

Statistical Analysis on Nightlife Entertainment District

Direction of Analysis

- ① PCR positive ↑ ➡ behavior modification, crowd ↓ ➡ PCR positive ↓
- ② Message from government ➡ wearing mask, avoiding 3C, staying indoor (crowd ↓)
 ➡ PCR positive ↓
- ③ Test (Test in the city ↑, intensive test* in the entertainment district ↑)
 ➡ in the short time : PCR positive ↑
 in the long term : PCR positive ↓
- ④ Shortening of business hours ➡ Crowd ↓ ➡ PCR positive ↓

- Analysis of the rough tendency : contribution ratio of the decreasing of crowd¹⁾ (July 1 – August 15 in the district), the number of test in the city (June 14 – August 22) /population of the city, the number of intensive test in (June 14 – August 22) /number of nightclub²⁾ to the number of PCR positive (June - August) in 5 districts
- Estimation of the effect of measures using weekly data considering the time lag

- 1) There are some classification in “crowd” such as the number of person who went shopping, etc. and the number of person who were in the nightlife entertainment district.
- 2) Nightclub under the Law Regulating Adult Entertainment Businesses.

* “Intensive test” means the inspection for the staff of the nightlife entertainment business and the inspection near the entertainment zoon (spot test) carried out at each entertainment district after April apart from the ordinary test for the person who has symptom or who has a close contact with PCR positive.

Contribution ratio

Model assumption

Decreasing ratio of weekly PCR positive

$$= k_0 + k_1 \times \text{Number of test/population} \\ + k_2 \times \text{Number of intensive test/number of nightclubs} + k_3 \times \text{Decreasing ratio of crowd} \\ + \epsilon$$

Decreasing ratio of weekly PCR positive

(Max of weekly PCR positive – min of weekly PCR positive) / max of weekly PCR positive [during June - August in the city]

k₀ (constant)

Decrease ratio of PCR positive when all the variables are zero. k_0 may express a factor such as wearing mask and avoiding 3C (Closed spaces, Crowded places, and Close-contact).

Number of test/population

The number of test in the city from June 14 to August 22 / population of the city

Number of intensive test/number of nightclubs

The number of intensive test in the district from June 14 to August 22 / number of nightclub

Decreasing ration of crowd

(Max of weekly crowd – min of weekly crowd) / max of weekly crowd [during the week of July 1 - August 15 in the district]

ϵ

Differences between calculated value and actual value

Contribution ratio

Decreasing ratio of weekly PCR positive

$$= k_0 + k_1 \times \text{Test/population} + k_2 \times \text{Intensive test/nightclubs} + k_3 \times \text{Dec. ratio of crowd} + \varepsilon$$

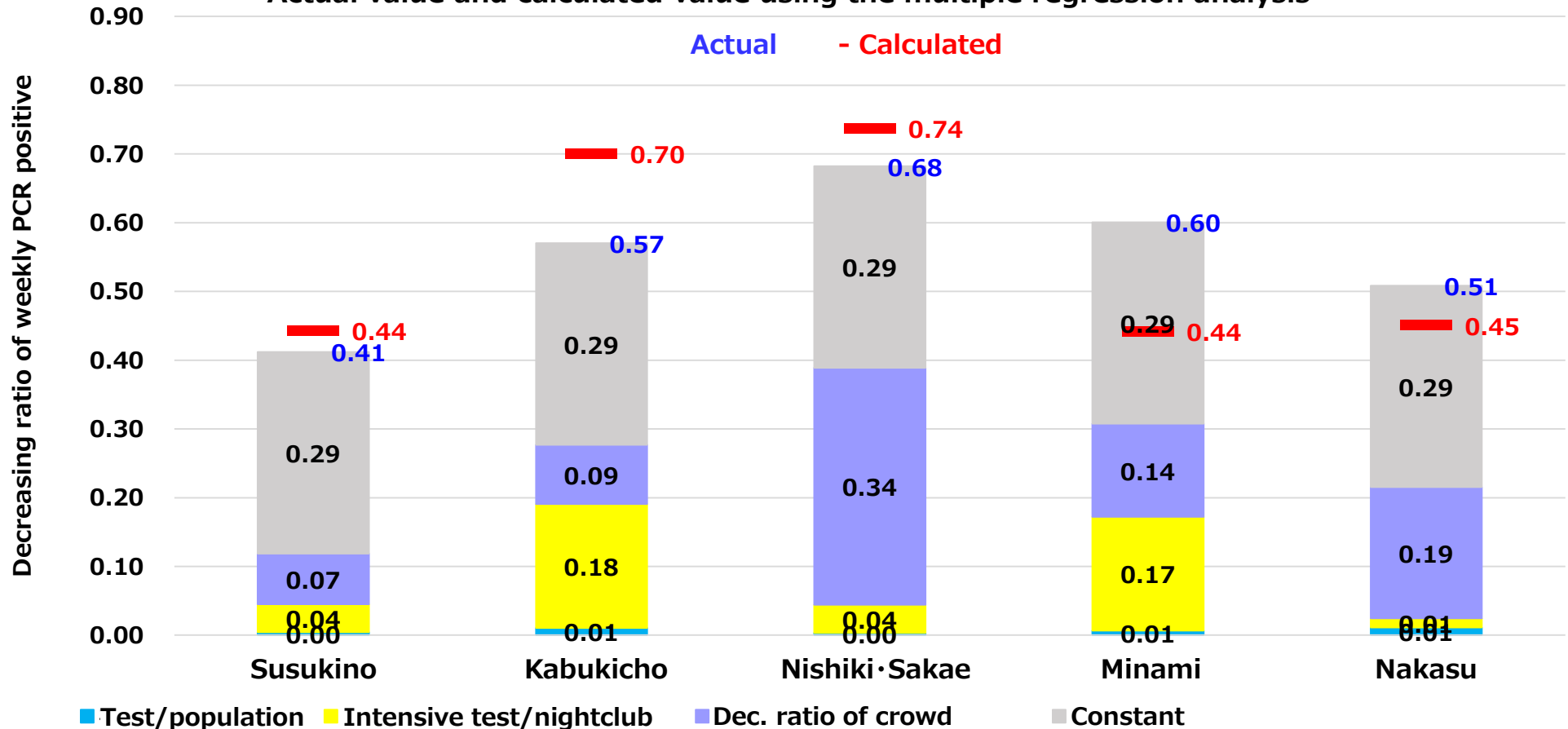
(ratio)

1.9%

40.9%

57.3%

Actual value and calculated value using the multiple regression analysis



[Reference] Relation between crowd in retail and entertainment sectors and number of infected persons

We have examined whether causal relation could be observed between change in outing ratio represented by Google mobility index and change in the number of newly infected persons. Significant relation was found in **outing ratio** caused by **the number of newly infected persons** in the first quarter only, but this finding was not established from the second quarter onwards.

Figure 1 the number of newly infected persons nationwide and Google Mobility (retail and entertainment)

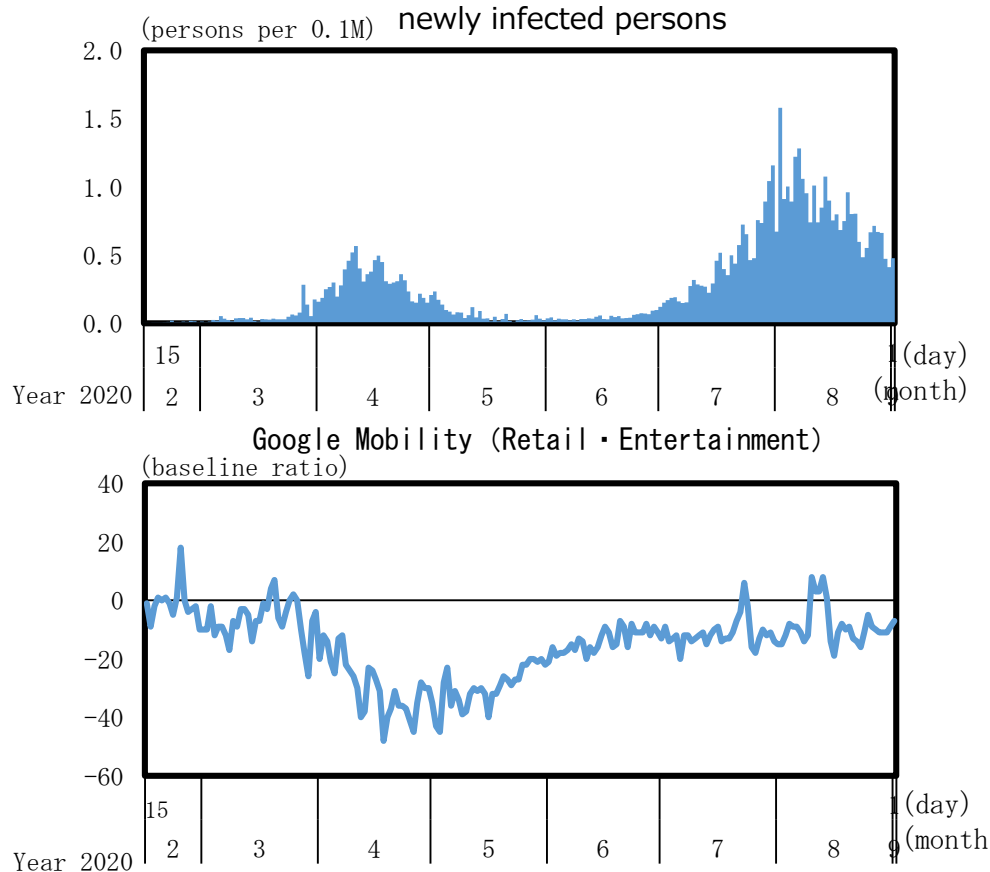


Figure 2 the relation between the number of newly infected and Google Mobility (retail & entertainment)

1st Quarter: 15th Feb~31st May	Granger causality
outing ratio \Rightarrow infected persons	No
infected persons $\uparrow \Rightarrow$ outing ratio \downarrow	Yes

2nd Quarter : 1 st Jun~1st Sep	Granger causality
outing ratio \Rightarrow infected persons	No
infected persons \Rightarrow outing ratio	No

Weekly Effect Analysis

Susukino / Sapporo City

Week	No. of tests per 10K (1.959M)	No. intensive tests per 1K night clubs (5841 clubs)	crowd	PCR positive
6/14~	5.63	0.00	434470	27
6/21~	3.51	0.00	472237	7
6/28~	4.48	0.00	465218	24
7/5~	4.20	0.00	494374	8
7/12~	5.46	0.00	482743	41
7/19~	5.98	21.57	489941	41
7/26~	9.51	87.13	454435	40
8/2~	12.21	87.13	455463	70
8/9~	8.86	42.78	450786	64
8/16~	8.42	24.45	457891	43
8/23~	9.77	29.96	491388	39
8/30~	10.50	43.02	468199	45
9/6~	9.74	36.31	488652	43

•With regard to the number of municipal tests, intensive tests and PCR positive it is important to look at the increasing ratio, therefore the boxes of statistics above average are colored; light pink for 0~1 deviation, pink for 1~2 deviations, red for 2~3 deviations above average during the period from 14th June to 29th August.

•With regard to the crowd it is important to look at the fluctuation, therefore the boxes of statistics 10% above or below the week of 14th June are colored; light blue for more than 10% below, and light pink for more than 10% above the 14th June line.

Weekly Effect Analysis

Kabuikicho / Shinjuku Ward

week	No. of tests per 10K (348K)	No. intensive tests per 1K night clubs (3964 clubs)	crowd	PCR positive
6/14~	7.44	65.34	244625	90
6/21~	9.57	84.01	256910	79
6/28~	15.52	136.23	238810	112
7/5~	20.69	181.63	235126	286
7/12~	29.91	262.61	230548	321
7/19~	20.69	181.63	229307	293
7/26~	28.25	247.98	234331	220
8/2~	13.05	114.53	233384	179
8/9~	9.34	81.99	239922	206
8/16~	8.71	76.44	237641	128
8/23~	8.22	72.15	263302	96
8/30~	8.56	75.18	273004	72
9/6~	6.35	55.75	275503	63

(Note) Clubs were requested to shorten their business hours during the period from 3rd August to 15th September.

Weekly Effect Analysis

Sakae/Nagoya City

Week	No. of tests per 10K (2.302M)	No. intensive tests per 1K night clubs (2379 clubs)	crowd	PCR positive
6/14~	0.83	0.00	342001	6
6/21~	0.79	0.00	362180	0
6/28~	0.64	0.00	352093	1
7/5~	0.82	0.00	367224	5
7/12~	1.79	0.00	380028	53
7/19~	3.50	48.34	308078	230
7/26~	6.72	102.56	261258	561
8/2~	9.70	97.10	218828	575
8/9~	1.35	51.70	172438	311
8/16~	11.56	26.48	206373	257
8/23~	13.30	39.09	267092	151
8/30~	12.95	13.87	267578	100
9/6~	9.97	38.25	280673	94

(Note) Clubs were requested to shorten their business hours during the period from 5th August to 24th August.

Weekly Effect Analysis

Minami / Osaka City

(Note) Clubs were requested to shorten their business hours during the period from 6th August to 20th August.

week	No. of tests per 10K (2.73M)	No. intensive tests per 1K night clubs (3906 clubs)	crowd	PCR positive
6/14~	1.47	0.00	380003	17
6/21~	1.83	0.00	404034	7
6/28~	2.92	0.00	411250	31
7/5~	4.89	0.00	405449	66
7/12~	6.06	46.59	392973	121
7/19~	9.18	151.56	408561	329
7/26~	16.09	245.78	358820	644
8/2~	18.67	299.28	338696	738
8/9~	19.23	301.33	323568	641
8/16~	20.38	271.38	332087	627
8/23~	15.99	154.38	350915	412
8/30~	13.50	120.33	360398	308
9/6~	13.07	96.26	373350	278

Weekly Effect Analysis

Nakasu/Fukuoka City

week	No. of tests per 10K (1.554M)	No. intensive tests per 1K night clubs (4343 clubs)	crowd	PCR positive
6/14~	5.25	2.30	203942	4
6/21~	5.96	17.96	218089	3
6/28~	7.87	69.54	218246	10
7/5~	8.48	8.75	219916	26
7/12~	10.29	5.07	229142	57
7/19~	15.23	0.00	209241	241
7/26~	29.30	0.00	202392	430
8/2~	36.54	0.00	196949	506
8/9~	29.33	0.00	159857	357
8/16~	27.38	0.00	202746	342
8/23~	27.46	0.00	215343	278
8/30~	29.95	0.00	204725	192
9/6~	27.43	0.00	207138	105

(Note) Clubs were requested to shorten their business hours during the period from 8th August to 21st August.

Prediction equation

- Based on the data of 5 districts (the number of weekly PCR positive, weekly test in the city, weekly intensive test, nightclub with the reception), an equation to predict the number of PCR positive is identified.

※ It needs a notice that this equation is identified by using data of 5 districts.

$$Y(t+2) = [0.75 \times Y(t+1)] + [0.10 \times T(t+2) - 0.08 \times T(t+1) - 0.01 \times T(t)] \\ + [0.08 \times I(t+2) + 0.02 \times I(t+1) - 0.04 \times I(t)] + 0.20 \times O(t+1)$$

Y(t) PCR positive in the week of t

T(t) number of test in the city in the week of t

I(t) number of intensive test in the week of t/number of nightclub with the reception (unit : thousand)

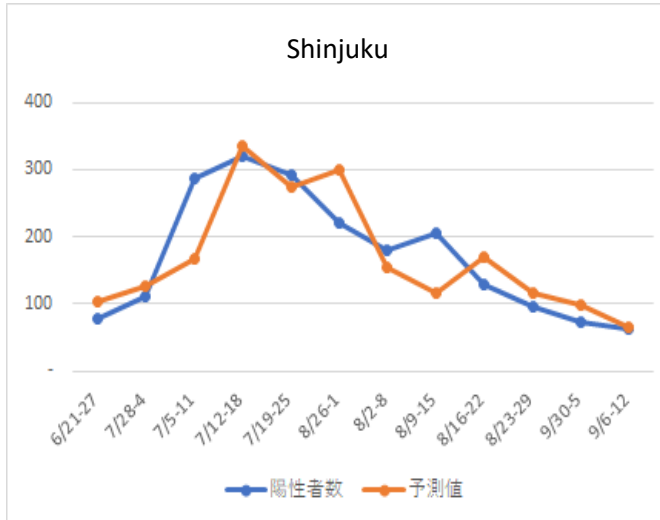
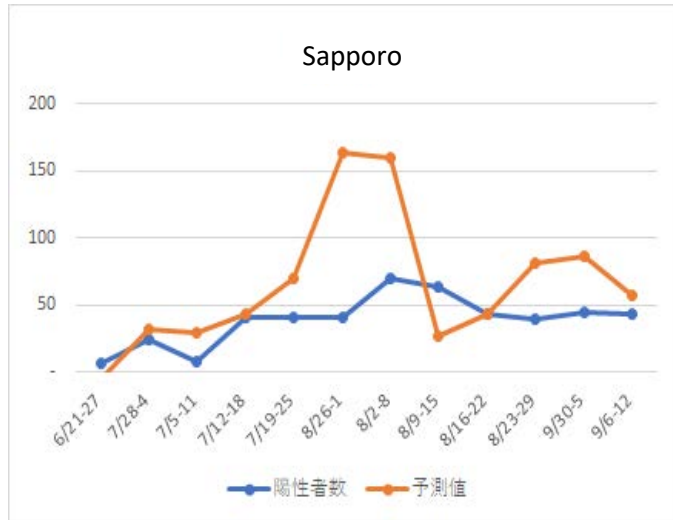
O(t) crowd in the district in the week of t (unit : 10 thousand)

- When and how many test should be taken will be suggested by the prediction equation. For example, suppose if there is a district with 0.5 thousand nightclubs with reception, one thousand test in the week of t will decrease around 80 positives in the week of t+2.

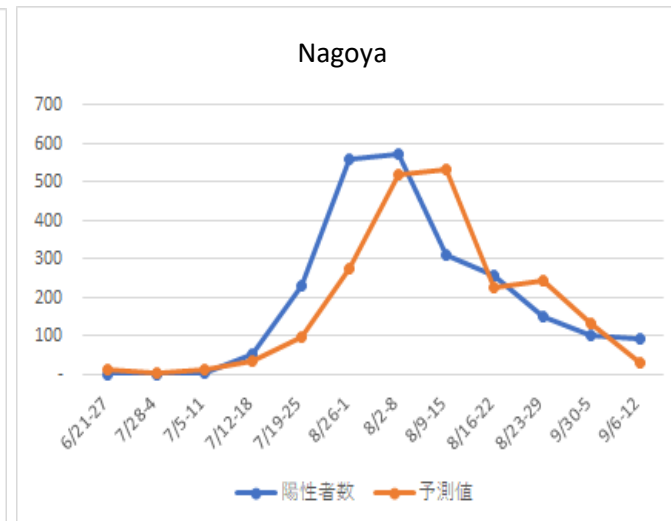
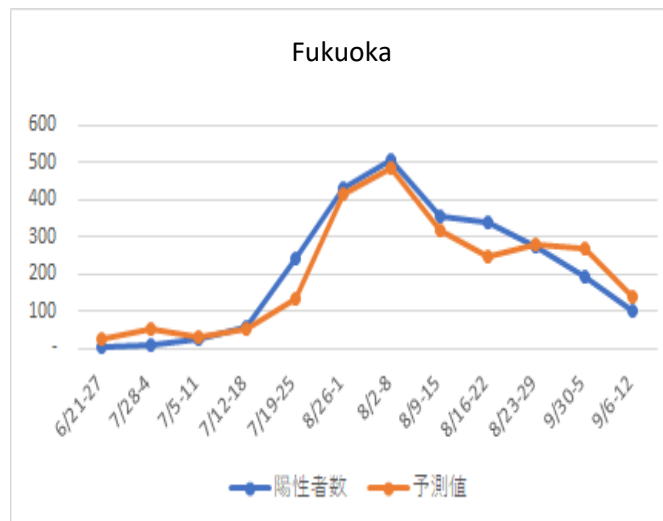
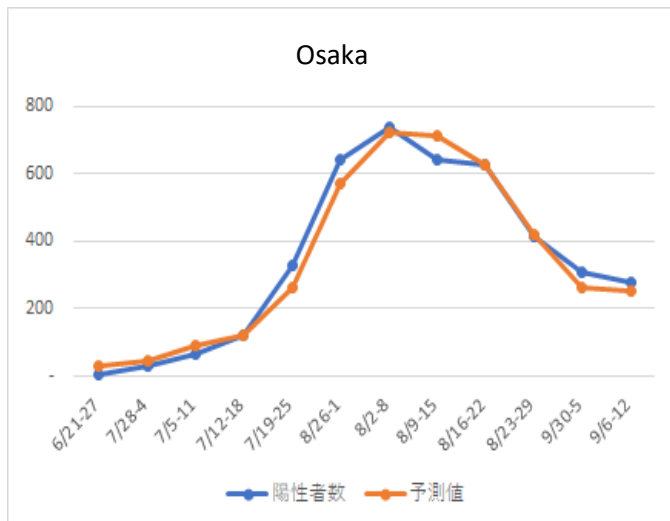
※ In the case that the effect by the ordinary test and the crowd is eliminated.

【Reference】 Estimation by Prediction Equation

The graphs below show comparison between the number of PCR positive estimated by the prediction equation and the actual number. It should be noted that the predicted estimation slightly lags behind the actual number when the virus is spreading.



Estimated prediction —●—
PCR positive (actual) —●—



Roundup

Consideration about each entertainment district

- **Sapporo, Susukino** The crowd did not decrease. The number of intensive test did not increase. The number of PCR positive did not decrease, but it did not apparently increase.
- **Shinjuku, Kabukicho** The crowd did not decrease, but it was thought that the number of PCR positive decreased by intensive test.
- **Nagoya, Nishiki・Sakae** There was not much number of intensive test, but the crowd decreased by the request for shortening business hours, and the number of PCR positive might decrease.
- **Osaka, Minami** The crowd decreased by the intensive test and request for shortening business hours, and the number of PCR positive might decrease.
- **Fukuoka, Nakasu** The intensive test was early. The number of PCR positive increased. Afterward, the crowd decreased and the number of PCT positive decreased by the test in the whole city and the request for short staying at nightclub.

General Remarks

- The intensive PCR test of enough numbers at early stage will connect to decrease of the number of infection.
- Shortening business hours in restricted area or type of business will be able to decrease the number of infection before a method such as state of emergency which has a huge influence on the economy by closing the business and reducing the activity. restrictively.

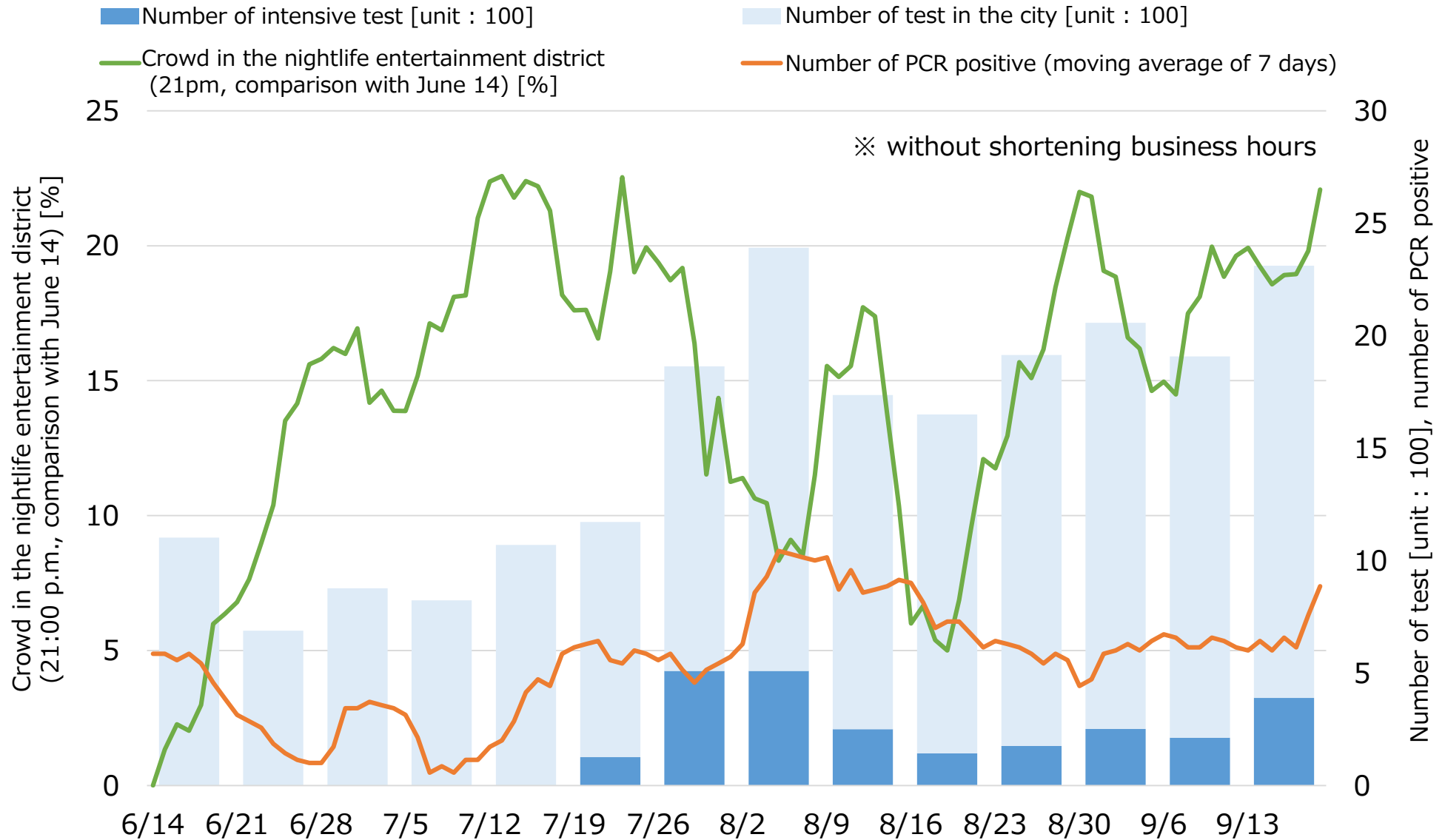
Reference

Data of 5 nightlife entertainment district

“Intensive test” means the inspection for the staff of the nightlife entertainment business and the inspection near the entertainment zoon (spot test) carried out at each entertainment district after April apart from the ordinary test for the person who has symptom or who has a close contact with PCR positive.

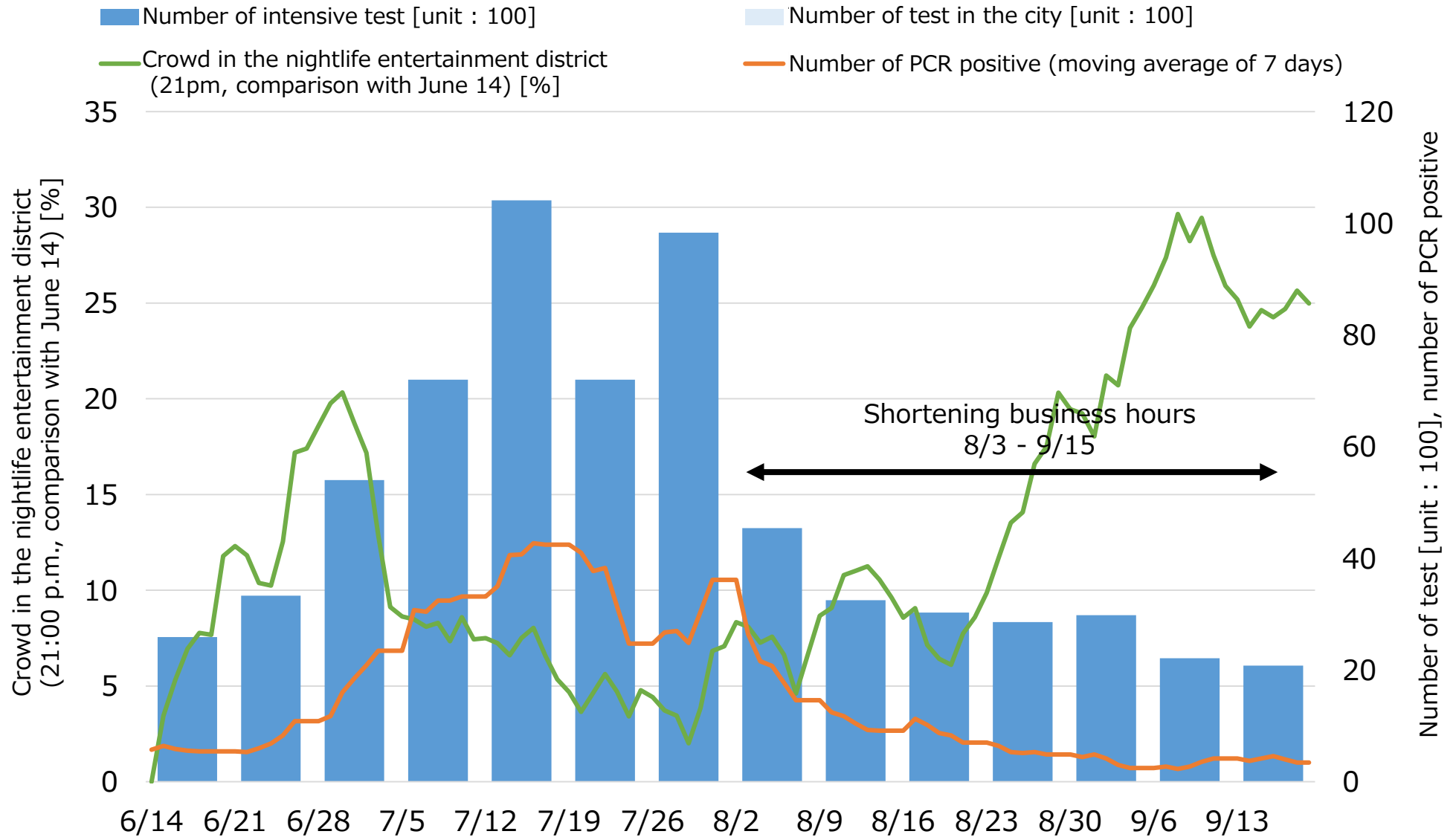
Number of PCR Positive, Test, Intensive Test, and Crowd

Sapporo City (Susukino)



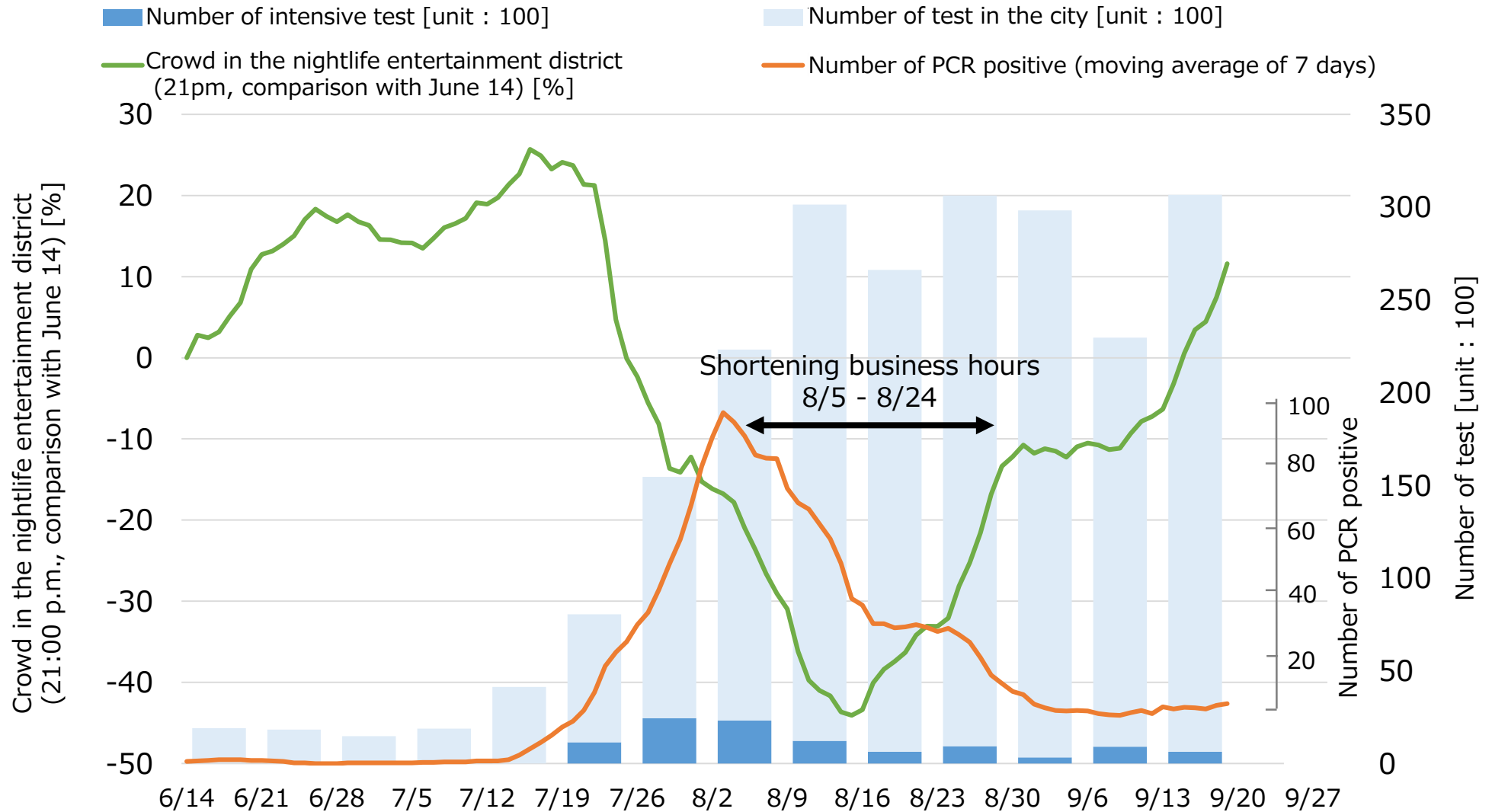
Number of PCR Positive, Test, Intensive Test, and Crowd

Shinjuku Ward (Kabukicho)



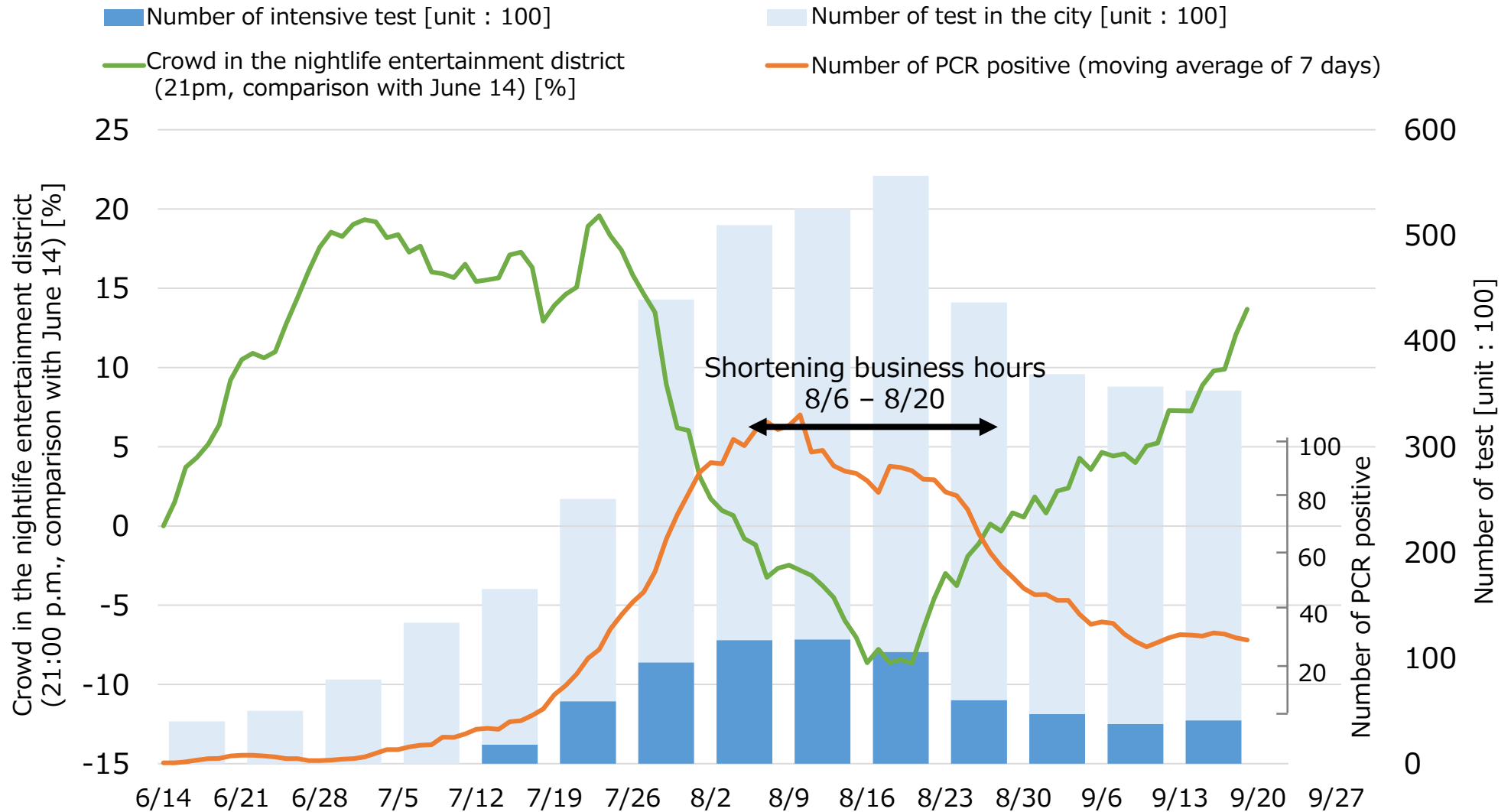
Number of PCR Positive, Test, Intensive Test, and Crowd

Nagoya City (Nishiki·Sakae)



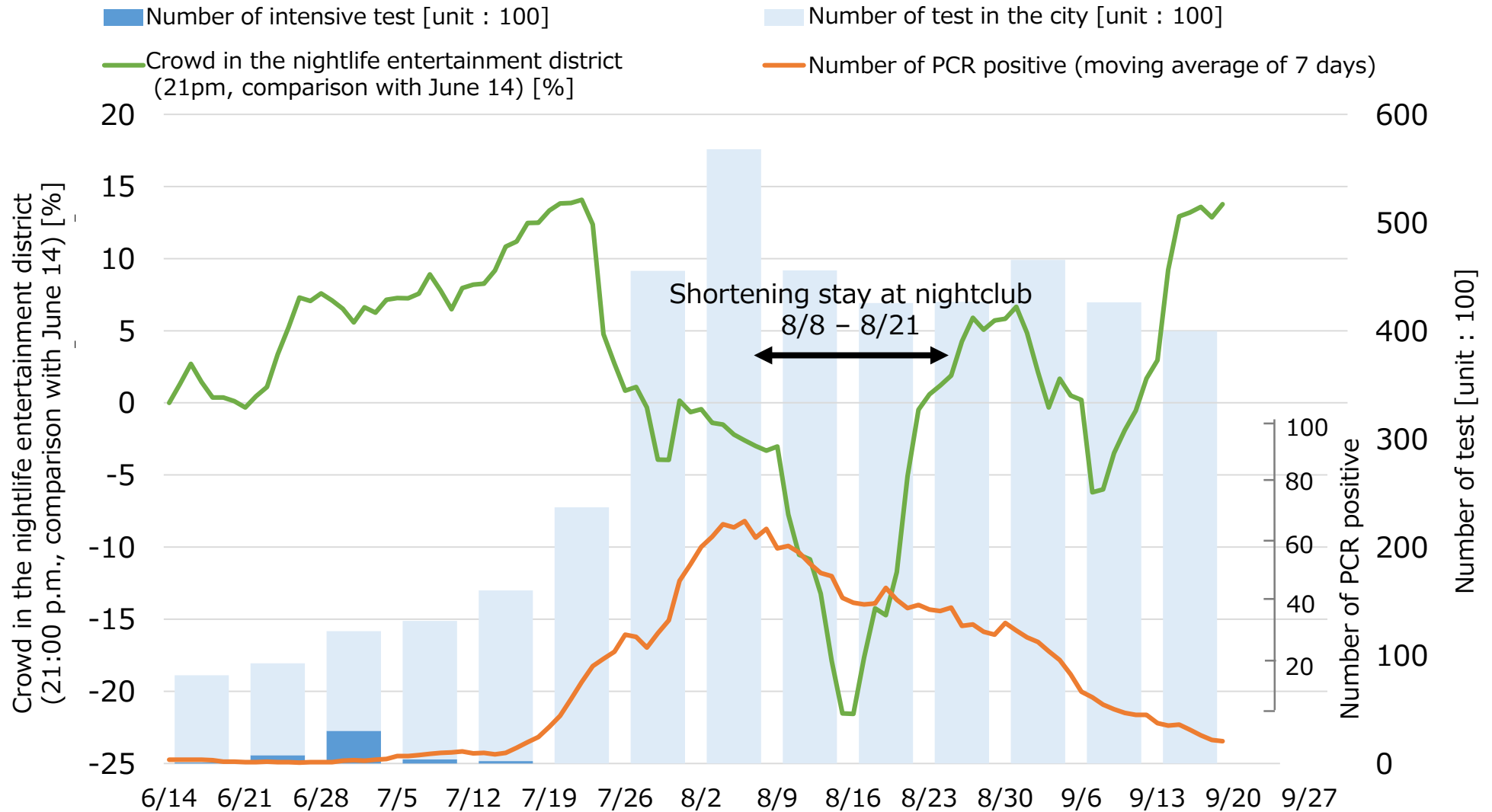
Number of PCR Positive, Test, Intensive Test, and Crowd

Osaka City (Minami)



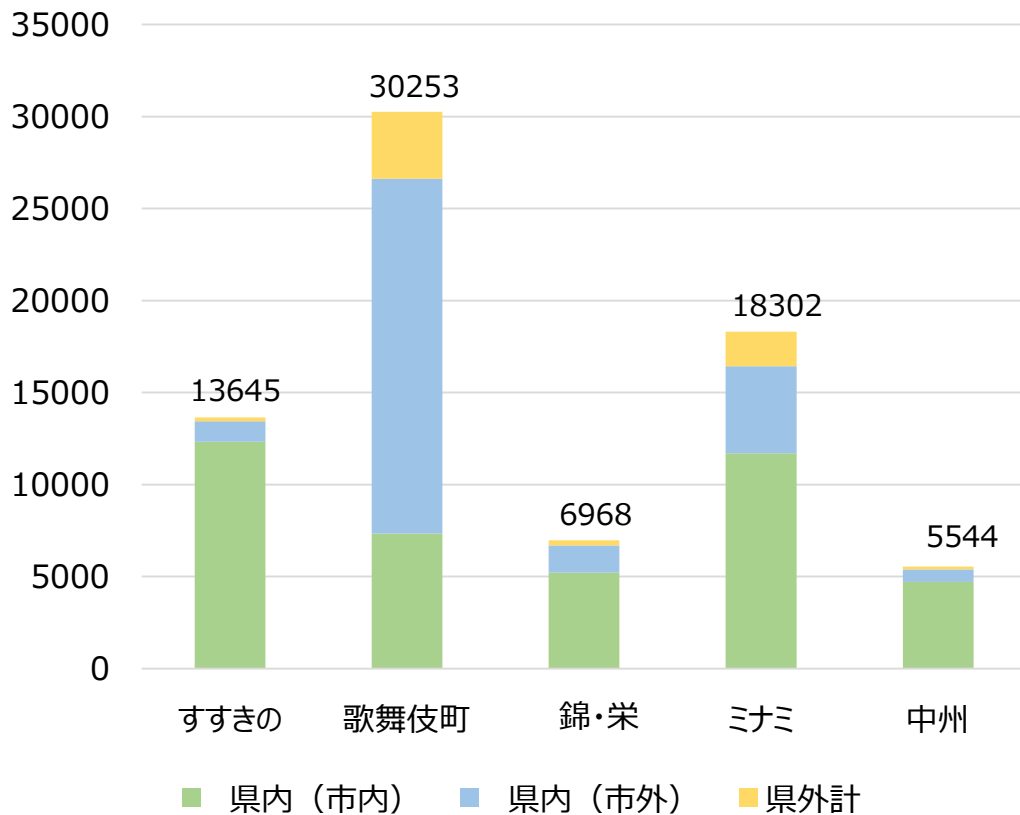
Number of PCR Positive, Test, Intensive Test, and Crowd

Fukuoka City (Nakasu)

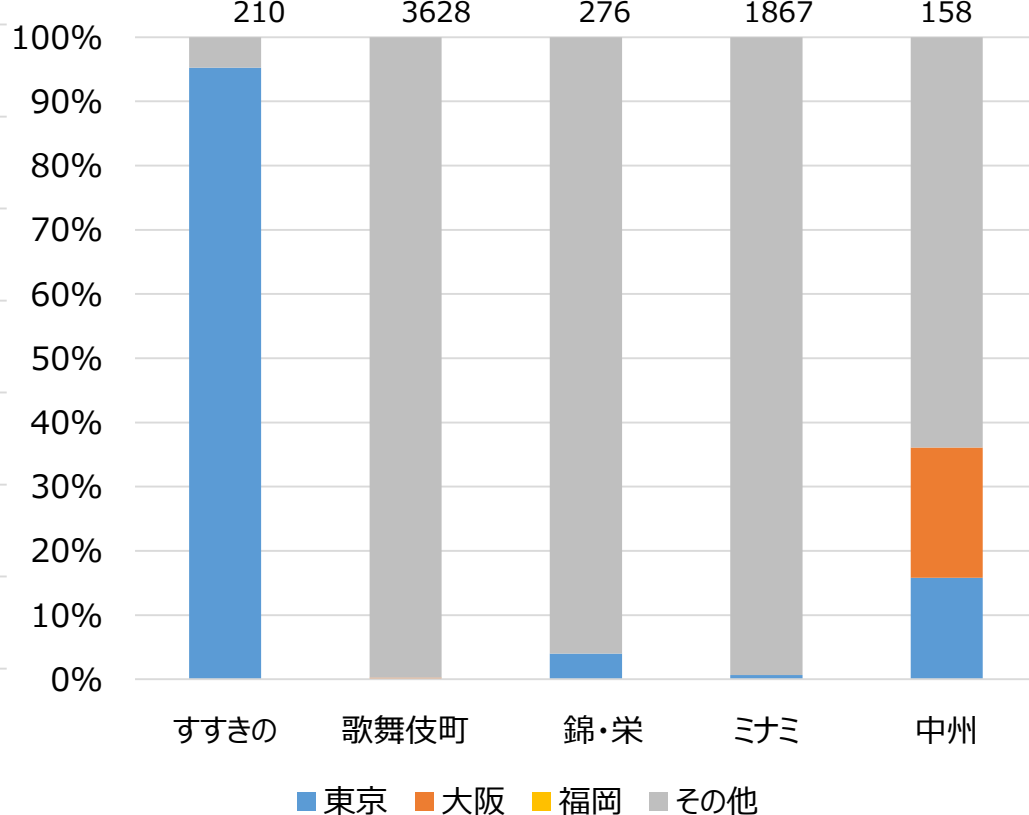


歓楽街における推定居住地別の人出（平日）

推定居住地別 平日夜の人出（9月30日(水)、21時台）



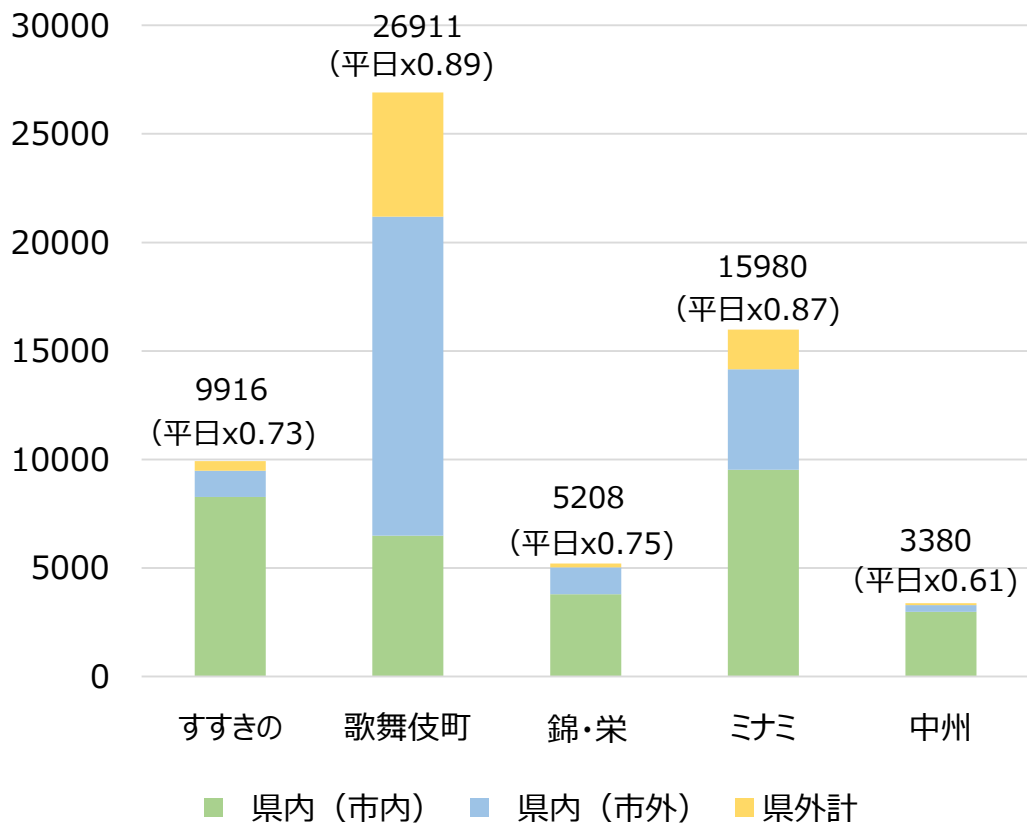
県外計に占める各都府県からの人の割合（9月30日(水)）



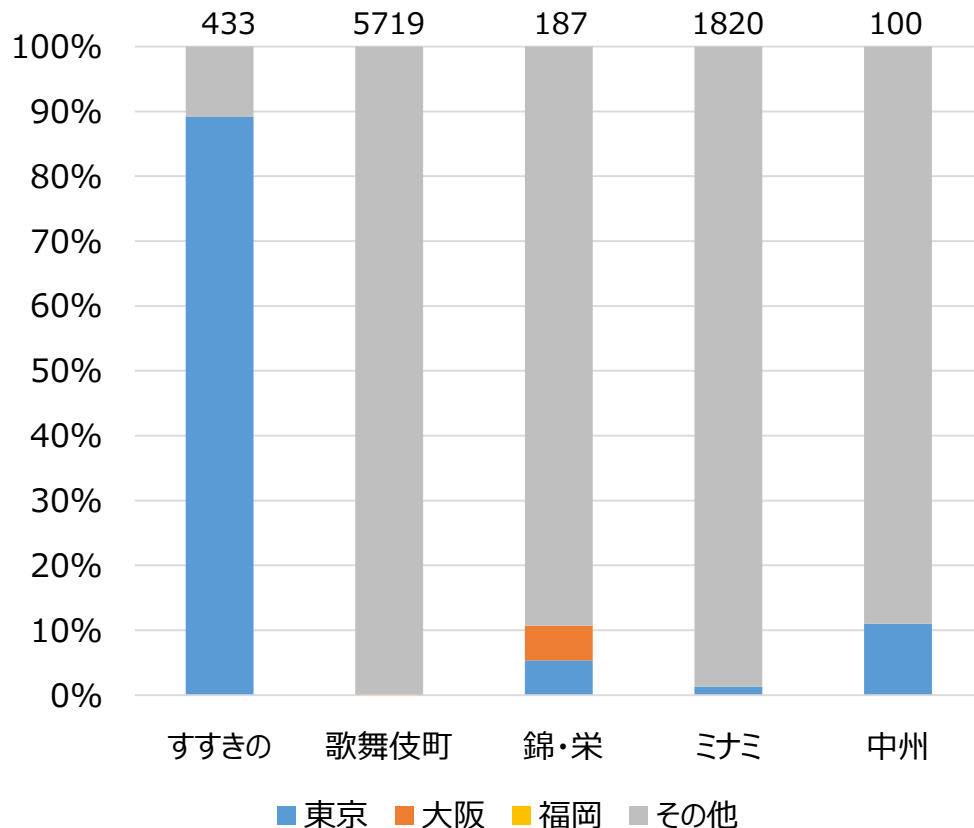
（資料）NTTドコモ提供データをもとに作成

歓楽街における推定居住地別の人出（休日）

推定居住地別 休日夜の人出（9月27日(日)、21時台）



県外計に占める各都府県からの人の割合（9月27日(日)）



（資料）NTTドコモ提供データをもとに作成