

Model of market share affected by social media reputation

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Market Share vs. Social Media

Market Share model ----- S T Berry 1994

Model for

Social Media ----- Mathematical model for
Hit Phenomena Ishii et. al. 2012

We present an idea to couple the two theories

The discrete choice model

S T Berry, Estimating discrete-choice models of product differentiation, RAND Journal of Economics 25 (1994) 242-262

Utility of consumer i for product j

$$u_{ij} = x_j \tilde{\beta}_i - \alpha p_j + \xi_j + \epsilon_{ij}$$

i : Consumer

j : product

x : demand

ξ : mean of consumer's valuations
of an unobserved product characteristic
such as product quality

p : price

ϵ : distribution of consumer preferences

α : invariant across consumers

β_k : mean level of the taste parameters
for product k

ξ_j : unobserved demand parameters

Example of utility

Case of a consumer: 1 inch ¥5,000、 iOS ¥15,000、 LTE1Mbps ¥1,000

iPhone	price	size	OS	LTE	utility
5s	50000	4	iOS	150Mbps	135000
6s	97000	4.7	IOS	300Mbps	241500
SE	70000	4	iOS	150Mbps	115000

$$\text{utility} = \text{size} * 5000 + \text{OS} + \text{LTE} * 1000 - \text{price}$$

$$6s > 5s > SE$$

Estimating market share from the mean utility levels

Market Share $s_j = s_j(x, p, \xi, \theta)$



$$s_j = s_j(\delta) (j = 1, \dots, N)$$



$$\delta_j(s) = x_j \beta - \alpha p_j + \xi_j$$



Market share of
product j

$$s_j(x, p, \xi, \theta) = \frac{e^{\delta_j}}{\sum_{k=0}^N e^{\delta_k}}$$

Extension of Market Share model as time-dependent model

$$u_{ij}(t) = \beta_j x_i(t) - \alpha p_j(t) + \xi_j + \epsilon_{ij}$$

How long is the time scale of time-dependency in market share?
A day? Weeks? Months?

This definition of utility is also available for
non-equilibrium economic states?

Coupled with hit phenomena

$$\delta_j(s, t) = \beta_j x_i(t) - \alpha p_j(t) + \underline{\gamma I(t)}$$

Social media effect
from model of Ishii 2012

Time-dependent Market Share

$$s_j(t) = \frac{e^{\delta_j(t)}}{\sum_{k=1}^N e^{\delta_k(t)}}$$

Equation of intention of each person in the society

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

Solve without communication

We obtain
market share equaton

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

Solve as society in the sense of
averaged field approximation

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

A(t) is time distribution
of advertisements on mass media

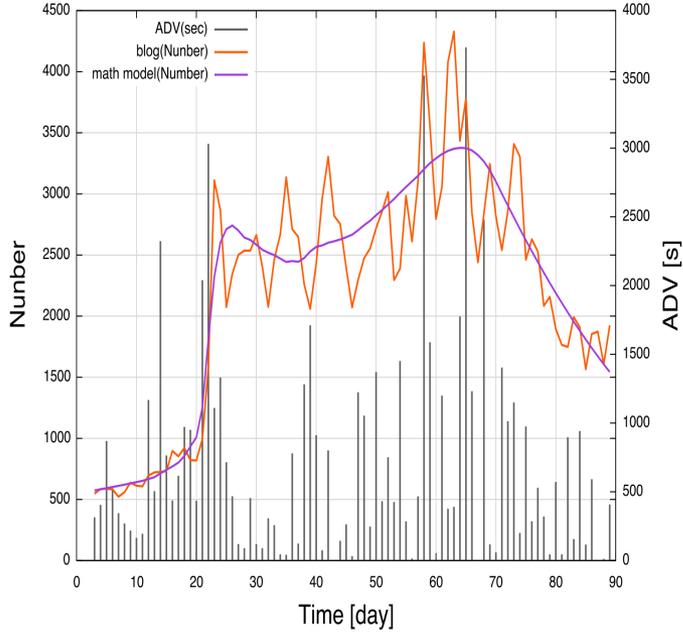
Paramters a, D and P are determined by using Monte Carlo technque
to adjust the calculated intention to the observe number of posting of
blog or twitter in each days.

Solve as 2 persons

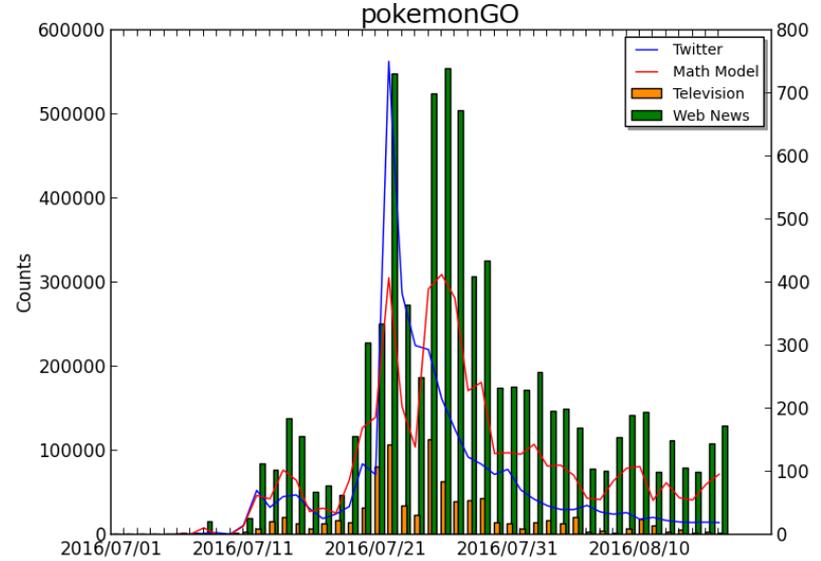
$$\begin{aligned} \frac{dI_1(t)}{dt} &= -a_1 I_1(t) + D_{12} I_2(t) \\ \frac{dI_2(t)}{dt} &= -a_2 I_2(t) + D_{21} I_1(t) \end{aligned}$$

S. Strogatz, Mathematics Magazine 61 (1988) 35
Equation of "Love Affair" of Romeo and Juliet

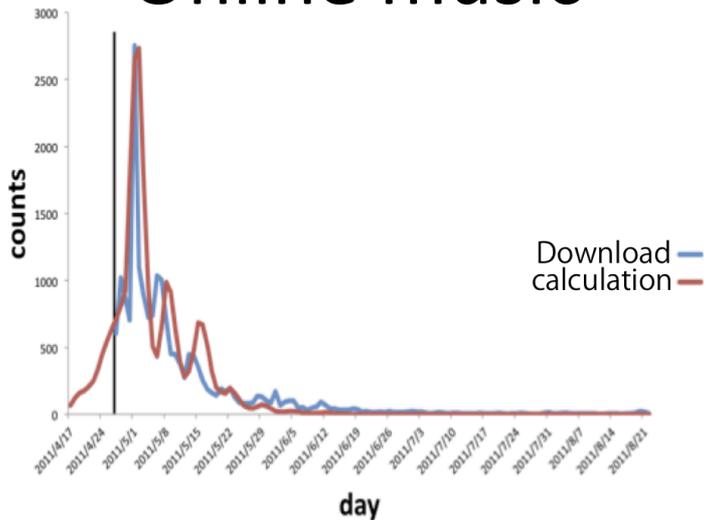
Film (Avatar)



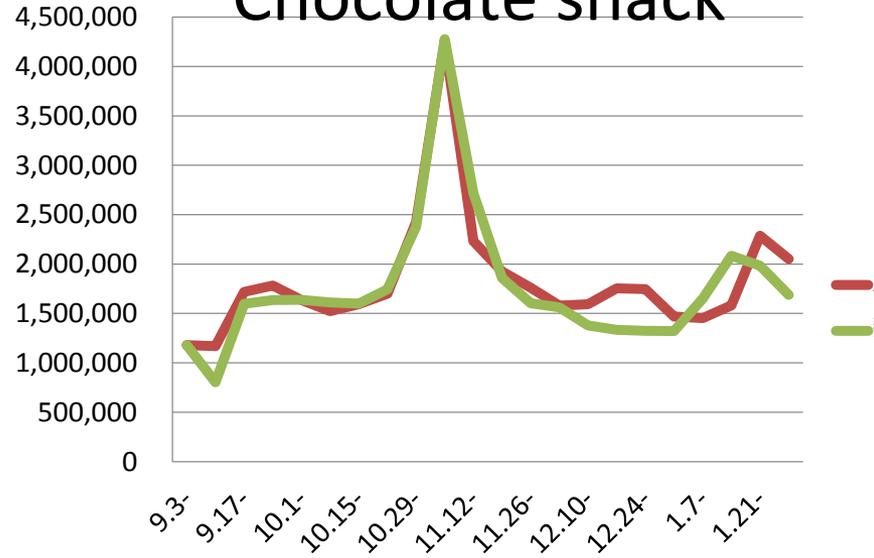
PokemonGO



Online music

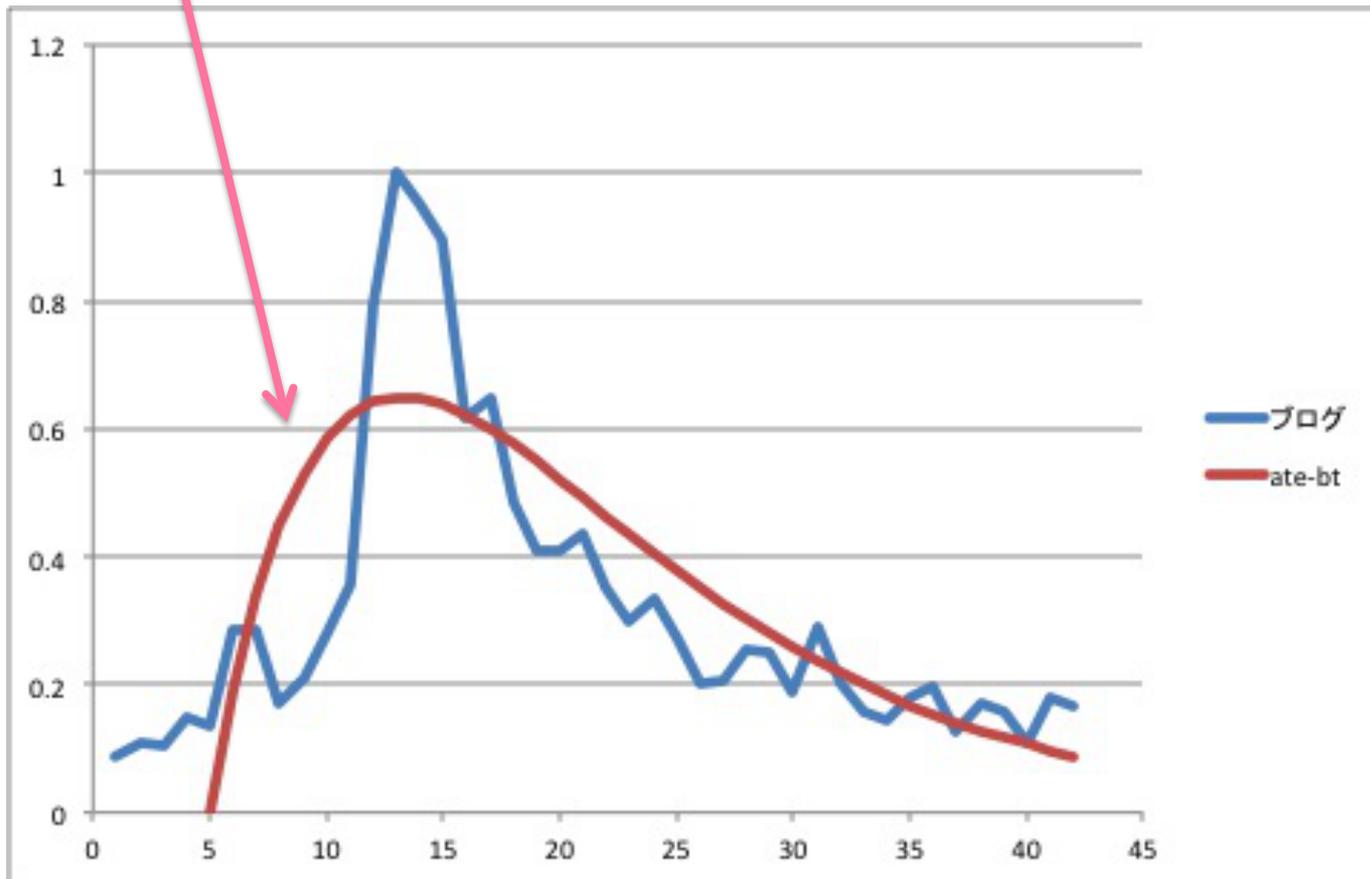


Chocolate snack



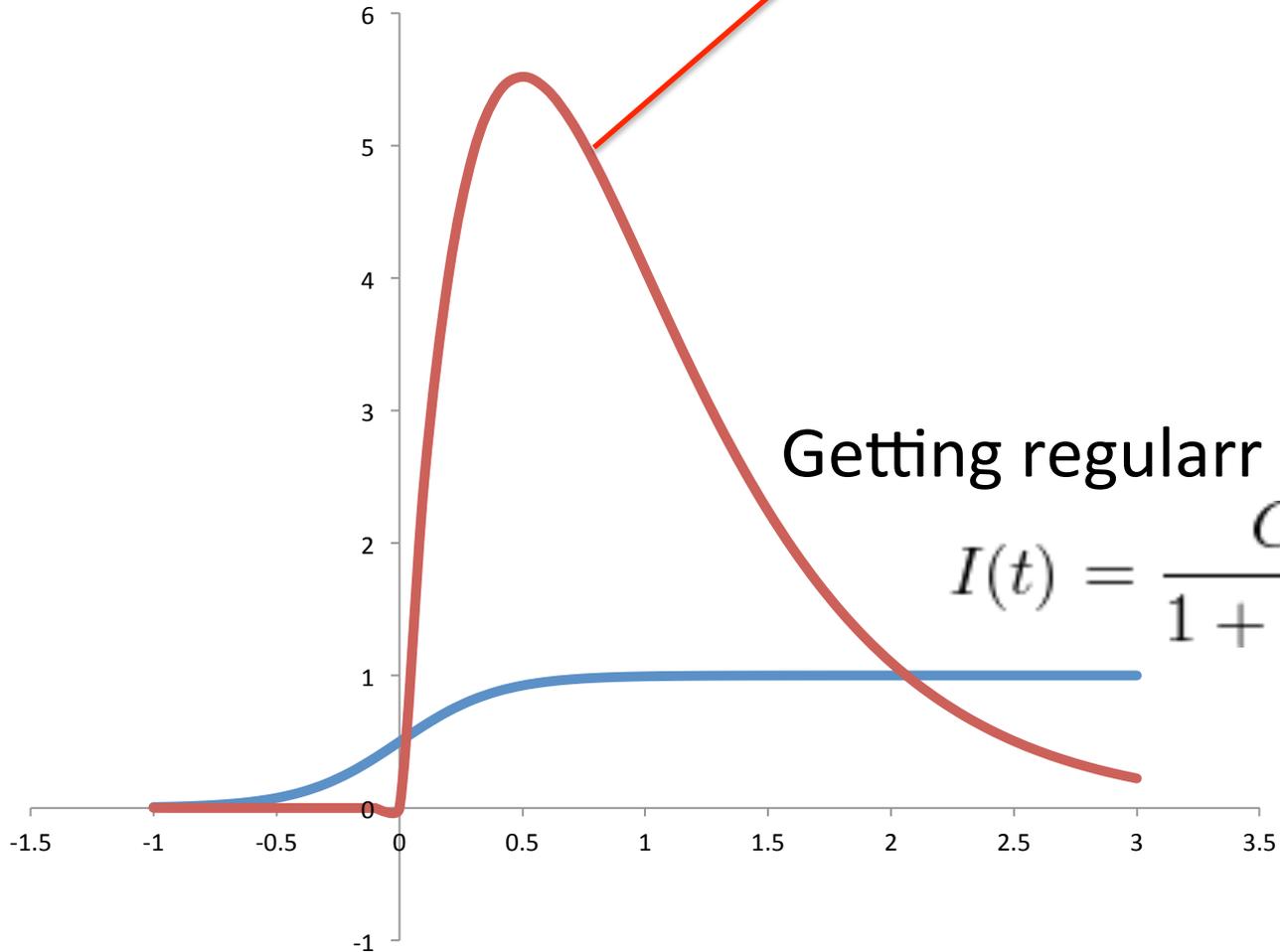
Simple model to approximate hit phenomena on social media

$$I(t) = C_1 t e^{-\alpha t}$$



Temporal hit

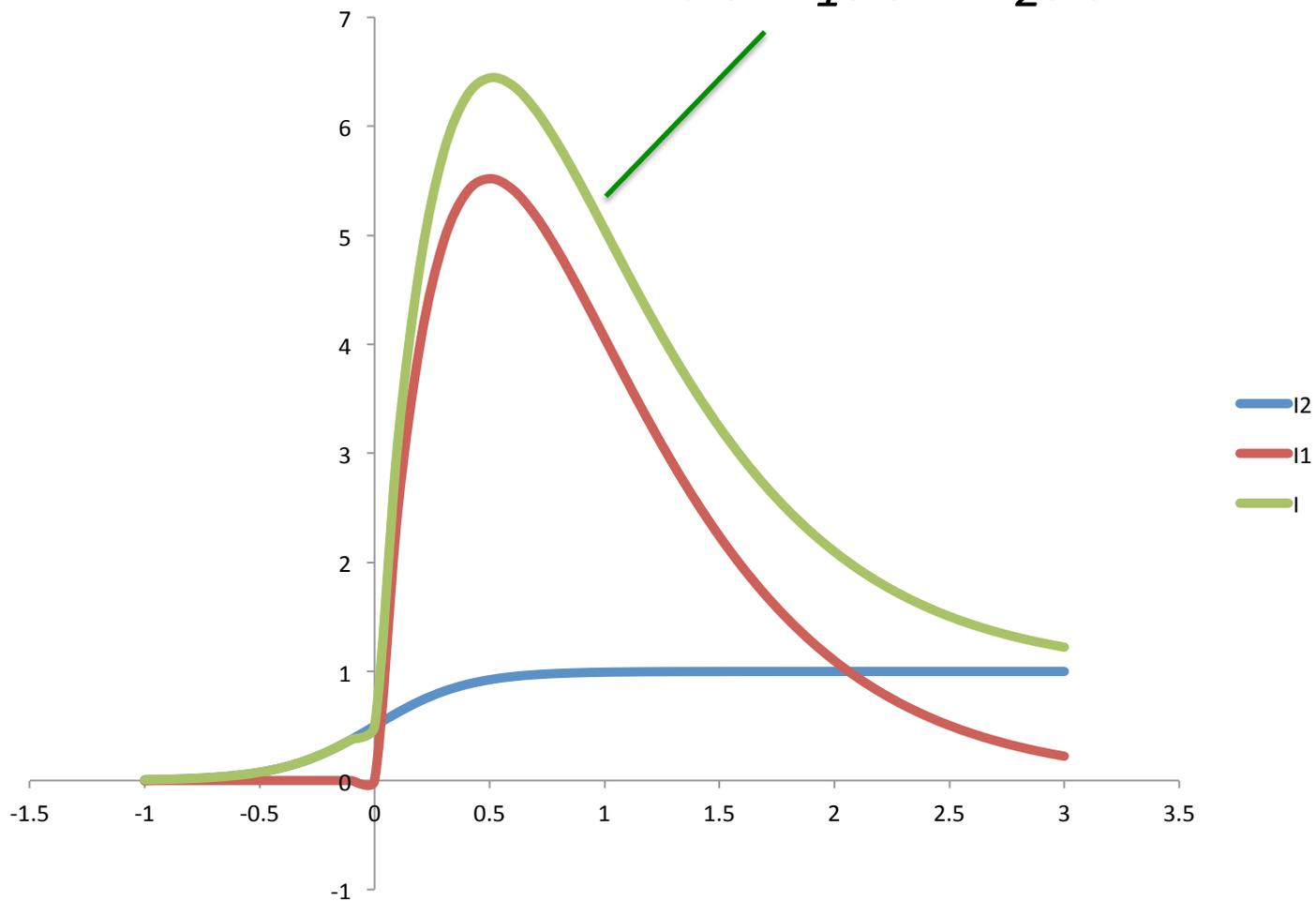
$$I(t) = C_1 t e^{-\alpha t}$$



Getting regular customer

$$I(t) = \frac{C_2}{1 + e^{-\beta t}}$$

$$I(t) = I_1(t) + I_2(t)$$



Model Calculation

$$s_j(t) = \frac{e^{\delta_j(t)}}{\sum_{k=1}^N e^{\delta_k(t)}}$$

$$\delta_j(s, t) = \beta_j x_i(t) - \alpha p_j(t) + \gamma I(t)$$

N=3, 3 firms

$$\delta_1 = \delta'_1 + \gamma I(t)$$

δ_2, δ_3 has no social media part

$$\delta'_1 = 0.1 \quad \delta_2 = 0.1 \quad \delta_3 = 0.5$$

$$I(t) = C_1 t e^{-at} + \frac{C_2}{1 + e^{-bt}}$$

Case1

$$\gamma = 0.1$$

$$a = 2$$

$$b = 5$$

$$C_1 = 30$$

$$C_2 = 1$$

Case2

$$\gamma = 0.1$$

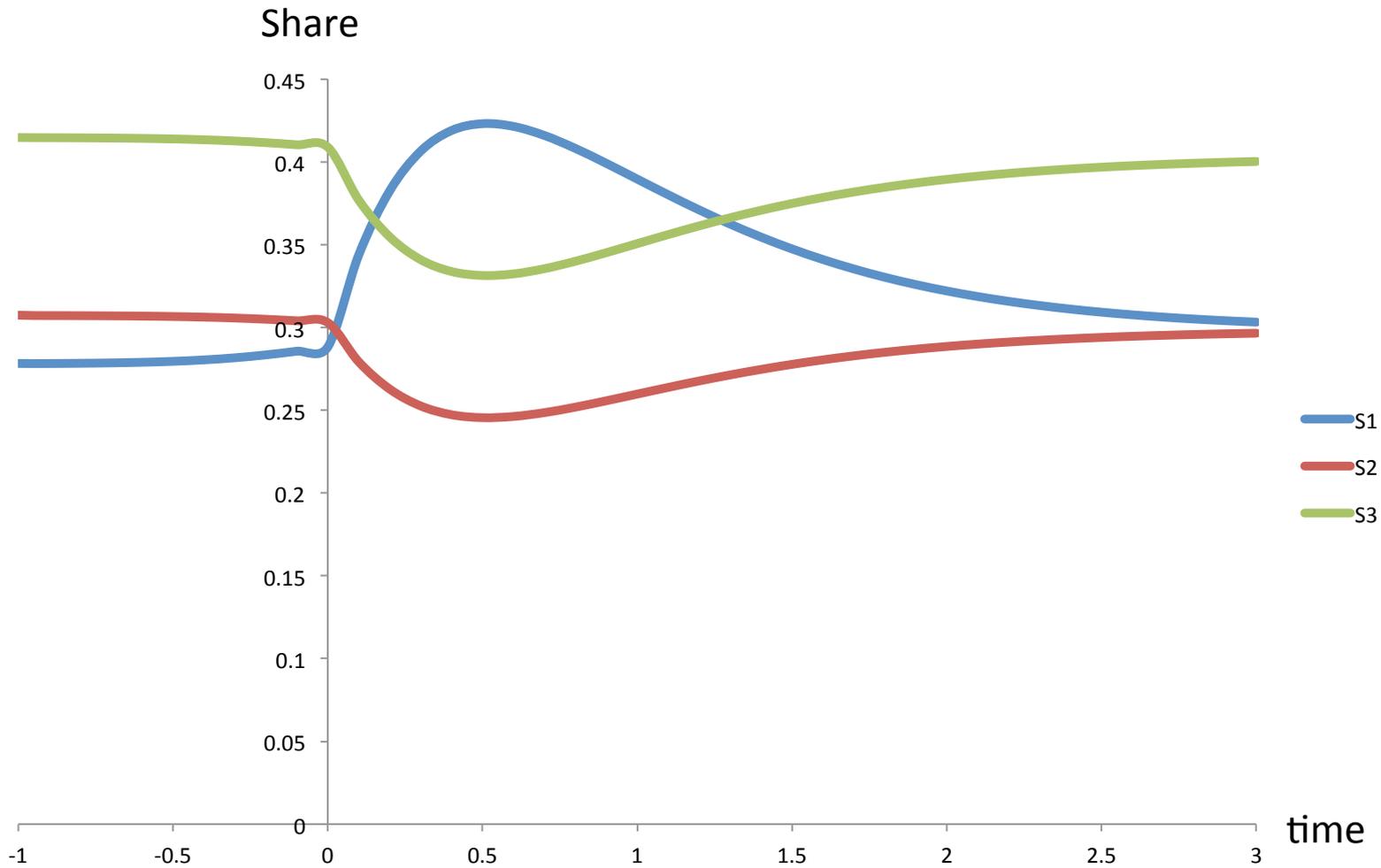
$$a = 2$$

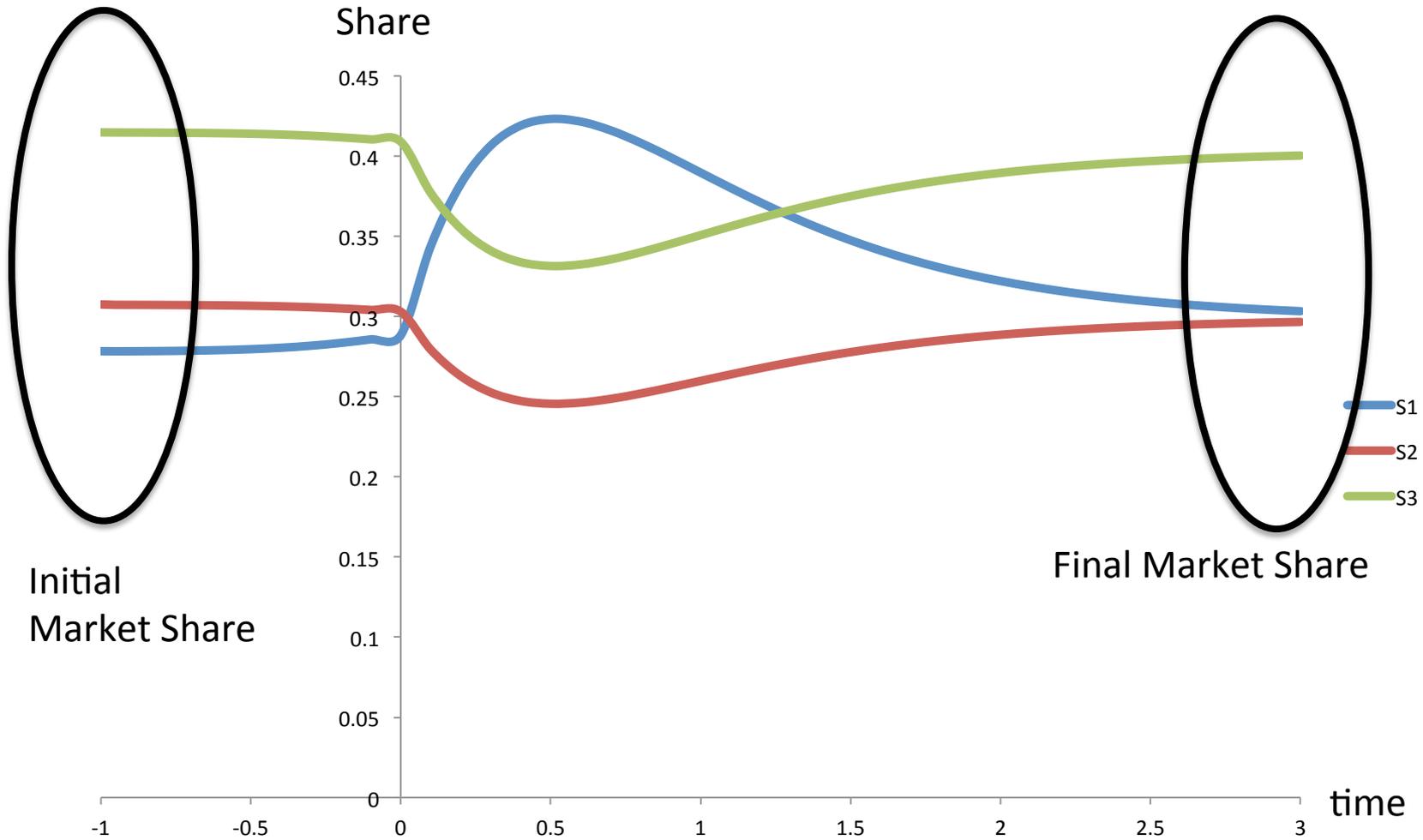
$$b = 5$$

$$C_1 = 30$$

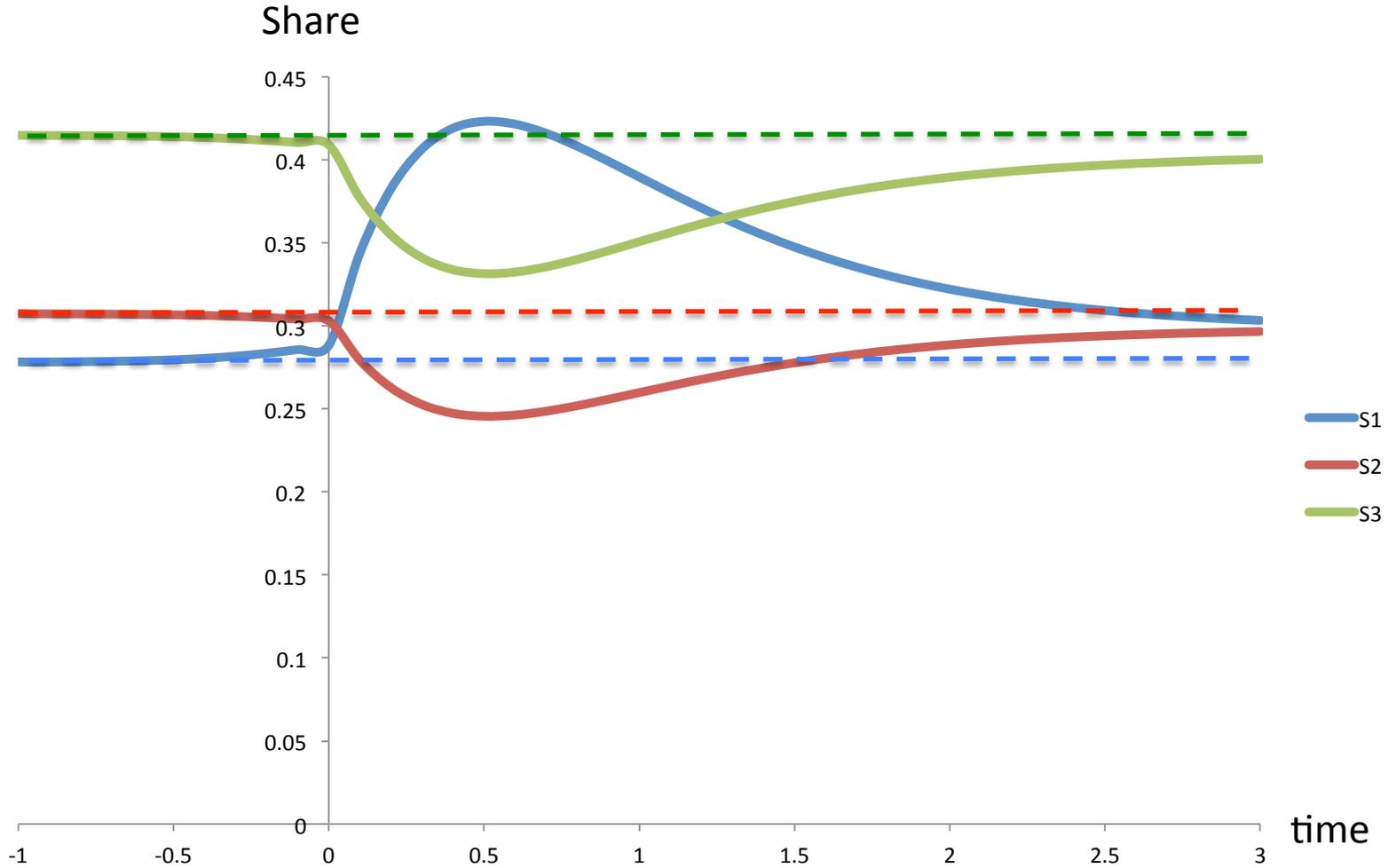
$$C_2 = 2$$

case 1

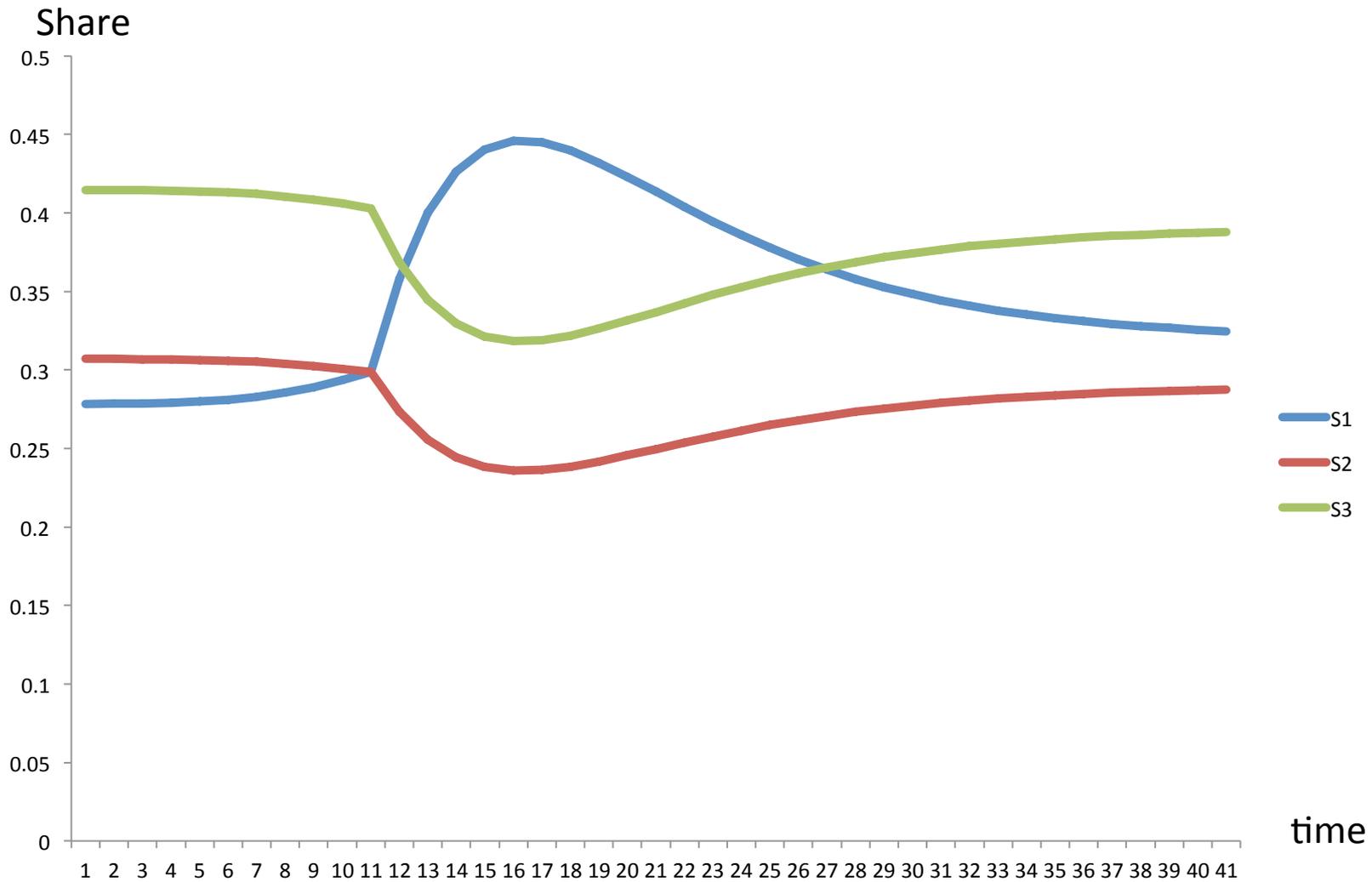




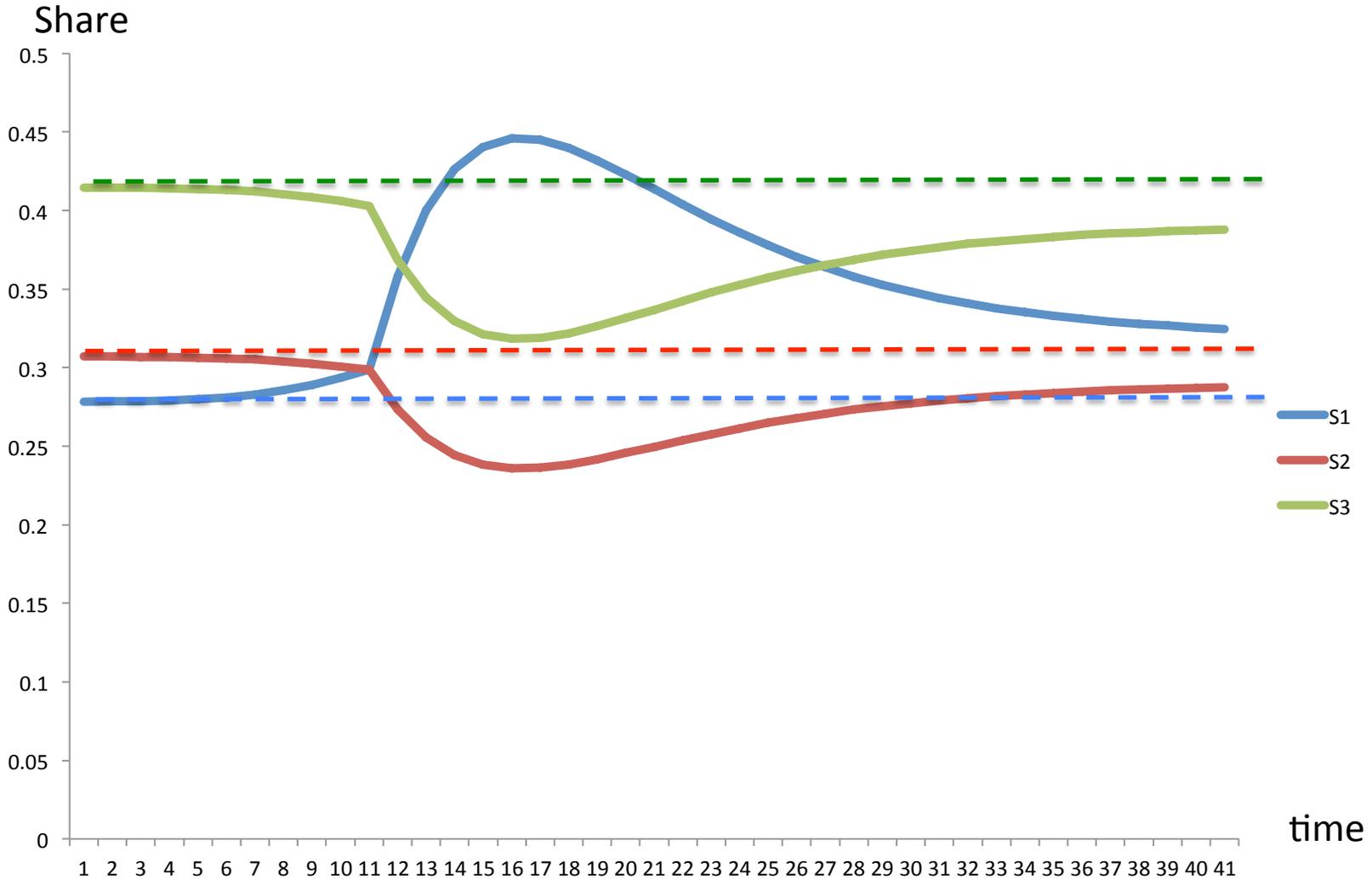
Change of final share



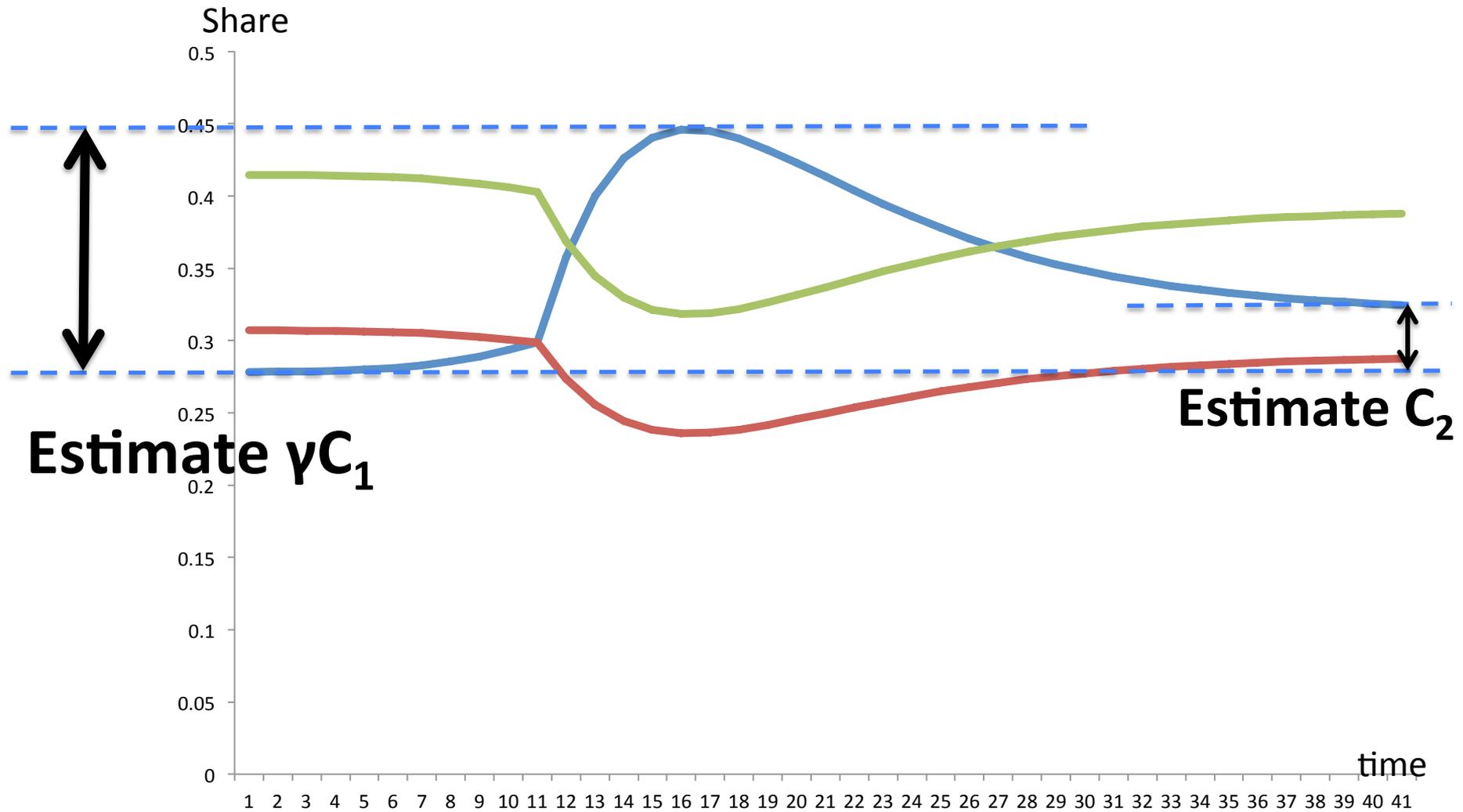
case 2



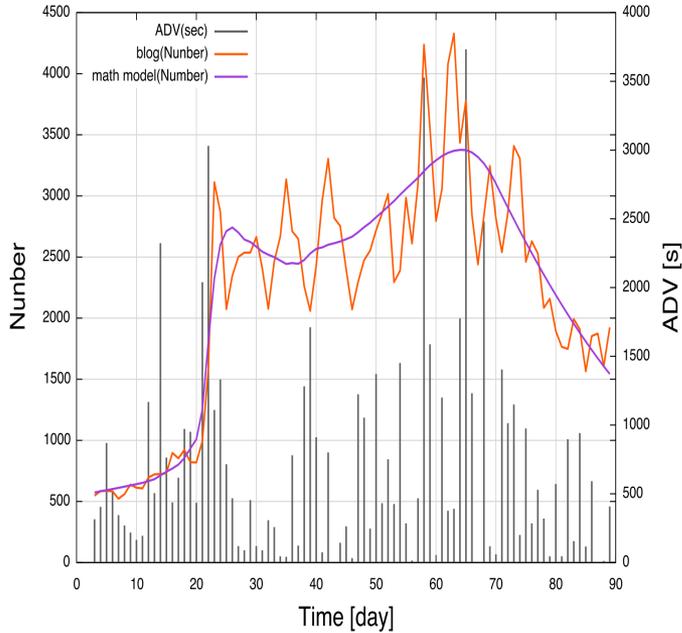
Change of final share



$$I(t) = C_1 t e^{-at} + \frac{C_2}{1 + e^{-bt}}$$

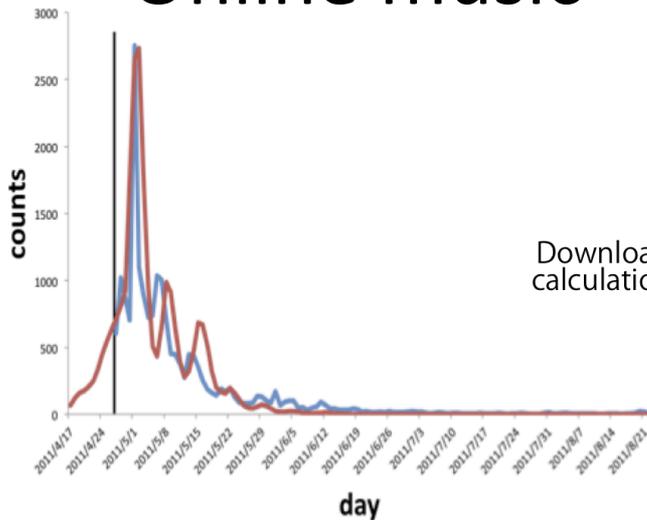


Film (Avatar)

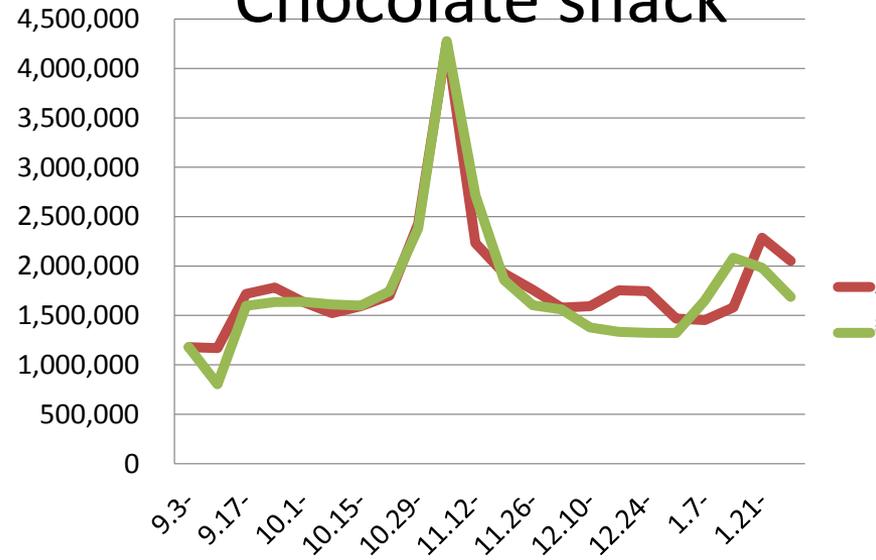


Our model can calculate real sales data

Online music



Chocolate snack



Conclusion

- We propose time-dependent market share model coupled with mathematical model for hit phenomena
- Simple model calculation seems to be natural
- Our model can be checked experimentally by using real market data

質問

- 映画は短期的だが、ポケモンGOはそのシステム全体を変えてしまいます。それはどう分けてモデル化する？
- 定常的なヒット(時間無限大でのヒット)だけが市場シェアとしては重要では？