

Analysis for Daily Food Delivery & Consumption Trends in the Post-Covid-19 Era through Big Data

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[Abstract]

In this paper, we suggest a method of analysis for daily food delivery & consumption trends through big data of the post-Covid-19 era. Through analysis of big data and the database system, four analyzed factors, excluding weather, was proved to have significant correlation with delivery sales for 'Baedarui Minjok' of a catering delivery application. The research found that KBS, MBC and SBS Media showed remarkable results in food delivery & consumption sales soaring up to about 60 percent increase on the day after the Covid-19 related new article was issued. In addition, it proved that mobile media and web surfing were the main factors in increasing sales of food delivery & consumption applications, suggesting that viral marketing and emotional analysis by crawling data from SNS used by Millennials might be an important factor in sales growth. It can contribute the companies in the economic recession era to survive by providing the method for analyzing the big data and increasing their sales.

▶ **Key words:** Database, Covid-19, Consumption trend, The confirmed, Consumption prediction

[요 약]

이 논문은 Covid-19 이후 기간의 빅데이터를 활용하여 일상에서 주문하는 음식 배달과 소비의 경향을 분석하는 방법을 제시한다. 빅데이터를 분석하고 데이터베이스 시스템을 이용하여, 날씨를 제외한 네 개의 요소들이 배달의민족 매출과 의미있는 상관관계가 있는 것으로 확인되었다. 이 연구는 KBS, MBC와 SBS 언론매체의 빅데이터 분석에서 Covid-19 관련 기사 다음 날에 음식 배달과 소비 증가가 거의 60%에 달하는 것을 발견하였다. 또한 Naver 검색결과에서도 Covid-19 관련 기사 다음 날에 심각하게 의미있는 음식 배달과 소비 증가를 발견하였다. 그 이외에, 소비의 흐름에 있어서 모바일을 통한 배달이 주류가 될 것이며 밀레니얼 세대가 대세가 될 것이라는 것도 알 수 있었다. 본 연구는 방대하고 구체적인 데이터를 사용하여 똑같은 방법으로 경기 침체에 다른 산업 분야에 대하여 분석을 가능하게 하는 것으로, 기업의 입장에서 빠른 대응으로 경기 침체 속의 호황을 맞이할 수 있는 분석과 방법을 제공하는 데 기여할 수 있다.

▶ **주제어:** 데이터베이스, 코로나, 소비 경향, 확진자, 소비 예측

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I. Introduction

1. Introductory Remarks

Big data play a critical role in today's unpredictable socio-economic environment and will continue to do so in the post-COVID-19 times. Data generate variations on two grounds: its production and its application. With the proper processing and the storage support of edge hardware, big data control and usage will be more important than ever especially from the business perspective. As the world adapts to the post-COVID-19 environment, data may hold the core of our new everyday life [1, 2]. The outbreak of the novel COVID-19 has changed the worldwide daily lives of citizens globally. As COVID-19 has found to be highly contagious, public anxiety levels rise and many policies have been implemented to control the spread of COVID-19 at the global level. Public health precautions include containment, social distancing, and home residency orders, which have been implemented at the local, regional and national levels. These policies have changed the way of life of citizens around the world, and gradually transformed a powerful socio-economic model into a contactless society. Many industrial sectors have been greatly influenced by these changes, especially in the trade and distribution of goods, education and business [3, 4, 5].

In Korea, social distancing has been adopted as a primary guideline to slow the spread of infection. Under these environments, the most common example of contactless service in Korea is food delivery. Consumers prefer to order food online through a mobile application and take it directly in their home. In addition, the delivery business has expanded its services to groceries and errands etc., and the consumption of these delivery services is expected to become increasing greatly as the pandemic continues [6, 7, 8].

Information on disease coronics and disasters provided by the government in Covid-19 pandemic era has become agile and accessible, which implies

the possibility of indiscriminate infection in the community. With more than half of the medical community predicting a prolonged Covid-19 and cases of cross-regional mass infection still prevalent around the world, consumers have brought increased demand of contactless services considering consumers' psychological stability, and companies are investing heavily the services by predicting these situations and needs [9, 10, 11, 12]. According to the report by Samsung Electronics [13], untact consumption and satisfaction among all age groups increased by 31.2 ~ 72 percent compared to a year earlier.

The research will analyze the relationship of untact consumption and satisfaction by sales data of 'Baedarui Minjok', Woowa Brothers Corp.'s catering delivery application, showing a rapid growth of more than 50% each year [14]. Especially, it will analyze the relationship among the sales data of untact consumption, Covid-19 confirmed patient data, Covid-19 media reports, weather information and week data, identify their relevance and key factors among the untact services and the number of sales, and provide useful results.

This paper is organized as follows: Section 1 describes introductory remarks, big data sources and previous research. Section 2 describes system architecture of this research including E-R (Entity-Relation) Model. Section 3 provides representative examples of utilization plans. Finally, discussions and contributions are described in Section 4.

2. Big Data Sources and Previous Research

2.1. Big Data Sources Utilized in the Research

The big data used in the analysis were provided by Naver Data Lab, Public Data Portal, Financial Data Exchange, the Korea Meteorological Administration, the Statistics Korea, three major broadcasting companies and etc. [15, 16, 17, 18, 19, 20, 21, 22]. The research will use sample data provided by the Financial Data Exchange, delivery sales data paid by only KB Kookmin Card from 'Baedarui Minjok',

Woowa Brothers Corp.'s catering delivery application [14]. In reality, the price of the whole data from 'Baedarui Minjok' was traded between about 15 million won and about 20 million won, which was not suitable for the researchers with operational budget caps. In the future, the data hub center to be established is expected to provide relatively cheap financial data to the researchers.

2.2. Analysis on the Survival Strategies of Restaurant Companies with the Appearance of Covid-19

The previous work [23] was performed to analyze important factors that change consumers' consumption trends with focusing on the survey-based structural approach, and provided the desirable response strategies for the Korean restaurant companies to the risk of Covid-19. As a result, the strategies revealed were that maintaining the distance among customers and hygiene management in the store were more important than customer sanitary services, that the most important factor to reduce fixed costs was hot potatoes in offline stores, and that increasing sales outside restaurant were due to the customer service with quick response. Instead of focusing on Korean restaurants, this paper will analyze important factors of the trends of consumers' consumption focusing on delivery services.

2.3. Analysis of the Impact of Covid-19 Occurrence on Regional Business Area Using Credit Card Big Data (A Case of Suwon City)

A previous study [24] analyzed through credit card sales, the impact of Covid-19 on the local economy and business districts in Suwon, where sales amount of business fell sharply after Covid-19. The direction of analyzing how much Covid-19 in the post-Covid-19 era directly affected sales amount was similar to that of this research, but the results were specifying detail by limiting the scope of the project to Suwon City, and the project data used in the analysis were given by direct support of credit card big data from the Korea

Data Industry Promotion Agency. Eventually, since April, 2020 the overall consumption activity in Suwon City recovered to the previous level before Covid-19, but the recovery was not sufficient for the consumption of the area which had showed a significant decline compared to the sales during proliferation. In addition, it was confirmed that commercial districts such as Suwon Station that relied on floating populations and relatively young weekend consumers were directly affected and saw a sharp drop in sales.

2.4. Effects of Social Risk from Covid-19 on Consumer Sentiment and HMR Purchase Patterns

A previous work [25] analyzed the purchase patterns and the threat of disease changed by Covid-19 on HMR (Home Meal Replacement), which drew a sharp upward linear graph in sales amount along with delivery food. And the way how it changed consumers were the topic of the research. Various quantitative data such as gender, monthly income level, occupation, child status and marital status were used to present specific conclusions. Qualitative analysis methods together with quantitative data were also used to analyze purchase patterns of consumers in the post-Covid-19 era in various ways.

Referring to the previous studies, the research will analyze the relationship among the sales data of untact consumption, Covid-19 confirmed patient data, Covid-19 media reports, weather information and week data etc.

II. System Architecture

To analyze the relationship among the sales data of untact consumption, Covid-19 confirmed patient data, Covid-19 media reports, weather information and week data, the database system was designed and implemented. The Entity-Relation Diagram (E-R diagram) was developed for the system as in Fig. 1.

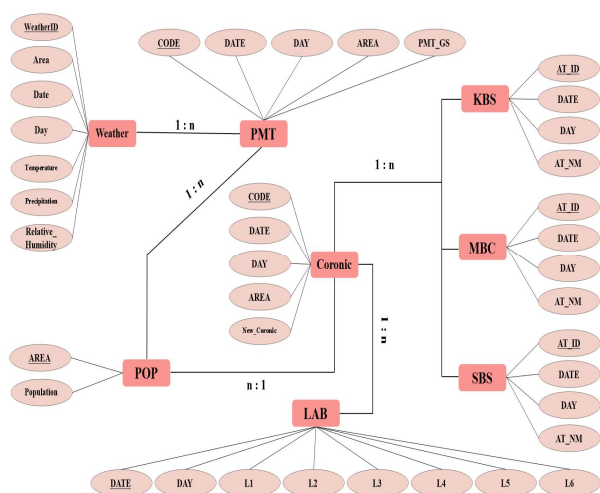


Fig. 1. E-R Diagram

The E-R Diagram shown in Fig. 1 investigated the daily food delivery & consumption trend in the post-Covid-19 era by sales data paid by only KB Credit Card from 'Baedarui Minjok', Woowa Brothers Corp.'s catering delivery application, from Jan. 1, 2020 to July 1, 2020 [14]. The system created 8 entities with the data: Population confirmed by Covid-19 (Coronic), Number of orders delivered (PMT), Media reporting related news (SBS, KBS, MBC), Analysis of search figures for set search terms (LAB), daily weather data (Weather), and population per region (POP).

The CORONIC relation has CODE, DATE, DAY, AREA, and NEW_CORONIC attributes, where CODE is the primary key. The MEDIA relation has AT_ID, DATE, DAY, and AT_NM attributes, where DATE was given as the primary key. The LAB relation has DATE, DAY, L1, L2, L3, L4, L5, L6 attributes, and L1~L6 refers to the search terms we set. L1 is 'Covid-19', L2 is 'Confirmed cases', L3 is 'Self quarantine', L4 is 'Regional infection', L5 is 'Foreign inflow', and L6 is 'Social distancing'. The PMT (PAYMENT) relation has CODE, DATE, DAY, AREA, and PMT_GS attributes, where CODE is the primary key. The WEATHER relation has WeatherID, AREA, DATE, TEMPERATURE, PRECIPITATION, and RELATIVE_HUMIDITY attributes, where we set WeatherID as the primary key. Lastly, the POPULATION relation has AREA and POPULATION attributes, where AREA is the primary key.

There is a 'Provide' relationship between the Coronic entity and the Media (SBS, KBS, MBC) entity, and this relationship is a one-to-many (1:n) relationship. There is a 'Fluctuate' relationship between the Coronic entity and the LAB entity, which is a one-to-many (1:n) relationship. Also, there is a 'Confirmed' relationship between the Coronic entity and the Population entity, and this relationship is a one-to-many (1:n) relationship. There is an 'Order' relationship between the Population entity and the Payment entity, and this relationship is a one-to-many (1:n) relationship. Finally, there is an 'Influence' relationship between the Payment entity and the Weather entity, which is a one-to-one (1:1) relationship.

III. Representatives of Useful Information

The database system was implemented for analyzing the relationship among the sales data of untact consumption, Covid-10 confirmed patient data, Covid-10 media reports, weather information and week data, based on the E-R Diagram in Fig. 1. The system used sales data provided by the Financial Data Exchange, delivery sales data paid by only KB Kookmin Card from 'Baedarui Minjok', Woowa Brothers Corp.'s catering delivery application. The representative valuable information drawn from the database system is as follow.

1. Daily and Regional Covid-19 Confirmed Cases

	Area	Date	Total confirmed person(persons)
1	DAEGU	2020-02-29	741
2	DAEGU	2020-03-03	520
3	DAEGU	2020-03-01	514
4	DAEGU	2020-03-02	512
5	DAEGU	2020-03-04	405
6	DAEGU	2020-03-07	390
7	DAEGU	2020-03-06	367
8	DAEGU	2020-02-27	340
9	DAEGU	2020-03-05	321
10	DAEGU	2020-02-28	297

Fig. 2. Top 10 Daily and Regional Covid-19 Confirmed Cases

The regions of the top 10 most new confirmed cases were all Daegu. On February 29, there were 741 new confirmed cases in Daegu, which recorded the highest number as illustrated in Fig. 2. The second place was 520 new confirmed cases in Daegu on March 3, and the third place was 514 new confirmed cases in Daegu on March 1. We could figure out that the highest number of new confirmed cases showed from late February to early March.

2. Daily and Regional Delivery Cases

	Area	Date	Total number of deliveries(cases)
1	DAEGU	2020-02-29	94
2	DAEGU	2020-02-28	70
3	DAEGU	2020-02-27	68
4	GYEONBUK	2020-02-26	64
5	DAEGU	2020-02-26	59
6	DAEGU	2020-02-24	57
7	DAEGU	2020-02-23	54
8	SEOUL	2020-06-13	51
9	GYEONBUK	2020-02-29	45
10	DAEGU	2020-02-22	44

Fig. 3. Top 10 Daily and Regional Delivery Cases

In Fig. 3 the top 10 delivery cases were in Daegu, Gyeongbuk, and Seoul. Most of the time, there was a lot of delivery cases in Daegu. On February 29, 94 delivery cases were reported in Daegu, recording the highest figure. Fig. 3 showed that the highest delivery cases were made at the end of February.

3. The Number of Deliveries in Rainy Weather by Region

	AREA	DATE	Total number of deliveries(cases)	Precipitation(mm)
1	SEOUL	2020-06-30	25	64.7
2	GYEONBUK	2020-06-30	12	61.7
3	JEJU	2020-01-27	2	60.3
4	CHUNGBUK	2020-05-18	5	53.7
5	GYEONBUK	2020-07-01	9	51.7
6	GYEONNAM	2020-05-09	12	50.3
7	SEOUL	2020-01-07	4	46.3
8	DAEGU	2020-06-29	17	42.2
9	SEOUL	2020-06-24	13	37.6
10	GYEONGGI	2020-05-18	3	37

Fig. 4. The Number of Deliveries in Rainy Weather by Region

There were deliveries on rainy days as shown in Fig. 4, but it was hard to conclude that the more precipitation the more delivery. Therefore, the delivery data said that there was little correlation between precipitation and the delivery case.

4. Headlines with Top 10 Delivery Days

Delivery cases on February 29 recorded the highest figure with 171 cases. Except 4 of the 30 headlines on KBS, MBC, and SBS as shown in Fig. 5, Fig. 6 and Fig. 7, the rest dealt with Covid-19. In other words, news headlines on days with a high number of delivery cases mostly consisted of Covid-19-related content. Also, the more news about Covid-19 was reported, the higher the number of deliveries were made.

Select top 10 PMT.Date, SUM(PMT.PMT_GS) as "Total number of deliveries(cases)", KBS.AT_NM as "KBS headline", MBC.AT_NM as "MBC headline", SBS.AT_NM as "SBS headline"

From PMT, KBS, MBC, SBS

Where PMT.date = KBS.date and PMT.date=MBC.date and PMT.date=sbs.date

Group by PMT.Date, KBS.AT_NM, MBC.AT_NM, SBS.AT_NM

Order by [Total number of deliveries(cases)] desc:

Date	Total number of deliveries(cases)	KBS Headline
2020-02-29	171	3,150 cumulative confirmed..." 42 shincheonji Arrivals in Wuhan"
2020-02-26	166	Over 1,200 confirmed cases... 37 days after first confirmed diagnosis.
2020-02-28	147	3 more deaths, 570 confirmed cases... What is the situation in Daegu and Gyeongsangbuk-do Province?
2020-02-27	128	500 more confirmed cases... Seventy years old man who was in self-quarantine in Daegu dead.
2020-02-24	119	Covid-19 8th death toll... More than 830 confirmed cases.
2020-02-23	117	Infectious Disease Crisis Alert Upgraded 'Serious'... "preemptive response"
2020-02-22	114	Add 229 confirmed cases in one day... Accelerate 'Group Infection'
2020-02-25	91	11th death and confirmed accumulation of 977... 56% related to Sincheonji.
2020-07-01	90	U.S.-North Korea summit required before the U.S. presidential election. "The door to dialogue is open"
2020-06-30	80	(China) The Hong Kong Security Law has been passed. (U.S) Hong Kong's Special Status Abandoned.

Fig. 5. Headlines with Top 10 Delivery Days (KBS)

Date	Total number of deliveries(cases)	MBC Headline
2020-02-29	171	40 days of Covid-19. More than 3,000 confirmed people.
2020-02-26	166	The explosion of Daegu Sincheonji. Over 1,000 confirmed...
2020-02-28	147	"There's a lot of religious group infections." The lack of beds become a reality. "Stay at home 790 Daegu patients."
2020-02-27	128	450 confirmed in Daegu and Gyeongsangbuk-do Province... "82% of the Sincheonji is positive"
2020-02-24	119	231 more confirmed... "We will stabilize Daegu in four weeks."
2020-02-23	117	Raise crisis alert to 'serious' level... The Prime Minister will take the lead.
2020-02-22	114	229 confirmed cases in a day... The whole country has been breached.
2020-02-25	91	All-out quarantine in Daegu and Gyeongsangbuk-do Province... President Moon Jae-in "Make an inflection point this week."
2020-07-01	90	Worries become reality... First In-School Infection?
2020-06-30	80	Lee In-young is a strong candidate for unification minister... Launch Personnel Verification.

Fig. 6. Headlines with Top 10 Delivery Days (MBC)

Date	Total number of deliveries(cases)	SBS Headline
2020-02-29	171	More than 3,000 confirmed cases in Korea... "The number of confirmed Daegu patients will increase."
2020-02-26	166	More than 1,000 confirmed cases in Korea... 81% of patients in Daegu and Gyeongsangbuk-do province.
2020-02-28	147	2,337 confirmed cases in Korea... "Pandemic's resolutions and establish countermeasures"
2020-02-27	128	505 confirmed cases in a day... Daegu Shincheonji 82% Confirmed.
2020-02-24	119	Covid-19 8th death in Korea... 833 confirmed cases so far.
2020-02-23	117	Infectious disease in 11 years, Raise crisis alert to 'serious' level. President Moon Jae-in demand "strong response without precedent"
2020-02-22	114	The number of confirmed cases more than doubled in one day... 80% increase in Daegu and Gyeongsangbuk-do Province.
2020-02-25	91	11 Corona deaths, 977 confirmed... simultaneous national growth.
2020-07-01	90	32 confirmed in five days... Gwangju Upgrades Social-Distancing to Second Level.
2020-06-30	80	The Democratic Party of Korea has a super extra budget of 35 trillion won...

Fig. 7. Headlines with Top 10 Delivery Days (SBS)

5. Top 10 Delivery Cases of Daily and Regional Covid-19 Confirmed Days

	AREA	DATE	New coronic(persons)	Number of deliveries(cases)
1	DAEGU	2020-02-29	741	94
2	DAEGU	2020-02-27	340	68
3	DAEGU	2020-02-28	297	70
4	GYEONGBUK	2020-02-26	268	64
5	DAEGU	2020-02-26	178	59
6	DAEGU	2020-02-24	155	57
7	DAEGU	2020-02-23	148	54
8	GYEONGBUK	2020-02-29	79	45
9	DAEGU	2020-02-22	70	44
10	GYEONGBUK	2020-02-28	64	44

Fig. 8. Top 10 Delivery Cases of Daily and Regional Covid-19 Confirmed Days

On February 29, Daegu recorded the highest number of new confirmed persons compared to the other region as illustrated in Fig. 8. And the number of Daegu delivery persons was 94 and also recorded the highest figure on the same day. Next, on February 27, there were 340 new confirmed persons with 68 delivery cases in Daegu. Therefore, the number of deliveries increased as the number of new confirmed persons increased.

6. Number of Daily Deliveries Based on 'Covid-19' Search Volume

The criteria of search volume were relatively measured from January 1 to July 1, 2020 and the highest search volume was 100%. The search for 'Covid-19 (Corona)' on February 25 was set to 100%, the highest rate. The number of delivery cases was 91, as shown in Fig. 9. On February 24, the search volume for 'Covid-19' was 91.59% and the number of delivery cases was 119. If the rate of 'Covid-19' search volume exceeded 50%, the number of delivery cases was mostly more than 100. The higher rate of 'Covid-19' search volume, the higher number of daily deliveries.

Select top 10 LAB.L1 as "Covid-19(%)", PMT.DATE, Sum(PMT.PMT_GS) as "Total number of deliveries(cases)"

From PMT, LAB

Where LAB.DATE= PMT.DATE

Group by PMT.DATE, LAB.L1

Order by [Covid-19(%) desc];

	Corona(%)	DATE	Total number of deliveries(cases)
1	100	2020-02-25	91
2	91.59004	2020-02-24	119
3	85.89328	2020-02-26	166
4	81.99333	2020-02-27	128
5	77.20061	2020-02-28	147
6	71.03224	2020-02-23	117
7	70.95608	2020-02-22	114
8	68.26237	2020-02-29	171
9	63.60004	2020-02-21	70
10	41.35139	2020-02-20	46

Fig. 9. Number of Daily Deliveries based on 'Covid-19' Search Volume

7. Covid-19 related Keywords Search Volumes based on the Number of New Confirmed Cases

Select top 10 Coronic.DATE, Sum(Coronic.New_Coronic) as "New coronic(persons)", LAB.L1 as "Covid-19(%)", LAB.L2 as "Confirmed cases(%)", LAB.L3 as "Self quarantine(%)", LAB.L4 as "Regional infection(%)", LAB.L6 as "Social distancing(%)"

From Coronic, LAB

Where Coronic.DATE = LAB.DATE

Group by Coronic.DATE, Coronic.New_Coronic,
LAB.L1, LAB.L2, LAB.L3, LAB.L4, LAB.L6
Order by [New coronic(persons)] desc:

DATE	New coronic(persons)	Corona(%)	Confirmed cases(%)	Self quarantine(%)	Regional infection(%)	Social distancing(%)
2020-02-29	741	68.26237	21.07896	4.39924	5.67253	0.90412
2020-03-03	520	60.07905	19.31908	4.70997	7.21959	2.31286
2020-03-01	514	58.5719	17.99758	3.98752	4.58819	0.92514
2020-03-02	512	73.17345	23.12114	4.1154	5.11388	1.72413
2020-03-04	405	53.87875	18.57989	3.31466	6.31714	2.7439
2020-03-07	390	32.72681	9.6339	1.59429	4.0825	1.25105
2020-03-06	367	40.81752	13.73149	2.10998	5.15685	2.05004
2020-02-27	340	81.98333	32.32415	15.90766	8.59475	0.29436
2020-03-05	321	47.68293	15.13624	2.51095	6.8758	2.36543
2020-02-28	297	77.20061	27.73777	34.34838	5.8874	0.57821

Fig. 10. Covid-19-related Keywords Search Volumes based on the Number of New Confirmed Cases

The research selected 'Covid-19 (Corona)' search volumes, 'Confirmed Case', 'Self-quarantine', 'Community Spread', and 'Distancing' for Covid-19 related search terms, as illustrated in Fig. 10. The terms were also relatively measured based on 100% of February 29, 2020, when the number of new confirmed cases reached the highest figure with 68% of 'Covid-19' search volumes, '21%' of 'Confirmed Case' search volumes, '4%' of 'Self-quarantine', 5% of 'Community Spread', and 0.9% of 'Distancing' search volumes. The more Covid-19 confirmed, the more Covid-19 search volumes. It was difficult to identify a linear correlation between the keyword search volume and the number of the new confirmed case. However, keywords related to Covid-19 were constantly being searched.

IV. Conclusions

The research suggested the method of analysis for daily food delivery and consumption trends through big data of the post-Covid-19 era. It was confirmed that using sales data of the food delivery application 'Baedarui Minjok' serviced by 'Woowa Brothers Corporation,' four factors, except weather, had a significant correlation with the sales data. Among them, the most closely correlated factor was data from three broadcasting companies

(KBS, MBC, SBS), that is, media. On the day after the Covid-19 related new article was released, food delivery sales soared up to about 60%, showing remarkable results. In addition, it was confirmed that a significant increase in sales occurred on the days before and after the relative figures of the Naver search results replacing SNS data soared up.

During the research, it was confirmed that factors such as mobile media and web surfing were also the main factors in the increase in sales of delivery applications. This suggested that crawling and analyzing data from social network services (SNS) used by Y, Z, generation and millennials could also be a major factor in increasing food delivery sales. Therefore, it can be seen that viral marketing can be an important key for market exploration and product positioning for companies that want to launch similar types of applications. In addition, it is expected that delivery companies in the post-Covid-19 era can be useful in business operation based on meaningful information derived from finding the association between the set external factor (entity) and the increase of delivery sales.

The research can contribute the companies in the economic recession era to survive by providing the method for analyzing the big data and increasing their sales.

Limitation of the research exists in collecting delivery application sales data. The price of the actual data was traded between about 15 million won and about 20 million won, which was not suitable for the researchers with operational budget caps. Therefore, the biggest limitation of this research is that the results are a little insufficient by using the delivery sales data paid by only KB Kookmin Card instead of the whole sales data from 'Baedarui Minjok'.

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