Challenge!! Open Governance 2016 Application Form for Citizens/Students

	No.	Title	Name of Municipality
Title of the Agenda (Note)	27	"Building a system where about 2,300 anti-crime activity groups in Kanagawa Prefecture can cooperate effectively with the police, municipalities, businesses, and relevant bodies such as schools to achieve safety and security of the area, and new anti-crime measures"	Kanagawa Prefecture
Title of the Idea (disclosed)	"A patrol route suggestion system for the police and municipalities using mathematical crime prediction"		

(Note) For the Title of the Agenda, please fill in the title of the agenda of the municipality that is applying for COG listed in the COG2016 website.

1. Applicant Information

Name of Team (disclosed)	Singular Perturbations	
Team Style (disclosed)	(•) 1. Team of citizens ( ) 2. Team of students ( ) 3. Team of both citizens and students	
Information of the representative (only the name will be disclosed)	Name (disclosed)	Yayoi Yamamoto
	e-mail (disclosed)	
	Tel#(disclosed)	
	Relationship in between the rep. and the municipality	

* About the conditions for the disclosure of information

What you are going to fill in in "2. Description of the idea" in the following pages will be reviewed and disclosed under the Creative Commons Attribution 4.0 International License (CC BY). However, if the applicant requests, it will be disclosed under the Creative Commons Attribution 4.0 International License (CC BY-NC). Please notify us when you apply if you prefer this. In either case, the credit will be given to the name of the team that applied.

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(Notes)

<Name of the file used for the application and where to send them>

1. Upon application, please name the file as COG2016_応募用紙_specific team name_relevant municipality name and send it to the following email address. The email address can be accessed from the “Application Acceptance Section” of the COG2016 website of the University of Tokyo, Graduate School of Public Policy. admin_padit_cog2016@pp.u-tokyo.ac.jp

<About Disclosure and non-disclosure>

2. The name of the idea, the name of the team, the team style, the name of the representative, and the “description of the idea” will be disclosed.
3. The above information will be disclosed after review. (For example, anything that is offensive to public order and morals or plagiarism will not be disclosed.)
4. “Self-evaluation of the screening items” will not be disclosed through the information provided in this application form. What has been determined to be excellent in content and can possibly be used for future reference may be disclosed after consulting with the applicant during the advice phase after the public screening.
5. Any parts of the sentences, photos, figures, and graphics used in the “Description of the idea” section whose intellectual property belongs to anyone other than the team should be noted in quotes in accordance with law or with an explanation that permission has been obtained from those who own the intellectual property rights. The same applies to the “Self-evaluation of the screening items” section.

<List of team members>

6. Please provide the list of the team members in a separate excel file and submit it with the application form. (The information of the members other than the name of the team representative, as described in 2. will not be disclosed by the office of COG. Please see the attached document for details.)

2. Description of the idea (disclosed)

Please tell us the story of the idea (public service) that will help concretize the agenda and solve related problems using data and information materials.s

(1) Content of the idea (disclosed)

For the idea, it is recommended to think of who does what, where, when, and how, construct the content with each of these elements, and organize the story. Please provide the content within the following section. (You may use figures and tables as needed.)

In Kanagawa Prefecture, the reported number of crimes have drastically decreased in the last 13 years thanks to the voluntary anti-crime activity groups, but the members of these groups have been mostly fixed and the activities have fallen into a rut in recent years. Therefore, effective measures are necessary to revitalize the activities. At the global level, things are changing faster than ever, especially in advanced countries, leading to crimes committed by people of various nationalities using diverse and high-tech methods, and the trend is toward nuclear families and the fragmentation of local communities. Therefore there is a growing need for prompt security measures. The number of attempts to visualize or notify past crimes is gradually increasing in Japan, but the key to forward-thinking crime deterrence has shifted from “prevention” to “prediction,” which is the trend most conspicuous in the United States. It has

actually been reported that highly efficient patrols based on crime prediction have had a great effect on crime deterrence. Against such a background, we propose the following two strategies as our idea in this application.

（1）An efficient patrol route suggestion system using a mathematical crime prediction algorithm

The applicant has developed a mathematical crime prediction algorithm called “data-derived Green’s function method,” or DDGF method), which has achieved the highest level of prediction accuracy in the world against the open crime data of the United States (see (2) for the basis of the idea in the next section). This method describes near-repeat victimization, which refers to the idea that criminals return to their crime scenes; using the point process, the method utilizes a mathematical framework to determine Green’s function based on past crime data. We are ready to build a system that allows us to predict where crimes tend to occur today based on past crime data and then suggest the best patrol routes that can contribute to the development of a safe and secure community.

（2）Mobile application that distributes and notifies the police of the results of crime prediction every day

The challenge in involving the working generation in anti-crime activities is the fact that the current anti-crime activities are high-burden tasks. The existing analog methods lack convenience from the viewpoint of those who are busy with work and household chores and cannot devote their time to the community from remote sites, such as homes or workplaces. Therefore, we propose a mobile application that connects those who are at work with anti-crime groups. The groups will notify those who are at work or away of the crime prediction results and information on anti-crime activities that are highly relevant to the users, such as information on their neighborhood or the school routes of their children, while the recipients send a feedback on cases that they think are interesting (a function equivalent to Facebook’s “Like”). This bi-directional communication will expand the possibilities that the workers will commit more of their time; this may be a step toward breaking out of the rut in terms of the members of the anti-crime groups.

To realize this public service, the three relevant parties, citizens, municipality, and police must cooperate with each other and with the researchers, who develop the crime prediction algorithm and the IT system.

1) Citizens: Anti-crime activities using the mobile application.

2) Municipality: Coordination with the police and securing the budget for the promotion and development of the app.

3) Police: Providing data and permission to use the data, providing a place where the researchers can conduct a demonstration experiment to verify the algorithm within the police organization.

2) Basis of the idea (disclosed)

Please explain the basis of the idea (why this idea), including numerical data that supports the idea (what can be shown by numerical values, such as past results, statistics, or questionnaires) and evidence (information materials, plans, or existing measures, etc.) (hereinafter collectively referred to as “data materials”). Please indicate the sources of the numerical data or evidences. Make sure you completely explain the basis within the following two-page section.

“Why crime prediction is possible”

Studies on crime prediction have been carried out mainly in the field of crime psychology, geography, and spatial information science. The trends in crime are evolving every day in recent years and diverse approaches are necessary, as internationalization, diversification, and advancement of technology continue. Under such circumstances, mathematical researchers specializing in physical mathematics or machine learning began to enter into the area of crime predictions [1]. Indeed, in the United States, associate professor George Mohler proposed a crime prediction algorithm using a machine learning method called expectation-maximization （EM） in 2011. Based on this algorithm, a start-up business that suggested patrol routes for the police was established (Predpol [2]) and reports indicate about a 20% decrease in the number of crimes, which is outstanding [3]. Bearing such global trends in mind, the applicant has devised a new method to predict crimes based on theoretical physics and is now working on an academic paper on this topic.

Occurrence patterns can be found in the past crime data in terms of time and space. Near-repeat victimization is known as a phenomenon where criminals return to their crime scenes and repeat crimes. The point process model, which predicts crimes based on the assumption that past crimes trigger future crimes, is a model that describes this phenomenon. There are two methods based on this model: the prospective hotspot mapping method (PHOT method [4]), which approximates the effect of past crimes using functions that include artificial parameters, and the method of inductively determining the effect of past crimes via the machine learning EM method [5]. With the parametric method, the control parameters of the model cannot be automatically determined and therefore there are issues with accuracy. The applicant attempted to build a data-producing non-parametric “DDGF method” using physics. As a result, we were able to embody the characteristic that the effect of past crimes are described on two time scales––a short and a long period of time––that allow us to make highly accurate predictions. The following are the results of a demonstration of this method:

Based on the petty crime data obtained from Mail Keishicho, crime prediction was carried out using the data of molesters, suspicious individuals, burglars, and thugs. Figure 1 shows the three-dimensional plot of the crime occurrence rate of July 2, 2015, which predicted using 100 days of data from March 24 to July 1, 2015. Green shows areas where crimes are least likely to occur; if the color is closer to red, crimes are more likely to occur. Arrows show the places where crimes actually occurred on July 2, 2015. Comparison between the prediction results and the

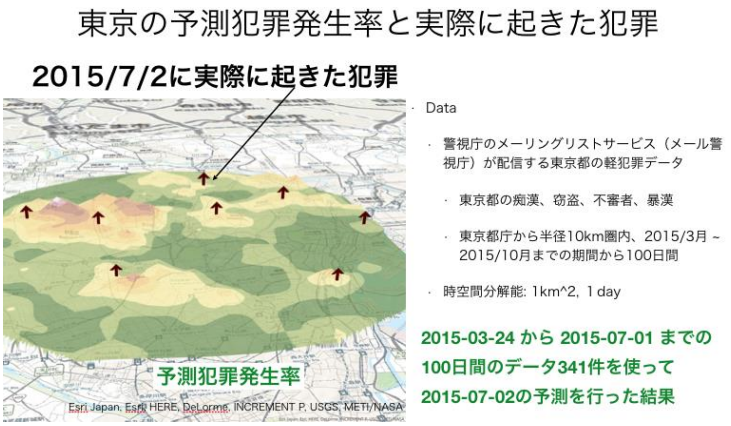
actual crimes shows that the crimes actually occurred in places where crimes were more likely to occur based on the prediction. We can estimate accuracy by repeating this experiment and testing several samples.

Figure 2 shows the measurement of the accuracy of prediction using Chicago's open data. Fifty days were chosen out of the home invasion cases of the year 2011 and the accuracy of the existing methods was compared with the method proposed here. The results show that the method proposed here has higher accuracy than the existing methods. The same results were obtained with the home invasion cases from New York. Although the EM method is known to have the highest prediction performance among the existing methods [6], the original method proposed here by the applicant has even higher potentials.

"How it is possible to develop a mobile app"

The applicant team has released an iOS application that distributes the past daily crime data displayed on the map in August 2014 [7]. This app was nominated for the MVP of the month in November 2014 in "Nekketsu!! App Battle" sponsored by Weekly Ascii and was ranked second [8]. Several companies subsequently approached us, and we sold this app to one of them. Based on this experience, we can build the same type of app within approximately a two-month period.

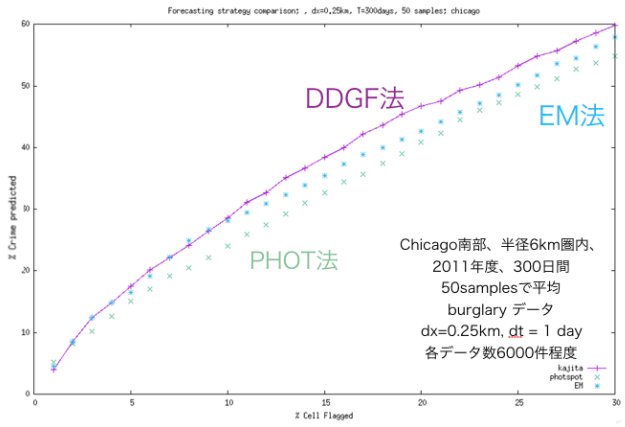
[1] http://www.ucl.ac.uk/cpc/?page_id=242
[2] http://www.predpol.com
[3] http://cooeydailypress.com/can-police-foretell-crime/
[4] Bowers, K.J., Johnson, S.D., and Pease, K., 2004. British Journal of Criminology, 44 (5), 641–658
[5] Mohler, G.O., et al., 2011. *Journal of the American Statistical Association*, 106 (493), 100–108
[6] Adepeju, M., Rosser, G. & Cheng, T. (2016) International Journal of Geographical Information Science.
[7] https://www.youtube.com/watch?v=Gz6Nceqdy0I
[8] https://www.youtube.com/watch?v=k1nO3yVGx9M



東京の予測犯罪発生率と実際に起きた犯罪	Predicted crime occurrence rate in Tokyo and actual crimes that occurred

2015/7/2 に実際に起きた犯罪	Crimes that occurred on July 2, 2015
予測犯罪発生率	Predicted crime occurrence rate
警視庁のメーリングリストサービス（メール警視庁）が配信する東京都の軽犯罪データ	Tokyo's petty crime data distributed by the mailing list service of the Tokyo Metropolitan Police Department (Mail Keishicho)
東京都の痴漢、窃盗、不審者、暴漢	Molesters, suspicious individuals, burglars, and thugs in Tokyo
東京都庁から半径 10km圏内、2015 年 3 月～2015 年 10 月までの期間から 100 日間	10 km radius from Tokyo Metropolitan Government Tower, during the 100 days from March 2015 to October 2015
時空間分解能	Temporal and spatial resolution
2015-3-24 から 2015-7-01 までの 100 日間のデータ 341 件を使って 2015-7-02 の予測を行った結果	Results of the prediction for July 2, 2015 based on the data of 100 days from March 24 to July 1, 2015

Figure 1: Places where petty crimes have occurred (↑) and the three-dimensional plot of the crime occurrence rate predicted via the DDGF method.



Chicago 南部、半径 6km 圏内、2011 年度、300 日間 50samples で平均 burglary データ	Southern part of Chicago; area within a radius of 6 km; FY2011; 300 days; average of 50 samples, burglary data
各データ数 6000 件程度	Number in each dataset: about 6,000 items

Figure 2: Comparison between the data-derived Green's function method (DDGF, originally created by the applicant), the expectation-maximization (EM) method, and the prospective hotspot maps (PHOT) method. The horizontal axis shows the ratio of the area (size) where crimes were predicted to occur. The vertical axis shows the ratio of the crimes that actually occurred in places where crimes were predicted to occur.

3) The flow of activities leading up to the realization of the idea (disclosed)

Please explain briefly the general flow of activities leading up to the realization of the idea, including the body in charge of the realization of the idea, specific processes, milestones, etc. within the following section. (You may use figures and tables as needed).

The above idea will be realized through the following three steps.

（1） April to August 2017

(Applicant) will verify the accuracy of several point process-based crime prediction methods. We already have compared the accuracy of these methods using the open data of Chicago and New York as well as open data distributed through the mailing list of the Tokyo Metropolitan Police Department (data set of Creative Common License has been collected). The same procedure will be applied to the open data of the Kanagawa Prefectural Police. Because the accuracy varies sensitively according to the type of crimes, area, period, and temporal and spatial resolution, the dataset suited to the comparison of the methods and the prediction results will be presented.

(Municipality) will coordinate the project for the police. The municipality will negotiate the permission necessary to use the crime data for distribution through the mobile application and the permission to conduct a test using the crime prediction algorithm within the police station.

（2） September to December 2017

(Police) will conduct a crime prediction experiment using crime data with the researchers.

(Municipality) will bring ideas that may contribute to effective crime deterrence and decide what kind of information needs to be gathered about citizens using the mobile application.

(Applicant) will conduct a test of the crime prevention algorithm within the police station and design the structure of anti-crime patrol activities using the mobile application.

（3）January 2018 onward

Citizens will be notified of the dangerous zones through the mobile application and a demonstration test will be carried out to verify its effectiveness. Information will be notified through curation notification based on the attributes of each citizen, such as gender, age, family structure, and sphere of life, while crime prediction information will be distributed to suggest effective citizen patrols.

(4) Others (disclosed)

Briefly explain the selling points of the idea, restrictions upon realization of the idea if any, near-term solutions, and potential for the future (for example, “if the limitation of XX can be eliminated in the future, we can also do YY”) within the following section.

The biggest restriction upon realization of the idea is the disclosure of open crime data and the permission to use it. There are two problems here.

（1）Permission to distribute the crime data using the mobile app (e.g., data of the cho-me resolution level given privacy policies).

（2）Permission to analyze the detailed crime data for the verification of the algorithm (e.g., high resolution data only permitted for use within the police station)

If we can resolve these problems, we can expect the following developments in the future.

Crime prediction depends heavily on detailed conditions, such as the type of crimes, area, and period of the year, while prediction accuracy is sensitive to the data or the model used. Because studies of crime prediction methods have been actively carried out primarily in countries that are willingly trying to make crime data open, i.e. in the United States and in Europe, the effectiveness of such methods has not been verified in Japan where data is not yet open. The distinctive feature of Japan is that the number of crime datasets is fewer than in other countries and therefore it is necessary to build an efficient prediction method for crimes with fewer datasets. If we can realize the strategy that has been proposed in this application, we can ultimately use the original crime prevention system and conduct a demonstration test with the police, which will be the first attempt in Japan to select and fine-tune an algorithm appropriate to Japan’s crime data.