STANDING OVATION

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Draft: June 28, 1996.

1. The Problem

> Consider the following situation: Agents are seated in an auditorium listening to a brilliant economics lecture. At the end of the talk, after wiping away the tears, the applause begins, and perhaps a standing ovation ensues. Model, using whatever techniques you desire, the process of a standing ovation. State the model, summarize the results and suggest some future directions for the model. Suggest some economic scenarios that could be usefully modeled using such a process.

2. Overview

We present a model of a standing ovation which is based on the actions and interactions of individual audience members. We describe the decision problem

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Journal of Economic Literature Classification. #-##..
Key words and phrases. Cascade, Complexity, heterogeneity..
Prepared for the Summer Institute in Computational Economics sponsored by the Santa Fe Institute, Santa Fe, New Mexico, Summer 1996.

OVAT04.TEX

faced by an individual audience member then simulate the actions of the auditorium as an interlinked collection of these individuals.

Briefly, each individual is postulated to care about a number of factors when deciding whether or not to stand up at some point after the end of the lecture. These factors include internal considerations based upon the agent's own characteristics (e.g. how much the agent liked the lecture) and external considerations which consist of influences from the rest of the audience(e.g. peer pressure). Therefore, the agent's behavior is a function of its own personal motivation as well as ques from its environment. In particular, she is more likely to stand if those in her line of sight are standing, and if the general noise level of applause is high (perhaps indicating a greater likelihood that a standing ovation will occur).

The external considerations are described by the structure of the audience. The audience structure describes the physical layout of the audience which affects the agents' visual and aural ques. Agents are nodes in a fully-linked lattice. The structure of the lattice is set up to mimic the seating arrangement of the audience. Hence, we can experiment with different seating arrangements and their effects upon ovation behavior.

Our analysis will also focus on the effects of audience heterogeneity. In particular, we posit that audience members differ along the following dimensions: subjective quality assessment of the talk, taste for the lecture topic, desire to comform with the rest of theaudience, and the strength of the influence of any friends or authority figures in the audience.

We will examine the behavior across agent types in audiences drawn from a larger population. In particular we will examine the characteristics of the time structure of the ovation (e.g. duration, start-up time) as well as the behavior of the overall likelihood of ovations as the composition of the population is varied.

3. AGENTS

3.1. Decision Rule. The agent is posited to follow a simple decision rule as follows. She evaluates a function D and decides to leave, sit still, clap, or clap and stand depending upon whether D surpasses certain threshold levels given by $thresh_{leave}$, $thresh_{clap}$, and $thresh_{stand}$. The function is given by

$$D\left(\cdot\right) = \left[\sum_{i\in\Omega} \alpha_i \ln\left(i\right)\right] e^{-\delta t}, \tag{1}$$

where the set Ω contains the values of the arguments to the decision rule and δ is a decay or "fatigue" factor.

In specifying the action of the individual we approach the problem from a low level decision rule. Rather than explicitly specifying a utility and deriving the decision rule, we work directly with what we see to be a plausible decision rule. In principle it would be possible to derive from our decision rule to determine a class of utility functions that are consistent with the rule laid out in (1), but for the present purpose we feel the approach taken here is sufficient.

The following subsections describes the arguments to the agents decision rule and specifies the relevant heterogeneities. We follow a plan of specifying high level parameters which capture the agents characteristics, and then map them into the parameters (α_i's) of the decision function as well as deeper parameters determining the specific values of the arguments. The three categories of influences (members of Ω) are a measure of the quality of the lecture (*quality*), a measure of the influence of the other visible audience members (*vision*), and the overall noise level generated by applause (*noise*).

3.2. Quality. The agents make a subjective determination of the quality of the performance which is partially determined by a commonly observed objective quality of the lecture. The agent also cares about the topic of the lecture when deciding upon whether or not to stand. This then gives a measure of the overall subjective quality of the lecture as

$$quality = \max\left[\bar{q} + \epsilon_j - \gamma_j \left(\bar{t} - t_j\right)^2, 0\right],$$

where $\bar{q}$ is the objective quality, ϵ_j is the subjective quality assessment, $\bar{t}$ is the lecture topic, t_j is the audience member's "ideal" topic, and γ_j is an individual specific parameter.

3.3. Vision. The links of the audience lattice act as the visual ques to the agents. Every agent is linked to every other agent, and the weights of each link depends on the relative position of two nodes (agents) and the degree of influence one agent may have upon the other, which depends upon three characteristics:

- **Elites:** Some members of the audience act as leaders that other audience members may wish to follow. For example, catholic agents may wish to mimic the Pope's actions or congressmen may wish to mimic their party leader.
- **Groups:** Audience members may come as couples or in groups. Members of such groups may be especially influenced by other members of their group.
- **Agent personality characteristics:** Some people are especially influenced by their friends and elites, while others only care about their own appreciation of the performance/presentation.

To model these behaviors of visual ques we randomly adjust the weights of the visual links to account for these possible heterogeneities. Given these weights, the vision parameter for an arbitrary agent i is determined by:

$$vision_i = \frac{\sum_j d_j^s d_{i,j}^{los} w_{ij}}{\sum_j d_{i,j}^{los}},$$

where d_j^s takes a value of 1 if agent j is standing, 0 if not; $d_{i,j}^{los}$ takes the value of 1 if agent j is in the visual cone of agent i; and $w_{i,j}$ is the weight which represents the level of influence of agent j on agent i.

3.4. Noise. A forward looking agent who values following the group will assess the likelihood of a standing ovation when deciding whether or not to be one of the first ones to stand. An explicit derivation and calculation of the expectations of oan ovation for the individual is a complicated task that we do not wish to impose (or undertake) here. Rather we assume that as a proxy the agent uses the current level of ambient noise in the auditorium to be a signal as to how likely it is that a standing ovation will occur.

Specifically the noise argument is generated by summing the noise levels generated by each individual in the audience. The amount of applause for each individual is proportional to the level of the decision function over and above the threshold level to generate applause:

$$noise = \sum_{j} \max\left[0, D_j\left(\cdot\right) - thresh_{j,clap}\right]. \tag{2}$$

3.5. Cost. The price of the ticket is hypothesized to have a positive impact on the likelihood of applauding. See Kahneman, Knetsch, and Thaler (JEP, 1991) for further discussion.

4. Personality Types

Currently the set of parameters affecting the behavior of the agents are drawn randomly from a population. In future work it would be possible to specify upper level charcterstics to derive the specific parameter values of the population.

These characteristics include:

- Sycophanticy. This variable describes how much the agent is influenced by other members of the audience. Specifically, it is used to modify the visual links from VIPs in the agent's visual range, and to modify the visual parameter, (vision, of the utility function (see below).
- Gregariousness. This variable, like sycophanticity, affects other agents' influence on the agent. However, this variable affects the visual links from group members instead of from VIPs.
- Camp. This variables describes the political/social/artistic leanings of the agent. For example, if camp = "democrat" then the agent is more likely to clap for Bill Clinton than for Bob Dole. If camp = "opera lover" then the agent is more likely to clap for Madame Butterfly than the Talking Heads.
- Appreciation. This variable indicates the agent's perception of the quality of the perfomance/presentation. This variable affects the quality parameter.
- Cost. This variables represents how much the agent spent to see this performance/presentation.
- Fatigue This variable indicates how quickly the agent tires of clapping and/or standing. It affects the fatigue parameter, δ.

We can then specify the high level characteristics of the individuals in our population and the mappings to the lower level parameters. As above we want to define people by the following: syncophatic, appreciation, ideal topic, gregariousness, stamina, ticket illusion sensitivity. See Table (1) for linkages.

5. Results of Computational Experiments

For the model simulations we find the following structure for standing ovations. Firgure 1 graphs the average time structure of the ovation for good and bad lectures when people arrive in groups and when they arrive individually. Figure 2 shows the level of noise as a function of time for the same simulatios.

Agent Characteristics	**Parameters**	**∂L/∂H**
Syncophatic	α_{noise}	+
	α_{vision}	+
	$Vision\ Parameters$	+
Appreciation	α_q	+
Camp	γ_j	+
Type a	$thresh_{j,clap}$	−
	$thresh_{j,stand}$	−
Gregariousness	α's, vision parameters	+
Fatigue	δ_j	+
Ticket Illusion	α_{cost}	+

TABLE 1. Parameter mapping