

# Predictions on the Population Density and the Net Crowd Flow via Coulomb's Law at the Macau Food Festival with Optimized Stands Locations

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## ABSTRACT

We made use of Coulomb's Law to predict the population density of customers and the net crowd flow at a certain location at the Macau Food Festival with optimized stands locations. The optimal layout diagram of stands may be defined in such a way that, while requiring the distance between every pair of stands should not be too far away from each other, the crowd control is well managed so that people may patronize stands more effectively. More popular stands may have larger patronage, resulting in higher pedestrian flow nearby. Therefore, to avoid customers from packing shoulder to shoulder around more popular stands, we may treat every stand as a charged particle carrying an effective charge: the more popular a stand is, the higher the effective charge it carries. Under this assumption, the problem is then converted to the minimization problem of Coulomb electrostatic potential energy on a specific configuration of charge locations, with which the global minimum may be found by the Simulated Annealing and Metropolis Algorithm. Electrostatic energy density is interpreted as population density of customers, while electric field the reversed crowd flow. Therefore, at a certain location we are able to predict the customer density by calculating the energy density and the net crowd flow with electric field lines. We also concluded that even though the required computation time to obtain a configuration of stand locations with the energy value close to the global minimum with a tolerable difference may be irrelevant to the randomly generated initial configuration of stand locations, setting up an appropriate initial configuration could be one of the key issues to find out the actual global minimum.

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## 1. Introduction

It is noted that local festivals are widely used as tourism promoters and boost regional economies[1]. Also, the local festival scene fits the pattern of regional sustainable economic development activities better than other scenes[2]. Because the uniqueness of cuisine has become one of the important factors to attract tourists to Macau, some annual national events such as Macau Grand Prix and Macau Food Festival are held each November[3]. Macau Food Festival that locates Sai Van Lake Square is one of the annual events that contains various culinary delights from Asia and Europe[4]. This landmark event gathers international chefs and key stakeholders across Asia and Europe, and it is also a fine example of Macao's expertise in hosting large-scale gastronomy-related events[5]. Owing to the fact that the local cuisine is an important part of the travel experience[6], Macau Food Festival takes food as an attraction to solicit tourists[7]. Su[8] showed that foreign tourists who flock to Macau's food festival have proven it a tourist attraction. Therefore, looking for a scientifically sound method to deploy a economic layout plan is imminent.

Since the utilization efficiency of regional tourism industry elements can be improved by a rational spatial organization of the tourism industry[9], various places are using optimal layout trying to optimize the facilities, such as proposing a macro layout planning method to better serve self-driving tour travelers[10], or layout optimization of tourist toilets[11]. It can even be used to solve problems like using mathematical optimization to determine the optimal layout of a dining room during the era of COVID-19[12], within the intended span of a metro station, address the layout planning of a public bicycle system[13] or even improve the damping effect of the MR damper[14]. Meanwhile, McMullen[15] estimated the optimal social distance at the outbreak of COVID-19 pandemic with Coulomb's Law by treating individuals carrying positive charges, which were also influenced by other negative stationary charges. In

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addition, Kamkarin and Hexmoor[16] designed an evacuation plan for crowds gathering inside a building with electric fields. Also, Zhuo et. al.[17] proposed a model with Coulomb's Law, together with superposition principles of electric field, to estimate the population density outside light patches.

However, it is theoretically flawed to connect electric field, which is a vector, with population density, which is a scalar. Moreover, it is artificial to divide areas into "inside light patches" and "outside light patches", because population density should be determined by only one common factor, for example, the usage of electricity.

In this paper, we calculated the population density and the net crowd flow in a layout with the optimized stands locations, taking the Macau food Festival as an example. There were 140 booths that were allocated among 200 possible locations. The optimization was obtained by minimizing Coulomb's law with SAMA, while treating the stand popularity as the effective charge (EffQ), which was acquired by questionnaire survey and data analysis, where we classified booths into more popular ones with higher values of EffQ and less popular ones with lower EffQs. After we calculated the optimized locations of stands (charged particles), the electrostatic energy density is naturally related to population density of customers, and the electric field the net movement of crowd at a specific location.

## 2. Methods

Suppose there are  $\mathcal{N}$  possible locations for the stands at the Macao food festival heritage labeled as  $[0, 1, 2, \dots, \mathcal{N} - 1]$ , and there are  $N$  possible stands, where  $N < \mathcal{N}$ . Also, let  $Q_i$  denote the effective charge (EffQ) of stand  $i$ . We then imagined a set of charged particles dispersing around in the 2-dimensional space. At the food festival, customers desire to patronize those more popular stands, equivalently referring to the highest charged particles. If the popular stands are located very near at the festival, it would be much easier for customers to get huddled together and also less convenient for customers to shop. To avoid crowding, our first idea was that it would be preferable to separate popular stands from one another as far as possible; nonetheless, it would cause inconvenience for customers to patronize popular stands. Keeping these in mind, we have to find out a layout plan whose stands are not too far away from one another while preventing most of the popular stands from locating close to one another. To the best of our imagination, this situation resembles that of the minimum energy of a system of two-dimensional electric charges. In other words, we would like to find out the locations for every charged particle (stand) such that the overall Coulomb electrostatic potential energy would be minimized. This is to say, we would like to find out the configuration of locations  $\{r_i, \forall i\}$ , such that the overall electric potential energy

$$E(\{r_i, \forall i\}) = \sum_{i < j} \frac{Q_i Q_j}{|\vec{r}_i - \vec{r}_j|} \quad (1)$$

is minimized. We then tried to calculate the global minimum via the simulated annealing and Metropolis algorithm (SAMA)[18]. It should not be overemphasized that the electrostatic energy density is proportional to square of electric field,  $E^2$ .

The idea of the algorithm may be summarized as follows. While the probability for the system with energy  $E_i$  is described by the Boltzmann distribution with  $\beta = 1/\tau = 1/k_B T$ ,  $k_B$  being the Boltzmann constant:

$$P(E_i) \propto e^{-\beta E_i}, \quad (2)$$

we arbitrarily generate an initial configuration of locations of our stands, then calculate the initial value of the quantity  $E_i$  in Eq.(1). Then, we generate another trial configuration of locations of stands by randomly picking up two locations of stands to swap, calculating again the quantity after the change in Eq.(1), say  $E_j$ . If the new quantity is smaller than the old one, we accept the swap. However, if the new quantity is larger than the old one, we may still try to accept the new configuration by introducing the Metropolis Algorithm with the following criteria[19],[20]:

$$P_\beta(E_j) = \begin{cases} 1 & \text{if } E_j \leq E_i; \\ e^{-\beta(E_j - E_i)} & \text{if } E_j > E_i. \end{cases} \quad (3)$$

$T_{\max}$	$T_{\min}$	$\tau = k_b T$
1.0	$1 \times 10^{-2}$	$1 \times 10^4$

**Table 1**

Parameters used in SAMA.

In practice, we generated a random number  $z \in [0, 1]$ , then if  $z$  satisfies

$$z \leq e^{-\beta(E_j - E_i)}, \quad (4)$$

we accept the swap; otherwise we reject the swap and go back to the previous configuration of stand locations. Throughout our study we have chosen values of the maximum temperature  $T_{\max}$ , minimum temperature  $T_{\min}$ , and  $\tau = k_b T$  as listed in Table 1. It is interesting to indicate that Karabin and Stuart[21] demonstrated that one may improve the efficiency of classical SAMA by allowing the temperature-varying  $k_b(T)$ .

Figure 1 indicates the map of the event. It shows the locations of all the 140 booths that were designated in the year 2020, together with 60 more empty locations we deliberately chose to allow possibilities for the stands to select. Each booth has a different ID number on it. Remade and redrawn were made on the original map acquired from the official Facebook website of Macau Food festival,[22] and stands were divided into eight types[23]. The red dot in Figure 1 represents the origin of the coordinate so we could get the coordinates of the booths in Table 2. In addition, the arrows stand for the entrance of the event.

In order to determine the value of  $Q_i$  of a stand in Eq.(1), we conducted a questionnaire survey. The first idea was that it would be better off if we may ask respondents to evaluate all 140 stands. However, it is not practical because it is time consuming for a person to answer. Therefore, we divided the questionnaire into eight parts. Besides a questionnaire of all *types* of stands, which we called *Grand* questionnaire as shown in Table 3, for every type of stands, we also made a questionnaire of the subcategory consisting of all stands for that particular type. The respondents may choose to answer either all of the eight questionnaires or only one of them. The popularity of every stand in the particular subcategory was denoted as average (together with the standard deviation) in the following tables: Chinese restaurant zone (Table 4), European delicacies zone(Table 5), Dessert zone(Table 6), Asia delicicas zone(Table 7), Local delicacies zone (Table 8), Sponsor and other(Table 9), and Game booth(Table 10). Notice that the Type Sponsor and Type Other were grouped together in the survey and results were listed together in Table 9. Afterward, the effective charge  $Q_i$  of each stand was obtained by multiplying the value of the type in the grand questionnaire with the value of that particular stand in the subcategory.

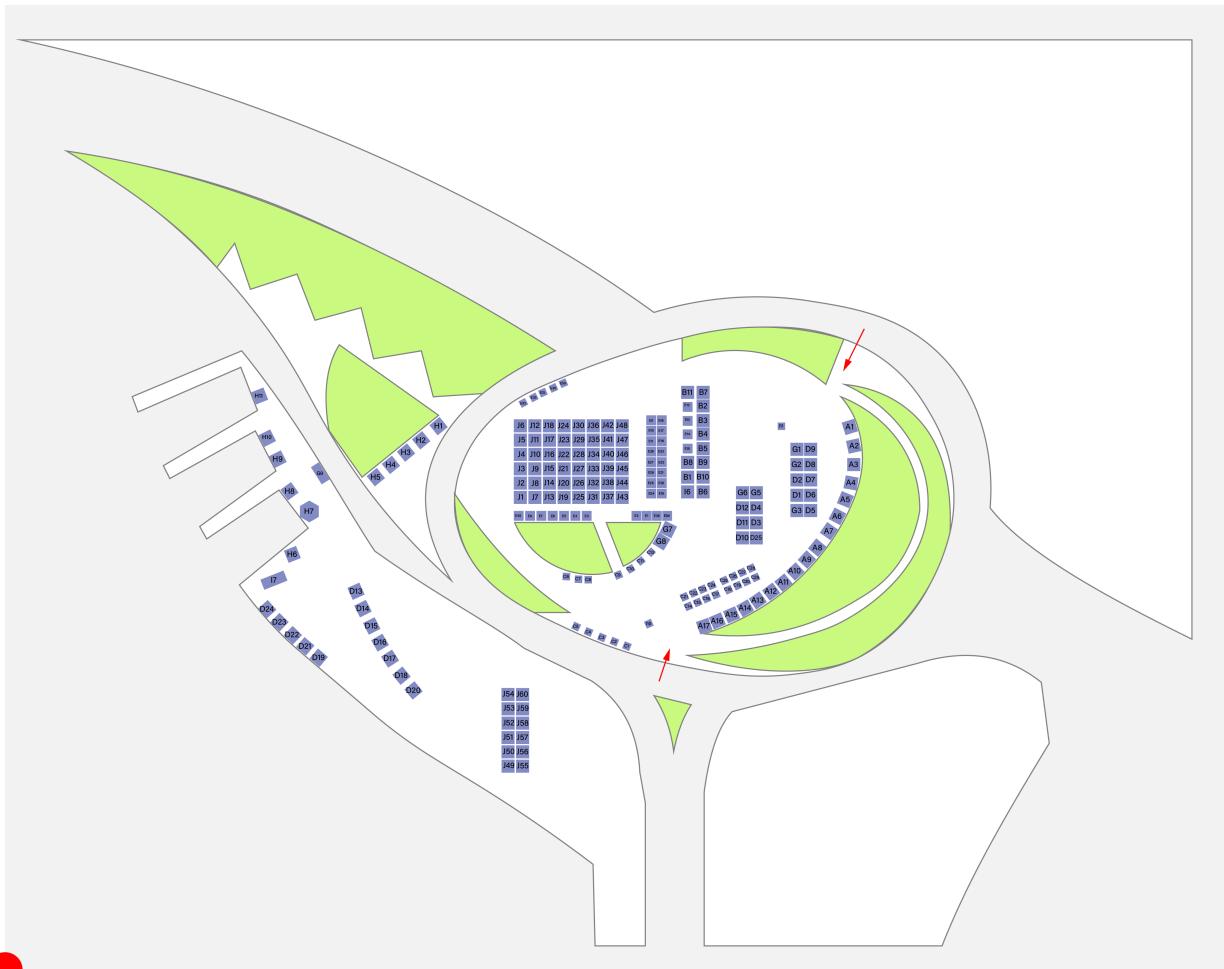
The error propagation was also considered. Suppose that there are two mean values  $\bar{x}$  and  $\bar{y}$  from the grand questionnaire and one of the subcategories, with the standard deviation of mean  $\sigma_{\bar{x}}$  and  $\sigma_{\bar{y}}$ , respectively. The  $Q_i$  of the stand may then be understood as  $Q_i = \bar{x}\bar{y} = \bar{x} \cdot \bar{y}$ , and the standard deviation of mean for  $\bar{x}\bar{y}$  is[24]

$$\sigma_{\bar{x}\bar{y}} = \sqrt{\left(\frac{\sigma_{\bar{x}}}{\bar{x}}\right)^2 + \left(\frac{\sigma_{\bar{y}}}{\bar{y}}\right)^2} \times \bar{x}\bar{y}. \quad (5)$$

After acquiring all the  $Q_i$ s, we normalized them with

$$Q' = \frac{Q - \bar{Q}}{\sigma}, \quad (6)$$

where  $\bar{Q}$  is the mean of the effective charge and  $\sigma$  is the standard deviation for  $Q$ . By doing so, the  $Q'$ s have properties that mean  $\bar{Q}' = 0$  and variance is equal to 1[25]. As a result, the normalized effective charges  $Q'$  of all stands were listed in Table 11.

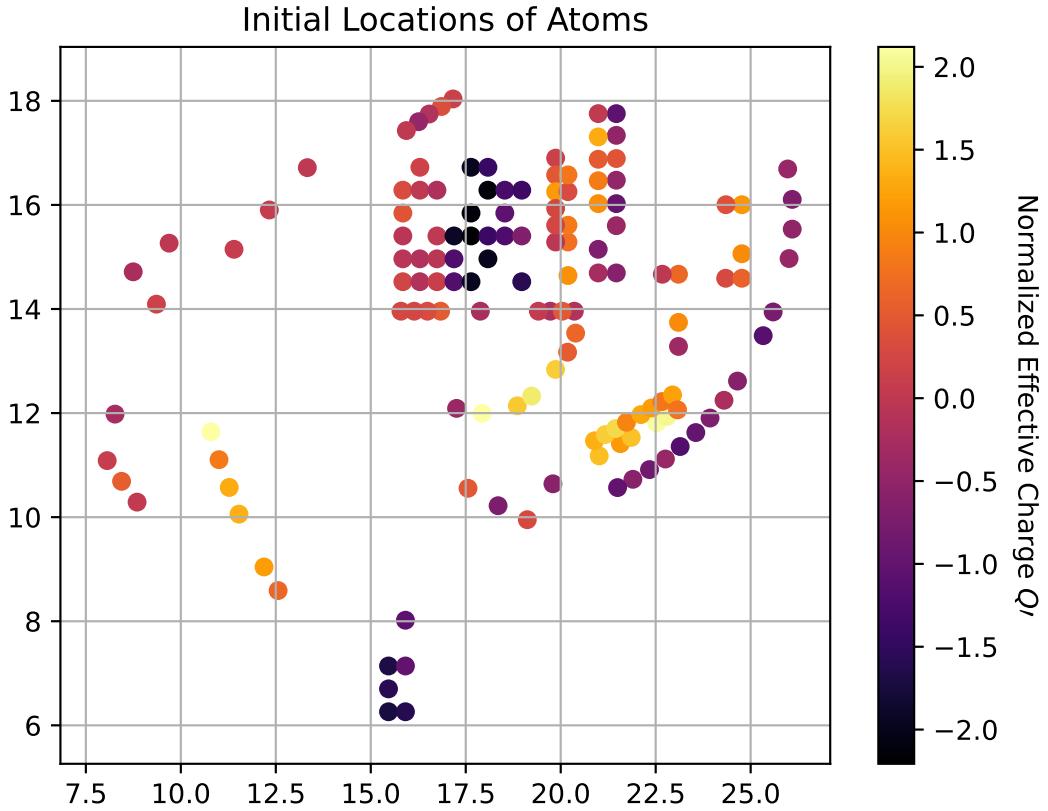


**Figure 1:** Locations of 140 stands at the Macau Food Festival and 60 other empty locations. Details for the stands numbers and coordinates were listed in Table 2

### 3. Results and Discussions

Figure 2 illustrated the initial locations of stands which was generated randomly at the very first. The color bar at the right-hand side indicated the normalized effective charge  $Qf$  mentioned in Eq.(6) with brighter color indicating higher  $Qf$ . As the figure showed, most of the atoms (stands) were focused on the area of the y-axis 14 to 18, and the x-axis 15.0 to 22.5. As we could see around the two-column booths at  $x = 20.0$ , the stands were quite close to each other. In spite of this, there was also a diffuse community: dispersing in the area of the x-axis from 7.5 to 15.0, and the y-axis 8 to 18. In addition, some booths formed an arch shape at the right-side of the diagram. The initial energy calculated by Eq.(1) was 477.55282. The complete list of stand locations were given in Table 12.

After randomly generating the above initial configuration of locations, we implemented the SAMA algorithm to try to find out the optimal value of energy by randomly picking up two locations to swap. In order to find out lower energy with some configuration of space, we allocated 60 more locations besides the original 140 ones which were already occupied by the stands. Under this circumstance, there were three possible cases when we randomly chose two locations to swap. The first case was that two of the locations were occupied by one booth each, therefore there was no problem for us to swap between them. Secondly, it could also be possible that only one of the two locations we picked up was occupied with a booth while the other was empty. In this case, we could still swap the two locations by

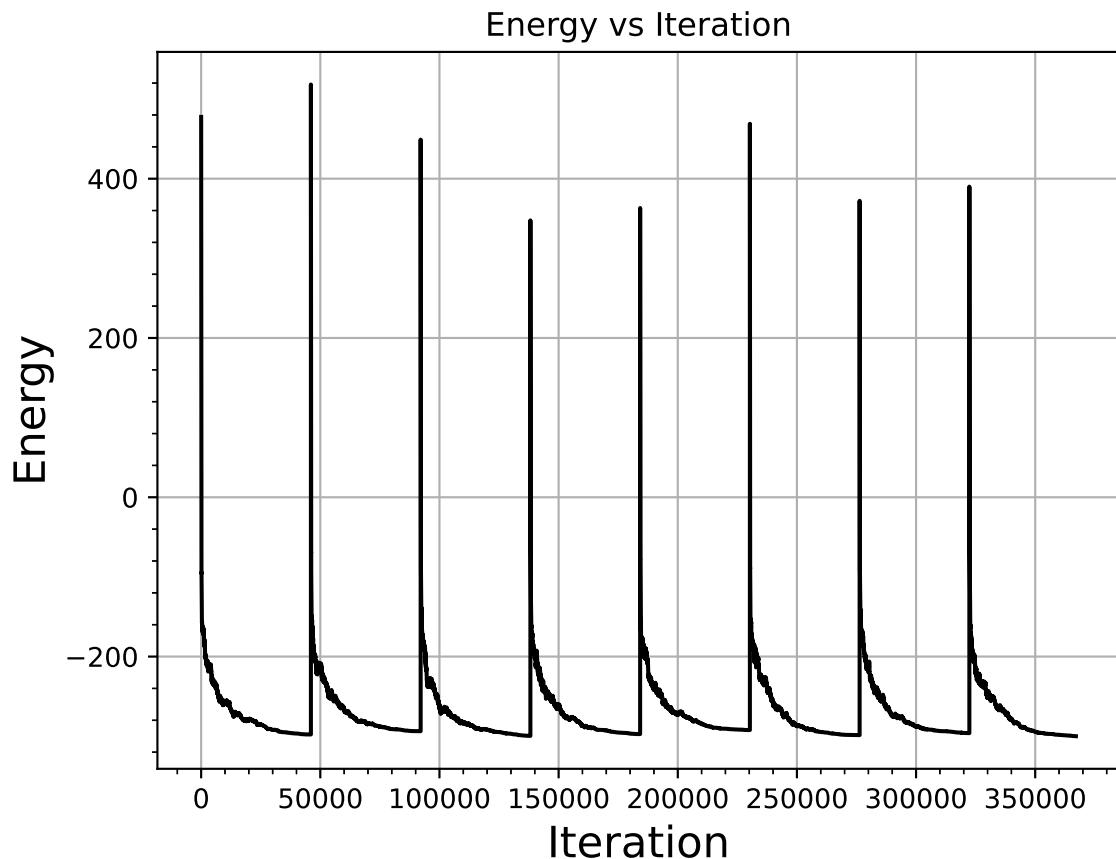


**Figure 2:** At the beginning of algorithm, 140 stands were randomly deployed among 200 possible locations. 60 more empty locations were also allowed to be selected for swapping.

carefully identifying the empty location. One more possibility that should be avoided was that we may also picked up two originally empty locations, which did not make any sense to swap between them.

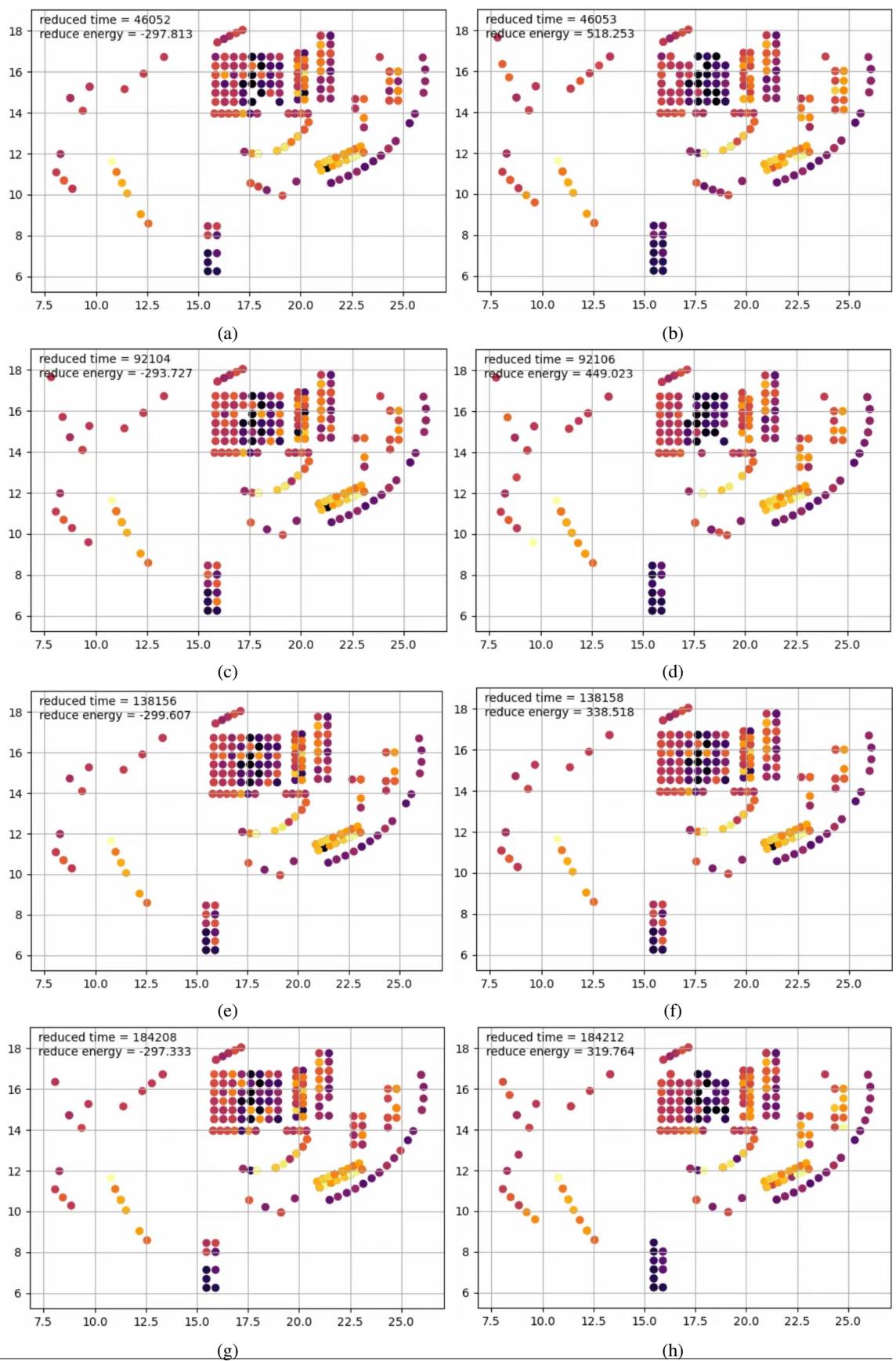
Figure 3 illustrated energy vs. iteration, which may be divided into eight periods along Iteration axis, with the interval of roughly 46 thousand iterations each. The first period started from the initial energy around 440. In the process of running the SAMA, it dropped very quickly from the initial value down to  $-200$  within less than 2000 iterations, whereas it took 46 thousand more iterations to reduce energy down to around  $-299$  with some shapes of serration, with the layout shown in Fig 4a. As we discussed earlier, this configuration may not be the global minimum. Therefore after 46 thousand iterations we randomly set up another initial configuration and started over the algorithm again, as shown in Fig 4b.

In the second period within Iteration 46 thousand to 92 thousand, energy dropped from 520 to  $-294$  (see also Fig 4b and Fig 4c) before we set up another initial condition as in Fig 4d. Similar patterns occurred in the following consecutive five periods, as indicated through Fig 4d to Fig 4n. However, since SAMA was purportedly designed to continue running until it found out an energy lower than  $-300$ , it did not succeed until in the eighth period. We may see that even if figures at the left-hand sides of Fig.4 were all very close to  $-300$ , for the SAMA to reach the optimal (or even more importantly, the global) minimum, it could be crucial for the system to start at the appropriate initial configuration, as indicated in Fig.4n. Snapshots in Fig.4 were taken from the animation videos[26] of stands locations in company with the aforementioned featuring iterations in Figure 3.

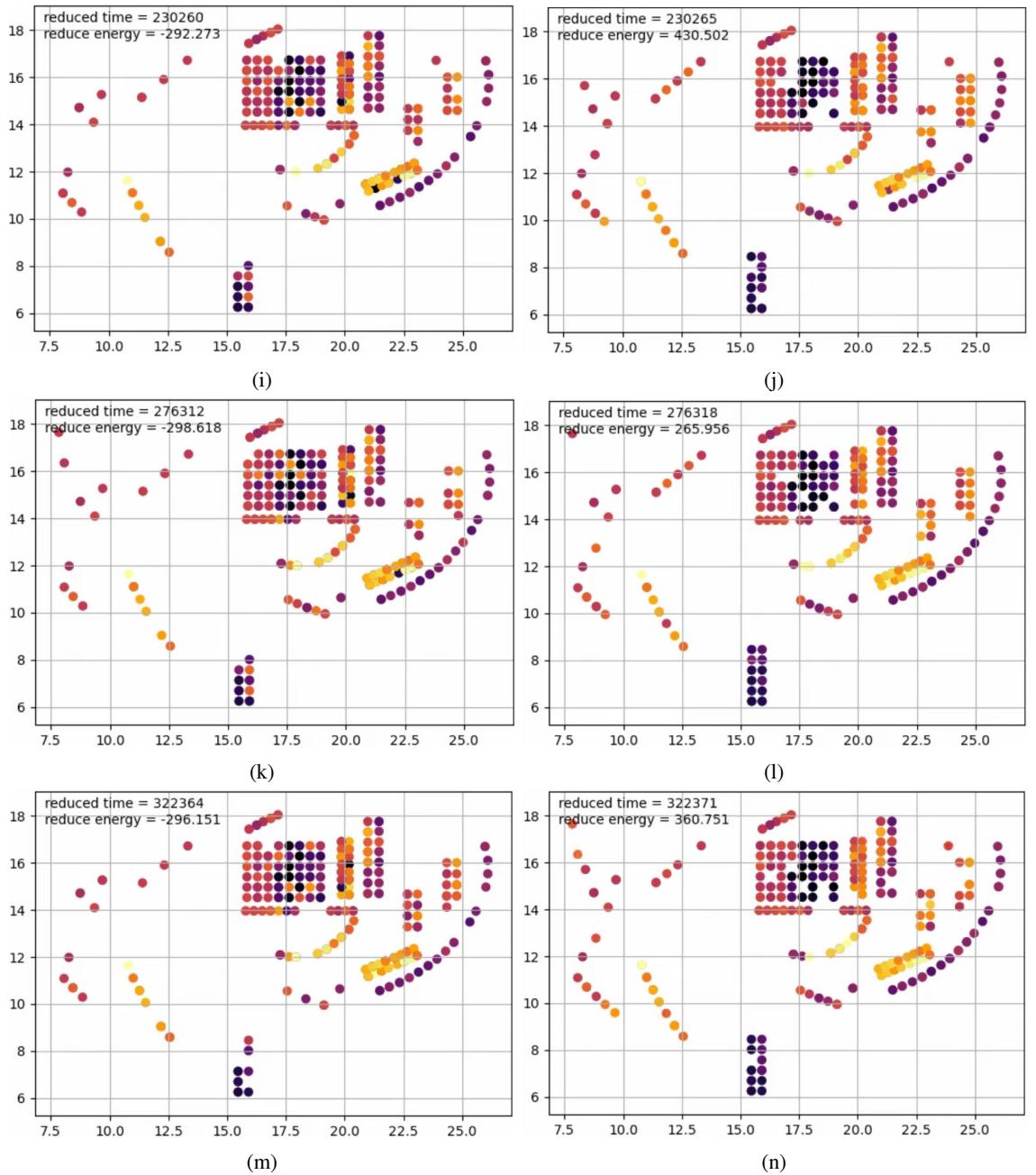


**Figure 3:** Energy vs. Iteration in the algorithm. The whole process may be roughly divided into eight periods along the Iteration (with the gap of 46 iterations), each starting up with a randomly generating initial configuration of stand locations, reducing down to energy around  $-299$ . The algorithm was set up to stop when it found an energy lower than  $-300$ .

## Predictions on the Population Density and the Net Crowd Flow



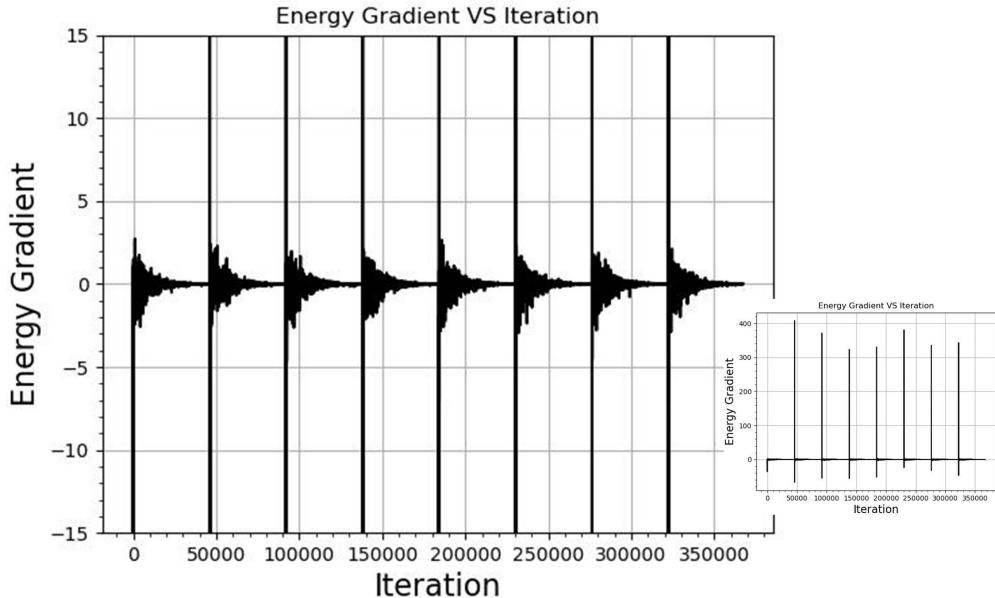
## Predictions on the Population Density and the Net Crowd Flow



**Figure 4:** Animation snapshots of the featuring iterations with the highest and lowest energy in the eight periods in Figure 3. Stands colors have the same meaning as the color bar in Fig.2

In addition, we also plotted the energy gradient (zoomed in between range  $\pm 15$ ) vs. iterations in Figure 5. Inset was the energy gradient for the whole range in the vertical axis. Envelopes formed by the curves in every period were almost very similar. This may demonstrate that the initial configuration of the system may be irrelevant for the algorithm to search for a configuration with tolerable energy difference to the desired optimal energy value.

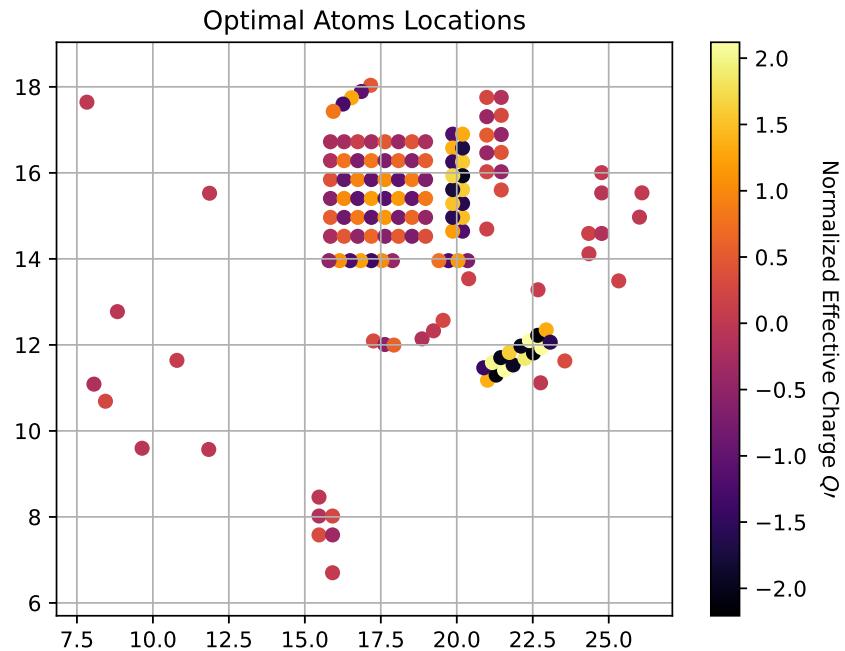
With the computer specs of Intel Core i7-4500U CPU @ 1.80 GHz 2.39 GHz and RAM 8GB, 64-bit operating system and x64-based processor, it took as about 5 hours to minimize energy from the initial 477.55282 to the optimal



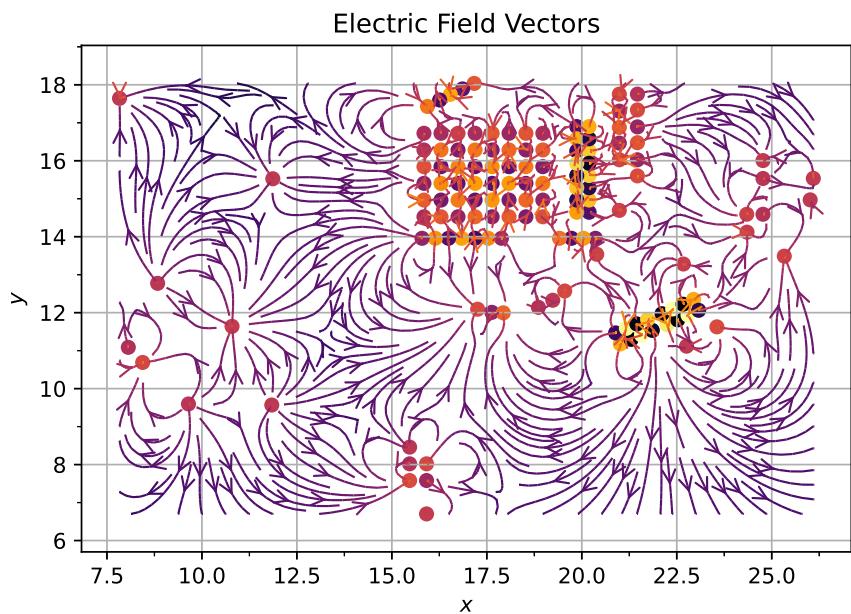
**Figure 5:** Energy gradient vs. Iteration. Notice that the shapes of envelopes within the several periods were also similar, which probably means that computation time required to search for the configuration with an acceptable energy value is not dependent on the initial configuration of our system. (Inset) The overview of energy gradient vs. Iteration. Shark peaks indicated the reset of initial conditions of booth locations.

-300.000073. Codes may be accessed in Ref.[27]. Figure 6 showed the optional locations of stands. Compared with the initial locations of stands in Fig.2, it had a significant difference. Generally speaking, the stands were well organized in the optimal layout as expected. Then, stands in Fig.6 were divided mainly into two parts apparently, mostly in the area of the x-axis 15.0 to 22.5, and the y-axis 14 to 18. One was that most of the stands were located on the upper right half the diagram, while lower left half part was composed of very few stands aligned with two columns, together with some sporadic booths surrounding around the Square holding the event. One interesting feature was that there were 2 parallel columns of stands, located along  $x = 20.0$  and the other skew one along near  $y = 12$ , alternately consisting of booths with the higher  $Q_f$  and the lower ones. This interesting arrangement demonstrated that it may be a good idea to allocate together popular booths with less popular ones. On the other hand, very few of the stands were dispersed in the area from x-axis 7.5 to 15.0, and the y-axis 10 to 18. This layout may accomplish our goal of allocating stands as close as possible while minimizing the overall electrostatic potential energy. The complete list of stand locations were given in Table 13.

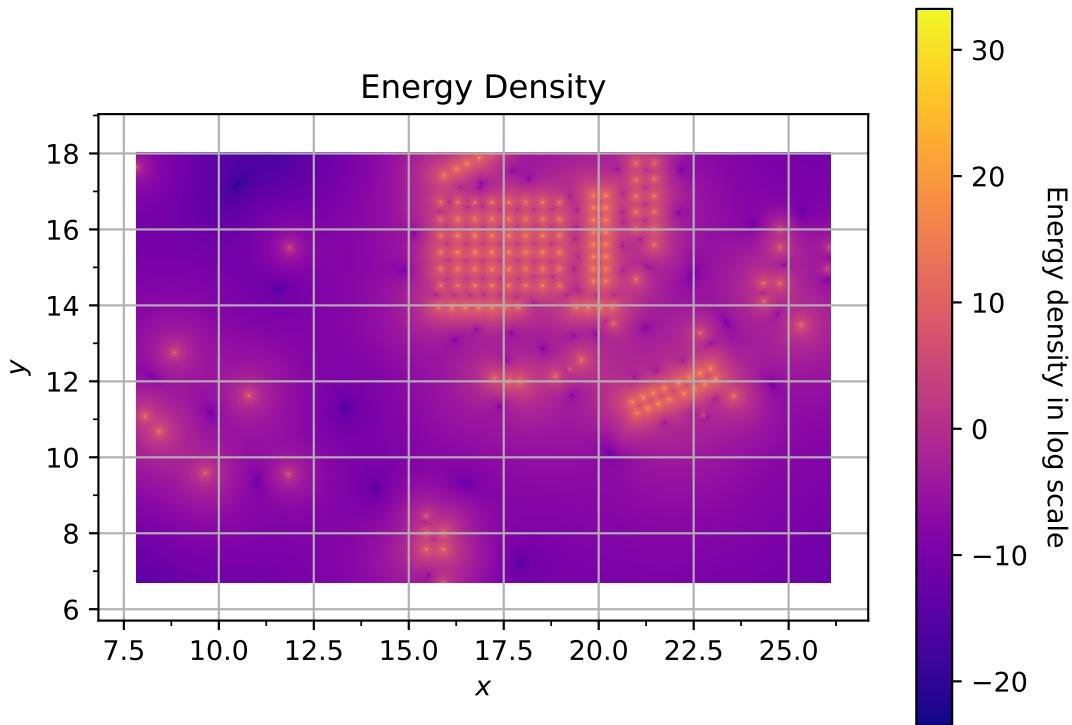
Electrostatic theorem was further brought upon with real-world applications once we interpret that the electrostatic energy density is the population density of customers, while the electric field line points to the reversed net crowd flow at the particular location. Fig. 7 showed the electric field vectors[28] of the optimal layout plan within  $1000 \times 1000$  grid. Vectors indicated the reversed net crowd flows, with directions toward high  $Q_f$  while outward away from the lower  $Q_f$ . Moreover, Fig. 8 showed the logarithmic energy density, which was the prediction of customer density at the Festival. By calculating the energy density and electric field line, we may be able to predict the customer density and net movement, making it possible to enhance customer service at the festival.



**Figure 6:** Optimal locations of stands, together with values of  $Q_r$  as various colors indicated at the color bar.



**Figure 7:** Electric field vectors for the system of booths with  $Q_r$ , which could help us predict the net crowd flow at a specific location.



**Figure 8:** Energy density (in log scale) of the optimal layout, from which the customer density was able to predict.

#### 4. Conclusions

We successfully built up a mathematical model to calculate the optimal layout plan for stands at the Macau Food Festival while treating the popularity of stands as the Effective Charges. The popularity of every stand was acquired by implementing questionnaire surveys. Stands were purportedly treated as charged particles carrying some effective charge with the concept of more popular stands carrying higher EffQs. Also, to avoid customers from gathering together around popular stands, as well as the requirements that stands should not be too far away from one another, it is convincing that the optimal layout plan could be justified by searching for the global minimum of Coulomb energy for a certain configuration of stand locations. The above reasoning may serve as a guideline for future similar applications of this method. Since the landmark annual event Macau Food Festival enhances the local economy effectively and attracts a large number of tourists, our model may help prevent customers from congregating around more popular stands effectively.

Our SAMA accomplished the purpose and reduced the initial energy from 477.55282 to  $-300.00073$  about 5 hours (computer specs: Intel Core i7-4500U CPU @ 1.80 GHz 2.39 GHz and RAM 8GB, 64-bit operating system and x64-based processor). Moreover, we also proposed the optimal locations for booths in Figure 6, with detailed coordinates listed in Table 13. Besides, electrostatic energy density is interpreted as population density of customers, and electric field is the reversed crowd flow. Therefore, our model could be used to predict the population density of customers and net crowd flow at any specific locations at the event, making it possible to assist a better tourist experience.

The effect of initial configuration of stands on the search of optimal energy value was further investigated by resetting the system several times until the desired energy value was found. We may observe that it could be significant for the

system to be initialized with a proper configuration for SAMA to attain a global minimum, whereas computation time was irrelevant to the initial configuration if one only requested an approximate configuration energy close enough to the global minimum.

All in all, it is our pleasure that the model may be executed in future events to providing an optimization of the booth layout, stimulating consumption and boost economic development for Macau.

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## Predictions on the Population Density and the Net Crowd Flow

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## Appendix A Names, Coordinates and ID numbers of Stands

Table 2: Names, Coordinates and ID numbers of Stands. Number J1 to J60 were 60 empty locations that we chose by our own discretion in order to find out lower value of energy configuration.

standID	number	type	name	x	y
1	A1	chinese restaurant zone	shanghai 456 restaurant	25.9754	16.6909
2	A2	chinese restaurant zone	metró pole	26.0947	16.106
3	A3	chinese restaurant zone	wong long frutos do mar casa de pasto	26.0947	15.535
4	A4	chinese restaurant zone	estabelecimento de comidas teng hou	26.0125	14.9698
5	A5	chinese restaurant zone	li jing xuan restaurante	25.8371	14.4576
6	A6	chinese restaurant zone	restaurante beautiful world	25.5923	13.9432
7	A7	chinese restaurant zone	estabelecimento de comidas tai long fong	25.3305	13.4876
8	A8	chinese restaurant zone	the plaza restaurant	24.9698	12.9823
9	A9	chinese restaurant zone	cafe rose garden	24.6543	12.6152
10	A10	chinese restaurant zone	estabelecimento de comidas seng cheong	24.2989	12.246
11	A11	chinese restaurant zone	estabelecimento de comidas fu loi mei sek	23.9314	11.9047
12	A12	chinese restaurant zone	estabelecimento de comidas tam kah barbatana	23.5566	11.6261
13	A13	chinese restaurant zone	estabelecimento de comidas soi lou weng fan tim	23.145	11.3575
14	A14	chinese restaurant zone	chan heng	22.7573	11.1175
15	A15	chinese restaurant zone	fok lam seng	22.3373	10.9144
16	A16	chinese restaurant zone	estabelecimento de comidas teng seng chuen yue	21.9011	10.7276
17	A17	chinese restaurant zone	vaca gorda	21.4973	10.5685
18	B1	european delicacies zone	estabelecimento de comidas pan one	20.9878	15.1472
19	B2	european delicacies zone	estabelecimento de comidas portuguesa porto	21.4644	17.337
20	B3	european delicacies zone	a cozinha mariana	21.4644	16.8913
21	B4	european delicacies zone	est abeleamento de codas cafe de novo tomato	21.4644	16.4748
22	B5	european delicacies zone	est abeleamento de codas san man fa	21.4644	16.025
23	B6	european delicacies zone	la gondola	21.4644	14.6932
24	B7	european delicacies zone	est abeleamento de codas "tain hao hui"	21.4644	17.7542
25	B8	european delicacies zone	est abeleamento de codas nova facção notari italia cozinha	20.9878	15.6011
26	B9	european delicacies zone	restaurante amigo cozinhbros	21.4644	15.1472
27	B10	european delicacies zone	est abeleamento de codas frangts grill	20.9878	17.7542
28	B11	european delicacies zone	cakez café	19.1208	9.9518
29	C1	dessert zone	KIKA GELATO	18.7347	10.0897
30	C2	dessert zone	MACAU SPiRT	18.352	10.2201
31	C3	dessert zone	leit aria i son	17.9413	10.3888
32	C4	dessert zone	Antique Macau		

33	C5	CC MOCHI	17.5603	10.5548
34	C6	GaoXing	17.2588	12.0906
35	C7	half lemon	17.6326	12.0083
36	C8	dessert zone	17.9323	11.9947
37	C9	gong cha(sucursal)	18.8584	12.1399
38	C10	lemoncello(macau)companha limitada	19.2352	12.3266
39	C11	ESTABELECIMENTO DE BEBIDAS NUSANT ARA-NAM YEONG	19.5499	12.5703
40	C12	one more drink	19.8645	12.8386
41	C14	good day good time	21.014	11.177
42	C15	tea water	21.2979	11.2969
43	C16	mick yi kei	21.5722	11.4127
44	C17	ice on me	21.8561	11.5326
45	C18	laraki	22.2441	11.6842
46	C19	angel box	22.5247	11.8116
47	C20	EST ABELICIMENTO DE COMDAS HUI LAU SHAN	22.7959	11.9347
48	C21	mrs fa	20.8896	11.4672
49	C22	Richa	21.1736	11.5871
50	C23	degree 45	21.4479	11.7029
51	C24	time hes coffee	21.7318	11.8229
52	C25	wheel cake	22.1121	11.971
53	C26	tiger sugar	22.3927	12.0984
54	C27	PADARA DA GUIA	22.6639	12.2215
55	C28	EST ABELICVENTO DE CODAS JAPONESAS SAMKU	22.9445	12.349
56	C29	little azucar	23.0765	12.0621
57	D1	digreen	24.342	14.5907
58	D2	ESTABELECIMENTO DE COMDAS COREANA STAE L N DAE	24.342	15.0619
59	D3	ESTABELECIMENTO DE COMDAS TIPICAS COREA KONG NAM UN	23.1007	13.7432
60	D4	ESTABELECIMENTO DE COMDAS DO MPERO ROYAL TALANDES	23.1007	14.2057
61	D5	ESTABELECIMENTO DE COMDAS TIN LUMLOUA DE SOPA DE FITAS	24.7698	14.1196
62	D6	idian garden	24.7698	14.5907
63	D7	EST ABELICIMENTO DE COMDAS HON SENG BLEAF	24.7698	15.0619
64	D8	EST ABELICIMENTO DE COMDAS HMALAYAN CASA	24.7698	15.533
65	D9	EST ABELICIMENTO DE COMDAS KLLNEY	24.7698	16.0042
66	D10	EST ABELICIMENTO DE COMDAS TOP FUSION	22.6744	13.2808
67	D11	Krua theoue	22.6744	13.7432
68	D12	thai yummy	22.6744	14.2057
69	D13	yawarat nina	10.7923	11.6393
70	D14	sushi mi tai japaneses preataurant	11.0054	11.1048
71	D15	EST ABELICIMENTO DE COMDAS TAI PAN KENG TOU	11.2746	10.5714

D16	72	asia delicias zone	LA ONE KITCHENETTE	11.5312	10.0583
D17	73	asia delicias zone	EST ABELECIMENTO DE COMDAS SHISU TSUKI	11.8389	9.5682
D18	74	asia delicias zone	EST ABELECIMENTO DE COMDAS COZNHA JAPONESA HOKKAIDO	12.1908	9.0432
D19	75	asia delicias zone	BARI UMA RAMEN	9.6459	9.596
D20	76	asia delicias zone	EST ABELECIMENTO DE COMDAS NAGANO CUIDADOS	12.5612	8.59
D21	77	asia delicias zone	EDO JAPANESE RESTAURANT	9.2312	9.9481
D22	78	asia delicias zone	EST ABELECIMENTO DE COMDAS NAN TEI	8.8488	10.2894
D23	79	asia delicias zone	COMDAS RAMEN KOU-JI	8.4402	10.6889
D24	80	asia delicias zone	CAFE LITTLE TOKYO	8.0617	11.0869
D25	81	asia delicias zone	CAFE POLI	23.1007	13.2808
E1	82	local delicias zone	ESTABELECEMENTO DE COMIDAS OUARTO IRMÃO	19.7282	13.958
E2	83	local delicias zone	ESTABELECEMENTO DE COMIDAS CHUI KUN	19.4127	13.958
E3	84	local delicias zone	DUMP LING TOWN	17.8843	13.958
E4	85	local delicias zone	ESTABELECEMENTO DE COMIDAS IENG FAT CHA CHAN TENG	17.5358	13.958
E5	86	local delicias zone	ESTABELECEMENTO DE COMIDAS ZEN CUISINE	17.1881	13.958
E6	87	local delicias zone	ESTABELECEMENTO DE COMIDAS LEI U MUN	16.8396	13.958
E7	88	local delicias zone	ESTABELECEMENTO DE COMIDAS TONG WU	16.4911	13.958
E8	89	local delicias zone	ESTABELECEMENTO DE COMIDAS A CHANG	16.1433	13.958
E9	90	local delicias zone	ESTABELECEMENTO DE COMIDAS YI YAN TANG	19.8669	16.8995
E10	91	local delicias zone	ESTABELECEMENTO DE COMIDAS IMPLACABEL SPICY	19.8669	16.5771
E11	92	local delicias zone	ESTABELECEMENTO DE COMIDAS OMAYA	19.8669	16.2548
E12	93	local delicias zone	ESTABELECEMENTO DE COMIDAS POU TIN LAO MEI LAO CHOU	20.9878	17.3065
E13	94	local delicias zone	ESTABELECEMENTO DE COMIDAS HEY HEY	20.9878	16.8771
E14	95	local delicias zone	ESTABELECEMENTO DE COMIDAS NO.5 FRENCH CUISINE	20.9878	16.4648
E15	96	local delicias zone	ESTABELECEMENTO DE COMIDAS SUN YICK	20.9878	16.025
E16	97	local delicias zone	ESTABELECEMENTO DE COMIDAS HAP SENG	20.1918	16.2548
E17	98	local delicias zone	COZNHA ASIATICA TREASURE LAKE	20.1918	16.5771
E18	99	local delicias zone	A COZINHA DO DCM	20.1918	16.8995
E19	100	local delicias zone	ESTABELECEMENTO DE COMIDAS KAM JOI MA	20.1918	14.6431
E20	101	local delicias zone	TIMES COMDASE SOPA	20.1918	14.9655
E21	102	local delicias zone	ESTABELECEMENTO DE COMIDAS HOI ON	20.1918	15.2878
E22	103	local delicias zone	ESTABELECEMENTO DE COMIDAS KAN TO POU	20.1918	15.6101
E23	104	local delicias zone	ESTABELECEMENTO DE COMIDAS LI LAI KA FEI MEI SHE	20.1918	15.9325
E24	105	local delicias zone	ESTABELECEMENTO DE COMIDASOI SIM SUM	19.8669	14.6431
E25	106	local delicias zone	ACUELAPANELA QUENTE	19.8669	14.9655
E26	107	local delicias zone	ESTABELECEMENTO DE COMIDAS PR. INCIBE KA FE MEI SEX	19.8669	15.2878
E27	108	local delicias zone	WICKED SNOW	19.8669	15.6101
E28	109	local delicias zone	ESTABELECEMENTO DE OOMIOAS MS	19.8669	15.9325
E29	110	local delicias zone	ESTABELECEMENTO DE COMIDAS WULOU CHA LJO NEI SEX	17.167	18.0361

E30	local delicias zone	ANTIGO MACAL TRADICIONL	16.8607	17.8911
111	local delicias zone	ESTABELEMENTO DE COMIDAS GATOS DE SABOR HUN YUET	16.5382	17.7468
112	local delicias zone	ESTABELEMENTO DE COMIDAS COZINHA DA ARTE	16.2584	17.599
113	local delicias zone	ESTABELEMENTO DE COMIDAS MEU BISTRO	15.937	17.4291
114	local delicias zone	ESTABELEMENTO DE COMIDAS CHENGDU HOT POT	20.3587	13.958
115	local delicias zone	ESTABELEMENTO DE COMIDAS YONG TAI NEI SN	15.7948	13.958
116	local delicias zone	VEGETARIAN DE GONGDEMEN	20.0418	13.958
117	local delicias zone	PASTEKARIA YENG KEE	24.3496	16.0042
118	sponsor	PASTEKARIA YENG KEE	24.3496	15.5331
119	sponsor	SOCIEDADE DE JOGOS DE MACAU, S.A.	24.3496	14.1196
120	G3	BANK OF CHINA MACAU BRANCH	23.1007	14.6681
121	G5	MACAU INDUSTRIAL LIMITED	22.6744	14.6681
122	G6	MACAU INDUSTRIAL LIMITED	20.3929	13.5369
123	G7	COMPANHADECHAMACAUVALLN LMITADA	20.1811	13.1701
124	G8	PERFECT SHOT	9.6923	15.2651
125	G9	STADB STILL	13.3303	16.7161
126	H1	TREASURE BUCKETS	12.7954	16.2812
127	H2	GOURMENT PARA DISE	12.3299	15.9027
128	H3	ROLLER BALL	11.8661	15.5257
129	H4	ROTARY ANIMAL PARK	11.4005	15.1472
130	H5	HOPPING FROG	8.834	12.7724
131	H6	SLAMBDUNK	9.3585	14.0929
132	H7	FISH CATCHER	8.747	14.7145
133	H8	COINING AROUND	8.3909	15.7023
134	H9	SANDY SKEE BALL	8.0627	16.3472
135	H10	BEER&SANCK	7.8306	17.643
136	H11	BEER&SANCK	20.9878	14.6932
137	I6	other	8.2676	11.98
138	I7	other	19.7954	10.6412
139	I10	other	23.8712	16.7128
140	I11	other	15.8448	14.5245
141	J1	other	15.8448	14.9642
142	J2	other	15.8448	16.723
143	J3	other	15.8448	15.4039
144	J4	other	15.8448	14.5245
145	J5	other	15.8448	16.2933
146	J6	other	15.8448	16.2933
147	J7	other	16.2933	14.9642
148	J8	other	16.2933	14.5039
149	J9	other	16.2933	15.4039

Predictions on the Population Density and the Net Crowd Flow

J10	150	16.2933	15.8436
J11	151	16.2933	16.2833
J12	152	16.2933	16.723
J13	153	16.7421	14.5245
J14	154	16.7421	14.9642
J15	155	16.7421	15.4039
J16	156	16.7421	15.8436
J17	157	16.7421	16.2833
J18	158	16.7421	16.723
J19	159	17.191	14.5245
J20	160	17.191	14.9642
J21	161	17.191	15.4039
J22	162	17.191	15.8436
J23	163	17.191	16.2833
J24	164	17.191	16.723
J25	165	17.6395	14.5245
J26	166	17.6395	14.9642
J27	167	17.6395	15.4039
J28	168	17.6395	15.8436
J29	169	17.6395	16.2833
J30	170	17.6395	16.723
J31	171	18.0842	14.5245
J32	172	18.0842	14.9642
J33	173	18.0842	15.4039
J34	174	18.0842	15.8436
J35	175	18.0842	16.2833
J36	176	18.0842	16.723
J37	177	18.529	14.5245
J38	178	18.529	14.9642
J39	179	18.529	15.4039
J40	180	18.529	15.8436
J41	181	18.529	16.2833
J42	182	18.529	16.723
J43	183	18.9746	14.5245
J44	184	18.9746	14.9642
J45	185	18.9746	15.4039
J46	186	18.9746	15.8436
J47	187	18.9746	16.2833
J48	188	18.9746	16.723

Predictions on the Population Density and the Net Crowd Flow

189	J49	15.4676	6.2612
190	J50	15.4676	6.7009
191	J51	15.4676	7.1406
192	J52	15.4676	7.5803
193	J53	15.4676	8.02
194	J54	15.4676	8.4597
195	J55	15.9132	6.2612
196	J56	15.9132	6.7009
197	J57	15.9132	7.1406
198	J58	15.9132	7.5803
199	J59	15.9132	8.02
200	J60	15.9132	8.4597

End of Table 2

## Appendix B Grand questionnaire

Time stamp	Type	Chinese restaurant zone	european delicacies zone	Dessert zone	Asia delicacies zone	Local delicicas zone	Game booth	Sponsor and Other
2021/11/15 am 10:58:33	9	7	10	9	8	8	8	6
2021/11/15 am 10:59:29	4	3	8	6	7	9	9	8
2021/11/15 am 11:00:00	7	8	9	8	7	9	9	7
2021/11/15 am 11:01:45	9	4	10	7	4	10	10	8
2021/11/15 am 11:06:10	10	9	9	9	8	3	3	5
2021/11/18 am 8:28:54	10	5	9	9	3	3	3	3
2021/11/18 am 8:54:37	5	8	8	9	7	4	4	4
2021/11/18 pm 12:28:14	1	7	9	8	6	5	5	5
2021/11/18 pm 2:25:51	8	7	7	6	9	6	7	7
2021/11/18 pm 2:35:05	7	8	10	7	8	8	7	7
2021/11/18 pm 6:03:14	5	7	6	6	6	2	2	2
2021/11/17 pm 11:18:02	9	8	7	8	7	9	3	3
2021/11/17 pm 11:30:59	5	8	6	6	7	5	6	6
2021/11/17 pm 11:53:06	10	10	8	8	10	5	5	5
2021/11/18 am 5:00:23	9	5	7	8	9	6	7	7
2021/11/18 am 8:46:09	10	5	5	10	10	9	7	7
2021/11/18 am 11:01:20	8	6	7	8	9	5	5	5
2021/11/18 pm 12:32:19	9	9	9	9	7	2	2	5
2021/11/18 pm 11:50:20	10	10	10	10	10	10	10	10
2021/11/19 am 1:46:52	3	7	7	7	7	5	5	5
2021/11/19 am 8:48:43	10	8	8	8	8	6	6	6
2021/11/19 am 9:01:30	9	9	7	7	7	5	6	6
2021/11/26 am 9:02:39	10	10	10	10	10	10	10	10
2021/11/26 am 9:03:46	5	8	8	8	9	2	2	10
2021/11/26 am 9:04:47	5	5	5	5	5	5	5	5
2021/11/26 am 9:06:50	8	8	8	8	8	8	8	8
2021/11/26 am 9:07:09	4	5	8	4	5	5	6	6
2021/11/26 am 9:07:51	8	6	9	7	5	10	9	9
2021/11/26 am 9:10:15	4	8	10	8	6	1	3	3
2021/11/26 am 9:11:17	4	8	7	9	9	10	10	10
2021/11/26 pm 2:14:52	7	10	10	8	10	6	9	9
2021/11/26 pm 2:18:52	3	4	7	8	9	1	5	5
2021/11/26 pm 2:18:54	8	7	8	8	7	9	9	9
2021/11/26 pm 2:19:15	7	8	7	9	9	5	3	3
2021/11/26 pm 2:19:21	1	5	10	5	7	1	5	5
2021/11/26 pm 2:19:45	1	1	2	4	6	6	6	6
2021/11/26 pm 2:20:22	6	9	10	9	7	10	10	10
2021/11/26 pm 2:20:24	8	6	5	8	7	1	2	2
2021/11/26 pm 2:20:33	7	7	10	9	8	10	10	10
2021/11/26 pm 2:21:19	8	7	10	5	10	6	6	6
2021/11/26 pm 2:21:46	7	8	10	8	8	3	8	8
2021/11/26 pm 2:22:07	5	8	9	8	7	5	6	6
2021/11/26 pm 2:23:20	1	1	1	1	1	1	1	1
2021/11/26 pm 2:25:46	4	6	10	5	7	8	5	5
2021/11/26 pm 10:30:53	8	8	8	8	7	7	7	7
2021/11/26 pm 11:28:21	5	5	9	7	6	10	7	7
average	6.543	6.870	8.043	7.413	5.957	0.442	6.283	0.347
standard deviation of mean	0.403	0.313	0.298	0.263	0.280			

Table 3: Grand questionnaire.

## Appendix C Chinese restaurant zone

StandID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time stamp	2021/1/1/3 pm 7:47:26	6	4	5	5	4	3	5	7	7	6	4	4	5	4	5	6
2021/1/1/5 am 11:02:20	10	7	9	8	10	5	8	9	6	9	6	10	6	9	9	7	7
2021/1/1/5 am 11:02:46	9	7	9	8	7	10	9	10	7	9	7	8	9	8	7	10	10
2021/1/1/5 am 11:05:48	7	6	5	4	5	5	5	5	3	7	6	4	6	6	5	5	8
2021/1/1/5 am 11:06:42	5	10	3	8	4	6	8	3	7	6	4	6	4	4	8	4	7
2021/1/1/5 am 11:09:39	2	4	10	10	8	5	9	9	4	3	2	10	10	10	2	10	3
2022/1/1/17 pm 11:22:45	7	4	5	5	1	6	3	7	5	6	2	1	5	5	7	5	7
2022/1/1/18 am 5:11:04	8	8	9	9	8	7	8	9	9	8	8	8	8	8	9	9	8
2022/1/1/18 am 11:11:25	8	8	9	9	8	8	8	8	8	8	9	8	7	8	9	8	8
2022/1/1/19 am 8:58:56	9	9	9	9	9	9	8	9	8	8	8	9	8	8	9	9	8
2022/1/1/26 am 9:08:45	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2022/1/1/26 am 9:09:11	8	7	6	7	7	6	7	8	7	8	7	7	7	7	8	8	7
2022/1/1/26 am 9:14:40	8	9	6	7	7	9	8	8	6	8	8	7	9	6	8	8	7
2022/1/1/26 am 9:15:36	7	5	8	6	3	6	4	10	5	3	3	8	4	3	5	4	7
2022/1/1/26 am 9:15:46	7	5	7	8	7	5	5	4	6	3	3	3	3	3	3	3	5
2022/1/1/26 am 9:17:10	7	7	9	6	8	9	8	8	7	9	7	9	8	7	7	7	7
2022/1/1/26 am 9:21:07	7	8	7	8	9	6	7	9	7	8	6	9	8	7	6	9	7
2022/1/1/26 am 9:21:19	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2022/1/1/26 pm 2:26:39	7	8	9	8	7	9	9	10	8	8	9	7	8	8	9	8	8
2022/1/1/26 pm 2:27:08	4	5	7	5	6	3	6	4	8	6	7	5	7	5	6	5	9
2022/1/1/26 pm 2:27:32	9	8	9	9	8	8	9	10	10	9	8	9	9	8	8	9	8
2022/1/1/26 pm 2:28:18	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	9
2022/1/1/26 pm 2:29:48	6	5	6	7	8	6	7	8	6	7	8	6	5	9	8	7	6
2022/1/1/26 pm 2:30:30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2022/1/1/26 pm 2:31:21	8	9	10	6	7	9	8	10	7	8	9	8	9	8	10	8	9
2022/1/1/26 pm 2:32:31	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
2022/1/1/26 pm 2:33:07	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2022/1/1/26 pm 2:33:53	3	6	3	5	4	1	1	2	1	1	1	3	3	5	2	3	2
2022/1/1/26 pm 2:34:08	10	4	3	3	4	1	4	10	2	3	3	3	5	2	3	2	3
2022/1/1/26 pm 2:36:01	3	3	2	2	3	3	3	4	1	1	1	5	5	2	2	1	1
2022/1/1/26 pm 10:36:08	8	8	8	8	8	8	8	8	9	9	8	8	8	10	8	8	8
2022/1/1/26 pm 11:31:26	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Predictions on the Population Density and the Net Crowd Flow

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Table 4: Chinese restaurant zone.

**European delicacies zone****Appendix D**

StandID	18	19	20	21	22	23	24	25	26	27	28
Time stamp	2021/1/5 am 10:59:06	8	10	5	10	4	9	7	10	7	10
2021/1/5 am 11:01:03	7	8	7	8	7	5	6	5	6	6	6
2021/1/5 am 11:01:39	8	5	7	5	4	8	7	5	4	8	9
2021/1/5 am 11:02:21	8	3	3	7	4	5	9	10	4	6	8
2021/1/5 am 11:08:33	9	10	5	3	3	9	9	9	4	10	3
2021/1/8 am 8:29:15	8	3	5	7	4	3	3	9	7	9	6
2021/1/8 pm 12:29:31	7	7	6	6	7	7	7	7	6	8	6
2021/1/17 pm 11:18:28	6	6	8	7	6	4	7	7	7	7	9
2021/1/17 pm 11:56:41	7	7	4	4	4	7	5	8	5	8	6
2021/1/18 am 5:01:48	7	9	6	8	6	7	7	8	7	8	8
2021/1/18 am 8:48:10	10	6	3	6	7	6	10	6	7	10	6
2021/1/18 am 11:02:37	6	7	6	8	8	8	9	8	7	8	8
2021/1/19 am 8:50:03	6	8	5	6	5	7	7	8	8	8	6
2021/1/19 am 9:02:11	7	8	7	7	6	7	7	7	7	7	7
2021/1/26 am 9:03:10	10	10	10	10	10	10	10	10	10	10	10
2021/1/26 am 9:05:10	5	5	5	5	5	5	5	5	5	5	5
2021/1/26 am 9:05:40	8	5	5	5	7	6	8	7	7	10	7
2021/1/26 am 9:08:11	5	6	7	8	7	6	5	9	7	8	6
2021/1/26 am 9:09:07	10	10	10	10	10	10	10	10	10	10	10
2021/1/26 am 9:10:44	9	6	7	6	5	9	10	8	4	8	6
2021/1/26 am 9:12:04	8	5	7	4	5	7	8	8	6	8	6
2021/1/26 am 9:13:15	9	7	6	6	7	8	10	8	7	10	6
2021/1/26 pm 2:19:39	8	7	8	7	7	8	9	8	7	9	6
2021/1/26 pm 2:19:54	8	7	5	6	4	6	8	4	4	5	10
2021/1/26 pm 2:20:05	8	8	6	7	8	5	4	8	8	9	4
2021/1/26 pm 2:20:06	5	4	5	7	4	6	6	7	6	7	6
2021/1/26 pm 2:20:43	9	9	8	6	8	10	6	9	8	7	9
2021/1/26 pm 2:21:09	9	9	10	8	9	10	8	8	8	7	6
2021/1/26 pm 2:21:42	5	5	5	5	5	7	3	3	3	5	3
2021/1/26 pm 2:21:50	10	5	2	5	1	3	6	9	3	4	7
2021/1/26 pm 2:22:56	6	4	7	5	3	5	9	7	7	7	5
2021/1/26 pm 2:23:10	8	8	8	8	8	8	9	9	9	9	10
2021/1/26 pm 2:23:34	10	6	5	6	5	5	10	10	8	10	7
2021/1/26 pm 2:24:11	1	1	1	1	1	1	1	1	1	1	1
2021/1/26 pm 2:27:59	6	2	2	2	2	2	3	1	2	2	5
2021/1/26 pm 10:31:40	8	8	8	8	8	8	8	8	8	8	8
2021/1/26 pm 11:28:41	7	7	8	9	7	7	8	8	6	6	5
average	7.459	6.514	6.000	6.378	5.892	6.595	7.027	7.324	6.270	7.514	6.595
standard deviation of mean	0.307	0.373	0.355	0.336	0.387	0.350	0.415	0.351	0.359	0.328	0.360

Table 5: European delicacies zone.

## Appendix E Dessert zone

StandID	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Time stamp																												
2021/1/15 am 11:00:03	10	9	8	10	9	10	9	9	10	8	10	9	9	9	7	8	9	9	7	8	9	9	7	9	8	8	8	8
2021/1/15 am 11:02:51	9	7	10	9	10	9	8	6	6	9	7	6	8	6	5	2	4	4	4	7	6	5	5	5	6	9	8	8
2021/1/15 am 11:02:58	9	4	6	7	8	8	3	8	3	9	3	9	3	9	3	9	10	7	8	6	5	4	7	6	7	6	4	4
2021/1/15 am 11:04:55	9	3	2	8	8	8	8	9	7	8	8	9	9	9	8	7	7	8	9	9	2	7	1	1	5	7	1	1
2021/1/18 pm 12:31:39	8	8	8	8	8	8	8	6	8	6	7	8	5	5	5	7	4	7	4	3	4	6	7	5	4	4	4	4
2021/1/10 7 pm 11:19:44	7	6	8	6	8	6	8	6	7	8	5	5	5	5	5	7	4	7	4	3	4	6	8	6	7	5	4	4
2021/1/17 pm 11:31:57	6	3	7	4	4	4	4	5	6	5	4	5	5	5	6	4	4	4	5	5	4	4	4	4	5	5	5	5
2021/1/18 am 12:00:22	6	6	8	6	10	8	8	8	10	7	7	7	7	7	7	6	6	6	6	6	4	8	7	6	8	8	6	6
2021/1/18 am 11:05:13	7	7	9	6	7	8	7	6	7	8	7	7	7	7	7	6	6	6	6	6	7	7	6	7	6	7	7	7
2021/1/19 am 8:53:01	7	7	10	6	6	6	6	6	6	6	7	7	7	7	7	6	5	5	5	5	5	5	6	5	5	5	5	5
2021/1/19 am 9:04:23	5	5	9	6	5	5	5	5	5	6	5	5	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10
2021/1/26 am 9:04:47	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 am 9:10:11	7	9	7	8	4	6	5	7	6	6	6	8	7	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2021/1/26 am 9:12:09	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 am 9:12:31	8	10	6	4	3	3	7	9	8	3	6	9	5	8	6	3	4	1	5	6	3	10	8	4	6	4	4	
2021/1/26 am 9:14:09	6	7	4	7	3	3	7	8	6	7	5	8	8	8	7	4	6	6	6	5	7	8	8	4	8	7	6	
2021/1/26 am 9:16:10	9	10	7	7	8	8	7	9	10	9	9	8	7	7	6	6	10	6	10	6	8	8	10	7	9	10	9	
2021/1/26 am 9:16:21	9	8	9	8	8	8	8	7	9	9	9	9	8	7	9	9	8	7	6	6	6	6	6	6	6	6	6	
2021/1/26 pm 2:21:51	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 pm 2:22:07	9	8	7	8	10	8	9	8	7	8	9	8	9	8	7	8	9	8	9	8	7	8	7	7	8	8	9	8
2021/1/26 pm 2:22:07	8	6	10	8	6	8	6	10	4	6	5	6	10	7	5	6	5	6	5	8	3	3	3	3	3	3	3	3
2021/1/26 pm 2:22:10	8	6	8	9	6	8	5	7	9	9	9	6	7	5	9	4	8	5	6	3	8	7	7	9	7	8	7	6
2021/1/26 pm 2:22:20	8	6	8	9	10	10	9	10	9	10	9	10	9	10	9	9	9	9	9	9	9	9	9	9	10	9	9	
2021/1/26 pm 2:23:01	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 pm 2:24:21	5	5	3	3	3	2	6	3	5	4	5	3	6	7	4	6	6	5	4	4	6	6	6	6	2	3	3	7
2021/1/26 pm 2:24:46	4	8	6	4	6	5	8	9	7	10	10	6	5	7	6	8	10	8	7	3	6	7	10	8	9	7	7	
2021/1/26 pm 2:25:18	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 pm 2:25:41	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 pm 2:25:53	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2021/1/26 pm 2:26:02	8	9	8	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 pm 2:30:24	10	10	10	9	10	7	8	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 pm 10:33:08	8	8	9	7	8	8	9	10	10	8	10	10	8	10	8	8	10	8	8	10	10	10	10	10	10	10	10	
2021/1/26 pm 11:29:34	10	9	9	10	10	9	7	7	10	6	6	6	9	7	10	8	7	6	10	5	10	10	5	5	5	5	5	
average	7.906	7.406	7.688	7.438	7.313	7.031	7.344	7.813	7.219	6.844	7.156	7.063	6.719	7.094	6.688	6.250	6.906	6.531	6.906	6.454	6.464	0.470	0.428	0.412	0.453	0.447		
standard deviation of mean	0.377	0.426	0.408	0.414	0.463	0.415	0.411	0.417	0.425	0.411	0.438	0.445	0.381	0.444	0.450	0.432	0.482	0.467	0.448	0.450	0.453	0.455	0.453	0.453	0.453	0.447		

Table 6: Dessert zone.

## Appendix F Asia delicicas zone

StandID	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Time stamp	2021/1/1/3 pm 7:48:33	7	6	9	6	5	5	4	4	4	8	6	4	6	5	4	4	4	4	4	4	6	6	4	6
2021/1/1/5 am 11:01:56	10	8	9	10	9	8	10	7	10	7	10	9	7	9	9	8	7	10	8	10	7	10	6	6	10
2021/1/1/5 am 11:05:17	9	9	7	7	6	7	7	7	5	6	5	7	9	10	9	8	7	8	7	6	8	8	6	7	7
2021/1/1/5 am 11:06:21	5	4	7	6	3	8	5	8	4	8	4	4	7	5	6	8	10	10	4	6	8	7	9	9	9
2021/1/1/5 am 11:08:39	9	3	2	5	3	8	9	2	9	4	9	10	10	2	9	4	10	4	2	2	10	2	1	1	10
2021/1/1/8 pm 12:33:34	5	5	7	6	7	6	7	7	7	8	6	9	9	9	9	9	9	9	8	9	9	8	9	9	8
2021/1/1/7 pm 11:21:58	6	6	5	6	6	5	8	7	8	7	6	6	4	6	6	7	7	7	6	6	7	6	6	6	4
2021/1/1/8 am 5:09:52	7	7	8	9	8	7	7	8	8	8	9	7	7	7	7	6	8	7	7	8	7	7	7	7	7
2021/1/1/8 am 11:10:08	7	8	8	7	6	6	6	6	6	7	7	8	8	9	9	9	8	8	8	8	8	8	8	8	7
2021/1/1/9 am 8:57:48	6	6	6	7	6	5	5	5	5	5	5	5	5	6	5	5	5	5	5	5	6	5	5	5	5
2021/1/1/9 am 9:00:47	8	8	8	7	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
2021/1/1/26 am 9:07:27	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2021/1/1/26 am 9:08:46	7	6	6	7	7	5	6	7	7	7	6	6	8	7	7	6	7	7	6	9	8	8	8	8	7
2021/1/1/26 am 9:13:57	10	8	9	9	7	4	5	6	4	6	10	7	10	10	7	9	7	9	8	9	9	5	8	6	8
2021/1/1/26 am 9:15:09	6	8	5	5	2	1	5	3	10	8	4	3	10	9	6	10	10	10	10	10	10	10	10	10	10
2021/1/1/26 am 9:15:11	10	10	7	8	5	5	5	7	8	5	5	7	9	9	7	8	7	8	7	8	6	8	9	8	6
2021/1/1/26 am 9:16:32	7	6	8	6	8	6	8	6	8	5	8	7	8	7	8	6	8	6	9	7	6	9	7	8	8
2021/1/1/26 am 9:20:27	6	5	6	5	4	5	4	8	7	9	10	7	9	6	10	9	8	10	9	8	10	9	8	6	6
2021/1/1/26 am 9:20:55	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2021/1/1/26 pm 2:21:42	6	2	7	2	8	8	2	8	2	8	3	8	2	8	3	8	7	8	2	8	9	10	8	7	8
2021/1/1/26 pm 2:25:57	9	9	9	8	7	7	6	6	8	9	8	9	8	10	9	9	9	8	9	7	8	9	7	8	8
2021/1/1/26 pm 2:26:20	5	3	8	7	5	8	7	2	5	6	4	3	5	7	8	4	5	6	4	5	6	4	7	6	4
2021/1/1/26 pm 2:26:46	8	7	9	8	7	9	9	8	7	8	9	8	8	10	7	8	8	9	7	8	9	7	8	7	8
2021/1/1/26 pm 2:27:31	9	9	9	8	9	9	9	8	8	9	8	9	8	9	8	9	9	9	9	9	9	9	8	9	8
2021/1/1/26 pm 2:28:49	9	8	7	7	5	6	7	8	9	7	6	7	8	10	8	8	8	9	8	9	9	8	8	8	4
2021/1/1/26 pm 2:29:11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2021/1/1/26 pm 2:30:38	9	8	9	7	10	7	9	8	10	8	9	7	10	9	8	7	8	7	10	8	7	10	9	8	8
2021/1/1/26 pm 2:30:51	5	2	4	4	3	2	4	3	4	4	5	4	5	2	2	4	2	2	2	2	2	2	2	2	1
2021/1/1/26 pm 2:31:28	10	10	10	10	8	8	9	8	10	9	9	1	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/1/26 pm 2:31:53	10	10	9	9	8	8	8	8	10	9	10	8	10	10	10	10	10	10	10	10	10	10	10	9	
2021/1/1/26 pm 2:32:30	1	4	4	1	1	3	3	10	5	8	2	5	4	1	10	10	3	7	7	7	7	7	7	2	
2021/1/1/26 pm 2:35:14	3	3	3	2	3	4	1	2	6	1	5	7	8	5	6	7	8	5	8	6	7	6	6	5	
2021/1/1/26 pm 10:35:34	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
average	7.147	6.529	7.029	6.588	6.147	6.324	6.559	6.265	7.000	6.794	7.000	7.647	6.647	6.971	7.725	7.529	6.794	7.294	7.559	7.225	7.324	6.471	6.735	6.445	
standard deviation of mean	0.425	0.449	0.395	0.412	0.433	0.391	0.405	0.412	0.455	0.377	0.427	0.380	0.480	0.434	0.350	0.420	0.413	0.399	0.420	0.404	0.399	0.436	0.445	0.421	

Table 7: Asia delicicas zone.

**Appendix G Local delicicas zone**

StampID	StartID	EndID	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117
Time stamp																													
2021/1/13 pm 7:50:48	8	7	8	6	6	5	6	6	4	7	9	8	7	6	7	5	4	4	7	7	4	7	5	3	4	2	3	6	
2021/1/13 pm 11:34:06	9	8	1	7	3	4	2	7	6	9	8	10	9	8	7	8	5	5	6	7	6	7	6	8	7	8	7	6	
2021/1/15 am 11:45:17	10	1	7	1	2	3	2	8	7	9	10	10	10	8	5	10	2	5	4	6	4	8	4	6	5	6	10	6	
2021/1/15 am 11:46:27	9	6	7	1	2	3	5	6	6	5	5	6	9	9	8	8	7	5	3	2	3	1	10	1	9	9	2	6	
2021/1/18 am 8:56:59	7	7	5	6	6	5	5	5	6	5	5	6	4	3	8	7	8	7	7	6	6	6	6	6	8	10	6	2	
2021/1/18 pm 2:26:56	5	6	5	4	3	7	7	6	4	3	8	2	8	5	4	3	4	4	4	4	4	4	2	7	3	4	4	2	
2021/1/17 pm 11:20:50	7	5	5	6	8	3	5	4	3	4	8	4	4	4	7	7	2	2	6	5	5	5	6	3	7	5	6	2	
2021/1/18 am 12:02:47	8	8	3	5	5	5	1	6	6	3	4	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	6	8	
2021/1/18 am 5:07:50	8	7	8	8	8	7	8	7	8	6	7	7	8	7	8	7	8	8	8	8	8	8	8	8	8	8	8	8	
2021/1/18 am 11:07:15	7	8	7	7	7	9	8	7	7	8	7	8	8	7	7	8	8	7	7	8	7	7	7	8	7	8	7	8	
2021/1/19 am 8:53:09	6	6	7	6	6	7	6	6	6	6	7	6	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	
2021/1/19 am 9:06:21	6	6	6	6	6	6	6	6	6	6	6	7	8	8	8	7	7	6	6	6	6	6	6	6	6	6	6	6	
2021/1/26 am 9:05:32	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 am 9:06:29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
2021/1/26 am 9:06:39	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
2021/1/26 am 9:07:50	5	8	7	7	6	7	6	7	6	7	7	8	7	7	8	7	7	6	7	6	7	6	6	7	6	7	8	7	
2021/1/26 am 9:11:52	8	6	8	7	6	8	6	8	6	8	7	8	7	8	6	8	8	6	8	7	5	3	2	5	7	5	9	10	
2021/1/26 am 9:13:42	7	8	9	6	5	7	4	5	6	6	5	10	9	10	8	9	8	6	7	6	7	6	7	5	4	5	4	5	
2021/1/26 am 9:13:43	6	5	7	4	5	7	4	6	5	6	10	5	8	6	8	6	5	3	3	8	6	5	3	7	6	4	5	4	
2021/1/26 am 9:15:14	5	7	4	5	7	4	6	7	6	7	7	8	7	8	6	7	8	6	8	7	8	7	8	8	7	8	8	7	
2021/1/26 am 9:18:04	3	2	3	2	3	2	3	2	3	1	1	4	3	2	3	2	3	1	6	10	5	5	5	5	5	5	5	5	
2021/1/26 am 9:18:47	8	9	8	7	6	8	7	6	5	9	6	8	9	6	8	9	8	9	10	9	9	8	7	10	9	8	7		
2021/1/26 pm 2:21:06	5	8	7	6	4	4	5	5	5	5	8	6	5	5	8	7	4	9	8	7	7	7	7	7	6	7	7	8	
2021/1/26 pm 9:11:52	8	6	8	7	6	8	6	8	6	8	7	8	7	8	6	8	8	7	5	3	2	5	7	5	9	10	6		
2021/1/26 pm 9:13:42	7	8	9	6	5	7	4	5	6	6	5	10	9	10	8	9	8	6	7	6	7	5	3	2	5	4	5		
2021/1/26 pm 9:13:43	6	5	7	4	5	7	4	6	5	6	10	5	8	6	8	6	5	3	3	8	6	5	3	7	6	4	5		
2021/1/26 pm 9:15:14	5	7	4	5	7	4	6	7	6	7	7	8	7	8	6	7	8	6	8	7	8	7	8	8	7	8	8		
2021/1/26 pm 9:18:04	3	2	3	2	3	2	3	2	3	1	1	4	3	2	3	2	3	1	6	10	5	5	5	5	5	5	5		
2021/1/26 pm 9:18:47	8	9	8	7	6	8	7	6	5	9	6	8	9	6	8	9	8	9	10	9	9	8	7	10	9	8	7		
2021/1/26 pm 2:21:06	5	8	7	6	4	4	5	5	5	5	8	6	5	5	8	7	4	9	8	7	7	7	7	6	7	7	8		
2021/1/26 pm 2:23:59	8	9	8	7	6	8	9	8	7	6	8	9	8	7	6	8	9	8	7	5	3	2	5	7	5	9	8		
2021/1/26 pm 2:34:04	8	9	8	7	6	8	9	8	7	6	8	9	8	7	6	8	9	8	7	5	3	2	5	7	5	9	8		
2021/1/26 pm 2:34:05	3	5	8	9	3	4	6	8	5	10	3	6	4	3	8	7	6	3	7	8	1	6	4	5	6	4	7	3	
2021/1/26 pm 2:34:28	8	7	9	8	7	9	8	7	8	6	7	8	9	8	7	6	8	9	8	7	5	3	2	5	7	5	9	8	
2021/1/26 pm 2:35:35	8	8	9	9	8	9	9	10	9	8	9	10	9	8	10	9	8	9	9	8	9	9	8	9	9	10	9		
2021/1/26 pm 2:36:31	5	9	7	6	7	8	7	4	6	8	5	8	7	6	8	7	6	5	7	8	7	6	5	7	6	5	7	6	
2021/1/26 pm 2:37:26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2021/1/26 pm 2:37:37	4	10	4	7	2	4	3	7	4	8	4	5	7	2	4	5	4	5	6	4	2	5	6	4	2	5	4	2	
2021/1/26 pm 2:38:16	6	4	5	7	5	5	4	4	7	2	5	4	5	4	5	4	5	4	5	6	4	2	5	6	4	2	5	4	
2021/1/26 pm 2:39:11	10	10	8	8	6	7	8	7	8	10	9	10	9	8	8	7	9	8	7	9	10	9	9	10	10	10	10		
2021/1/26 pm 2:39:53	8	8	9	8	9	8	9	9	8	9	10	9	9	8	8	8	8	8	8	9	9	9	8	9	9	10	8		
2021/1/26 pm 2:39:55	3	2	3	2	3	2	3	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2021/1/26 pm 2:39:29	7	7	8	8	8	8	8	8	8	9	10	9	10	9	10	9	10	9	10	9	10	9	10	9	10	9	10		
2021/1/26 pm 10:34:16	8	8	8	8	8	8	8	8	8	9	10	9	10	9	10	9	10	9	10	9	10	9	10	9	10	9	10		
2021/1/26 pm 11:30:17	6	1	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
average	6.81	6.703	6.919	6.405	6.108	6.568	6.405	6.811	7.027	6.946	7.216	6.541	6.568	6.622	6.649	6.740	6.324	6.297	6.784	6.486	6.486	6.973	6.865	6.865	6.405	6.405	6.405		
standard deviation of mean	0.346	0.406	0.305	0.354	0.343	0.343	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	
standard deviation of mean	0.346	0.406	0.305	0.354	0.343	0.343	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373	

Table 8: Local delicicas zone.

## Appendix H

	Sponsor and other	StandID	118	119	120	121	122	123	124	125	137	138	139	140
Time stamp		2021/11/13 pm 7:49:23	3	4	4	3	4	7	5	6	6	5	8	8
2021/11/15 am 11:01:25		2021/11/15 am 11:04:33	10	8	8	7	9	7	10	8	9	9	7	9
2021/11/15 am 11:05:40		2021/11/15 am 11:07:21	7	8	3	4	4	4	5	4	5	5	7	7
2021/11/15 am 11:07:36		2021/11/17 pm 11:21:17	6	4	7	3	8	4	6	7	4	5	7	6
2021/11/18 am 5:08:16		2021/11/18 am 11:08:41	3	7	9	1	1	3	3	1	8	8	9	10
2021/11/18 am 8:56:10		2021/11/19 am 9:08:11	3	7	6	4	7	3	9	6	7	4	2	7
2021/11/26 am 9:12:24		2021/11/26 am 9:14:09	10	10	8	8	8	8	8	7	7	7	6	5
2021/11/26 am 9:14:17		2021/11/26 am 9:15:52	7	7	3	3	5	5	5	3	7	7	10	10
2021/11/26 am 9:18:53		2021/11/26 am 9:19:44	5	5	8	7	8	8	8	7	8	7	8	7
2021/11/26 pm 2:22:00		2021/11/26 pm 2:24:40	9	3	9	2	2	8	2	10	3	8	9	2
2021/11/26 pm 2:25:09		2021/11/26 pm 2:25:28	9	9	8	7	8	7	7	8	9	9	8	7
2021/11/26 pm 2:26:38		2021/11/26 pm 2:27:20	6	4	9	7	6	5	1	1	1	1	6	5
2021/11/26 pm 2:28:05		2021/11/26 pm 2:29:04	1	1	1	1	1	1	1	1	1	1	1	1
2021/11/26 pm 2:29:38		2021/11/26 pm 2:30:00	5	5	5	10	6	5	6	5	1	1	1	1
2021/11/26 pm 2:31:12		2021/11/26 pm 2:33:31	1	1	1	5	4	5	6	8	1	1	1	1
2021/11/26 pm 10:34:48		2021/11/26 pm 11:30:34	8	8	8	8	8	8	8	8	8	8	9	9
average		average	6.313	6.281	5.438	5.406	5.125	5.219	5.406	5.375	5.719	5.813	6.500	6.438
standard deviation of mean		standard deviation of mean	0.534	0.500	0.553	0.516	0.493	0.451	0.506	0.509	0.567	0.563	0.537	0.555

Table 9: Sponsor (stand ID: 118-125) and other (stand ID: 137-140).

## Appendix I Game booth

StandID	Time stamp	126	127	128	129	130	131	132	133	134	135	136
2021/11/3 pm 7:45:29	7	5	6	4	4	6	8	9	9	6	4	7
2021/11/5 am 10:53:36	9	4	7	5	8	7	9	7	10	8	6	7
2021/11/5 am 10:59:25	10	9	9	7	7	9	9	7	10	9	8	7
2021/11/5 am 11:01:41	7	6	8	8	9	9	10	10	10	9	9	7
2021/11/5 am 11:03:29	10	3	3	9	9	9	10	10	3	9	5	2
2021/11/5 am 11:10:18	3	2	4	10	2	3	3	3	2	3	2	2
2021/11/8 pm 12:38:14	8	6	7	8	6	7	8	8	10	7	7	6
2021/11/8 pm 2:25:14	7	7	5	8	4	8	8	10	7	4	4	4
2021/11/17 pm 11:18:53	6	7	8	7	8	7	8	6	7	6	6	8
2021/11/17 pm 11:58:12	4	4	7	8	8	8	9	9	9	9	8	7
2021/11/18 am 5:03:37	7	8	8	8	9	9	8	8	10	6	6	10
2021/11/18 am 8:46:41	4	4	8	9	9	9	8	8	10	6	6	10
2021/11/18 am 11:03:32	7	6	5	5	5	5	5	4	5	4	4	4
2021/11/19 am 8:50:52	5	5	5	5	5	5	5	5	5	5	5	5
2021/11/19 am 9:02:51	5	5	5	5	5	5	5	5	5	5	5	5
2021/11/26 am 9:03:43	10	10	10	10	10	10	10	10	10	10	10	10
2021/11/26 am 9:05:36	5	5	5	5	5	5	5	5	5	5	5	5
2021/11/26 am 9:06:39	5	6	6	8	8	7	6	6	5	7	6	7
2021/11/26 am 9:11:07	7	6	7	7	6	6	6	6	5	7	6	5
2021/11/26 am 9:11:22	2	3	3	3	5	4	4	5	5	5	5	5
2021/11/26 am 9:12:03	9	8	8	10	9	8	8	8	8	9	8	9
2021/11/26 am 9:12:55	4	4	6	7	9	10	9	7	8	7	8	8
2021/11/26 am 9:13:33	1	1	1	1	1	1	1	1	1	10	1	1
2021/11/26 pm 2:20:21	7	3	5	4	5	5	5	4	4	6	4	2
2021/11/26 pm 2:20:37	8	7	9	10	9	7	8	9	7	7	6	6
2021/11/26 pm 2:20:47	10	5	10	9	10	9	10	1	1	10	4	10
2021/11/26 pm 2:20:59	5	4	3	6	4	4	4	5	6	4	4	4
2021/11/26 pm 2:20:59	10	10	10	10	10	10	10	10	10	10	10	10
2021/11/26 pm 2:21:49	10	9	9	9	9	10	8	10	9	9	9	9
2021/11/26 pm 2:22:45	10	7	10	7	10	4	6	6	10	2	4	10
2021/11/26 pm 2:23:36	6	3	5	4	6	5	5	8	10	6	7	6
2021/11/26 pm 2:24:22	5	5	5	5	5	5	5	5	6	5	5	5
2021/11/26 pm 2:24:30	1	1	1	1	1	1	1	1	1	1	1	1
2021/11/26 pm 2:24:45	1	1	1	1	1	1	1	1	1	1	1	1
2021/11/26 pm 2:25:46	3	7	6	4	8	5	4	9	4	8	7	6
2021/11/26 pm 2:29:10	6	5	8	7	7	10	3	1	8	7	6	3
2021/11/26 pm 10:32:07	8	8	9	9	9	9	9	9	9	9	8	8
2021/11/26 pm 11:28:57	10	10	10	10	10	10	10	10	10	10	10	10
average	6.368	5.500	6.342	6.605	6.789	6.526	6.158	7.263	6.395	5.974	6.189	
standard deviation of mean	0.452	0.402	0.420	0.429	0.434	0.439	0.461	0.508	0.457	0.411	0.453	

Table 10: Game booth.

## Appendix J Normalized effective charges $Q'$ of stands

Table 11: The normalized effective charges  $Q'$  of stands were obtained as follows. First, we calculated  $\bar{x}$  and  $\sigma_{\bar{x}}$ , referring to the mean of the popularity of the sub-categorical stand, and the standard deviation of mean for the particular stand, respectively. Second, we also calculated  $\bar{y}$  and  $\sigma_{\bar{y}}$ , respectively referring to the mean of the popularity from the grand questionnaire for a specific type of stands, and the standard deviation of mean for that particular type of stands. Third, we calculated the final mean of each stand by calculating  $\bar{xy} = \bar{x}\bar{y}$ , together with the error propagation  $\sigma_{\bar{xy}}$  described in Eq.(5). Finally we also calculated  $Q'$ s by Eq.(6) at the last column, which were the effective charges of stands in our algorithm.

StandID	Mean( $\bar{x}$ )	SD of mean( $\sigma_{\bar{x}}$ )	Mean( $\bar{y}$ ) from Grand Questionnaire	sd of mean( $\sigma_{\bar{y}}$ ) from Grand Questionnaire	Final mean ( $\bar{xy}$ )	Final sd of mean( $\sigma_{\bar{xy}}$ )	$Q'$
1	6.875	2.459	6.543	0.403	44.983	16.328	-0.443
2	6.594	2.354	6.543	0.403	43.143	15.627	-0.696
3	6.813	2.608	6.543	0.403	44.574	17.285	-0.499
4	6.906	2.441	6.543	0.403	45.188	16.212	-0.415
5	6.531	2.423	6.543	0.403	42.734	16.069	-0.752
6	6.125	2.904	6.543	0.403	40.076	19.163	-1.117
7	6.688	2.468	6.543	0.403	43.756	16.374	-0.611
8	7.125	2.756	6.543	0.403	46.619	18.261	-0.218
9	6.594	2.686	6.543	0.403	43.143	17.777	-0.696
10	6.281	2.854	6.543	0.403	41.098	18.843	-0.976
11	6.063	2.627	6.543	0.403	39.667	17.359	-1.173
12	6.906	2.656	6.543	0.403	45.188	17.601	-0.415
13	6.438	2.816	6.543	0.403	42.121	18.609	-0.836
14	6.719	2.691	6.543	0.403	43.961	17.814	-0.583
15	6.250	2.700	6.543	0.403	40.894	17.845	-1.005
16	6.594	2.883	6.543	0.403	43.143	19.052	-0.696
17	6.813	2.546	6.543	0.403	44.574	16.880	-0.499
18	7.459	1.865	6.870	0.313	51.243	13.022	0.417
19	6.514	2.268	6.870	0.313	44.745	15.716	-0.476
20	6.000	2.160	6.870	0.313	41.217	14.959	-0.960
21	6.378	2.046	6.870	0.313	43.817	14.197	-0.603
22	5.892	2.354	6.870	0.313	40.475	16.279	-1.062
23	6.595	2.127	6.870	0.313	45.302	14.759	-0.399
24	7.027	2.522	6.870	0.313	48.273	17.464	0.009
25	7.324	2.135	6.870	0.313	50.315	14.846	0.289
26	6.270	2.181	6.870	0.313	43.074	15.113	-0.705
27	7.514	1.995	6.870	0.313	51.615	13.904	0.468
28	6.595	2.192	6.870	0.313	45.302	15.197	-0.399
29	7.906	2.131	8.043	0.298	63.594	17.298	2.113
30	7.406	2.408	8.043	0.298	59.572	19.492	1.560
31	7.688	2.306	8.043	0.298	61.834	18.691	1.871
32	7.438	2.341	8.043	0.298	59.823	18.959	1.595
33	7.313	2.620	8.043	0.298	58.818	21.190	1.457
34	7.031	2.621	8.043	0.298	56.556	21.186	1.146
35	7.344	2.350	8.043	0.298	59.069	19.030	1.491
36	7.875	2.324	8.043	0.298	63.342	18.844	2.078
37	7.813	2.361	8.043	0.298	62.840	19.137	2.009
38	7.219	2.406	8.043	0.298	58.064	19.473	1.353
39	7.438	2.327	8.043	0.298	59.823	18.849	1.595
40	7.531	2.475	8.043	0.298	60.577	20.038	1.698

## Predictions on the Population Density and the Net Crowd Flow

41	6.844	2.516	8.043	0.298	55.048	20.339	0.939
42	7.156	2.157	8.043	0.298	57.561	17.480	1.284
43	7.063	2.514	8.043	0.298	56.807	20.328	1.181
44	6.719	2.543	8.043	0.298	54.042	20.552	0.801
45	7.094	2.441	8.043	0.298	57.058	19.748	1.215
46	6.688	2.729	8.043	0.298	53.791	22.041	0.766
47	6.250	2.640	8.043	0.298	50.272	21.314	0.283
48	6.906	2.532	8.043	0.298	55.550	20.469	1.008
49	6.531	2.627	8.043	0.298	52.534	21.221	0.594
50	6.906	2.656	8.043	0.298	55.550	21.464	1.008
51	7.000	2.423	8.043	0.298	56.304	19.601	1.112
52	7.906	2.333	8.043	0.298	63.594	18.912	2.113
53	6.750	2.449	8.043	0.298	54.293	19.805	0.836
54	7.188	2.348	8.043	0.298	57.813	19.005	1.319
55	7.219	2.562	8.043	0.298	58.064	20.719	1.353
56	7.063	2.526	8.043	0.298	56.807	20.430	1.181
57	7.147	2.476	7.413	0.263	52.981	18.449	0.655
58	6.529	2.620	7.413	0.263	48.403	19.496	0.027
59	7.029	2.303	7.413	0.263	52.109	17.169	0.536
60	6.588	2.401	7.413	0.263	48.839	17.883	0.086
61	6.147	2.524	7.413	0.263	45.568	18.782	-0.363
62	6.324	2.279	7.413	0.263	46.877	16.978	-0.183
63	6.559	2.364	7.413	0.263	48.621	17.607	0.057
64	6.265	2.403	7.413	0.263	46.441	17.892	-0.243
65	7.000	2.651	7.413	0.263	51.891	19.741	0.506
66	6.794	2.199	7.413	0.263	50.365	16.398	0.296
67	6.735	2.490	7.413	0.263	49.929	18.544	0.236
68	6.647	2.214	7.413	0.263	49.275	16.506	0.146
69	6.971	2.801	7.413	0.263	51.673	20.847	0.476
70	7.647	2.533	7.413	0.263	56.688	18.886	1.164
71	7.794	2.042	7.413	0.263	57.778	15.273	1.314
72	7.000	2.449	7.413	0.263	51.891	18.251	0.506
73	7.353	2.411	7.413	0.263	54.508	17.974	0.865
74	7.529	2.326	7.413	0.263	55.816	17.353	1.045
75	6.794	2.447	7.413	0.263	50.365	18.226	0.296
76	7.294	2.355	7.413	0.263	54.072	17.565	0.805
77	7.559	2.325	7.413	0.263	56.034	17.349	1.075
78	7.235	2.284	7.413	0.263	53.636	17.036	0.745
79	7.324	2.543	7.413	0.263	54.290	18.951	0.835
80	6.471	2.596	7.413	0.263	47.967	19.323	-0.033
81	6.735	2.453	7.413	0.263	49.929	18.273	0.236
82	6.811	2.106	7.348	0.280	50.045	15.592	0.252
83	6.703	2.471	7.348	0.280	49.250	18.250	0.143
84	6.919	1.862	7.348	0.280	50.839	13.815	0.361
85	6.405	2.153	7.348	0.280	47.066	15.923	-0.157
86	6.108	2.145	7.348	0.280	44.881	15.850	-0.457
87	6.568	2.089	7.348	0.280	48.257	15.458	0.007
88	6.405	2.266	7.348	0.280	47.066	16.750	-0.157
89	6.811	2.209	7.348	0.280	50.045	16.343	0.252
90	7.027	2.267	7.348	0.280	51.633	16.772	0.470
91	6.946	2.697	7.348	0.280	51.038	19.914	0.388
92	7.216	2.800	7.348	0.280	53.024	20.674	0.661
93	6.541	2.501	7.348	0.280	48.059	18.468	-0.021

### Predictions on the Population Density and the Net Crowd Flow

94	7.189	1.984	7.348	0.280	52.825	14.715	0.634
95	7.081	2.087	7.348	0.280	52.031	15.461	0.525
96	6.541	2.181	7.348	0.280	48.059	16.127	-0.021
97	6.568	2.141	7.348	0.280	48.257	15.842	0.007
98	6.622	2.302	7.348	0.280	48.655	17.013	0.061
99	6.649	2.111	7.348	0.280	48.853	15.623	0.088
100	6.730	2.219	7.348	0.280	49.449	16.415	0.170
101	6.324	2.381	7.348	0.280	46.470	17.585	-0.239
102	6.297	2.093	7.348	0.280	46.271	15.481	-0.266
103	6.297	2.459	7.348	0.280	46.271	18.156	-0.266
104	5.973	2.327	7.348	0.280	43.888	17.182	-0.593
105	6.784	2.200	7.348	0.280	49.846	16.278	0.225
106	6.486	2.501	7.348	0.280	47.662	18.469	-0.075
107	6.486	2.090	7.348	0.280	47.662	15.464	-0.075
108	6.973	2.398	7.348	0.280	51.236	17.726	0.416
109	6.865	2.043	7.348	0.280	50.442	15.138	0.307
110	6.405	2.204	7.348	0.280	47.066	16.296	-0.157
111	6.405	2.192	7.348	0.280	47.066	16.203	-0.157
112	6.568	2.243	7.348	0.280	48.257	16.582	0.007
113	6.730	2.117	7.348	0.280	49.449	15.667	0.170
114	6.676	2.322	7.348	0.280	49.052	17.164	0.116
115	6.514	2.631	7.348	0.280	47.860	19.420	-0.048
116	6.568	2.102	7.348	0.280	48.257	15.555	0.007
117	6.378	2.361	7.348	0.280	46.867	17.441	-0.184
118	6.313	3.021	6.283	0.347	39.659	19.104	-1.174
119	6.281	2.831	6.283	0.347	39.463	17.920	-1.201
120	5.438	3.131	6.283	0.347	34.162	19.760	-1.929
121	5.406	2.917	6.283	0.347	33.965	18.420	-1.956
122	5.125	2.791	6.283	0.347	32.198	17.625	-2.199
123	5.219	2.549	6.283	0.347	32.787	16.118	-2.118
124	5.406	2.861	6.283	0.347	33.965	18.071	-1.956
125	5.375	2.882	6.283	0.347	33.769	18.203	-1.983
126	6.368	2.784	5.957	0.442	37.934	16.822	-1.411
127	5.500	2.480	5.957	0.442	32.761	14.969	-2.121
128	6.342	2.592	5.957	0.442	37.777	15.690	-1.433
129	6.605	2.646	5.957	0.442	39.344	16.030	-1.217
130	6.789	2.673	5.957	0.442	40.442	16.200	-1.067
131	6.526	2.709	5.957	0.442	38.874	16.390	-1.282
132	6.158	2.843	5.957	0.442	36.680	17.151	-1.583
133	7.263	3.134	5.957	0.442	43.263	18.940	-0.679
134	6.395	2.814	5.957	0.442	38.090	17.001	-1.389
135	5.974	2.531	5.957	0.442	35.582	15.304	-1.734
136	6.158	2.727	5.957	0.442	36.680	16.467	-1.583
137	5.719	3.205	6.283	0.347	35.929	20.234	-1.686
138	5.813	3.187	6.283	0.347	36.518	20.124	-1.605
139	6.500	3.037	6.283	0.347	40.837	19.216	-1.012
140	6.438	3.141	6.283	0.347	40.444	19.861	-1.066

### Appendix K Coordinates of stands for the initial layout plan

Table 12: Coordinates of stands for the initial layout plan. Integer -1 in Columns **StandID** and **Charge** actually means that there is **NO** stand at that particular location.

standID	X	Y	charge
0	25.9754	16.6909	-0.444
1	26.0947	16.106	-0.698
2	26.0947	15.535	-0.501
3	26.0125	14.9698	-0.416
-1	25.8371	14.4576	-1.000
4	25.5923	13.9432	-0.754
5	25.3305	13.4876	-1.121
-1	24.9698	12.9823	-1.000
6	24.6543	12.6152	-0.613
7	24.2989	12.246	-0.219
8	23.9314	11.9047	-0.698
9	23.5566	11.6261	-0.980
10	23.145	11.3575	-1.177
11	22.7573	11.1175	-0.416
12	22.3373	10.9144	-0.839
13	21.9011	10.7276	-0.585
14	21.4973	10.5685	-1.008
15	20.9878	15.1472	-0.698
16	21.4644	17.337	-0.501
17	21.4644	16.8913	0.418
18	21.4644	16.4748	-0.477
19	21.4644	16.025	-0.964
20	21.4644	14.6932	-0.605
21	21.4644	17.7542	-1.066
-1	20.9878	15.6011	-1.000
22	21.4644	15.6011	-0.401
-1	21.4644	15.1472	-1.000
23	20.9878	17.7542	0.009
24	19.1208	9.9518	0.290
-1	18.7347	10.0897	-1.000
25	18.352	10.2201	-0.708
-1	17.9413	10.3888	-1.000
26	17.5603	10.5548	0.469
27	17.2588	12.0906	-0.401
-1	17.6326	12.0083	-1.000
28	17.9323	11.9947	2.120
29	18.8584	12.1399	1.566
30	19.2352	12.3266	1.878
-1	19.5499	12.5703	-1.000
31	19.8645	12.8386	1.601
32	21.014	11.177	1.462
-1	21.2979	11.2969	-1.000
33	21.5722	11.4127	1.150
34	21.8561	11.5326	1.497
-1	22.2441	11.6842	-1.000
35	22.5247	11.8116	2.086
36	22.7959	11.9347	2.016
37	20.8896	11.4672	1.358
38	21.1736	11.5871	1.601

Predictions on the Population Density and the Net Crowd Flow

39	21.4479	11.7029	1.705
40	21.7318	11.8229	0.942
41	22.1121	11.971	1.289
42	22.3927	12.0984	1.185
43	22.6639	12.2215	0.804
44	22.9445	12.349	1.220
45	23.0765	12.0621	0.769
46	24.342	14.5907	0.284
-1	24.342	15.0619	-1.000
47	23.1007	13.7432	1.012
-1	23.1007	14.2057	-1.000
-1	24.7698	14.1196	-1.000
48	24.7698	14.5907	0.596
49	24.7698	15.0619	1.012
-1	24.7698	15.533	-1.000
50	24.7698	16.0042	1.116
-1	22.6744	13.2808	-1.000
-1	22.6744	13.7432	-1.000
-1	22.6744	14.2057	-1.000
51	10.7923	11.6393	2.120
52	11.0054	11.1048	0.838
53	11.2746	10.5714	1.323
54	11.5312	10.0583	1.358
-1	11.8389	9.5682	-1.000
55	12.1908	9.0432	1.185
-1	9.6459	9.596	-1.000
56	12.5612	8.59	0.658
-1	9.2312	9.9481	-1.000
57	8.8488	10.2894	0.027
58	8.4402	10.6889	0.537
59	8.0617	11.0869	0.087
60	23.1007	13.2808	-0.364
61	19.7282	13.958	-0.184
62	19.4127	13.958	0.057
63	17.8843	13.958	-0.244
-1	17.5358	13.958	-1.000
-1	17.1881	13.958	-1.000
64	16.8396	13.958	0.507
65	16.4911	13.958	0.297
66	16.1433	13.958	0.237
67	19.8669	16.8995	0.147
68	19.8669	16.5771	0.477
69	19.8669	16.2548	1.169
70	20.9878	17.3065	1.319
71	20.9878	16.8771	0.507
72	20.9878	16.4648	0.868
73	20.9878	16.025	1.048
74	20.1918	16.2548	0.297
75	20.1918	16.5771	0.808
-1	20.1918	16.8995	-1.000
76	20.1918	14.6431	1.078
-1	20.1918	14.9655	-1.000
77	20.1918	15.2878	0.748

Predictions on the Population Density and the Net Crowd Flow

78	20.1918	15.6101	0.838
-1	20.1918	15.9325	-1.000
-1	19.8669	14.6431	-1.000
-1	19.8669	14.9655	-1.000
79	19.8669	15.2878	-0.033
80	19.8669	15.6101	0.237
81	19.8669	15.9325	0.253
82	17.167	18.0361	0.143
83	16.8607	17.8911	0.362
84	16.5382	17.7468	-0.158
85	16.2584	17.599	-0.459
86	15.937	17.4291	0.007
87	20.3587	13.958	-0.158
88	15.7948	13.958	0.253
89	20.0418	13.958	0.472
90	24.3496	16.0042	0.390
-1	24.3496	15.5331	-1.000
-1	24.3496	14.1196	-1.000
91	23.1007	14.6681	0.663
92	22.6744	14.6681	-0.021
93	20.3929	13.5369	0.636
94	20.1811	13.1701	0.527
95	9.6923	15.2651	-0.021
96	13.3303	16.7161	0.007
-1	12.7954	16.2812	-1.000
97	12.3299	15.9027	0.061
-1	11.8661	15.5257	-1.000
98	11.4005	15.1472	0.089
-1	8.834	12.7724	-1.000
99	9.3585	14.0929	0.171
100	8.747	14.7145	-0.240
-1	8.3909	15.7023	-1.000
-1	8.0627	16.3472	-1.000
-1	7.8306	17.643	-1.000
101	20.9878	14.6932	-0.267
102	8.2676	11.98	-0.267
103	19.7954	10.6412	-0.596
-1	23.8712	16.7128	-1.000
104	15.8448	14.5245	0.226
105	15.8448	14.9642	-0.075
106	15.8448	15.4039	-0.075
107	15.8448	15.8436	0.417
108	15.8448	16.2833	0.308
-1	15.8448	16.723	-1.000
109	16.2933	14.5245	-0.158
110	16.2933	14.9642	-0.158
-1	16.2933	15.4039	-1.000
-1	16.2933	15.8436	-1.000
111	16.2933	16.2833	0.007
112	16.2933	16.723	0.171
113	16.7421	14.5245	0.116
114	16.7421	14.9642	-0.048
115	16.7421	15.4039	0.007

### Predictions on the Population Density and the Net Crowd Flow

-1	16.7421	15.8436	-1.000
116	16.7421	16.2833	-0.185
-1	16.7421	16.723	-1.000
117	17.191	14.5245	-1.178
118	17.191	14.9642	-1.205
119	17.191	15.4039	-1.936
-1	17.191	15.8436	-1.000
-1	17.191	16.2833	-1.000
-1	17.191	16.723	-1.000
120	17.6395	14.5245	-1.963
-1	17.6395	14.9642	-1.000
121	17.6395	15.4039	-2.207
122	17.6395	15.8436	-2.125
-1	17.6395	16.2833	-1.000
123	17.6395	16.723	-1.963
-1	18.0842	14.5245	-1.000
124	18.0842	14.9642	-1.990
125	18.0842	15.4039	-1.416
-1	18.0842	15.8436	-1.000
126	18.0842	16.2833	-2.129
127	18.0842	16.723	-1.438
-1	18.529	14.5245	-1.000
-1	18.529	14.9642	-1.000
128	18.529	15.4039	-1.222
129	18.529	15.8436	-1.071
130	18.529	16.2833	-1.287
-1	18.529	16.723	-1.000
131	18.9746	14.5245	-1.589
-1	18.9746	14.9642	-1.000
132	18.9746	15.4039	-0.682
-1	18.9746	15.8436	-1.000
133	18.9746	16.2833	-1.395
-1	18.9746	16.723	-1.000
134	15.4676	6.2612	-1.740
135	15.4676	6.7009	-1.589
136	15.4676	7.1406	-1.693
-1	15.4676	7.5803	-1.000
-1	15.4676	8.02	-1.000
-1	15.4676	8.4597	-1.000
137	15.9132	6.2612	-1.611
-1	15.9132	6.7009	-1.000
138	15.9132	7.1406	-1.016
-1	15.9132	7.5803	-1.000
139	15.9132	8.02	-1.070
-1	15.9132	8.4597	-1.000

### Appendix L Coordinates of stands for the optimal layout plan

Table 13: Coordinates of stands for the optimal layout plan. Integer  $-1$  in Columns **StandID** and **Charge** actually means that there is **NO** stand at that particular location.

standID	X	Y	charge
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-1	25.9754	16.6909	-1
-1	26.0947	16.106	-1
23	26.0947	15.535	0.009
86	26.0125	14.9698	0.007
-1	25.8371	14.4576	-1
-1	25.5923	13.9432	-1
99	25.3305	13.4876	0.171
-1	24.9698	12.9823	-1
-1	24.6543	12.6152	-1
-1	24.2989	12.246	-1
-1	23.9314	11.9047	-1
108	23.5566	11.6261	0.308
-1	23.145	11.3575	-1
111	22.7573	11.1175	0.007
-1	22.3373	10.9144	-1
-1	21.9011	10.7276	-1
-1	21.4973	10.5685	-1
-1	20.9878	15.1472	-1
46	21.4644	17.337	0.284
85	21.4644	16.8913	-0.459
17	21.4644	16.4748	0.418
0	21.4644	16.025	-0.444
-1	21.4644	14.6932	-1
84	21.4644	17.7542	-0.158
-1	20.9878	15.6011	-1
65	21.4644	15.6011	0.297
-1	21.4644	15.1472	-1
88	20.9878	17.7542	0.253
-1	19.1208	9.9518	-1
-1	18.7347	10.0897	-1
-1	18.352	10.2201	-1
-1	17.9413	10.3888	-1
-1	17.5603	10.5548	-1
24	17.2588	12.0906	0.290
13	17.6326	12.0083	-0.585
48	17.9323	11.9947	0.596
87	18.8584	12.1399	-0.158
92	19.2352	12.3266	-0.021
66	19.5499	12.5703	0.237
-1	19.8645	12.8386	-1
54	21.014	11.177	1.358
126	21.2979	11.2969	-2.129
51	21.5722	11.4127	2.120
119	21.8561	11.5326	-1.936
30	22.2441	11.6842	1.878
121	22.5247	11.8116	-2.207
35	22.7959	11.9347	2.086
127	20.8896	11.4672	-1.438
36	21.1736	11.5871	2.016
124	21.4479	11.7029	-1.990
38	21.7318	11.8229	1.601
123	22.1121	11.971	-1.963

Predictions on the Population Density and the Net Crowd Flow

28	22.3927	12.0984	2.120
122	22.6639	12.2215	-2.125
53	22.9445	12.349	1.323
131	23.0765	12.0621	-1.589
67	24.342	14.5907	0.147
-1	24.342	15.0619	-1
-1	23.1007	13.7432	-1
-1	23.1007	14.2057	-1
-1	24.7698	14.1196	-1
110	24.7698	14.5907	-0.158
-1	24.7698	15.0619	-1
105	24.7698	15.533	-0.075
57	24.7698	16.0042	0.027
98	22.6744	13.2808	0.089
-1	22.6744	13.7432	-1
-1	22.6744	14.2057	-1
97	10.7923	11.6393	0.061
-1	11.0054	11.1048	-1
-1	11.2746	10.5714	-1
-1	11.5312	10.0583	-1
95	11.8389	9.5682	-0.021
-1	12.1908	9.0432	-1
106	9.6459	9.596	-0.075
-1	12.5612	8.59	-1
-1	9.2312	9.9481	-1
-1	8.8488	10.2894	-1
81	8.4402	10.6889	0.253
61	8.0617	11.0869	-0.184
-1	23.1007	13.2808	-1
118	19.7282	13.958	-1.205
77	19.4127	13.958	0.748
11	17.8843	13.958	-0.416
49	17.5358	13.958	1.012
133	17.1881	13.958	-1.395
44	16.8396	13.958	1.220
128	16.4911	13.958	-1.222
76	16.1433	13.958	1.078
117	19.8669	16.8995	-1.178
37	19.8669	16.5771	1.358
125	19.8669	16.2548	-1.416
27	20.9878	17.3065	-0.401
64	20.9878	16.8771	0.507
3	20.9878	16.4648	-0.416
104	20.9878	16.025	0.226
29	20.1918	16.2548	1.566
136	20.1918	16.5771	-1.693
70	20.1918	16.8995	1.319
10	20.1918	14.6431	-1.177
32	20.1918	14.9655	1.462
137	20.1918	15.2878	-1.611
31	20.1918	15.6101	1.601
120	20.1918	15.9325	-1.963
55	19.8669	14.6431	1.185

Predictions on the Population Density and the Net Crowd Flow

135	19.8669	14.9655	-1.589
34	19.8669	15.2878	1.497
134	19.8669	15.6101	-1.740
39	19.8669	15.9325	1.705
26	17.167	18.0361	0.469
139	16.8607	17.8911	-1.070
41	16.5382	17.7468	1.289
130	16.2584	17.599	-1.287
43	15.937	17.4291	0.804
1	20.3587	13.958	-0.698
16	15.7948	13.958	-0.501
33	20.0418	13.958	1.150
-1	24.3496	16.0042	-1
-1	24.3496	15.5331	-1
59	24.3496	14.1196	0.087
-1	23.1007	14.6681	-1
-1	22.6744	14.6681	-1
82	20.3929	13.5369	0.143
-1	20.1811	13.1701	-1
-1	9.6923	15.2651	-1
-1	13.3303	16.7161	-1
-1	12.7954	16.2812	-1
-1	12.3299	15.9027	-1
115	11.8661	15.5257	0.007
-1	11.4005	15.1472	-1
114	8.834	12.7724	-0.048
-1	9.3585	14.0929	-1
-1	8.747	14.7145	-1
-1	8.3909	15.7023	-1
-1	8.0627	16.3472	-1
96	7.8306	17.643	0.007
112	20.9878	14.6932	0.171
-1	8.2676	11.98	-1
-1	19.7954	10.6412	-1
-1	23.8712	16.7128	-1
63	15.8448	14.5245	-0.244
94	15.8448	14.9642	0.527
103	15.8448	15.4039	-0.596
90	15.8448	15.8436	0.390
116	15.8448	16.2833	-0.185
100	15.8448	16.723	-0.240
89	16.2933	14.5245	0.472
12	16.2933	14.9642	-0.839
47	16.2933	15.4039	1.012
9	16.2933	15.8436	-0.980
45	16.2933	16.2833	0.769
101	16.2933	16.723	-0.267
2	16.7421	14.5245	-0.501
52	16.7421	14.9642	0.838
129	16.7421	15.4039	-1.071
40	16.7421	15.8436	0.942
8	16.7421	16.2833	-0.698
113	16.7421	16.723	0.116

Predictions on the Population Density and the Net Crowd Flow

93	17.191	14.5245	0.636
138	17.191	14.9642	-1.016
42	17.191	15.4039	1.185
14	17.191	15.8436	-1.008
75	17.191	16.2833	0.808
102	17.191	16.723	-0.267
20	17.6395	14.5245	-0.605
50	17.6395	14.9642	1.116
5	17.6395	15.4039	-1.121
73	17.6395	15.8436	1.048
15	17.6395	16.2833	-0.698
68	17.6395	16.723	0.477
71	18.0842	14.5245	0.507
4	18.0842	14.9642	-0.754
69	18.0842	15.4039	1.169
21	18.0842	15.8436	-1.066
56	18.0842	16.2833	0.658
22	18.0842	16.723	-0.401
25	18.529	14.5245	-0.708
91	18.529	14.9642	0.663
19	18.529	15.4039	-0.964
72	18.529	15.8436	0.868
6	18.529	16.2833	-0.613
107	18.529	16.723	0.417
83	18.9746	14.5245	0.362
18	18.9746	14.9642	-0.477
78	18.9746	15.4039	0.838
132	18.9746	15.8436	-0.682
58	18.9746	16.2833	0.537
7	18.9746	16.723	-0.219
-1	15.4676	6.2612	-1
-1	15.4676	6.7009	-1
-1	15.4676	7.1406	-1
74	15.4676	7.5803	0.297
109	15.4676	8.02	-0.158
79	15.4676	8.4597	-0.033
-1	15.9132	6.2612	-1
62	15.9132	6.7009	0.057
-1	15.9132	7.1406	-1
60	15.9132	7.5803	-0.364
80	15.9132	8.02	0.237
-1	15.9132	8.4597	-1