Initiatives Supporting COVID-19 Countermeasures and Contributing to Society Using Dynamic Population Analysis from Smartphone Location Data

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1. About AGOOP Corp.

Agoop was established as a wholly owned subsidiary of SoftBank in 2009, as an enterprise specializing in location Big Data. We have contributed to SoftBank Mobile Corp. (now SoftBank Corp.) becoming the "No. 1 Smartphone for ease of connection" in 2012, by collecting and analyzing smartphone packet connection rate data, using GIS to identify areas with poor connectivity and helping to improve wireless service efficiently. Since 2014, we have conducted analysis using our own technology to collect location and sensor data with a smartphone application, developed dynamic population data to visualize the movements of people, and provided valuable information that brings new perspectives to business in a wide range of fields, including disaster response, tourism and marketing.

In 2018, we started a new service called "Kompreno," which provides real-time visualization of dynamic population data. This was followed by other services including the "Papilio" service in 2019, which makes it easy to know the population staying by time of day at locations such as train stations and touristic sites throughout Japan, and "Population-flow statistics reports" in 2020, which provide detailed analysis and visualizations according to customer requirements. In 2022, we also began providing "Machi Repo," which is a dynamic population marketing tool that enables free definition of areas to be investigated, so visitors to that area can be studied.

2. Initiatives supporting COVID-19 countermeasures

2.1 Overview

To support countermeasures for the COVID-19 pandemic, we have provided dynamic population analysis reports from major areas throughout Japan (major train stations, commercial and touristic areas) to government agencies (Cabinet Secretariat, MIC) local governments and the media throughout Japan since April 2020. Providing such dynamic population analysis reports to each local government and administrative agency enables them to quickly understand changes in population flow at a regional level, due to factors such as the declarations of emergency and requests for residents to constrain their movements, and has been helpful in verifying the effects of countermeasures taken and in planning further measures. By also releasing dynamic population reports to the media free-of-charge, conditions of people going out was reported daily, increasing residents' awareness of COVID-19 and contributing to suppressing spread of infection.

2.2 Features of dynamic population data

(1) Graphs of dynamic population trends in 20,000 locations throughout Japan

The dynamic population data used for COVID-19 countermeasures consisted of statistics based on smartphone

Figure 1: Major train station example (Tokyo station)

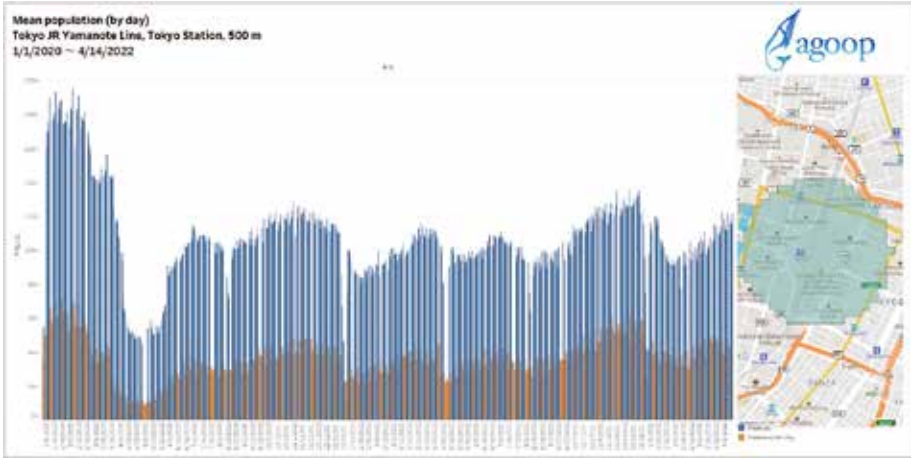


Figure 2: Major touristic/entertainment area example (Kyoto, Arashiyama)

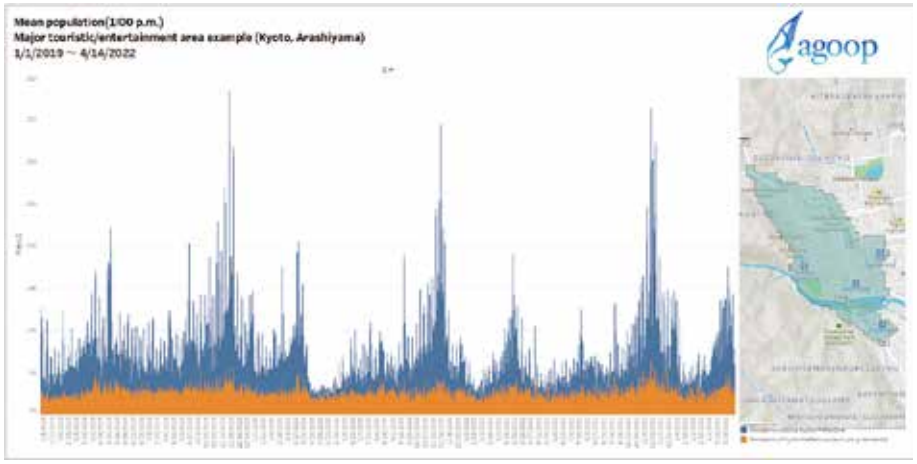
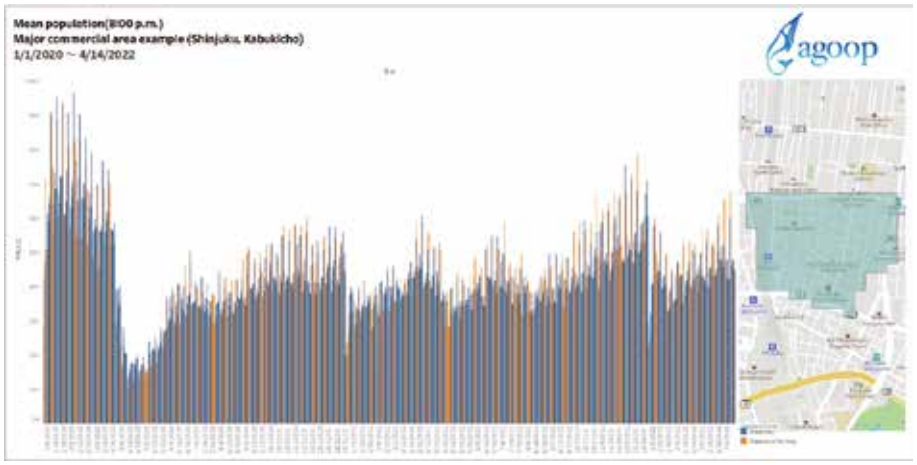


Figure 3: Major commercial area example (Shinjuku, Kabukicho)



Figures 1-3 are excerpts from "Analysis of dynamic population changes with the spread of COVID-19" on the Agoop web site (https://www.agoop.co.jp/coronavirus/)

location data, which is converted to a mesh covering the entire population of Japan. It can be used to display graphs of hourly dynamic population trends at 20,000 locations throughout Japan, such as major train stations, commercial and touristic locations, from January 2020 till the day before the service started. Dynamic population analysis reports from over 100 selected train stations, commercial and touristic locations for every day since April 2020 are summarized and published free-of-charge on our web site.

(2) Visualization of visitors' areas of residence

Visitors can be aggregated based on their area of residence (in city/town/village, in prefecture, or outside prefecture), so that population flows can be known at finer detail than the prefectural level. These can be used to show changes due to COVID-19 countermeasures or seasonal fluctuations in the in-flow to major touristic areas from other prefectures.

(3) Adjustment of areas

For major commercial and touristic areas, which cannot generally be designated with concentric circles, polygon data was prepared to define the optimized ranges for these areas. Major areas throughout Japan, such as Kabukicho (in Shinjuku, Tokyo), were defined so that they can be analyzed using optimized areas.

2.3 Issues with providing and publishing data and how it is handled

In the past, use of Big Data required data scientists because expensive analytical tools had to be purchased and were difficult to use. To actively promote utilization of data, we have moved from providing data to providing results of analysis, and attempted data-use in a wide range of fields. We have prepared population-flow trend graphs in PDF files that can be viewed easily, so that difficult tools and other systems that were required for data utilization earlier are no longer needed. We have also implemented Robotic Process Automation (RPA) for all operations in dynamic population analysis, so that information can be provided reliably

at any time, for any time period and regardless of weekday or holidays. By implementing RPA, we can provide the information needed, quickly and at low-cost, without the need to purchase expensive analytical tools or employing data scientists, and have built a new information service providing analysis reports.

2.4 Seed technologies

Seed technologies used for dynamic population analysis include a location data collection software development kit (SDK), data collection applications, a Big Data processing cloud platform, RPA implementation, data anonymization technology and data scientists.

(1) We have developed our own software for smartphone applications (an SDK) for collecting comprehensive GPS data using very low-power computation, for safe collection of GPS data that is the basis of dynamic population data, without collecting personal information from any individuals.

(2) GPS information is privacy data, so obtaining agreement from users in a form that is easy to understand is a major assumption. We also develop applications and when incorporating functions that use GPS, our applications obtain agreement to collect GPS data at the time the application is launched for the first time, before using such data.

(3) Technology for building a cloud-based processing platform to rapidly accumulate, process and analyze at high speed, the large amount of GPS data sent from user terminals.

(4) Technology for building systems that analyze and process GPS data in various ways, to generate dynamic population data and implement RPA without the need for human intervention.

(5) GPS data itself contains privacy data with potential for identifying individuals, so we have technology for anonymization, which masks information regarding individuals' range of movements (their homes, etc.).

(6) Our internal data scientists are also an important technology seed (HR), with their ability to produce analysis suitable for each objective by trial and error, and derive results that convey to correct meaning to users.

These six points are important seeds for providing value, starting with data collection and including everything from storage, processing, analysis, and report generation. In particular, the most important things when handling Big Data are not to have large amounts of data, but to have a wide range of data that can be analyzed from various perspectives, to have technology that can process and provide it quickly, and to have personnel that can perform analysis and development quickly in rapidly-changing crisis conditions.

2.5 Publishing analysis supporting economic recovery from COVID-19

We have published reports of analysis to support economic recovery after the prolonged economic suppression due to COVID-19 on our web site. With all of Japan operating in a self-restraint mode, business districts, large-scale commercial areas and touristic areas experienced dramatic decreases in visitors, and many areas suffered economic distress. We are providing evidence for solutions to this issue, with quantitative dynamic population data that shows the movements of people. These can be used for a new type of area marketing based on changes in people's movements.

Figure 4: Changes in staying population and demand as COVID-19 spread

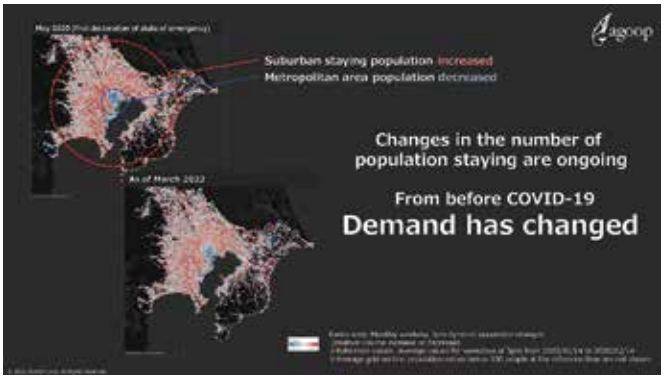
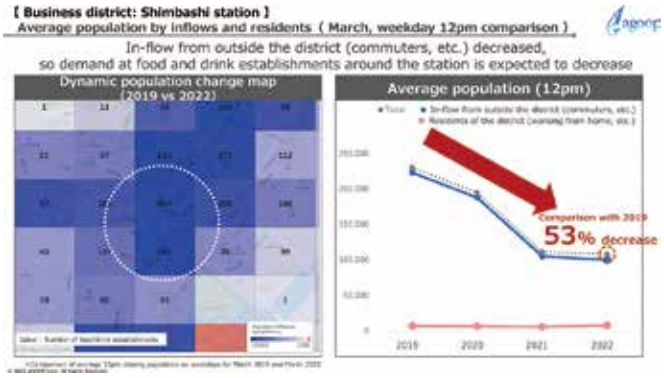


Figure 5: Shimbashi station average in-flow and resident populations



Figures 4-5 are excerpts from "Analysis supporting economic recovery" on the Agoop web site (https://www.agoop.co.jp/coronavirus/)

3. Initiatives contributing to society

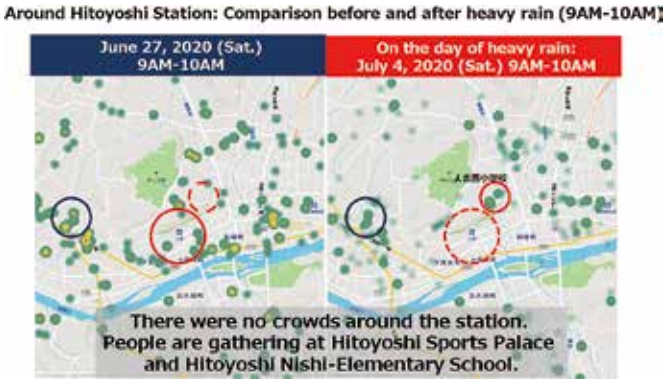
3.1 Use of dynamic population data during disaster

When heavy rains occurred beginning on July 3, 2020 in the Kyushu and Chubu regions of Japan, mainly in Kumamoto Prefecture, we published analysis of people gathering at refuge centers based on our dynamic population data, which was used for decision making in the initial stages of response to the disaster at the Japanese Red Cross Kumamoto Hospital.

Based on the analysis of evacuation conditions that we provided, the infrastructure support team, which handles improvements to the living environment at refuge shelters, decided to go to the Hitoyoshi-Kuma region for disaster response. This was one of the first cases in Japan, in which dynamic population data based on location data from smartphone applications was

used for decision making in the initial stages of disaster response.

Figure 6: Evacuation situation analysis provided to the Japanese Red Cross Kumamoto Hospital

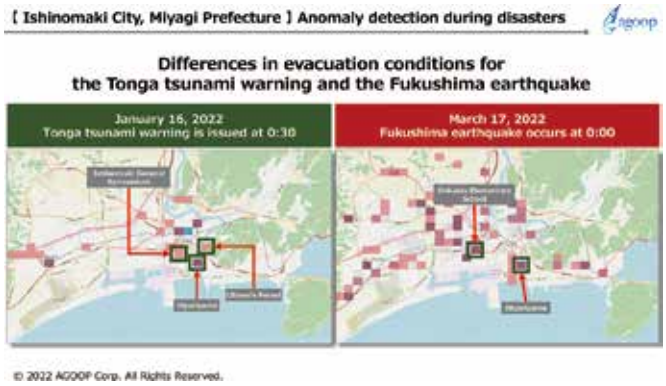


3.2 Research using AI to detect anomalies in dynamic population during disaster

In joint research with the National Research Institute for Earth Science and Disaster Resilience (NIED) (under the Public/Private R&D Investment Strategic Expansion PrograM (PRISM)), we are developing AI technology to detect anomalous increases and decreases in dynamic population. When a disaster occurs, sudden changes in population fluctuations to usual are detected as anomalies. Areas experiencing anomalies are selected by analyzing conditions 15 minutes prior. Other research is being done to support rapid initial mobilization, by quickly providing an understanding of operations at refuge centers, evacuation conditions to other locations, and other conditions such as blocked roadways, congestion at train stations that can delay evacuation.

As an example, we analyzed anomalies in Ishinomaki City, Miyagi Prefecture, during disasters. When the Tonga tsunami warning was issued on January 16, 2022, most of people did not evacuate, but after the Fukushima earthquake on March 17, 2022, people seeking refuge at refuge centers increased, showing that they were evacuating quickly. This may have been because when the Tonga tsunami warning was issued, it did not accompany an earthquake, so many people thought they would be okay without evacuating. For the Fukushima event, people felt the earthquake, resulting in mobilization of the affected people.

Figure 7: Difference in evacuation conditions in Ishinomaki City, Miyagi Prefecture disasters, detecting anomalies for the Tonga Tsunami warning and the Fukushima earthquake



3.3 Carbon-neutral initiatives using dynamic population data

As a company facing the challenge of creating new value in the world with technology, we are all working together to solve problems for people and society and to contribute to SDGs that will realize a sustainable society. As such, we have set as our vision, to "Create mechanisms that bring happiness to people and society." One of the many problems facing society that we have chosen to prioritize is achieving carbon neutrality.

In urban and touristic areas that do not have much public transport, congestion occurs because tourists use rental cars and commuters use their own vehicles, and chronic congestion results in increased CO_2 emissions. To reduce CO_2 emissions, private vehicles need to be replaced with EVs and the environment must be reorganized to make transport easier, without being dependent on private vehicles. To study new means of mobility that will reduce CO_2 emissions, we are using dynamic population data on commuting to work and school as evidence supporting proposed improvement measures. By reexamining and studying public transportation using dynamic population data as an index, we hope to contribute to maintaining safe and secure lifestyles for people, with cooperation of regions and companies on measures such as changing modes of transport or staggering work hours based on data.

Figure 8: Reviewing public transportation using dynamic population data