行政院國家科學委員會補助專題研究計畫成果報告

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計畫主持人：任立中

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中　華　民　國 90 **年** 08 **月** 15 **日**

行政院國家科學委員會專題研究計畫成果報告
跨國產品擴散型態之連結：以層級貝氏模型預測電影票房銷售
THE LINKAGE OF CROSS-NATIONAL PRODUCT DIFFUSION PATTERNS: AN APPLICATION FOR PREDICTING BOX-OFFICE ATTENDANCE OF MOTION PICTURES

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中文摘要

雖然對國際行銷人員而言，與擴散有關之新產品上市策略是非常重要的議題，但過去只有很少文獻探討跨國擴散。而且，這些探討多國擴散之研究，多半只著重於消費者耐久財或工業性技術創新產品。因此，本研究欲將跨國擴散模型延伸應用於新奇流行品-電影之擴散型態，探討跨國與屬性因素，後者包括類型、卡司、上映日期、創新及模仿效果。本研究之主要目的是應用跨國擴散整合架構，預測台灣即將上映電影之票房潛力，藉此在新產品進入國外市場之前，產生跨國擴散型態之預測。

關鍵詞：擴散模型、銷售預測、新產品成長

Abstract

Although diffusion-related new product launching strategies address critical issues for international marketing managers, only a few studies have explored cross-national diffusion. Also, previously published studies on multinational diffusion have concentrated mainly on consumer durable and industrial technological innovations. Hence, this study attempts to extend the knowledge in this area by empirically capturing the diffusion patterns of motion pictures, one kind of a novelty product, in cross-national context and integrating perceived attributes, including the genre, cast and release date of the movie and a lead-lag effect into a framework. In particular, the main objective of this research is to apply the proposed integrated framework for forecasting the box-office potential of new motion pictures in Taiwan where sales data are not available. Thereby yielding some insights into the nature of the expected diffusion pattern in foreign countries prior to market entry.

Keywords: Diffusion Model, Sales Forecast, New Product Growth

Introduction

The new product diffusion model has been one of the most important theories for explaining the formation of product life cycle in marketing literature since it was introduced by Bass (1969). However, it has not been accepted without criticisms. First of all, the model is post hoc in nature, which means that a historical dataset must exist before the parameters of the model can be estimated. Secondly, most research objects were consumer durable goods, such as automobiles and home appliances. For the most consumer goods with very short product life cycle, only a few researches was conducted by using fashion goods, such as motion pictures, as research objects. However, the purposes of those researches were aimed to study the optimal launch timing (Krider & Weinberg, 1998; Radas & Shugan, 1998) or to establish model of sales growth (Jedidi, Drider, & Weinberg, 1998). The issue about how to predict product life cycle before the announcement of the new product still remains un-addressed. Third, despite global marketing research is getting more attentions in recent years, little efforts have been devoted to modeling and linking the diffusion patterns across countries. Thus, the purpose of this study is to build a model that can predict the diffusion patterns of a product before it is introduced into a foreign country. Specifically, we adopt the motion picture industry as the research object to explore the factors that influence the diffusion of American movies in America and to establish a model for predicting the sales of American movies in Taiwan market. This model will help the scholars and practitioners to better understand the characteristics of diffusion patterns in foreign countries and to forecast more accurately the product life cycle and to develop a more efficient marketing strategy.

The American movie industry based in Hollywood, California, USA, has been a global empire. Her products have been distributed all over the world. According to the survey of Motion Picture Association of America (1998), American movie industry produced 490 films and re-produced 19 films in 1998. In the same year, the revenue in US market was up to 6.9 billions US dollars. Its overseas revenue was even larger than that of North America area. In 1992, for example, its major overseas markets, in terms of revenue, were Europe (59%), Far Eastern Asia (30%), and Latin America (9%) (Dale, 1997). One of the major features of movie products, and of other fashion products, is the short life cycles and little repetitive purchase, which meet the assumptions of the diffusion model.

The diffusion theory and the empirical results of international diffusion research have suggested the following. First, the speed of diffusion is determined by such factors as customers' perceptions on the attributes of the innovated products, the openness of the social systems, and the acceptability of the products to the society (Rogers, 1995). In this early efforts to model product diffusion across countries, we considered the effects of customers' perceptions on product attributes only and included three major attributes in the model. The first one is the types of movies. Movie type is one of the major movie attributes that would meet consumers' needs (e.g. recreation, sensory excitement), or influences consumers' beliefs or values. Litman (1983) has suggested that the types of movies affect sales performance. The second influential perceived attribute is the leading actor or actress of the movies. The audience often chose the movies solely because of the leading actor or actress. The third factor is seasonal effect. Movies launched at different time point of the year will have different pattern of diffusion (Radas & Shugan, 1998). Therefore, we predict that whether if the movie is launched on weekend or holidays will influence the diffusion pattern.

The pattern of diffusion in foreign countries is influenced by the lead-lag effects of product introduction. The fast development of international media has helped the distribution of product information across countries. Therefore, the lead-lag effect of movie introduction in foreign countries gives the foreign audiences an opportunity to learn about the movie before they go to theaters in their own countries. This opportunity, together with the advertising and the promotion campaigns of the movie, will positively affect the acceptance of the foreign audiences and help to speed up the product diffusion in the foreign countries. That is, the potential customers in the foreign countries will become the innovators through the international over-spill leaning effect, which is the combination of leading and lead-lag effects (Takada and Jain, 1991; Tseng, 1998).

On the premises of lead-lag effect, this study built a model on the basis of the diffusion record of the movies in America and the attributes of the movies. The results showed that their sales in Taiwan could be predicted accurately before they were introduced into Taiwan. This model can help to predict the diffusion pattern of innovated products at their introduction stage of life cycle and hence, to plan the marketing strategy and allocate marketing resources effectively.

Product Diffusion Model

Diffusion model is a set of quantitative functions used to describe the patterns of diffusion process which influence the form of product life cycle. It helps to forecast the success of the product at introduction stage and the sales volume in the whole life cycle. In marketing area, Bass (1969) has proposed a new product-first purchase model in which integrates the concepts of new product adoption and imitation. In this model, he classified new product customers into innovators and imitators. While the purchase decision of innovators depends on the message conveyed in the promotion campaign (i.e., external influence) and is not influenced by the opinions of the current users, the purchase decision of imitator is affected by the word-of-mouth of current users of the product (internal influence).

Drawing from hazard function, Bass built a diffusion model, as shown in equation (1), in which, at time t, the probability of a purchase made by an individual who has not purchased before time t is a linear function of the number of buyers prior to time t.

$$\frac{f(t)}{[1-F(t)]}=p+qF(t)$$

where,

f(t): the probability density function of purchase at time t

F(t): the cumulative distribution function of purchase at time t

The core argument of the Bass diffusion model is that the purchase probability at time t is positively associated with the number of purchasers before time t. The parameter q reflects the imitation effect and the parameter p represents the rate of innovation effect. If q equals zero, then f(t) is negative exponential distributed.

Let the parameter m be the total number of potential users. Then n(t)=m*f(t) is the number of purchasers at time t and N(t)=m*F(t) indicates the cumulative number of purchasers at time t. Using the preceding definitions as a basis, n(t) can be derived as shown in equation (2).

$$n(t)=\frac{dN(t)}{dt}=p[m-N(t)] + \frac{q}{m}N(t)[m-N(t)] \qquad (2)$$

The term $p[m$ - N(t)] in equation (2) indicates the number of innovators who are not affected by the current users before time (t). The term (q/m) N(t)[m - N(t)] in the same equation represents the number of imitators who become users due to the influence of the current users before time t.

Note that when the time t in equation (2) is equal to zero, the function n(0) will equal pm. If q>p, then the sales curve will be in the form of an inverted U shape. If $q \leq p$, then the sales curve will decline continuously (Figure 1).

Mahajan, Mason, and Srinivasan (1986) have suggested that non-linear least-squared method is the best approach to estimating the parameters of Bass's diffusion model. Following the suggestion of Mahajan et al., this study used non-linear least-squared method to estimate the three parameters of Bass's diffusion model: innovation coefficient (p), imitation coefficient (q), and market potential (m).

Equation (1) can result in equation (3) shown below.

$$f(t)=\frac{dF(t)}{dt}=(p+qF(t))(1-F(t)) \qquad (3)$$

Let F(t = t_0 = 0) = 0 and integrate equation (3), we can obtain equation (4).

$$F(t)=\frac{1-e^{-(p+q)t}}{1+(q/p)e^{-(p+q)t}} \qquad (4)$$

Let $\left[\frac{F(t_i)-F(t_{i-1})}{1-F(t_{i-1})}\right]$ denotes the probability of an individual who makes purchase at time t but did not at time t_{i-1} and before. We can estimate the parameters of innovation coefficient (p), imitation coefficient (q), and market potential (m) by equation (5).

$$X(t)=(m-N(t_{i-1}))\left[\frac{F(t_i)-F(t_{i-1})}{1-F(t_{i-1})}\right]+e_i$$

(5)

where,

x(i): the total purchasers at time t (time period of (t_{i-1}, t_i))

m: market potential

N(t_{i-1}): the cumulative purchasers at time t_{i-1}

F(t_i) = N(t)/m = the purchase ratio at time t_i

e_i = error term

Data

This study chose those motion pictures that were announced between October 1997 and December 1998 and that were among top 100 sales ranking in the US market. Among them, those motion pictures that were played for more than three weeks in Taiwan were retained as parts of this study. A total of 51 motion pictures of different types were obtained. The motion picture Titanic was excluded because it was believed that most the audiences had seen it more than once. Thus, Titanic did not fit the purpose of Bass's diffusion model for first purchase.

The analysis unit was the total amount of audiences of a week (from Friday to next Thursday). The audience amounts in the announcement weeks that did not include weekends were not included as parts of the study.

Except for the box-office in Taipei metropolitan area, no reliable record was available for the rest of Taiwan area. However, a rule of thumbs used very often by the owners of theaters was to simply multiply the total box-office of Taipei market by two to estimate the total box-office of the entire Taiwan market (Lu, 1997). This study followed this rule of thumbs to estimate the total sales of American motion pictures in Taiwan market on the basis of their sales in Taipei. The record of box-office of Taipei market was offered by Taipei Motion Picture Association. The chosen record ranged from December 19, 1997 to March 1999.

The total amount of audiences per week of the US market was estimated by dividing the total dollar sales by the average ticket fee of 5 US dollars. The total dollar sales were surveyed and reported by AC Nielsen EDI and Variety magazine. The record chosen ranged from October 17, 1997 to February 1999.

The 51 motion pictures included in this study can be classified into action (10), science fiction (8), comedy (7), drama (6), animation (4), love story (12), and horror (4). Table 1 presents the announcement date in USA and Taipei, the difference of announcement date in weeks between USA and Taipei, and the number of weeks in which data were collected for each motion picture.

The average announcement date difference was 10 weeks. The animation, Anastasia, had a maximum difference of 37 weeks because the audience in Taipei was the young who had more free time in summer vacation. The 51 motion pictures were played in USA for a time length ranging from 19 to 23 weeks. They were played in Taiwan for an average of 7 weeks. Most of the 51 motion pictures attracted most of the audience within the first weeks after they were announced. The sales curve was in an exponential shape and was presented in Table 1b, which fitted Bass's diffusion model in which $p \geq q$. The exponential pattern of diffusion can be attributed to the wide release strategy of the motion picture agents.

Quite often, motion picture agents choose between wide release strategy and platform release strategy. Motion pictures with high budget and great casts often were released under wide release strategy. That is, the agents have most of the theaters play the motion picture at the same time from the beginning. They decrease the number of theaters playing the motion pictures in proportional to decline in demand and decrease in number of audience. In contrast, the platform release strategy begins by having a few theaters play the motion pictured promoted. After accepted by the audience to some extent, the number of theaters increases to all over the country.

【Insert Table 1 here】

On the basis of Bass diffusion model, non-linear least-squared analyses were conducted to estimate the diffusion coefficients for USA and for Taiwan markets. The results were presented in Table 2 and Table 3, respectively.

Most of the $\overline{R}^2$'s were high, indicating that the goodness of fit were significant. The motion pictures that had a low $\overline{R}^2$ in USA were *Anastasia* (0.66192), *Good Will Hunting* (0.79898), and *Wag the Dog* (0.81476). In Taiwan, only *As Good As It Gets* was low (0.61128).

The diffusion coefficients indicate that most the diffusion pattern of American motion pictures was in an exponential shape, which were different from the pattern of durable consumer goods. The innovation coefficient, *p*, of several science fictions and one horror (*Halloween:H20*) were the highest in USA. In Taiwan, the action motion picture (*Out of Sight*) and the horror motion picture (*Bride of Chucky*) had the highest *p*. Some science fiction and horror movies also had high innovation coefficients.

The imitation coefficients, *q*, of 19 movies in USA were very low. A re-estimation was made by setting the lower bound limit at 0.001. The movies that had the highest *q* were *Wag the Dog*, *Anastasia*, and *Mouse Hunt*. In Taiwan, *The Wedding Singer*, *Hope Floats*, *Small Soldiers*, and *Tomorrow Never Dies* had the highest values in imitation coefficients.

【Insert Table 2 here】
【Insert Table 3 here】

The results show that the diffusion coefficients, particularly imitation coefficients, of Taiwan tended to be higher than those of USA, indicating that the diffusion patterns were different between these two countries.

Table 4 and Table 5 present the differences in diffusion coefficients between Taiwan and USA when the following factors were taken into consideration. For USA data, the factors included whether the key actor or actress was famous, whether the movie was announced during such major holidays as summer vacation, Thanksgiving day, Christmas and New Year holiday（Radas & Shugan, 1998）. For Taiwan data, the factors included whether the announcement day was within summer vacation, New Year holidays, or Chinese lunar new year holidays.

Table 4 shows that the potential market of comedies and science fictions were the highest in USA. In Taiwan, science fictions and actions were most preferred by the audience. The results in Table 5 indicate that whether the movies played during holidays had a significant influence on the box-office both in USA and in Taiwan. Whether the key actor or actress was famous was significantly related to the potential market in Taiwan.

【Insert Table 4 here】
【Insert Table 5 here】

Sales Forecast Model

Based on Bass's diffusion model, this study analyzed the diffusion patterns of American motion pictures in America and Taiwan, followed by multiple regression analyses with an aim to identifying the factors influencing the diffusion patterns and to building a prediction model.

To build a sales prediction model, seemingly unrelated regression (SUR) analyses were conducted to identify the factors that influenced the leading effect and lead-lag effect on the diffusion of American movies in Taiwan. The model is shown as in equations (6)-(8).

$$y_p = x\boldsymbol{\beta}_p + \boldsymbol{\varepsilon}_p \quad (6)$$

$$y_q = x\boldsymbol{\beta}_q + \boldsymbol{\varepsilon}_q \quad (7)$$

$$y_m = x\boldsymbol{\beta}_m + \boldsymbol{\varepsilon}_m \quad (8)$$

where,

y_p : the innovation coefficient matrix of diffusion model for innovated products in Taiwan market

y_q : the imitation coefficient matrix of diffusion model for innovated products in Taiwan market

y_m : the potential market matrix of diffusion model for innovated products in Taiwan

x : matrix of independent variables, including constants

$\boldsymbol{\beta}_p$: matrix of influence coefficients of innovation propensity

$\boldsymbol{\beta}_q$: matrix of influence coefficients of imitation propensity

$\boldsymbol{\beta}_m$: matrix of influence coefficients of market potential

$\boldsymbol{\varepsilon}_p$, $\boldsymbol{\varepsilon}_q$, $\boldsymbol{\varepsilon}_m$: error terms matrix

Empirical studies have suggested that the time-lag of product introduction give the potential adopters of foreign countries an opportunity to learn about how the product have diffused successfully in the innovation country. This helps to reduce the risk and to speed up the diffusion rate in adoption countries. We hypothesize that the leading and lead-lag effects should make the experience of successful diffusion can be easily learned by the foreign potential innovators through the helps of international media. That is, the innovation coefficient (US_p), imitation coefficient (US_q), and potential market (US_m, in million people) in USA should affect the diffusion pattern in Taiwan.

To test the hypothesis, the movies included in this study were re-classified into four types: horror, science fiction, drama, and others. Type of motion pictures was considered as an antecedent of diffusion pattern and was recoded by dummy variables.

The evaluation of the influence of the fame of movie stars on diffusion patterns were made based on the results of survey conducted to rate the value of movie stars to box-office (The International Entertainment Weekly, 1998). Since not all movie stars were included in the ranking, a dummy variable (STR) was created to measure whether the key actor or actress was in the ranking would have a significance on diffusion pattern. The rank of the movie stars (RNK) was used to evaluate wheterh the key actor or actress was in the rank would influence the box-office.

Lu (1997) has suggested that in Taiwan, the amount of movie audience was at its peak during summer vacation, New Year holidays, and Chinese lunar New Year holiday. Thus, a dummy variable (HDY_p) was created to reflect the influences of whether the announcement day was during holidays on innovation coefficients. A dummy variable (HDY_q) was used to reflect the influences of whether the movies were played during summer vacations, lunar Chinese new year holidays, and winter vacations on imitation coefficients. Basically, the two dummy variables were used to measure the effects of holidays (HDY_m) on market potential.

Table 6 presents the results of the SUR model for the prediction of diffusion patterns of American movies in Taiwan. The results of model 1 indicated that the diffusion patterns of American movies in Taiwan were influences by factors inside Taiwan society, not by the factors in American society. Due to the intercorrelations among the diffusion coefficients, the diffusion coefficients in America were not significant. In model 2, the influences of diffusion coefficients in American on those in Taiwan were analyzed and the sales of American movies in Taiwan were predicted. The model was shown below.

$$TW_p = \alpha_p + \beta_1 US_p + \beta_2 US_q + \beta_3 HR + \beta_4 SF + \beta_5 DR + \beta_6 STR + \beta_7 RNK + \beta_8 HDY_p + \boldsymbol{\varepsilon}_p$$

$$TW_q = \alpha_q + \gamma_1 HR + \gamma_2 SF + \gamma_3 DR + \gamma_4 STR + \gamma_5 RNK + \gamma_6 HDY_q + \boldsymbol{\varepsilon}_q$$

$$TW_m = \alpha_m + \eta_1 US_m + \eta_2 HR + \eta_3 SF + \eta_4 DR + \eta_5 STR + \eta_6 RNK + \eta_6 HDY_m + \boldsymbol{\varepsilon}_m$$

TW_p, TW_q, and TW_m represented the innovation coefficient, imitation coefficient, and potential market (in millions of people) of American movies in Taiwan, respectively. HR, SF, and DR indicated horror movies, science fiction movies and drama, respectively. The definitions of the other variables were the same as before.

【Insert Table 6 here】

The contribution of this study was to build a prediction model of the sales of American movies in Taiwan on the basis of limited information. That is, only the experience of diffusion in America and the attributes of the movies were used for the prediction of sales in Taiwan. This model is particularly valuable for predicting the sales in the product introduction stage when the diffusion pattern is exponential distributed.

To test the prediction ability of the model, the prediction of 5 different types of movies: *Soldier*, *The Siege*, *Meet Joe Black*, *I Still Know What You Did Last Summer*, and *A Bug's Life*, were conducted. The prediction performance was indicated by mean absolute deviation (MAD) and root mean squared error (RMSE) in Table 7. Figure 2 represented the comparison between the actual and the predicted sales of the aforementioned movies in Taiwan. The results showed that the predictive performance of the model was satisfactory. The prediction of the movie *A Bug's Life* deserves more attention. *A Bug's Life* was promoted very intensively with several peripheral measures when it was played in Taiwan, which greatly influenced its diffusion pattern in Taiwan. However, such marketing factors were not taken into consideration in our model.

【Insert Table 7 here】
【Insert Figure 2 here】

Conclusions

To our best knowledge, few studies have been conducted to analyze the across-countries diffusion of American movies. Using the time-lag of product introduction as a premises, the study integrated the effects of the experience of diffusion in American and the attributes of the movies to build a prediction model for estimating the sales of American movies in Taiwan before they were introduced into Taiwan. This model is of particularly importance when the product analyzed is of fashion nature and when the sales of the product is exponential distributed across time. The satisfactory predictive performance of the model proposed in this study can help to understand and predict the diffusion pattern of a product before it is introduced into Taiwan, and help firms to form effective marketing strategies and allocate marketing resources optimally.

The diffusion theory suggests that the difference in the structure of social culture leads to differentiated acceptability of innovated products to the society and differentiated preference to the diffusion channels. A comparison and contrast between the diffusion patterns of American movies in America and Taiwan indicates that the imitation coefficients of Taiwan market were larger than those of American market. This implied that word-of-mouth was the most preferable communication method in Taiwan market of such features as emphasizing inter-personal relationship, valuing others' opinions, and communicating in a high-contextual way. Thus, the marketers of American movies in Taiwan should not only rely on mass media to promote their products, but also make best use of such events as movie previews and rehearsals.

In contrast to durable consumer goods, the diffusion of fashion products is influenced more by external factors. Therefore, according the data from American Motion Picture Association, the high expenditure ratio of advertising for promoting American movies in America implies that advertising expenditure can be one of the influential factors of the diffusion of American movie in America. We, however, did not include advertising expenditure in our model because such data were not available in Taiwan. Another limitation is that we used the sales record of Taipei market only to conduct the analyses. This might limit the generalizability of the inference made in this study to the whole Taiwan market.

Since cultures could shape the pattern the diffusion, whether the model could be applied to other countries deserves further study. The fact that the overseas revenue of American movies is larger than that of domestic market should warrant the efforts of analyzing the differences in diffusion patterns of American movies across countries and using the similarity in diffusion pattern to segment the global market.

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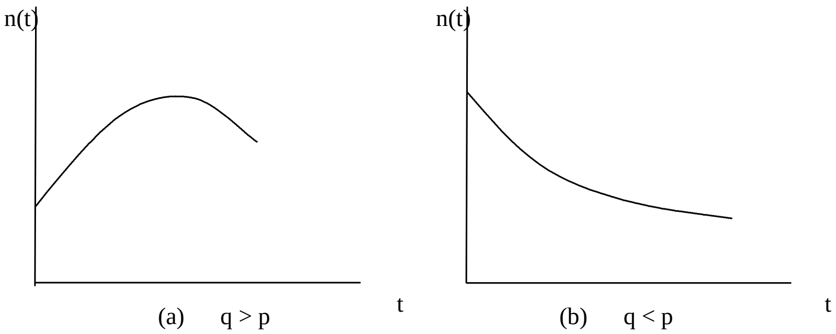

Figure 1 Product Life Cycles based on relative values of *p* and *q*

Figure 2(a) Forecasting Results: Weekly Box-Office Attendance (Soldier)

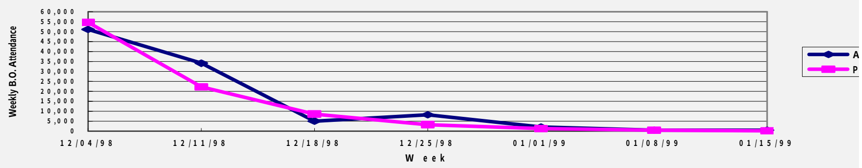

Figure 2(b) Forecasting Results: Weekly Box-Office Attendance (The Siege)

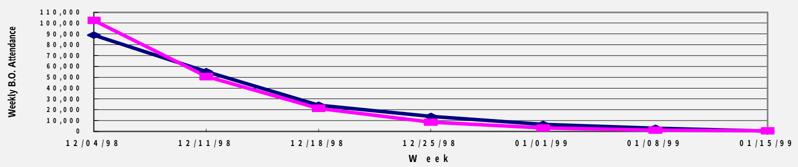

Figure 2(c) Forecasting Results: Weekly Box-Office Attendance (Meet Joe Black)

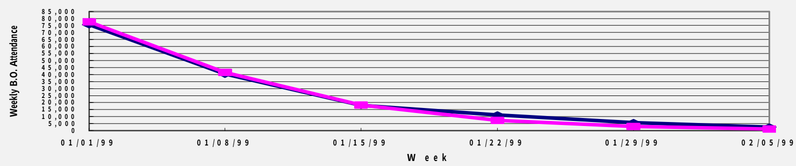

Figure 2(d) Forecasting Results: Weekly Box-Office Attendance (I Still Know What You Did Last Summer)

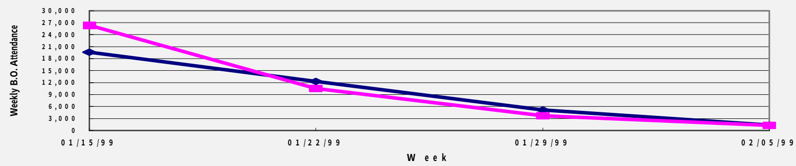

Figure 2(e) Forecasting Results: Weekly Box-Office Attendance (A Bug's Life)

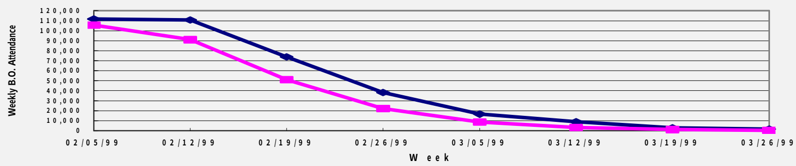

Table 1. The Descriptions for Selected Motion Pictures Shown in the USA and in Taiwan

No	Movie Title	Opening Date in Taiwan	Opening Date in USA	Lag in Weeks	Featuring Weeks in Taiwan	Featuri Weeks USA
1	I Know What You Did Last Summer	98/02/21	97/10/17	18	4	26
2	Starship Troopers	97/12/19	97/11/07	6	5	16
3	Anastasia	98/08/01	97/11/14	37	5	22
4	Alien Resurrection	98/01/27	97/11/24	9	4	12
5	Flubber	98/01/27	97/11/24	9	4	21
6	Good Will Hunting	98/03/07	97/12/05	13	13	35
7	Scream 2	98/03/20	97/12/12	14	6	12
8	Mouse Hunt	98/02/14	97/12/19	8	6	21
9	Tomorrow Never Dies	98/01/24	97/12/19	5	7	24
10	As Good As It Gets	98/02/21	97/12/22	8	15	26
11	Wag the Dog	98/05/01	97/12/22	18	6	19
12	Great Expectations	98/05/09	98/01/30	14	5	8
13	The Wedding Singer	98/07/04	98/02/13	20	3	26
14	Sphere	98/03/21	98/02/13	5	5	10
15	U.S. Marshals	98/05/01	98/03/06	8	8	20
16	The Man in the Iron Mask	98/04/18	98/03/13	5	7	17
17	Primary Colors	98/05/16	98/03/20	8	6	14
18	Wild Things	98/05/30	98/03/20	10	5	16
19	Lost in Space	98/06/12	98/04/03	10	6	19
20	Mercury Rising	98/06/27	98/04/03	12	7	14
21	City of Angels	98/05/23	98/04/10	6	7	20
22	The Object of My Affection	98/06/13	98/04/17	8	5	11
23	Deep Impact	98/06/06	98/05/08	4	9	18
24	The Horse Whisperer	98/10/03	98/05/15	20	9	21
25	Godzilla	98/06/19	98/05/18	4	12	18
26	Hope Floats	98/09/12	98/05/29	15	3	20
27	A Perfect Murder	98/10/10	98/06/05	18	6	13
28	The Truman Show	98/11/14	98/06/05	23	9	18
29	Six Days, Seven Nights	98/08/08	98/06/12	8	8	19
30	The X-Files	98/08/28	98/06/19	10	5	15
31	Mulan	98/07/11	98/06/19	3	10	22
32	Dr. Dolittle	98/07/04	98/06/26	1	8	24
33	Out of Sight	98/12/12	98/06/26	24	3	11

34	Armageddon	98/07/24	98/06/29	4	10	22
35	Small Soldiers	98/09/12	98/07/10	9	5	19
36	Lethal Weapon 4	98/08/21	98/07/10	6	8	17
37	There's something about Mary	98/10/23	98/07/13	14	9	31
38	The Mask of Zorro	98/08/07	98/07/17	3	5	26
39	Saving Private Ryan	98/09/25	98/07/24	9	16	16
40	The Parent Trap	98/08/29	98/07/27	4	7	18
41	The Negotiator	98/10/31	98/07/27	13	8	16
42	Ever after	98/10/10	98/07/31	10	5	22
43	Halloween:H20	98/11/12	98/08/03	14	5	17
44	Snake Eyes	98/10/23	98/08/07	11	6	19
45	Wrongfully Accused	98/09/11	98/08/21	3	5	8
46	Rush Hour	98/09/26	98/09/18	1	9	23
47	Ronin	98/11/28	98/09/25	9	4	13
48	Antz	98/11/07	98/10/02	5	9	20
49	What Dreams May Come	98/12/24	98/10/02	12	7	15
50	Bride of Chucky	98/12/24	98/10/16	10	6	13
51	Practical Magic	99/01/15	98/10/16	13	5	14

Table 2. The Estimation of Diffusion Model for Movies in US Market

No	Movie Title	Innovation Rate, p (std. Error)	Imitation Rate, q (std. Error)	Potential Market, m (std. Error)	$\overline{R}^2$
1	I Know What You Did Last Summer	0.30976 (0.006885)	0.154092 (0.019631)	14280004 (35434)	0.99720
2	Starship Troopers	0.74542 (0.027719)	0.00100 (0.06828)	10915541 (38053)	0.99802
3	Anastasia	0.11939 (0.04188)	0.538471 (0.18287)	11350362 (298555)	0.66192
4	Alien Resurrection	0.742063 (0.045056)	0.00100 (0.114089)	7568655 (54185)	0.99574
5	Flubber	0.372951 (0.0453)	0.00100 (0.11381)	16463913 (340125)	0.92560
6	Good Will Hunting	0.016204 (0.0037)	0.293838 (0.0294)	27464713 (374845)	0.79898
7	Scream 2	0.542201 (0.03296)	0.00100 (0.08956)	19373344 (207724)	0.99229
8	Mouse Hunt	0.223783 (0.03437)	0.41945 (0.11878)	12058354 (165611)	0.91133
9	Tomorrow Never Dies	0.389659 (0.02459)	0.242408 (0.07076)	24607123 (140581)	0.98431
10	As Good As It Gets	0.148238 (0.01077)	0.00100 (0.03195)	29470837 (757179)	0.93296
11	Wag the Dog	0.042242 (0.0129)	0.593545 (0.09169)	8446134 (161401)	0.81476
12	Great Expectations	0.545914 (0.029947)	0.176079 (0.09081)	5279403 (52987)	0.99627
13	The Wedding Singer	0.359136 (0.0171)	0.00100 (0.04381)	15714565 (113386)	0.98532
14	Sphere	0.696428 (0.029934)	0.143707 (0.081366)	7344449 (36753)	0.99835
15	U.S. Marshals	0.440365 (0.01279)	0.168578 (0.035617)	11448427 (35297)	0.99723
16	The Man in the Iron Mask	0.524438 (0.008446)	0.040536 (0.022361)	11317942 (23453)	0.99929
17	Primary Colors	0.497646 (0.012539)	0.00100 (0.034275)	7751434 (34175)	0.99828
18	Wild Things	0.500715 (0.02068)	0.216822 (0.058263)	5898216 (25385)	0.99629
19	Lost in Space	0.502164 (0.021947)	0.039092 (0.0580)	13611505 (74841)	0.99391
20	Mercury Rising	0.517891 (0.014506)	0.00100 (0.039068)	6536970 (30603)	0.99798
21	City of Angels	0.322989 (0.008635)	0.008457 (0.024086)	15684523 (83836)	0.99589
22	The Object of My Affection	0.514818 (0.017566)	0.00100 (0.049614)	5835020 (41584)	0.99744
23	Deep Impact	0.435839 (0.01463)	0.00100 (0.03893)	27998837 (153265)	0.99564
24	The Horse Whisperer	0.288519 (0.01262)	0.09324 (0.03622)	14956466 (104493)	0.98912

25	Godzilla	0.723602 (0.05692)	0.00100 (0.13733)	23270428 (168682)	0.98903
26	Hope Floats	0.398717 (0.011906)	0.00100 (0.031364)	11837686 (59154)	0.99573
27	A Perfect Murder	0.38068 (0.012354)	0.167255 (0.036755)	13593096 (71840)	0.99701
28	The Truman Show	0.432323 (0.009287)	0.01641 (0.024973)	25081559 (85073)	0.99824
29	Six Days, Seven Nights	0.368744 (0.015235)	0.08555 (0.042681)	14701948 (90059)	0.99270
30	The X-Files	0.675349 (0.028084)	0.00100 (0.070676)	16572578 (78210)	0.99705
31	Mulan	0.362699 (0.009584)	0.098846 (0.026533)	23893228 (82102)	0.99666
32	Dr. Dolittle	0.375516 (0.006881)	0.00100 (0.01809)	28630900 (79762)	0.99808
33	Out of Sight	0.552417 (0.013581)	0.13630 (0.038472)	7471063 (26529)	0.99905
34	Armageddon	0.365532 (0.01189)	0.00100 (0.03103)	36227757 (198379)	0.99404
35	Small Soldiers	0.500884 (0.010428)	0.056531 (0.027648)	10830062 (27254)	0.99865
36	Lethal Weapon 4	0.489864 (0.009099)	0.018257 (0.024265)	25758976 (69606)	0.99893
37	There's something about Mary	0.137277 (0.00526)	0.068834 (0.01605)	34641229 (252334)	0.98281
38	The Mask of Zorro	0.432104 (0.014852)	0.00100 (0.037384)	18459017 (80739)	0.99364
39	Saving Private Ryan	0.295765 (0.00501)	0.00100 (0.01499)	38433075 (184828)	0.99836
40	The Parent Trap	0.373142 (0.007656)	0.042279 (0.021274)	12177400 (42769)	0.99816
41	The Negotiator	0.474242 (0.019405)	0.00100 (0.052297)	8236574 (56361)	0.99459
42	Ever after	0.251142 (0.006272)	0.095934 (0.018261)	13120297 (53976)	0.99597
43	Halloween:H20	0.701849 (0.032419)	0.00100 (0.080962)	9134546 (41524)	0.99633
44	Snake Eyes	0.516726 (0.019674)	0.00100 (0.050164)	11050826 (55215)	0.99525
45	Wrongfully Accused	0.687545 (0.05393)	0.242675 (0.154845)	1902246 (18500)	0.99594
46	Rush Hour	0.342731 (0.0172)	0.00100 (0.04484)	27639159 (242050)	0.98434
47	Ronin	0.502712 (0.015926)	0.004336 (0.04348)	8360143 (47513)	0.99750
48	Antz	0.25907 (0.01365)	0.11363 (0.04038)	18038275 (158588)	0.98404
49	What Dreams May Come	0.427867 (0.007773)	0.164076 (0.022239)	11083806 (27008)	0.99909
50	Bride of Chucky	0.53909 (0.015645)	0.199109 (0.044112)	6444656 (21810)	0.99858
51	Practical Magic	0.428023 (0.020294)	0.139362 (0.058467)	9293657 (65997)	0.99390

Table 3. The Estimation of Diffusion Model for Movies in Taiwan

No	Movie Title	Innovation Rate, p (std. Error)	Imitation Rate, q (std. Error)	Potential Market, m (std. Error)	$\overline{R}^2$
1	I Know What You Did Last Summer	0.541747 (0.003797)	0.770295 (0.014844)	106903 (122)	0.99998
2	Starship Troopers	0.833319 (0.052935)	0.181367 (0.156826)	129853 (1314)	0.99885
3	Anastasia	0.450419 (0.020324)	0.554239 (0.079099)	60788 (569)	0.99829
4	Alien Resurrection	0.966199 (0.15361)	0.009833 (0.456453)	147952 (4790)	0.99507
5	Flubber	0.724229 (0.072626)	0.805581 (0.238448)	94758 (916)	0.99902
6	Good Will Hunting	0.271334 (0.024397)	0.191943 (0.078513)	330082 (5730)	0.96907
7	Scream 2	0.704263 (0.143857)	0.040807 (0.42157)	104317 (4699)	0.96963
8	Mouse Hunt	0.547648 (0.036254)	0.474629 (0.121205)	146509 (1471)	0.99717
9	Tomorrow Never Dies	0.300854 (0.018009)	1.031785 (0.079772)	390770 (2405)	0.99722
10	As Good As It Gets	0.049521 (0.018343)	0.386602 (0.103923)	220173 (9439)	0.61128
11	Wag the Dog	0.370261 (0.005219)	0.640893 (0.020407)	33091 (78)	0.99979
12	Great Expectations	0.368158 (0.024433)	0.77618 (0.104139)	32493 (380)	0.99629
13	The Wedding Singer	0.49216 (NA)*	1.67633 (NA)*	12757 (NA)*	NA*
14	Sphere	0.560999 (0.066675)	0.400931 (0.23256)	117236 (2847)	0.99087
15	U.S. Marshals	0.577154 (0.011715)	0.00100 (0.035022)	255827 (1289)	0.99939
16	The Man in the Iron Mask	0.386428 (0.034317)	0.538527 (0.125674)	214834 (3043)	0.99048
17	Primary Colors	0.492124 (0.018081)	0.483213 (0.063007)	54030 (333)	0.99891
18	Wild Things	0.62589 (0.075403)	0.564076 (0.255709)	15583 (263)	0.99498
19	Lost in Space	0.632994 (0.060669)	0.00100 (0.194095)	145229 (4219)	0.99036
20	Mercury Rising	0.52217 (0.019873)	0.33332 (0.064253)	237389 (1526)	0.99857
21	City of Angels	0.622656 (0.025371)	0.112648 (0.077173)	255035 (2115)	0.99840
22	The Object of My Affection	0.434409 (0.023051)	0.604263 (0.091586)	30885 (327)	0.99765
23	Deep Impact	0.477532 (0.020289)	0.196247 (0.062382)	417280 (3215)	0.99704
24	The Horse Whisperer	0.488935 (0.026638)	0.395992 (0.084344)	37012 (260)	0.99655
25	Godzilla	0.4581 (0.012324)	0.129659 (0.035635)	419830 (1841)	0.99835

*NA: not available because there are only three weeks data to estimate three parameter

Table 3. The Estimation of Diffusion Model for Movies in Taiwan (Continuous)

No	Movie Title	Innovation Rate, p (std. Error)	Imitation Rate, q (std. Error)	Potential Market, m (std. Error)	$\overline{R}^2$
26	Hope Floats	0.312162 (NA)*	1.516892 (NA)*	24876 (NA)*	NA*
27	A Perfect Murder	0.493781 (0.076481)	0.611086 (0.272296)	116656 (2561)	0.98443
28	The Truman Show	0.347586 (0.020662)	0.302889 (0.070582)	192698 (2206)	0.99220
29	Six Days, Seven Nights	0.41786 (0.014367)	0.573669 (0.050194)	218419 (950)	0.99874
30	The X-Files	0.692104 (0.047383)	0.283005 (0.151061)	144764 (1822)	0.99792
31	Mulan	0.281806 (0.021591)	0.301503 (0.075926)	419384 (6259)	0.98305
32	Dr. Dolittle	0.440049 (0.012211)	0.333384 (0.040009)	196359 (932)	0.99891
33	Out of Sight	1.294331 (NA) *	0.00100 (NA)*	44369 (NA)*	NA*
34	Armageddon	0.418214 (0.013838)	0.185416 (0.042636)	658282 (4065)	0.99766
35	Small Soldiers	0.453045 (0.094751)	1.242729 (0.39611)	35490 (628)	0.99094
36	Lethal Weapon 4	0.736681 (0.017072)	0.00100 (0.046444)	365716 (1391)	0.99956
37	There's something about Mary	0.288075 (0.021642)	0.448581 (0.078934)	183421 (2206)	0.98830
38	The Mask of Zorro	0.41757 (0.023794)	0.862497 (0.097165)	78646 (641)	0.99820
39	Saving Private Ryan	0.36405 (0.020652)	0.193394 (0.061105)	439235 (3393)	0.98933
40	The Parent Trap	0.375799 (0.019876)	0.587058 (0.074215)	63000 (506)	0.99673
41	The Negotiator	0.349485 (0.022353)	0.550445 (0.081639)	105384 (969)	0.99424
42	Ever after	0.423664 (0.07411)	0.579484 (0.29988)	21921 (825)	0.97174
43	Halloween:H20	0.845448 (0.08692)	0.043909 (0.254355)	49334 (987)	0.99615
44	Snake Eyes	0.818855 (0.032064)	0.181342 (0.089603)	167077 (864)	0.99946
45	Wrongfully Accused	0.722614 (0.04671)	0.281501 (0.148069)	66092 (747)	0.99839
46	Rush Hour	0.413539 (0.017967)	0.437151 (0.05991)	216778 (1293)	0.99733
47	Ronin	0.785343 (0.120142)	0.098262 (0.412675)	79867 (3502)	0.99125
48	Antz	0.733507 (0.051179)	0.00100 (0.135749)	102781 (1092)	0.99539
49	What Dreams May Come	0.621467 (0.02449)	0.00100 (0.076598)	199373 (2122)	0.99814

50	Bride of Chucky	1.02761 (0.024423)	0.00100 (0.061653)	148319 (392)	0.99988
51	Practical Magic	0.537359 (0.031369)	0.272002 (0.114831)	78293 (1285)	0.99684

Table 4 The Means and Standard Deviations of Diffusion Coefficients of America Movies in the US Market and Taiwan Market, by Movie Type

	Estimates of the US Market			Estimates of Taiwan Market		
	$\hat{p}_{US}$ (SD)	$\hat{q}_{US}$ (SD)	$\hat{m}_{US}$ (SD)	$\hat{p}_{TW}$ (SD)	$\hat{q}_{TW}$ (SD)	$\hat{m}_{TW}$ (SD)
Movie Type						
Love Stories	0.339193 (0.1494)	0.088378 (0.0931)	14536910 (7405096)	0.419974 (0.1593)	0.590584 (0.521)	121777 (113916)
Actions	0.465871 (0.0646)	0.057488 (0.0901)	14956828 (8340636)	0.621598 (0.2991)	0.349780 (0.370)	194182 (120981)
Science Fictions	0.610800 (0.1522)	0.02360 (0.0503)	17938719 (10377275)	0.629933 (0.1930)	0.173432 (0.1325)	272553 (201415)
Comedies	0.371791 (0.1733)	0.113093 (0.1592)	18707943 (11308476)	0.492286 (0.1774)	0.461946 (0.1864)	134691 (59333)
Dramas	0.373581 (0.1845)	0.170026 (0.2260)	14239983 (12161559)	0.455422 (0.1022)	0.505198 (0.1624)	145572 (161121)
Animations	0.310511 (0.1614)	0.201870 (0.2260)	16027982 (6186056)	0.479694 (0.1872)	0.524868 (0.529)	154611 (178684)
Horrors	0.523225 (0.1613)	0.088800 (0.1030)	12308138 (5722980)	0.779767 (0.207)	0.214003 (0.371)	102218 (40614)

Table 5 The Comparison of the Means of Diffusion Coefficients of Other Attributes of American Movies in the US Market and Taiwan Market

	Estimates of the US Market			Estimates of Taiwan Market		
	$\hat{p}_{US}$ (SD)	$\hat{q}_{US}$ (SD)	$\hat{m}_{US}$ (SD)	$\hat{p}_{TW}$ (SD)	$\hat{q}_{TW}$ (SD)	$\hat{m}_{TW}$ (SD)
Key Actor or Actress						
Infamous	0.447037 (0.185)	0.099816 (0.143)	14910279 (8132047)	0.576360 (0.188)	0.431645 (0.423)	130781 (128648)
Famous	0.411162 (0.160)	0.089391 (0.131)	16225875 (9448575)	0.513598 (0.240)	0.404267 (0.348)	189358 (142040)
Tests						
H_o：	$\alpha_1 \leq \alpha_2$	$\alpha_1 \leq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \leq \alpha_2$	$\alpha_1 \leq \alpha_2$	$\alpha_1 \geq \alpha_2$
T-Value	0.73	0.27	-0.53	1.04	0.24	-1.53
P-Value	0.23	0.39	0.30	0.15	0.40	0.066
Announce-ment Week						
Non-holidays	0.436306 (0.143)	0.085865 (0.089)	13830598 (7303049)	0.524602 (0.226)	0.402071 (0.349)	134196 (112770)
Holidays	0.418721 (0.197)	0.102003 (0.170)	17365230 (9895249)	0.564435 (0.213)	0.438225 (0.428)	217519 (163550)
Tests						
H_o：	$\alpha_1 \leq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \geq \alpha_2$
T-Value	0.37	-0.43	-1.46	-0.63	-0.31	-1.96
P-Value	0.36	0.34	0.076	0.27	0.38	0.030
Play Period						
Non-Holidays	0.459222 (0.118)	0.090942 (0.0857)	11734272 (6798589)	0.552579 (0.239)	0.388367 (0.341)	129506 (95844)
Holidays	0.405024 (0.199)	0.096297 (0.163)	18361374 (9135420)	0.510703 (0.175)	0.474983 (0.452)	243403 (183249)
Tests						
H_o：	$\alpha_1 \leq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \leq \alpha_2$	$\alpha_1 \geq \alpha_2$	$\alpha_1 \geq \alpha_2$
T-Value	1.22	-0.15	-2.97	0.70	-0.68	-2.34
P-Value	0.11	0.44	0.0023	0.24	0.25	0.015

Table 6 The Estimations of SUR Model

	Model I			Model II		
	TWp	TWq	TWm	TWp	TWq	TWm
Intercept	0.374454	1.066507	-23.168	0.11452	0.56679	-5.42551
	(1.981)*	(2.881)***	(-2.728)***	(1.157)	(5.463)***	(-1.754)*
USp	0.426584	-0.7276	25.20311	0.78021		
	(1.439)	(-1.272)	(1.907)*	(4.239)***		
USq	0.087032	-0.68065	26.54601	0.37840		
	(0.311)	(-1.259)	(2.117)**	(1.895)*		
USm	-0.00778	-0.01086	1.289266			0.88520
	(-1.703)*	(-1.217)	(6.258)***			(6.634)***
Horror (Dummy)	0.256103	-0.27769	0.780313	0.21660	-0.35278	3.29345
	(2.315)**	(-1.266)	(0.156)	(1.981)*	(-1.721)*	(0.675)
Science Fiction (Dummy)	0.081799	-0.28959	5.946822	0.00327	-0.43695	10.48246
	(0.801)	(-1.431)	(1.268)	(0.037)	(-2.912)***	(2.819)***
Action (Dummy)	0.054633	-0.04272	3.841909	0.04030	-0.08145	5.18457
	(0.826)	(-0.331)	(1.291)	(0.609)	(-0.675)	(1.772)*
Major Star (Dummy)	-0.00462	0.512799	-14.394	-0.00301	0.46598	-12.20840
	(-0.022)	(1.261)	(-1.537)	(-0.014)	(1.185)	(-1.284)
Rank of Star	0.000607	-0.00812	0.230374	0.00038	-0.00752	0.20411
	(0.233)	(-1.581)	(1.955)*	(0.144)	(-1.551)	(1.722)*
Holiday (Dummy)	0.05628	0.143867	4.787529	0.02728	0.13155	5.83492
	(1.114)	(1.429)	(1.857)*	(0.529)	(1.329)	(2.248)**

Note: t-statistics in parentheses; * significant at level 0.1; ** significant at level 0.05; *** significant at level 0.01.

Table 7 The Forecasting of Box-Office Attendance for Motion Pictures in Taiwan Market

	Soldier		The Siege		Meet Joe Black		I Still Know What You Did Last Summer		A Bug's Life	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
Week 1	51106	54691	88963	102370	75491	77607	19584	26308	111927	105660
Week 2	34071	22195	55063	50675	40313	41513	12302	10519	110646	91078
Week 3	5044	8556	24062	21389	17944	18259	5137	3725	73869	51181
Week 4	8117	3232	13905	8414	11070	7334	1351	1261	38230	22123
Week 5	2041	1212	6350	3218	5584	2837			16506	8465
Week 6	409	453	2996	1217	2586	1082			8773	3086
Week 7	458	169	302	458					2710	1105
Week 8									1461	393
Cumulative	101246	90508	191641	187741	152988	148632	38374	41813	364122	283091
Weekly Average	14464	12930	27377	26820	25498	24772	9594	10453	45515	35386
	MAD	MAPE	MAD	MAPE	MAD	MAPE	MAD	MAPE	MAD	MAPE
Cumulative	10738	11%	3900	2%	4356	3%	3439	9%	81031	22%
Weekly Average	1534	11%	557	2%	726	3%	859	9%	10129	22%
Weighted Average	913	4%	1193	2%	299	1%	1049	7%	1835	3%