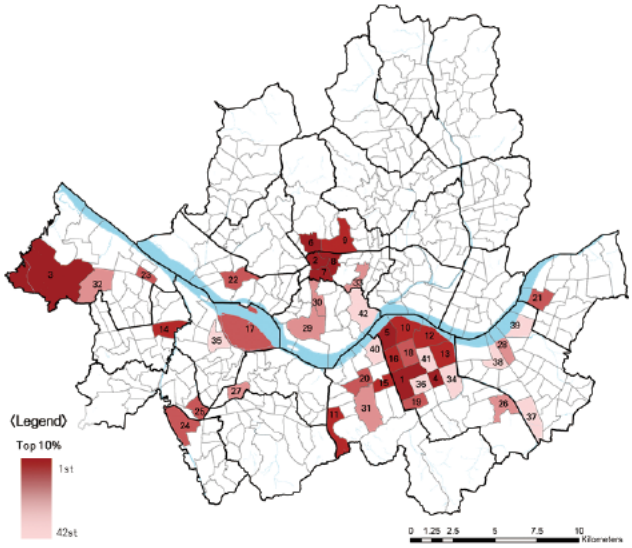

Figure 4. The present situation of 30s consumption area

Table 5. Region where 30s consumption have occurred

Ranking	Dong name	Ranking	Dong name
1	Yeoksam 1-dong	22	Seogyo-dong
2	Sogong-dong	23	Deungchon 1-dong
3	Gonghang-dong	24	Gasan-dong
4	Daechi 4-dong	25	Guro 3-dong
5	Sinsa-dong_ Gangnam-gu	26	Suseo-dong
6	Sajik-dong	27	Sindaebang 2-dong
7	Hoehyeon-dong	28	Jamsil 6-dong
8	Myeong-dong	29	Hangangno-dong
9	Jongno 1,2,3,4ga-dong	30	Namyeong-dong
10	Apgujeong-dong	31	Seocho 3-dong
11	Bangbae-dong	32	Balsan-dong
12	Cheongdam-dong	33	Jangchung-dong
13	Samsung 1-dong	34	Daechi 2-dong
14	Mok-dong	35	Yeongdeungpo-dong
15	Seocho 4-dong	36	Yeoksam 2-dong
16	Nonhyeon 1-dong	37	Munjeong 2-dong
17	Yeouido-dong	38	Jamsil 3-dong
18	Nonhyeon 2-dong	39	Pungnap 2-dong
19	Dogok 1-dong	40	Jamwon-dong
20	Banpo 4-dong	41	Samsung 2-dong
21	Cheonho 2-dong	42	Hannam-dong

1-dong includes Dachi Elementary School, Daecheong Middle School, Dan-kook High School; Yongshin-dong includes Yongdu Elementary School, Daegwang Middle School and

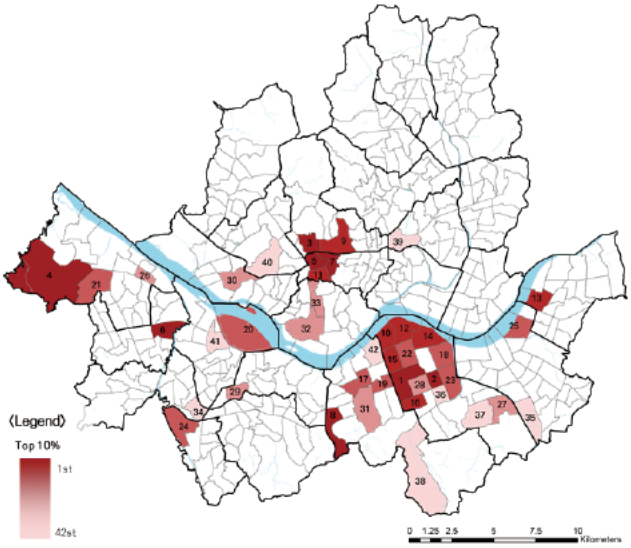

Figure 5. The present situation of 40s consumption area

Table 6. Region where 40s consumption have occurred

Ranking	Dong name	Ranking	Dong name
1	Yeoksam 1-dong	22	Nonhyeon 2-dong
2	Daechi 4-dong	23	Daechi 2-dong
3	Sajik-dong	24	Gasan-dong
4	Gonghang-dong	25	Pungnap 2-dong
5	Sogong-dong	26	Deungchon 1-dong
6	Mok-dong	27	Suseo-dong
7	Myeong-dong	28	Yeoksam 2-dong
8	Bangbae-dong	29	Sindaebang 2-dong
9	Jongno 1,2,3,4ga-dong	30	Seogyo-dong
10	Sinsa-dong_ Gangnam-gu	31	Seocho 3-dong
11	Hoehyeon-dong	32	Hangangno-dong
12	Apgujeong-dong	33	Namyeong-dong
13	Cheonho 2-dong	34	Guro 3-dong
14	Cheongdam-dong	35	Munjeong 2-dong
15	Nonhyeon 1-dong	36	Daechi 1-dong
16	Dogok 1-dong	37	Ilwonbon-dong
17	Banpo 4-dong	38	Yangjae 2-dong
18	Samsung 1-dong	39	Yongsin-dong
19	Seocho 4-dong	40	Shinchon-dong
20	Yeouido-dong	41	Yeongdeungpo-dong
21	Balsan-dong	42	Jamwon-dong

Daegwang High Shool. The analysis of the amount of sales by business category showed that consumption was highest in the category of educational services. One difference was that the amount of sales was higher near the preparatory hagwons in Daechi 1-dong, while it was higher near the general hagwons in Yongshin-dong. Both of the dongs reflected the consumption behavior of those in their forties with children of school age, focused on education services.

The total amount of purchases by those in their fifties was 24.7 trillion KRW, and the sum of the purchases in the administrative dongs ranked in the top 10% in sales was 12.3 trillion KRW (60.2%). The amount of consumption is lower than that of those in their forties, but the top 3 administrative dongs are still Yeoksam 1-dong (12.4%), Daechi 4-dong (6.01%) and Sajik-dong (5.28%), the same as those in their forties and sixties. There was not an administrative dong that particularly reflected the unique consumption behavior of the specific age group (see Figure 6 and Table 7).

The total amount of purchases by those in their sixties was 11.7 trillion KRW; the sum of purchases in the administrative dongs ranked in the top 10% in sales was 6.2 trillion KRW (52.9%). The top 3 administrative dongs are Yeoksam 1-dong (8.70%), Daechi 4-dong (5.34%) and Sajik-dong (4.76%), the same as those in their forties and fifties. The administrative dongs that were ranked in the top 10% only in the amount of purchases by those in their sixties were Sangil-dong (0.81%), Shinjeong 7-dong (0.59%), Ihwa-dong (0.56%), Anam-dong (0.48%), Guro 5-dong (0.43%) and Guro 2-dong (0.43%). Sangil-dong, Ihwa-dong, Anam-dong and Guro 2-dong include or are adjacent to university hospitals, such as Seoul National University Hospital, Korea University Medical Center (Anam Hospital) and Gangdong Kyung Hee

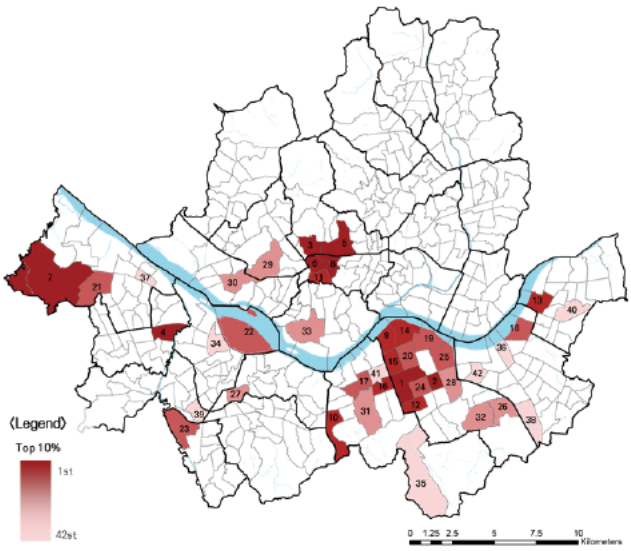

Figure 6. The present situation of 50s consumption area

Table 7. Region where 50s consumption have occurred

Ranking	Dong name	Ranking	Dong name
1	Yeoksam 1-dong	22	Yeouido-dong
2	Daechi 4-dong	23	Gasan-dong
3	Sajik-dong	24	Yeoksam 2-dong
4	Mok-dong	25	Samsung 1-dong
5	Jongno 1,2,3,4ga-dong	26	Suseo-dong
6	Sogong-dong	27	Sindaebang 2-dong
7	Gonghang-dong	28	Daechi 2-dong
8	Myeong-dong	29	Shinchon-dong
9	Sinsa-dong_ Gangnam-gu	30	Seogyo-dong
10	Bangbae-dong	31	Seocho 3-dong
11	Hoehyeon-dong	32	Ilwonbon-dong
12	Dogok 1-dong	33	Hangangno-dong
13	Cheonho 2-dong	34	Yeongdeungpo-dong
14	Apgujeong-dong	35	Yangjae 2-dong
15	Nonhyeon 1-dong	36	Jamsil 6-dong
16	Seocho 4-dong	37	Deungchon 1-dong
17	Banpo 4-dong	38	Munjeong 2-dong
18	Pungnap 2-dong	39	Guro 3-dong
19	Cheongdam-dong	40	Gil-dong
20	Nonhyeon 2-dong	41	Banpo 1-dong
21	Balsan-dong	42	Jamsilbon-dong

University Hospital. Shinjeong 7-dong and Guro 5-dong include living facilities such as neighborhood parks and commercial areas. The characteristics of these administrative dongs are consistent with the finding that the amount of purchases by those in their sixties is high in the sequence of hospitals, insurance companies, and general merchandise stores. The consumption behavior in the administrative dongs reflected the life cycle characteristics of the elderly, focused on leisure life and health management (see Figure 7 and Table 8).

3) Sub-Conclusions About Consumption Status

Summarizing the analytical results until now, the administrative dongs ranked in the top 10% in purchases include many transportation facilities, are easily accessed from other regions, and incorporate many commercial and business facilities that increase the inflow of population. These characteristics were generally found in the amount of purchases

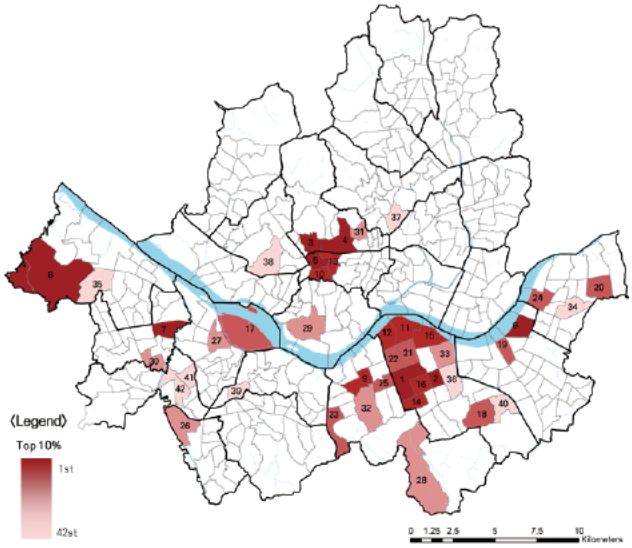

Figure 7. The present situation of over 60s consumption area

Table 8. Region where over 60s consumption have occurred

Ranking	Dong name	Ranking	Dong name
1	Yeoksam 1-dong	22	Nonhyeon 1-dong
2	Daechi 4-dong	23	Bangbae-dong
3	Sajik-dong	24	Cheonho 2-dong
4	Jongno 1,2,3,4a-dong	25	Seocho 4-dong
5	Sogong-dong	26	Gasan-dong
6	Pungnap 2-dong	27	Yeongdeungpo-dong
7	Mok-dong	28	Yangjae 2-dong
8	Gonghang-dong	29	Hangangno-dong
9	Banpo 4-dong	30	Sinjeong 7-dong
10	Hoehyeon-dong	31	Ihwa-dong
11	Apgujeong-dong	32	Seocho 3-dong
12	Sinsa-dong_ Gangnam-gu	33	Samsung 1-dong
13	Myeong-dong	34	Gil-dong
14	Dogok 1-dong	35	Balsan-dong
15	Cheongdam-dong	36	Daechi 2-dong
16	Yeoksam 2-dong	37	Anam-dong
17	Yeouido-dong	38	Shinchon-dong
18	Ilwonbon-dong	39	Sindaebang 2-dong
19	Jamsil 6-dong	40	Suseo-dong
20	Sangil-dong	41	Guro 5-dong
21	Nonhyeon 2-dong	42	Guro 2-dong

by all age groups. In particular, the amount of purchases in administrative dongs ranked in the top 10% in purchases by those in their thirties and fifties are the same as the amount

of purchases by all the other age groups combined. However, the consumption by those in their twenties was focused in the areas adjacent to universities, the consumption by those in their forties in the areas specialized in educational services, and the consumption by those in their sixties or higher in the areas with large hospitals. This finding is consistent with the life cycle theory that the difference of the income level among the age groups results in the difference of the consumption, suggesting that the space of consumption is dependent upon the age.

The consumption status analysis showed the difference of the consumption spaces in Seoul according to the regions and age groups. An additional analysis was performed for typifying the regions to understand the causes of the difference in more details.

Ⅳ. Analysis of Regional Types Depending on Consumption Sales

In this study, a cluster analysis was performed to typify the regions in order to show that the regional characteristics factors, such as the density of population attracting facilities and land use, cause the difference of the consumption space among the regions and age groups. A principal component analysis was employed to select the variables to be used in the cluster analysis.

1. Principal Component Analysis

A principal component analysis is a data modification method to combine correlated variables with those who have similar characteristics to downscale them to a smaller number of principal components. A principal component analysis is performed to extract factors for describing the entire group in consideration of the correlations between the variables (Koo et al., 2005; Suh et al., 2012). The number of principal components is determined by the eigenvalues and variance of the factors. The determined principal components are, not individual statistical indicators, but new components that represent arbitrary characteristics, and the characteristics represented by the principal components can be understood through the variables constituting the them. A principal component analysis is employed to understand the structure of variables when the amount of information should be reduced or the variables of a low important should be removed. In the present study, a principal component analysis was performed to select the final variables by considering the importance of the variables selected through the review of the previous studies.

1) Variables Used in Principal Component Analysis

The variable that was employed in the present study to represent the consumption characteristics was the amount of purchases by different age groups. The data were calculated for the age groups of twenties, thirties to fifties, and sixties of higher. This was based on the life cycle theory and previous studies, which suggested that the consumption behavior is similar among the age groups of those in their thirties to fifties, as they have higher income and a higher ratio of saving than the youths and the elderly. In addition, the post-hoc test of the ANOVA indicated that the age group of the thirties is similar to the groups of those in their forties ($p = 0.883$) and those in their fifties ($p = 0.262$). Based on these findings, the sum of the amount of purchases by those in their thirties to fifties was used as a variable in the present study.

From the viewpoint of population characteristics, the resident population has been used as an important variable in the classical location market area theory, being utilized as a basic factor to calculate the size of a commercial area where consumption occurs or to estimate the amount of sales of stores. Hence, the resident population was selected in the present study as the population characteristic variable that affects the consumption, and the registered resident population data of the individual administrative dongs, provided by the Korean Statistical Information Service (KOSIS), was used in the analysis.

The status analysis showed that the general merchandise stores are ranked high places in the amount of sales by business category in Seoul. This suggests from the viewpoint of economic characteristics that the number of businesses and the number of employees in the regions may affect the consumption. Kim and Yang (2013) also reported that the change of the businesses affects the inflow and outflow of population. Therefore, the data about the number of businesses and the number of employees in the individual administrative dongs was applied to the analysis in the present study, as provided by the KOSIS. In addition, to correct the difference of the number of businesses with respect to

the area of the individual administrative dongs, the density of businesses and the density of employees were considered as variables.

In view of the characteristics of urban spatial structure, land use zoning may affect the consumption, because buildings of different sizes, densities and uses are built according to the land use, which gives a macroscopic effect on the location of commercial areas. In addition, the status analysis described above also indicates that the land use distribution is different between the administrative dongs ranked in the top 10% in sales and those ranked bottom 10% in sales. Therefore, the areas of the residential, commercial, industrial and green zones, provided by the Urban Planning Information Service (UPIS), were converted to their ratios, which were then applied to the analysis.

In view of location characteristics, customer attracting facilities can attract population, incurring consumption not only at the facilities but also in the surrounding areas. Customer attracting facility, which has not been clearly defined in previous studies, is defined in the present study as a facility that causes consumption or that facilitates consumption in the surrounding areas. In the present study, the business categories that show a large amount of credit card purchases in Seoul were found, and a total of 8 facility variables were identified as facilities that cause the sales. The selected variables were large stores, hospitals, accommodation facilities, amusement facilities, government offices, broadcasting and communication facilities, universities and cultural facilities.

With regard to large stores, the 'large store' data from the local administrative licensing data service (LOCAL DATA) was used to obtain the number of large commercial facilities in each administrative dong, including department stores, superstores and outlets, removing the businesses that are closed temporarily or permanently. With regard to hospitals, the 'hospital' and 'clinic' data from the LOCAL DATA was used. Considering the size of the hospitals, the analysis was performed with the general hospitals having at least 30 beds or beds for long-term care according to Article 3, Paragraph 2 of the Medical Service Act. With regard to the accommodation facilities, the data for 'tourism and accommodation business,' 'tourism and pension business,' 'accommodation business' and 'urban lodging business for international tourists' were taken from the LOCAL DATA and processed to be used in the analysis. Considering the size of the accommodation facilities, only the number of accommodation facilities having at least 100 rooms was calculated. With regard to the amusement facilities, the data for 'general amusement facility business,' 'comprehensive amusement facility business,' 'miscellaneous amusement facility business' were taken from the LOCAL DATA, and only the data for theme parks was applied to the analysis. With regard to the government offices, only city halls and ward offices were considered. Although consumption does not occur at city halls and ward offices, they are anchor facilities that can incur consumption in the surrounding areas, and thus considered as customer attracting facilities. From the data for the government offices throughout Korea, provided by the Korea National Spatial Infrastructure Portal, only the data corresponding to Seoul was processed and applied to the analysis. The data about the broadcasting and communication facilities was also obtained from the Korea National Spatial Infrastructure Portal, and the facilities specifically named as 'broadcasting station' were taken into consideration. Universities were also considered as customer attracting facilities by the same rationale as city halls and ward offices. The data about the current status of universities in 2020 was prepared by complementing the Seoul campus big data for 2017, the newest available data. Finally, the data about cultural facilities was prepared by using the 'urban life map – cultural facility information' data from the Open Data Service of the Seoul Metropolitan Government. This dataset included the information about the culture and leisure-related facilities, such as movie theaters, concert halls and exhibition halls, and the data were processed for the individual administrative dongs to be applied to the analysis.

With respect to the traffic characteristics, the conventional location market area theory explains that consumption is decreased, as the distance to a commercial facility is increased. Due to the development of means of transportation in the modern society, the traffic characteristics of a region, rather than the simple distance, are considered as an important factor to the determination of consumption location. Therefore, subway stations, rail stations, and bus terminals were selected as traffic-related variables in the present study. The subway in Seoul, having a modal share of approximately 40% as of 2018, is a critical traffic-related variable. Therefore, the number of subway stations in the individual administrative dongs was investigated from the data pro-

Table 9. Principal component analysis input variables

Characteristics	Description of variable	Source
Consumption characteristics	Sales by age group	SKT
Population characteristics	Resident population	KOSIS
Economic characteristics	Number of businesses, Business density, Number of employees, Worker density	KOSIS
Land use zoning	Ratio of residential area, Ratio of commercial area, Ratio of industrial area, Ratio of green area	UPIS
Population inflow facility	Number of large stores, Number of general hospitals with or higher, Number of accommodation with 100 or more rooms, Number of amusement park	LOCAL DATA
	Number of city hall and ward offices, Number of broadcast stations	UPIS
	Number of universities	Seoul big data campus
	Number of cultural facilities	Seoul open data
Traffic characteristics	Number of subway station, Number of rail stations	KLID
	Number of bus terminals	UPIS

As of 2019, Using Dong unit data

vided by the Korea Local Information Research & Development Institute (KLID), and applied to the analysis. The number of rail stations was also investigated by using the data from the KLID, calculating the number of rail stations of the Gyeongbu, Honam and Gyeongchun railways located in Seoul. The data about the bus terminals was obtained from the Korea National Spatial Infrastructure Portal to investigate the size and location of the Seoul Express Bus Terminal, the Nambu Bus Terminal, the Sangbong Bus Terminal, and the East Seoul Bus Terminal (see Table 9).

2) Results of Principal Component Analysis

According to the results of the principal component analysis, the factors having an eigenvalue of 1 or greater were extracted. Table 10 shows the loads of the 4 extracted factors. The variables showing a high load on PC 1 are the density of businesses, the ratio of commercial area, the density of employees, and the number of large stores, which represent the characteristics of commercial facilities and commercial areas. The variables showing a high load on PC 2 are the number of employees, the number of businesses and the number of subway stations, which represent the characteristics of the business areas in subway station spheres. With regard to PC 3, the ratio of industrial area and the number of rail stations show a load of a positive (+) value, while the ratio of residential area shows a load of a negative (–) value. Therefore, the variables related to PC 3 represent the characteristics of the region where the ratio of industrial area is

Table 10. Factors extracted from principal components analysis and load

Variable	PC1	PC2	PC3	PC4
Sales by age group total	.219	.703	-.053	.017
Ratio of residential area	-.121	-.040	-.720	-.071
Ratio of commercial area	.820	.102	-.037	.032
Ratio of industrial area	.105	-.045	.827	.052
Number of businesses	.664	.605	.245	.043
Number of employees	.445	.744	.276	.042
Business density	.911	.092	-.004	-.015
Worker density	.760	.444	.122	.024
Number of large stores	.671	.200	.207	.053
Number of universities	-.196	.255	-.151	.635
Number of cultural facilities	.116	.555	-.146	.227
Number of general hospitals with or higher	.081	.064	.154	.668
Number of subway station	.100	.685	.161	.019
Number of rail stations	-.056	.308	.460	-.276
Number of bus terminals	.070	-.028	-.007	.518
Eigen value	4.862	1.539	1.420	1.084
Adjusted variance (%)	32.41	10.26	9.50	7.22
Cumulative adjusted variance (%)	32.41	42.67	52.17	59.39

high. Finally, the variables showing a high load on PC 4 are the number of universities and the number of general hospitals, which represent the characteristics of the university areas with a university hospital.

Based on the results of the principal component analysis, the variables of a low importance, not belong to any of the principal components, were removed to ensure the independence of the variables applied to the cluster analysis.

2. Cluster Analysis

A cluster analysis is a method for classifying objects into homogeneous groups according to the correlation based on their distance. The present study was conducted by using the K-means clustering, which is the most frequently used method of non-hierarchical cluster analysis, in order to typify the regions according to the consumption by the age group (Kim and Choi, 2006; Song and Chang, 2010). The statistical processing was performed by using the SPSS program. In the present study, the consumption regions in Seoul were typified by performing the K-means clustering with the consumption characteristics, population characteristics, economic characteristics, urban space structure characteristics, locational characteristics and traffic characteristics as the variables.

1) Variables Used in Cluster Analysis

Table 11 shows the variables derived to typify the consumption regions by the principal component analysis, described above, performed to remove the variables of a low importance.

2) Results of Cluster Analysis

All the administrative dongs of Seoul were categorized through the K-means clustering into the 7 types as described below (see Figure 8 and Tables 12 and 13).

Among 7 types, Types Ⅰ, Ⅱ, Ⅲ, Ⅳ and Ⅶ distinctively showed the regional characteristics related to consumption. Type Ⅲ corresponds to a single administrative dong of Banpo 4-dong. Although Type Ⅲ well reflected the traffic characteristics among the regional characteristics, it was excluded from the interpretation because of the small sample size. Types Ⅴ and Ⅵ were also excluded from the interpretation, because, in contrast to the other types, these types showed

Table 11. Setting of variable

Characteristics	Description of variable		Unit
Consumption characteristics	Sales by age group		Sales ranking by age (20's, 30's~50's, 60's up)
Economic characteristics	Number of businesses		Count
	Business density		Count/km^2
	Number of employees		Person
	Worker density		Person/km^2
Land characteristics	Land use zoning	Ratio of residential area	%
		Ratio of commercial area	%
		Ratio of industrial area	%
Locational characteristics	Population inflow facility	Number of large stores	Count
		Number of hospitals with 30 or more beds	Count
		Number of universities	Count
		Number of cultural facilities	Count
Traffic characteristics	Number of subway station		Count
	Number of rail stations		Count
	Number of bus terminals		Count

As of 2019, Using Dong unit data

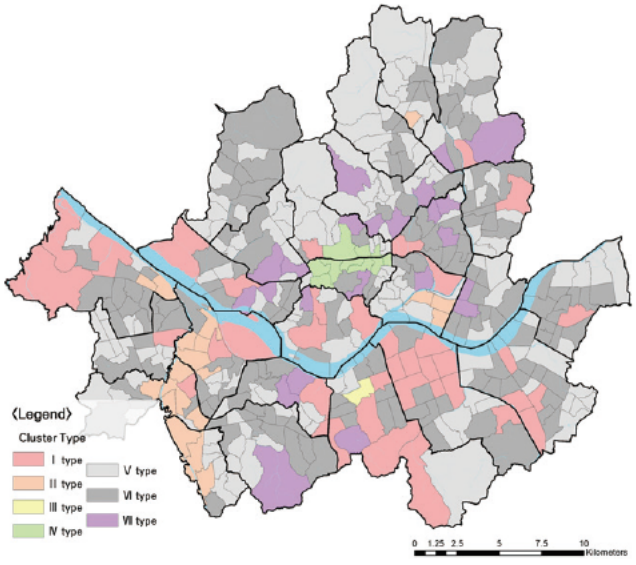

Figure 8. Results of cluster analysis

Table 12. Basic statistics on sales by cluster

Unit: trillion Won

Cluster	Average	Standard deviation	Maximum value	Minimum value	Total
Ⅰ type	1.313	2.498	15.345	0.109	51.201
Ⅱ type	0.276	0.226	0.841	0.058	5.238
Ⅲ type	1.240	0.000	1.240	1.240	1.240
Ⅳ type	1.075	1.178	3.458	0.049	10.746
Ⅴ type	0.044	0.021	0.123	0.002	7.340
Ⅵ type	0.205	0.231	1.652	0.062	33.569
Ⅶ type	0.176	0.129	0.568	0.023	4.040

no significant different regional characteristics in the context of consumption, and include the administrative dongs having a high ratio of residential areas.

Therefore, the analytical results of the present study were interpreted by focusing on the four types (Ⅰ, Ⅱ, Ⅳ and Ⅶ) that showed clear regional characteristics in the context of consumption and had an appropriate number of samples.

(1) Type Ⅰ—High-sales and High-employee Number Reigion

Type Ⅰ included the administrative dongs that had the highest average sales and the highest number of employees among the 7 types, and was named as 'high-sales and high-employee number region'.

Table 13. Description and source of variable

Cluster	Characteristics	Count	Area
Ⅰ type	High-sales business density area	39	Yeoksam 1-dong, Daechi 4-dong, Sajik-dong, Gonghang-dong, Sinsa-dong_Gangnam-gu, Mok-dong, Bangbae-dong, Nonhyeon 1-dong, Cheongdam-dong, Samsung 1-dong, Nonhyeon 2-dong, Yeouido-dong, Seogyo-dong, Suseo-dong, Daechi 2-dong, Hangangno-dong, Jamsil 6-dong, Seocho 3-dong, Yeongdeungpo-dong, Namyeong-dong, Munjeong 2-dong, Yangjae 2-dong, Banpo 1-dong, Yongsin-dong, Samsung 2-dong, Gayang 1-dong, Yangjae-dong, Hannam-dong, Gil-dong, Guro 5-dong, Sangam-dong, Mangwoobon-dong, Gongreung 1-dong, Banghwa 2-dong, Garakbon-dong, Sadang 1-dong, Sadang 2-dong, Yongdap-dong, Garak 1-dong
Ⅱ type	Highly business-intensive Semi-Industrial Zone	19	Gasan-dong, Deungchon 1-dong, Guro 3-dong, Seongsu 2-ga 3-dong, Guro 2-dong, Mullae-dong, Doksan 1-dong, Seongsu 2-ga 1-dong, Shiheung 1-dong, TangShan 2-dong, Yeomchang-dong, TangShan 1-dong, Seongsu 1 ga 2-dong, Yangpyung 1-dong, Gocheok 1-dong, Sindorim-dong, Chang 2-dong, Dorim-dong, Guro 1-dong
Ⅲ type	Bus terminals and large stores Included Area	1	Banpo 4-dong
Ⅳ type	Urban commerce and business density area	10	Sogong-dong, Jongno 1, 2, 3, 4 ga-dong, Hoehyeon-dong, Myeong-dong, Euljiro-dong, Gwanghui-dong, Jongno 5, 6 ga-dong, Sindang-dong, Hwanghak-dong, Changshin 1-dong
Ⅴ type	Low-sales Residential Area	168	Gahoe-dong, Junggye 1-dong, Junggyebon-dong, Yeomni-dong, Sinjeong 2-dong, Seongbuk-dong, Jeungsan-dong, Hongje 1-dong, Sinjeong 1-dong, Macheon 2-dong, Sinnae 2-dong, Jamsil 2-dong, Guui 2-dong, Ssangmun 3-dong, Songpa 2-dong, Seongsan 1-dong, Muk 2-dong, Sinsa 1-dong, Ilwon 2-dong, Jungnim-dong, Oksu-dong, Myeonmok 7-dong, Dobong 1-dong, Sinsu-dong, Jayang 2-dong, Doksan 2-dong, Bulgwang 2-dong, Doksan 3-dong, Junggok 4-dong, Hwagok 8-dong, Oryu 1-dong, Bomun-dong, Gocheok 2-dong, Sinwol 1-dong, Myeonmok 5-dong, Chang 1-dong, Gusan-dong, Sinwol 5-dong, etc
Ⅵ type	High-sales Residential Area	164	Apgujeong-dong, Seocho 4-dong, Dogok 1-dong, Cheonho 2-dong, Pungnap 2-dong, Balsan-dong, Sindaebang 2-dong, Yeoksam 2-dong, Jamwon-dong, Ilwonbon-dong, Jamsilbon-dong, Seocho 2-dong, Jamsil 3-dong, Seocho 1-dong, Ihwa-dong, Cheongnyong-dong, Yongsan 2 ga-dong, Bangi 2-dong, Sanggye 6, 7-dong, Daechi 1-dong, Deungchon 3-dong, Jeonnong 1-dong, Sanggye 2-dong, Daerim 1-dong, Sangil-dong, Haengdang 1-dong, Banpo 3-dong, Jangan 1-dong, Bangbae 1-dong, Sinjeong 4-dong, Guui 3-dong, Eungam 1-dong, Seokchon-dong, Jayang 3-dong, Hwagok 1-dong, Songjung-dong, Dongseon-dong, Sangbong 2-dong, etc
Ⅶ type	Nearby university area	23	Shinchon-dong, Jangchung-dong, Hwayang-dong, Anam-dong, Bangbae 3-dong, Hoegi-dong, Heukseok-dong, Sageun-dong, Gongneung 2-dong, Sangdo 1-dong, Wolgok 2-dong, Daeheung-dong, Seogang-dong, Samseon-dong, Hyehwa-dong, Gunja-dong, Daehak-dong, Cheongpa-dong, Chunghyeon-dong, Wolgye 1-dong, Jeonnong 2-dong, Imun 1-dong, Jeongneung 3-dong

The type of the high-sales and high-employee number regions reflect PC 2 from the principal component analysis, which includes the characteristics related to the business areas in subway station spheres. Therefore, the variables having the highest impacts on the consumption in the regions of this type are the number of employees, the number of businesses, and the number of subway stations.

It is noted that 33 dongs (84.6%) out of the 39 administrative dongs constituting this type are those ranked in the top 20% in sales among all the administrative dongs in Seoul. In addition, 29 dongs (74.4%) out of the 39 administrative dongs are in the south of the Han River, particularly, in the Yeongdeungpo-Yeoido area, which is one of the 3 downtown areas, and the areas corresponding to the two Gangnam downtown areas. While the number of subway station per administrative dong is 0.5 to 1.9 in average in other types, the number is 2.3 in average and the maximum is 5 in Type I, indicating that the population flow is high in the areas corresponding to this type.

The total amount of consumption in this type is 5.12 trillion KRW, including 506 billion KRW by those in their twenties (9.9%), 4.164 trillion KRW by those in their thirties to fifties (81.3%), and 449 billion KRW by those in their sixties and higher (8.8%). With reference to the business category, the amount of purchaes by those in their twenties was high in healthcare (22.8%), food and beverage (18.7%), financing/insurance/real-estate (15.0%), and communication service (14.0%); the amount of purchases by those in their thirties to fifties in financing/insurance/real-estate (24.37%), communication service (22.32%), healthcare (14.69%), food and beverage (11.37%), transportation (8.58%); and the amount of purchases by those in their sixties in financing/insurance/real-estate (37.67%), healthcare (18.22%), communication service (10.39%), food and beverage (8.66%), and transportation (7.44%).

(2) Type Ⅱ – High Business/Employee Density Semi-industrial Regions

All the administrative dongs classified as Type Ⅱ include a semi-industrial zone, and have the highest average density of businesses and employees. Therefore, Type Ⅱ is named as 'high business/employee density semi-industrial region'.

The type of high business/employee density semi-industrial region, having a high ratio of industrial area, is highly related to PC 3. Therefore, the consumption in the regions included in this type reflects the regional characteristics of an industrial area.

The analysis of the status showed that the average ratio of the semi-industrial area in the regions of this type was 61.6% of the area of the administrative regions. This is a representative characteristic of this type, because the ratio of the semi-industrial area is between 0.0% and 1.4% in the regions of other types.

The total amount of consumption in this type is 0.52 trillion KRW, which is in the 4th place among the 7 types. The total amount of consumption by those in their twenties is 56 billion KRW (10.74%). With reference to the business category, the amount of purchases by those in their twenties was high in food and beverage (29.54%), transportation (26.80%), healthcare (10.89%), and general merchandise (10.52%). The amount of purchases by those in their thirties to fifties was 414 billion KRW (79.16%), and the proportion was high in the order of transportation (24.66%), food and beverage (20.98%), healthcare (15.55%), general merchandise (10.67%), and miscellaneous retail business (7.64%). The amount of purchases by those in their sixties and higher was 52 billion KRW (10.09%), and the proportion was high in the order of healthcare (24.66%), transportation (19.56%), food and beverage (14.74%), general merchandise (13.46%), and miscellaneous retail business (9.18%). In Type Ⅱ, the proportions of the sales in the business categories of transportation, retail business, and food and beverage were high in the purchases by all the age groups, which reflects the regional characteristics of the high business/employee density semi-industrial region.

(3) Type Ⅳ – Urban Commerce-Business Region

The regions classified as Type Ⅳ, located in the downtown areas of Seoul, showed the highest average ratio of commercial areas and the highest number of businesses, and thus named as 'urban commerce-business region'.

The regions classified as this type distinctively show the characteristics of PC 1. The large stores, such as department stores and superstores, and the high ratio of commercial area significantly affect the amount of consumption in the regions classified as this type.

In contrast to other types, the urban commerce-business regions are spatially clustered with the Hanyang Wall at the

center. This spatial characteristic may be because the ratio of commercial area in all the regions in Type Ⅳ is as high as about 75% of the entire area of the administrative dongs, and thus the many businesses are clustered in the downtown areas where the central functions are concentrated.

The total amount of consumption in this type is 1.074 trillion KRW; including 136 billion KRW by those in their twenties (12.73%), 854 billion KRW by those in their thirties to fifties (79.47%), and 83 billion KRW by those in their sixties and higher (7.78%). With reference to the business category, the amount of purchases by those in their twenties was high in transportation (36.33%), food and beverage (21.89%), general merchandise (16.47%) and clothing (7.72%); the amount of purchases by those in their thirties to fifties in transportation (33.90%), food and beverage (16.41%) and financing/insurance/real-estate (14.07%); and the amount of purchases by those in their sixties or higher in transportation (32.09%), financing/insurance/real-estate (19.21%), food and beverage (13.58%), and healthcare (11.95%). Notably, the proportion of transportation was highest in the purchases by both those in their thirties to fifties and those in their sixties or higher.

(4) Type Ⅶ – University-Neighboring Region

The regions classified as Type Ⅶ are adjacent to the administrative dongs incorporating a university or neighboring to a university, and thus are under the influence. Therefore, Type Ⅶ is named as 'university-neighboring region'. The regions of this types show the characteristics of the university vicinities near to a university campus or a university hospital, which are PC 4 of the principal component analysis.

The total amount of consumption in this type is 404 billion KRW, including 50 billion KRW by those in their twenties (13.10%), 300 billion KRW by those in their thirties to fifties (74.56%), and 40 billion KRW by those in their sixties and higher (12.31%).

With reference to the business category, the amount of purchases by those in their twenties was high in food and beverage (38.89%), general merchandise (23.53%), healthcare (18.05%), tourism/entertainment/leisure (4.03%), and life service (3.74%); and the amount of purchases by those in their thirties to fifties in healthcare (35.70%), food and beverage (26.89%), general merchandise (15.21%), and transportation (5.69%). The amount of purchases by those in their sixties or higher was highest in healthcare (53.70%), like those in their thirties to fifties, followed by food and beverage (14.24%), transportation (12.70%), and general merchandise (6.61%).

In this type, the business category that showed the highest share in the purchases by both the middle-aged and the elderly was healthcare, because the regions in the type included general hospitals, like university hospitals, as well as university campuses.

3) Comprehensive Analysis of Cluster Types

Table 14 comprehensively shows the regional characteris-

Table 14. Comprehensive analysis result analysis

Cluster type			Characteristics	PCA result
CIty center/ Upper sales area	Ⅰ type	High-sales business density area	- Including Yeongdeungpo and Yeouido, downtown Gangnam - 2.3 subway stations on average - Highest average revenue - Unlike other types, high medical expenses for young people are found to occur in plastic surgery	PC2
	Ⅳ type	Urban commerce and business density area	- Include downtown Seoul City Wall - Spatial characteristics clustered around Seoul City Wall - Area with high ratio of commercial area	PC3
Region of single impact factor	Ⅱ type	Highly business-intensive Semi-Industrial Zone	- Composed of areas that include semi-industrial areas - Highest density of business and employees - The amount of transportation is large due to the location of logistics and distribution facilities	PC1
	Ⅶ type	Nearby university area	- Administrative dong, including or located near the university - Expenditure on medical expenses for middle-aged and elderly people as a university hospital - The characteristics of university districts generate consumption among young people	PC4

tics of the types derived by the cluster analysis, which are 'high-sales and high-employee number region (Ⅰ),' 'high business/employee density semi-industrial region (Ⅱ), 'urban commerce-business region (Ⅳ),' and 'university-neighboring region (Ⅶ).'

The business categories ranked high in sales are different among the types, but they are usually healthcare, financing/insurance/real-estate, food and beverage, and transportation. There may be two reasons why the such a small number of business categories have large proportions in the sale in all the types. One reason is that healthcare and financing/insurance/real-estate are the business categories where the amount of sale per transaction is greater than that of other business categories. The other reason is that the business categories of food and beverage and transportation are large in scale and closely related to daily living regardless of the regional characteristics.

In addition, as found in the previous studies, the comparative analysis between the cluster types showed that the main items of consumption are significantly dependent upon the stages of life cycle. In generally, as the age is increased, the portion of the expenditure in financing/insurance/real-estate and healthcare is high. As the age is decreased, the portion of the expenditure in tourism/entertainment/leisure and clothing is high.

Although the expenditure in healthcare is generally increased with the increase of the age, in Type 1, the proportion of purchases in healthcare by those in their twenties was 22.8%, which is higher than that of the middle-aged (14.7%). The proportion of the purchases in healthcare by those in their twenties in Type 1 was almost double the number in other types. The investigation of the sub-business category in the healthcare purchases by those in their twenties in Type 1 showed that 46.7% of the healthcare purchases was in the plastic surgery. This explains why the amount of purchases in healthcare by those in their twenties in Type 1 was almost double the number in other types.

Type Ⅰ may be compared with Type Ⅳ, because both types have a high amount of sales and include urban areas with the central functions of the city. The biggest difference between the two types is the ratio of the commercial areas in the administrative dongs. It is generally anticipated that the amount of consumption may be higher in the urban commerce-business region (Ⅳ) where the ratio of the commercial area is higher. However, the amount of sales is actually higher in the high-sales and high-employee number region (Ⅰ) where the ratio of the residential area is the highest in the administrative dongs. This may be because different land uses are in individual land use zones, and suggests that the amount of consumption is affected more by the distribution of specific business categories that incur a large amount of sales, such as healthcare and financing/insurance/real-estate, than the ratio of commercial areas.

The other types, high business/employee density semi-industrial region (Ⅱ) and university-neighboring region (Ⅶ), are affected by a single impact factor to the amount of sales.

First, Type Ⅱ has a large number of businesses and employees because of the land use characteristics of the regions where the key land use zone is the semi-industrial area. Unlike other types, the proportion of the sales in transportation is high among the business categories that incur sales. This may be because the expenditure of the circulation and distribution-related facilities located in the semi-industrial area. Type Ⅱ suggests that the consumption pattern may be dependent upon the specific categories of businesses located in individual regions, because the amount of sales is high in the administrative dongs where there are general retail stores related to electronic devices and office machines and many IT companies are located.

Type Ⅶ comprises the regions where the consumption by the youths is incurred in the areas near university campuses and the consumption by the middle-aged and the elderly is incurred by the university hospitals. This demonstrates that the inflow of the population, caused by the large university hospitals, leads to the consumption in the nearby areas.

Ⅴ. Conclusions

The present study was conducted by using the credit card sale big data for the year 2019 to investigate the spatial distribution of the consumption and the consumption behavior of different age groups in Seoul, and to typify the differences in the consumption depending on the regional characteristics through a cluster analysis to empirically analyze the regional characteristics.

The analysis of the status of the consumption by regions and age groups showed that the spatial distribution was generally similar among the administrative dongs ranked in the

top 10% in the consumption in Seoul and among those ranked bottom 10%. However, the characteristics of the consumption space were different among the age groups. The characteristics of the consumption space were more significant in the purchases by those in their twenties , forties and sixties than other age groups. The consumption by those in their twenties was most in the regions near to university campuses such as Hwayang-dong, Gayang 1-dong and Seocho 3-dong. The consumption by those in their forties was much in Daechi 1-dong and Yongshin-dong, the regions specialized in educational services. The consumption by those in their sixties or higher was much in the spaces including large general hospitals and many life convenience facilities, such as Sangil-dong, Sinjeong 7-dong, Ihwa-dong, Anam-dong, Guro 5-dong and Guro 2-dong. These results showed that the consumption by different age groups are incurred in different regions. To clarify the characteristics of the individual regions, a principal component analysis and a cluster analysis were performed to typify the administrative dongs in Seoul into 7 clusters.

The comprehensive review of the analytical results showed that, according to the business category, as the age is increased, the portion of the expenditure in financing/insurance/real-estate and healthcare is high; and as the age is decreased, the portion of the expenditure in tourism/entertainment/leisure and clothing is high. In other words, consumption was occurred in different expenditure items by different age groups. The finding of the status analysis that the consumption by the youths is concentrated in the regions near to university campuses was also found in the cluster analysis, indicating that the regional characteristics affect the amount of purchases by the individual age groups. The analysis of the amount of sales in the individual regions in consideration of the commercial area showed that the customer attracting facilities and the category of the businesses have a greater impact on the consumption than the distribution of commercial areas in the regions.

Three suggestions were derived from the analytical results of the present study, as described below. The results showed that 44 dongs (64.7%) out of the 68 administrative dongs included in Types Ⅰ, Ⅱ, and Ⅳ with high amount of consumption are located in the south of the Han River, and the remaining 24 dongs (35.3%) are located in the north of the Han River. The difference is related to the difference of amount of consumption between the regions. Therefore, various strategies may need to be prepared to reduce the gap in pursuit of the balanced development between the regions in the south and north of the Han River.

The analysis also showed that the regions where much consumption is incurred are not always commercial areas. This suggests that an increase of the amount of consumption may significantly attribute to the attraction of the business categories with a high amount of transaction and the activation of the consumption spaces that are closely related to the daily living of various age groups. Therefore, it is necessary to arrange and attract business categories and land uses that can induce the consumption by not only the current major consumption groups but also the consumers of various age groups, especially the consumption revitalization strategies customized to individual regions.

Finally, the results of the present study showed that the consumption behavior and the amount of purchases are dependent upon the regional characteristics of the types. Therefore, when preparing the implementation plans of the life sphere plans for individual Metropolitan, Regional and District Centers in Seoul or establishing the district unit plans, the consumption characteristics of individual regions and age groups should be positively applied to the plans for arranging the business categories and land use, and distributing the commercial and business facilities to the individual central places.

The present study has limitations that the credit card sales data used in the present study do not reveal the information about the locations where the transactions actually occur, because the amount of purchases is integrated in each collection unit. In addition, the data used in the present study may not clearly represent the consumption characteristics of those in their twenties and sixties whose consumption is relatively small in comparison with other age groups.

In the present study, the causal relations between the regional characteristics and the amount of consumption were investigated by an inductive method through the typification of the regions. Further studies may need to be conducted to directly investigate the causal relations of the individual variables with the amount of consumption..

References

1. Hyundai Research Institute (HRI), 2017. *Characteristics and Challenges of Consumption Structure – It Is Urgent to Come up with Measures to Cope with Sluggish Consumption by Age!*, Economic Review.
현대경제연구원, 2017.「소비 구조의 특징과 과제–연령별 소비 부진 대응책 마련이 시급하다!」, 경제주평.

2. Hwang, S.M., Han, K.O., and Kim, J.Y., 2015. "What Are Korean Consumer Psychology and Trend Revealed by Individual's Desire", Paper presented at the annual meeting for the The Korean Psychological Association, Seoul: Grand Hilton.
황상민·한규옥·김제연, 2015. "한국인의 소비욕망을 통해 확인하는 소비심리와 트렌드", 2015. 한국심리학회 연차학술대회, 서울: 그랜드 힐튼.

3. Jang, H.R., 2019. "An Analysis of Commercial Gentrification Characteristics by Analyzing Business Type Diversity – In Residential Areas of Seoul ", University of Seoul.
장하림, 2019. "업종 다양성분석을 통한 상업 젠트리피케이션 발생지역의 특성 분석–서울시 주거지역을 중심으로", 서울시립대학교 학위논문.

4. Kang, H.M. and Lee, S.K., 2018. "An Analysis of the Effects of Customer Characteristics on Sales of Alley Market Area Using Geographically Weighted Regression", *Journal of the Korean Society of Surveying*, 36(6): 611-620.
강현모·이상경, 2018. "지리가중회귀분석을 이용한 고객특성별 골목상권 매출액 영향 연구",「한국측량학회지」, 36(6): 611-620.

5. Kang, S.Y. and Lee, H.C., 2011. "A Study on the Factors of Regional Characteristics Affecting Urban Creativity", *Journal of Korea Planning Association*, 46(5): 81-92.
강수연·이희정, 2011. "도시 창조성에 영향을 미치는 지역특성요인에 관한 연구",「국토계획」, 46(5): 81-92.

6. Kim, H.C. and Lee, S.G., 2019. "A Study on the Factors Affecting the Revenue in Seoul's Side Street Trade Areas", *Seoul Studies*, 20(1):117-134.
김현철·이승일, 2019. "서울시 골목상권 매출액에 영향을 미치는 요인에 관한 연구",「서울도시연구」, 20(1): 117-134.

7. Kim, J.H. and Kim, H.J., 2019. "Analysis of Start-up and Closing of Individual Business Using Credit Card Big Data", *Journal of Digital Contents Society*, 20(10): 2,035-2,044.
김준호·김형중, 2019. "신용카드 빅데이터를 활용한 개인사업자 창업과 폐업 분석",「한국디지털콘텐츠학회논문지」, 20(10): 2035-2044.

8. Kim, K.K. and Yeom, M.B., 2015. "A Study of Private Expenditures and Regional Consumption by using Credit Card", *Journal of Korean National Economy*, 33(1):121-142.
김경근·염영배, 2015. "소비 대리변수로서의 신용카드 사용액과 지역별 소비특성에 관한 연구",「경제연구」, 33(1): 121-142.

9. Kim, K.K. and Yeom, M.B., 2017. "A Study on the Characteristics of Regional Consumption by using Big Data of Credit Card Big Data", *Journal of Korean National Economy*, 35(4): 129-153.
김경근·염영배, 2017. "신용카드 빅데이터를 활용한 지역별 소비 유출입 특성 연구",「경제연구」, 35(4): 129-153.

10. Kim, L.Y. and Seo, W.S., 2016. "Investigating Spatial Patterns and Urban Influential Factors of the School-Age Population using Spatial Econometric Analysis", *Journal of the Korean Regional Development Association*, 28(2): 113-130.
김리영·서원석, 2016. "공간계량기법을 이용한 학령별 인구의 공간적 분포 및 지역특성 영향요인 연구",「한국지역개발학회지」, 28(2): 113-130.

11. Kim, L.Y. and Yang, K.S., 2013. "Empirical Analysis of Regional Characteristic Factors Determining Net Inflow and Outflow of the Population", *Journal of the Korean Regional Development Association*, 25(3): 1-19.
김리영·양광식, 2013. "인구 유입과 유출을 결정하는 지역 특성요인에 관한 연구",「한국지역개발학회지」, 25(3): 1-19.

12. Kim, S.B. and Choi, H.H., 2006. "The Characteristics and Types of Urban Zoning Areas by Factor Analysis and Cluster Analysis in Korea", *Journal of the Korean Urban Geographical Society*, 9(1): 127-136.
김선범·최호현, 2006. "요인분석과 군집분석을 이용한 용도지역의 특성과 유형분류",「한국도시지리학회지」, 9(1): 127-136.

13. Kim, S.J. and Kim, H.B., 2019. "A Study on Consumption Expenditure of Single Households in South Korea", *Journal of Regional Studies*, 27(2): 13-37.
김수진·김호범, 2019. "1인 가구 소비지출의 특징과 결정요인 분석",「지역사회연구」, 27(2): 13-37.

14. Koo, J.Y., Yu, M.J., Kim, S.G., and Shim M.H., 2005. "Estimation of Long-term Water Demand by Principal Component and Cluster Analysis and Practical Application", *Journal of Environmental Engineering Research*, 27(8): 870-876.
구자용·유명진·김신걸·심미희·소천명, 2005. "주성분분석과 군집분석을 이용한 장기 물수요예측과 활용",「대한환경공학회지」, 27(8): 870-876.

15. Korea Institute of Finance (KIF), 2014. *Policy Measures to Increase Consumption of the Elderly*, Financial Brief.
한국금융연구원, 2014.「고령층 소비증대를 위한 정책방안」, 금융브리프.

16. Korea Research Institute for Human Settlements, 2017. *Exploring Consumption Structure and Economic Performance in Regions*, Sejong: KRIHS report.
국토연구원, 2017.「지역의 소비구조 탐색을 통한 지역경제 활성화 전략 연구」, 세종: KRIHS 보고서.

17. Lee, J.H. and Ji, M.W., 1998. "A Study on the Rise of New Commercial Districts in Incheon and the Changes in Consumer's Consumption Pattern - Focused on Large Distribution Companies", *Hwanghae Review*, 19: 128-156.
이진희·지민웅, 1998. "인천지역 내 새로운 상권의 부상과 소비자들의 소비패턴 변화에 관한 연구-대형 유통업체 중심으로",「황해문화」, 19: 128-156.

18. Lee, J.S., 2002. "A Study on the Classification of Regional Patterns by Cluster Analysis Utilizing Factor Scores, *Journal of Korea Planning Association*, 37(4): 191-199.
이종상, 2002. "지역유형구분을 위한 요인점수의 군집분석",「국토계획」, 37(4): 191-199.

19. Song, M.K. and Chang, H., 2010. "Charaterization of Cities in Seoul Metropolitan Area by Cluster Analysis", *Journal of the Korean Society for Geospatial Information Science*, 18(1): 83-88.

송민경·장훈, 2010. "군집분석을 이용한 수도권 도시의 유형화에 관한 연구", 「한국지형공간정보학회지」, 18(1): 83-88.

20. Song, B.G. and Park, K.H., 2017. "Analyzing Characteristic of Business District in Urban Area Using GIS Methods – Focused on Large-Scale Store and Traditional Market", *Journal of the Korean Association of Geographic Information Studies*, 20(2): 89-101.
송봉근·박경훈, 2017. "GIS 기법을 활용한 도시지역 상권 특성 분석–대형할인점과 전통시장을 중심으로", 「한국지리정보학회지」, 20(2): 89-101.

21. Suh, K., Kim, T.G., Lee, J.M., and Lee, J.J., 2012. "Effective Classification Framework Design and Implementation for Rural Regional Information using Principal Component Analysis and Cluster Analysis", *Journal of the Korean Society of Agricultural Engineers*, 54(1): 73-81.
서교·김태곤·이지민·이정재, 2012. "주성분 분석 및 군집분석을 이용한 지역정보 유형화 프레임워크의 설계와 구현", 「한국농공학회논문집」, 54(1): 73-81.

12. Sung, Y.A., 2013. "Cluster Analysis for the Consumption Expenditure Patterns of One-Person Households of Different Age Groups", *Journal of Consumer Studies*, 24(3): 157-181.
성영애, 2013. "군집분석을 통해 살펴본 1인 가구의 연령대별 소비지출패턴", 「소비자학연구」, 24(3): 157-181.

23. Turan, G., Akalin, M., and Zehir, C., 2013. "Literature Review on Selection Criteria of Store Location based on Performance Measures", *Procedia-Social and Behavioral Sciences*, 99: 391-402

24. Won, J.H. and Chung, J.E., 2015. "The Segmentation of Single-Person Households Based on Sheth's Theory of Consumption Values", *Journal of Consumer Studies*, 26(1): 73-99.
원종현·정재은, 2015. "소비가치에 따른 1인 가구 세분화와 구매행동-Sheth의 소비가치이론을 중심으로", 「한국소비자학회지」, 26(1): 73-99.

25. Yoo, H.J., 2018. "Consumption Life Problems and Consumption Gaps by the Area", *Journal of Consumer Policy Studies*, 49(2): 45-76.
유현정, 2018. "지역별 소비생활문제와 소비격차", 「소비자문제연구」, 49(2): 45-76.

Date Received	2020-09-28
Reviewed(1st)	2020-11-25
Date Revised	2021-02-02
Reviewed(2nd)	2021-02-13
Date Revised	2021-02-16
Reviewed(3rd)	2021-02-23
Date Accepted	2021-02-23
Final Received	2021-03-03