PREDICT FACEBOOK IMPRESSIONS ADOPTING A MATHEMATICAL MODEL OF THE HIT PHENOMENON

Kawahata Yasuko[1],Genda Etuso[2],and Ishii Akira[2]

[1]Department of Contents and Creative Design, Graduate School of Design, Kyushu University 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581,Japan
[2]Department of Applied Mathematics and Physics Tottori University, Koyama, Tottori 680-8554,Japan

Abstract.

A mathematical model for the hit phenomenon in entertainment within a society is presented as a stochastic process of interactions of human dynamics. The calculations for the Japanese motion picture market based on to the mathematical model agree very well with the actual residue distribution in time. Views of Facebook could be predicted by the number of all the action in the viewer Facebook on this paper. In other words, Views So if determined by the actions for which you want to advertise, we will begin to see is how to should be utilized in advertising using Facebook future.

Keywords

Hit phenomena, Stochastic process, Advertisement, Facebook

1. INTRODUCTION

Today, festivals centered around the local artists to activate the area actively have been made in Japan.[1,2] However, it has a challenge should carry out activities without imposing how the advertising costs in the process of the announcement of the activity. In this study, we targeted the troupe Tinker Bell in Fukuoka city. Without having made a public relations via the Internet so far, the first promotion for the theater company started in 2012-2013 for this collaboration. We thought doing web publicity for the theater company will also lead to stimulate motivation in the creation of the artist, and also help in subsequent activities. We can in the course in the activity of this time, Advertise the activities of the troupe to people living in other provinces in each announcement. In this method, we have measured the access number of official page on Facebook. The number of pages of view for the theater company will tend to increase when a single event was held. We thought these increasing phenomenon is the hit phenomenon for the theater company.

2. MATHEMATICAL THEORY FOR HIT PHENOMENA FOR FACEBOOK

The mathematical model for hit phenomena where the movement of human minds are considered as stochastic processes influenced by the media advertisement, communications with their friends

DOI : 10.5121/ijitmc.2014.2106

and the rumor in the society. In this paper, the access with friends is considered as direct access or two-body interaction. The page in Facebook is considered as indirect access or three-body interaction. In this model, we define the intention for person "*i*" in the Facebook to activities as $I_i(t)$. The model can describe the intention of each person for viewing as the equation of the intention of person *i* with two-body interaction and three-body interaction terms. According to the Reference, we write down the equation of the intention at the individual level as

$$\frac{dI_i(t)}{dt} = -aI_i(t) + \sum_j d_{ij} I_j(t) + \sum_j \sum_k h_{ijk} d_{jk} I_j(t) I_k(t) + f_i(t) \quad (1)$$

where d_{ij}, h_{ijk}, and $f_i(t)$ are the coefficient of the direct access, the coefficient of the indirect access, and the random effect for person *i*, respectively. We consider the above equation for every person in the Facebook so that i = 1, N_p where N_p is the effective population of the Facebook for a certain Facebook pages.

The advertisement and publicity effect for each person can be described as the random effect $f_i(t)$. Eq. (1) is the equation for all individual persons, but it is not convenient for analysis. Thus, we consider here the ensemble average of the intention of individual persons as follows:

$$\langle I(t) \rangle = \frac{1}{N} \sum_i I_i(t) \quad (2)$$

Taking the ensemble average of Eq. (1), we obtain for the left-hand side:

$$\left\langle \frac{dI_i(t)}{dt} \right\rangle = \frac{1}{N} \sum_i \frac{dI_i(t)}{dt} = \frac{d}{dt} \left(\frac{1}{N} \sum_i I_i(t) \right) = \frac{d\langle I \rangle}{dt} \quad (3)$$

For the right-hand side, the ensemble average of the first, second, and third is as follows:

$$\left\langle \sum_j \sum_k p_{ijk} I_j(t) I_k(t) \right\rangle = \left\langle p \sum_j \sum_k I_j(t) I_k(t) \right\rangle$$

$$= \frac{1}{N} \sum_i p \sum_j \sum_k I_j(t) I_k(t)$$

$$= \sum_i p \frac{1}{N} \sum_j \sum_k I_j(t) I_k(t)$$

$$= Np \sum_i \frac{1}{N} \sum_j I_j(t) \frac{1}{N} \sum_k I_k(t)$$

$$= N^2 p \langle I(t) \rangle^2$$

$$\langle -aI_i \rangle = -a \frac{1}{N} \sum_i I_i(t) = -a \langle I(t) \rangle \quad (4)$$

$$\left\langle \sum_j d_{ij} I_j(t) \right\rangle = \left\langle \sum_j dI_j(t) \right\rangle = \frac{1}{N} \sum_i \sum_j dI_j(t) = \sum_i d \frac{1}{N} \sum_j I_j(t) = Nd \langle I(t) \rangle$$

(5)

$$d_{ij} \cong d$$
$$h_{ijk} d_{jk} = p_{ijk} \cong p \quad (6)$$

where we assume that the coefficient of the direct and indirect access can be approximated to be under the ensemble average.

For the fourth term of Eq. (1), the random effect term, we consider that the random effect can be divided into two parts: the collective effect and the individual effect:

$$f_i(t) = \langle f(t) \rangle + \Delta f_i(t) \quad (7)$$

$$\langle f_i(t) \rangle = \frac{1}{N} \sum_i f_i(t) = \langle f(t) \rangle \quad (8)$$

where $\Delta f_i(t)$ means the deviation of the individual external effects from the collective effect, $\langle f_i(t) \rangle$. Thus, we consider here that the collective external effect term $\langle f_i(t) \rangle$ corresponds to advertisements and publicity to persons in the Facebook. The deviation term $\Delta f_i(t)$ corresponds to the deviation effect from the collective advertisement and publicity effect for individual persons, which we can assume to be

$$\langle \Delta f_i(t) \rangle = \frac{1}{N} \sum_i \Delta f_i(t) = 0 \quad (9)$$

Therefore, we obtain the equation for the ensemble-averaged intention to viewing in the following manner as shown in Refernce:

$$\frac{d\langle I(t) \rangle}{dt} = -a\langle I(t) \rangle + D\langle I(t) \rangle + P\langle I(t) \rangle^2 + \langle f(t) \rangle \quad (10)$$

here

$$Nd = D$$
$$N^2 p = P \quad (11)$$

Facebook Action are the very important factor to increase the intention of each person for viewing pages in Facebook. We consider the action effect as an external force term A(t) to the intention as follows,

$$\frac{dI_i(t)}{dt} = -aI_i(t) + A(t) + \text{access} \quad (12)$$

where $A(t)$ is the Facebook's advertisement effect. The actual formula used in the calculation to analyze the SNS response are introduced in detail in Reference.[7-10]

alpha	Interest willingness attenuation ratio of daily
Cadv	Percentage of increase of Views from behavior of visitors
before	Cadv to become stronger as it approaches the peak of access number
after	Cadv to become weaker with increasing distance from the peak of access number
a	Percentage of Cadv attenuation of each course of the day
NpDnn	Direct access (Between people have not seen the article or content)
NpDny	Direct access (People who have not seen a person who saw the content and articles)
Np2Pnn	Indirect access (between people have not seen the content articles and touch the content)
Np2Pny	Indirect access (people you have not seen a person who looked at content articles and touch)

Table 1. ParametaList

3. RESULT

We chose the timing of the event in order to measure the number of access Facebook page to be analyzed 2013 August 3 -September 29. The results of previous studies, Increasing the number (Like!, Share!, Comments!) Of action is important in order to carry out the public relations of the troupe.Therefore, in order to stage the theater company was held in 2013/9/1, we increased the number of actions in the schedule of the before and after deliberately.[]

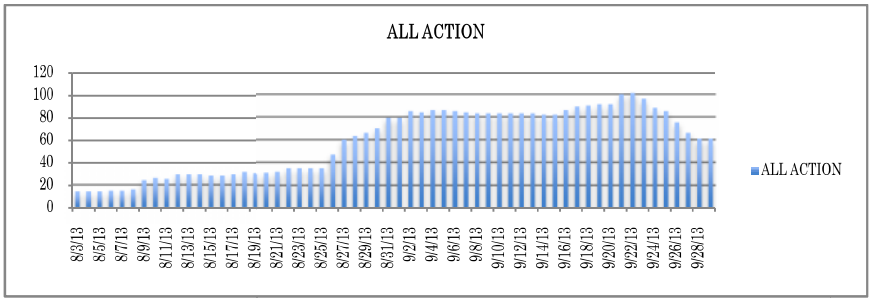

Fig. 1. All action(2013/8/3-2013/9/29.)

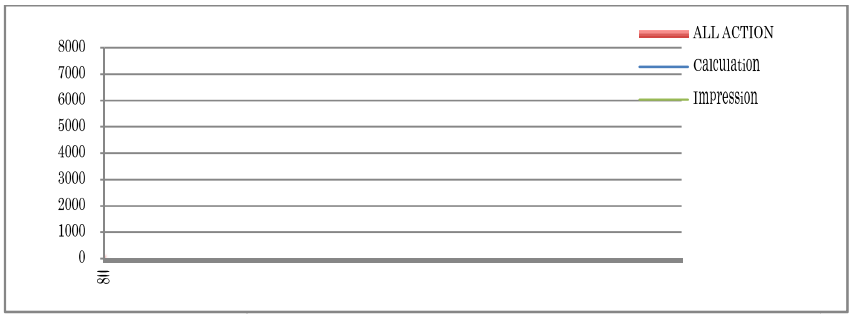

Fig. 2. Simulation results

From Figure 1-2, it was possible to increase the Total Number of deliberately increasing the number of Action. It was possible to predict as well mathematical model.

4. CONCLUSION

We found the following four points in this study.

Table 2. Before 2013/9/1's stages.

alpha	1.3631872495173317
Cadv	33.648555179372451
before	7.9668364933573317
a	1.2475576130717430
NpDnn	1.0496308324609643
Np2Pnn	1.0494944847288918

Table 3 After 2013/9/1's stages.

alpha	7.3941230610241885
Cadv	70.777339671182034
before	8.0074090559207258
a	17.459373760590164
NpDnn	2.1761137981055933
Np2Pnn	2.3674200899568540

①As See Table.2,3, it was possible accuracy comparable studies past a high prediction even with facebook pages Impressions actual aid of the mathematical model of the hit phenomenon.

②In the method of this paper, we use number are 3 factors,
1, The update of an article of the facebook page
2, The number of 'Like!' and 'shares!'
3, Number of all actions as a factor variable that determines .Number of prediction have increased by calculating the factor variable.However, there are some differences in the predicted value and the actual value if the impact of the event itself is large.
③Number of views of table.3 was overwhelmingly proportion of Cadv.
After the increasing action number was also keeping the advertising effect.

We can apply the mathematical theory for Number of the impression analysis of Facebook and The calculation using our mathematical model for hit phenomena presents the intention to watching in the Facebook. Present method was able to get results without being affected by the notice of other media.We need to do the analysis and application of this model with respect to advertisement methods of professional artists in the middle of going to actively publicity by the media such as TV and magazines as a policy of future research. Future, empirical research will be with respect to parameters of indirect access and direct access by making a comparison with the organic number of users who access the actual.

Acknowledgement

The authors would like to thank CEO Uchiyama Kouki of Hotlink, CEO Koguchi Hidehiko of Perspective Media , Theatre TinkerBell for giving them Database and helpful discussions. Great creaters who have supported the motivation of this study, We also thank Troup Tinker Bell in Fukuoka (Hara Chinami and Kinoshita Tsuguo, Hisada Shigeki) and versity KANSEI center for Arts and Science, ADAA (Asia Digital Arts Awards) which gives the best environment to do their studies in particular, to carry out development activities creativity of Asia. In adidition , it is enormously grateful family and friends and Genda Lab. Members , also ancestors who have supported much emotional support. Y.Kawahata also thanks the Japan Student Services Organization for the scholarship.

References

[1] Kawahata Y Etsuo Genda and Akira Ishii" Analysis of Local Concerts using Facebook Adapting the Mathematical Model of Hit Phenomena " the Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering series, in press.
[2] "THEATRE TINKER BELL",Available at;https://www.facebook.com/JuTuantinkaberu
[3] Ishii A, Arakaki H, Matsuda N, Umemura S, Urushidani T, Yamagata N and Yoshida N, 2012.New Journal of Physics 14 (2012) 063018 (22pp)
[4] Ishii A, Matsumoto T and Miki S, Prog.Theor.Phys. : Suppliment No.194 pp.64-72.
[5] Y.Kawahata, E.Genda and A.Ishii, Revenue Prediction of music concerts Using the Mathematical Model of Hit Phenomena, the proceedings of the 2013 International Conference on Biometrics and Kansei Engineering (ICBAKE2013) 208-213
[6] A.Ishii, S.Ota, H.Koguchi and K.Uchiyama, Quantitative analysis of social popularity of entertainments using mathematical model for hit phenomena for Japanese pop girl group AKB48, the proceedings of the 2013 International Conference on Biometrics and Kansei Engineering(ICBAKE2013) 143-147
[7] A Ishii, K Furuta, T Oka, H Koguchi and K Uchiyama, 2012."Mathematical Model of Hit Phenomena as a theory for collective motion of human mind in societies, " the Frontiers of Artificial Intelligence and Applications (FAIA) series (IOS Press) in press.
[8] Ferebee, Susan Shepherd, and James Wayne Davis.2009. "Use of SNS as a method of outreach ." Proceedings of the 4th International Conference on Persuasive Technology. ACM.
[9] Ross, Craig, et al. 2009."Personality and motivations associated with Facebook use." Computers in Human Behavior25.2: 578-586.
[10] Viswanath, Bimal, et al. "On the evolution of user interaction in facebook." Proceedings of the 2nd ACM workshop on Online social networks. ACM, 2009.
[11] "Kaneko Misuzu short movie contest",Available at; https://www.facebook.com/misuzu.smc2012
[12] "Misuzu 燦参 SUN2012",Available at; http://misuzu333.jp/
[13] "Sawaki Jun Workshop"Retrieved. at;http://tkbell.cocolog-nifty.com/blog/2013/03/post-6c0f.html
[14] " We held public presentation of “Kaneko misuzu of World” in April 14 2013 at Hakata citizen’s Center."Retrieved. at; http://hakata-fukuoka.mypl.net/event/00000114698