Modeling and Simulating Fan Participation at Large Scale Sporting Events

Blue Jays Unlimited

Presenter:
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JHU AMS 550.400 Fall 2012

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Overview

Participants and Sponsors

- Student participants:
  - Steven Su
  - Danni Tang
  - Ahmed Aly
- Sponsor: Blue Jays Unlimited

Who are Blue Jays Unlimited?

- Blue Jays Unlimited (BJU) was established in 1995 [1]
- Volunteer group of over 3000 alumni, friends, and staff, based in Baltimore, MD, dedicated to supporting and promoting Johns Hopkins University (JHU) athletics [1]
- Official booster club for JHU athletics [1]

The logo of Blue Jays Unilimited. *Courtesy of:*

http://www.hopkinssports.com/bluejays-unlimited/

What Does BJU do for Hopkins?

- Raised more than $4 million in funds to improve experience for JHU student athletes and fans alike [1]
- Funds provide money for capital projects as well as scholarships and operational endowments [1]
- Past projects include renovation of the Newton H. White Athletic Center and recognition banners for championship teams. [1]

The Newton H. White Athletic Center after renovations. *Courtesy of: http://events.jhu.edu/WhiteAthleticCenter#.UHhNK1GRWSo*

BJU at Sporting Events

- BJU is present at nearly all major JHU sporting events
- Encourage fans to cheer on their Blue Jays to victory in a vociferous and family-friendly manner
- BJU's goal is to provide Hopkins' teams with the ultimate advantage: a spirited home crowd

Problem Statement Background: Why is Cheering Important?

- A loud and supportive home crowd is the ultimate home team advantage to any collegiate sports team.
- Fan participation in events such as chanting the school fight song, waving a rally towel, doing the wave, or general applause, show support for the home team as well as enhance the general atmosphere of a sporting event.
- Note that we will hence refer to all these activities as "cheering".

Problem Statement

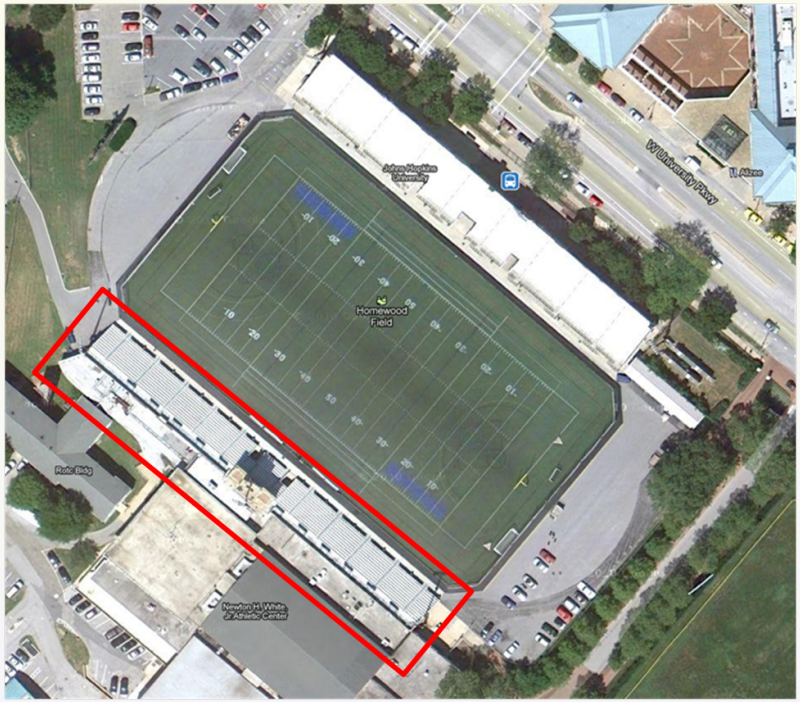
- BJU is interested in maximizing cheering at Homewood Field located on the Homewood campus of JHU in Baltimore, MD.
- BJU believes that they can increase cheering by placing "cheer starters" in the home crowd.
- "Cheer starters" are student volunteers who urge other fans around them to cheer.

Official Problem Statement

- BJU wants to know if "cheer starters" can actually increase cheering and also want a simple model of fan participation in cheering.

Important Details To Consider

- Homewood Field's capacity is approximately 8500 spectators [2]
- Long rectangular section of the bleachers in the lower left is traditionally reserved for Blue Jays' fans and seats approximately 4000 fans.



A satellite image of Homewood Field. The home team bleachers are highlighted in red. *Courtesy of: www.google.com*

Important Details to Consider

- Home bleachers are usually filled to capacity for all major Hopkins sporting events
- Because of how fans normally sit, BJU is specifically interested in maximizing cheering in the home team bleachers

Official Objectives

- Our task is to provide BJU with a simple model of fan participation in cheering at Homewood Field in the home team bleachers as well as simulation results from the model which determine if their belief about cheer starters is accurate.
- If cheer starters are found to be effective, we will attempt to provide BJU with more details about the quantity and location at which cheer starters should be placed in order to maximize cheering.

Overview of Entire Model

- Two models will be created: single fan model and multi fan model
- Single fan model will be stochastic in nature and will determine if a single fan starts to cheer
- Multi fan model will use the single fan model to simulate a large crowd of fans

A Model for a Single Fan: General Parameters

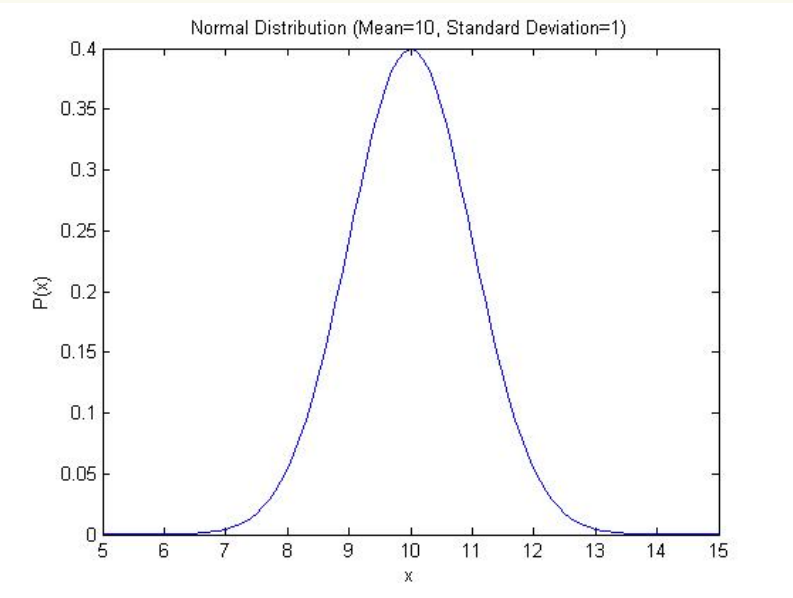
- Stochastic model will use serveral parameters/variables to calculate a *cheering metric*, C_{Total}, which determines whether a fan will participate in cheering
  - Fan's innate level of support of the team
  - Number of fans around a given fan who are cheering
  - Threshold of cheering

A Model for a Single Fan: Fan's Innate Level of Support for Team

- The greater the level of support a fan has for a team, the more likely he/she will cheer his/her team on.
- Model for single fan is stochastic in that the support level for the team will be randomized between fans
- This more accurately reflects reality where different fans can have different levels of support for the same team.

A Model for a Single Fan: Fan's Innate Level of Support for Team

- Currently thinking of using a Normal Distribution (a bell curve) to randomly assign a score to represent a fan's innate support level.
- The majority of fans who go to sporting events are average fans who go to games because they like the team. A smaller proportion of fans at sporting events are are fanatics for the team. A smaller proportion are also spectators who don't care for the team.



MATLAB plot of a normal distribution with a mean of 5 and a standard deviation of 1.

A Model for a Single Fan: Number of Fans Surrounding a Fan Who Are Cheering

- The more people surrounding a fan who are cheering, the more likely the fan is to join the cheering
- Will scale a given fan's innate support level score by the number of adjacent fans around the given fan who are cheering

A Model for a Single Fan: Cheering Metric (C_{Total}) and Cheering Threshold ($C_{Threshold}$)

- Considering to define C_{Total} as follows:

$$C_{Total} = (Innate\ Support\ Level)(Number\ of\ Adjacent\ Fans\ Who\ Are\ Cheering)$$

- The following condition must be satisfied for start cheering:

$$C_{Total} > C_{Threshold}$$

- $C_{Threshold}$ is an arbitrary pre-defined parameter

Multi Fan Model: Matrix Representation of a Crowd

- Considering the use of matrices to represent a large crowd of fans
- Each element in a matrix will represent a fan
- One matrix will store each fan's C_{Total} value, another will store each fan's innate support level score, and another will keep track of which of the fans in the crowd are cheering

Multi Fan Model: Matrix Representation of a Crowd

- Matrices will be long and rectangular to reflect the spatial arrangement of the home team bleachers at Homewood Field
- Due to computatational limits, we will downscale the home team bleachers at Homewood Field and model a home crowd of 100-1000 people

Multi Fan Model: Simulation of Time (Cycling)

To simulate the passing of time:

1. Setup matrices with appropriate initial conditions (i.e. randomly assign innate support levels to each fan and choose quantity and location of cheer starters)
2. Check to see if any new fans join cheering
3. Update matrices
4. Repeat for 10 cycles

Multi Fan Model: Simulation of Time (Cycling)

- Each cycle will represent the passing of 3-5 seconds
- We will assume that once a fan starts cheering, he/she will continue cheering until the end of the simulation

Multi Fan Model: Determining if Cheer Starters Increase Cheering

- Repeatedly run the previously described simulation (Monte Carlo methods) and get an average percentage of fan participation in cheering for a given cheer starter setup
- Compare this to simulation results with no cheer starters
- Time permitting, will try using Monte Carlo methods for various cheer starter setups and attempt to identify any patterns in setups which maximize cheering

Final Parameters

- Rows, $n = 20$
- Columns, $m = 100$
- Initial Threshold, $T_{init} = 11$
- Absolute Threshold, $T_{absolute} = 46$
- Rounds, $R = 10$
- Number of Cheer Starters, CS (Variable)

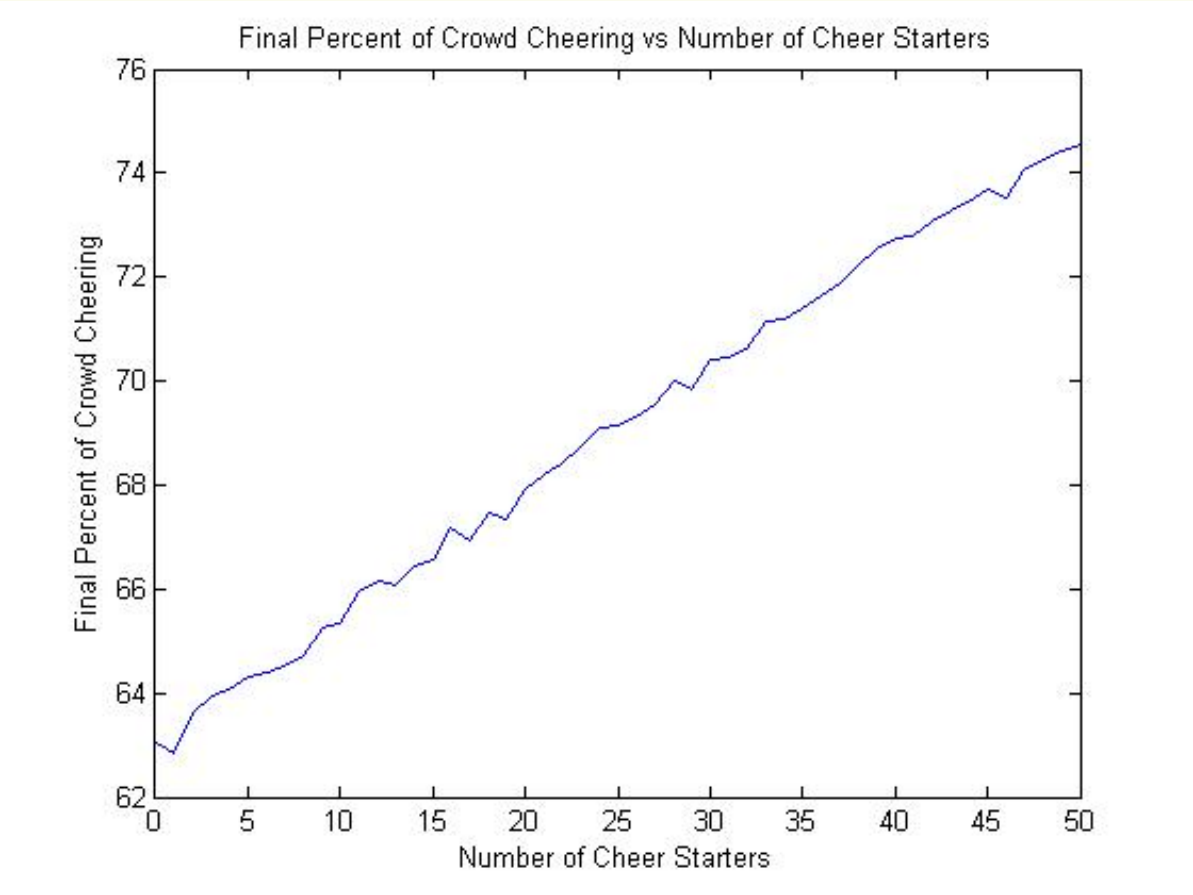
Monte Carlo Simulation

- For a given CS value, the CS cheer starters were randomly placed in the crowd. The crowd simulation was then ran and the final percentage of cheering fans after 10 rounds was computed.
- For a given CS value this was procedure was repeated for 1000 trials (Monte Carlo Simulation) and the average final percentage of cheering fans after 10 rounds over the 1000 trials was computed.
- Repeated this for $1 \leq CS \leq 50$.
- The average final percentage of cheering fans for each CS value was compared to that of when $CS = 0$ using a t-test.

$CS \geq 39$ Produces Statistically Significant Increase in Cheering

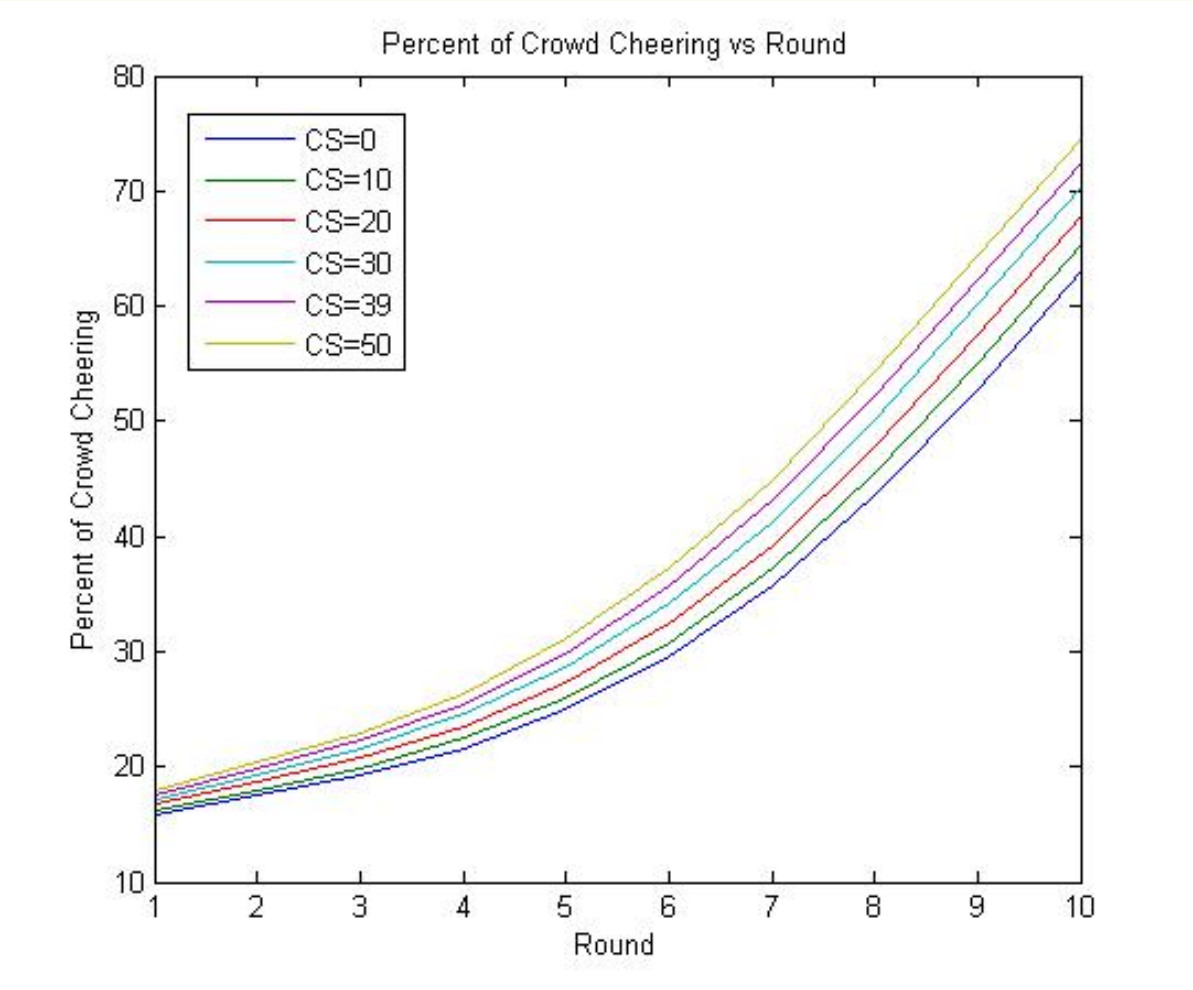
- When $CS \geq 39$, there is a statistically significant $(p < 0.05)$ increase in the average final percentage of the crowd who are cheering
- If CS is increased further, the final percentage of the crowd cheering increases, and the p-value decreases

Final Percent of Crowd Cheering vs Number of Cheer Starters



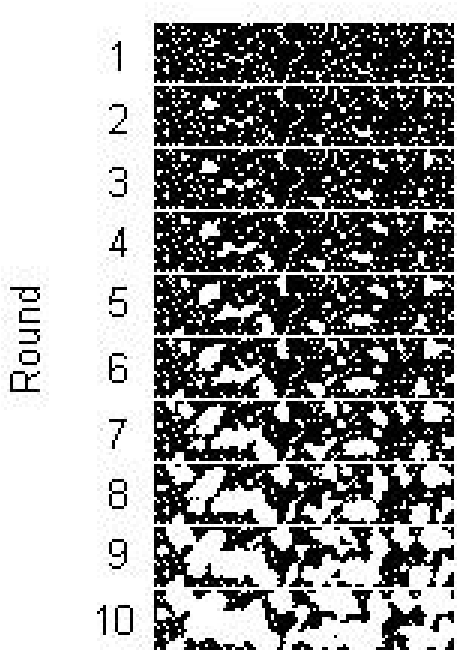
Final cheering percentage for various CS values.

Percent of Crowd Cheering Over Time For Various *CS*

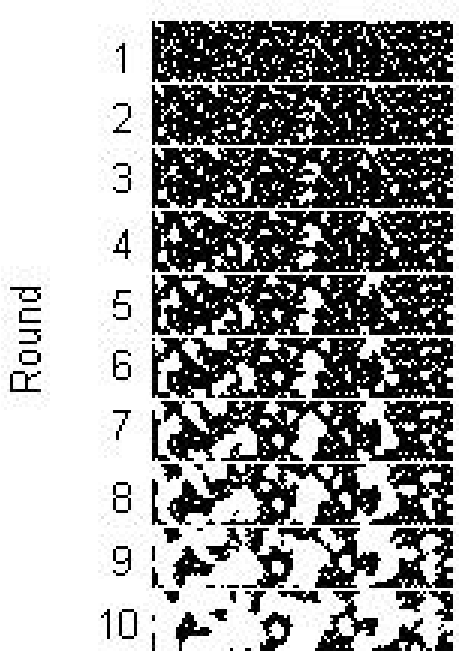


Percent of crowd cheering over time for various *CS* values.

Visualization of Cheering



Cheering over time when $CS = 0$. White indicates cheering.



Cheering over time when $CS = 39$. White indicates cheering.

Deliverables

The model will be coded on MATLAB R2009b. All computations will be performed on a Intel Core i7 Desktop PC.

Deliverables

From Team to Sponsor:

- MATLAB R2009b and R combination package. The model will be coded in MATLAB but a complete set of documentation will be provided in R. We will also generate some test scripts that can be used to reproduce our numerical and simulation test results
- If time permits, a list of patterns of cheer starter setups (i.e. the number of cheer starters and location of them) that maximize fan cheering
- Technical report and presentations summarizing the work

Deliverables

From Sponsor to Team:

- Timely responses to inquiries

Timeline of Milestones

- Work Statement due date, Sep 28, 2012.
- Midterm Presentation due date, Oct 17, 2012.
- Progress Report due date, Oct 26, 2012.
- Final Presentation due date, Nov 16, 2012.
- Final Report due date, Nov 30, 2012.

Remaining Work

- Begin coding the model in MATLAB.
- Run simulations using the model.
- Time permitting, try to find patterns in cheer starter setups which maximize cheering.

Recommendations for Future Research

- It would be interesting to see if this model could be applied to other social events (concerts, college lectures, theaters, etc.) where there are large crowds and applause is relevant.

References

[1] Blue Jays Unlimited - Johns Hopkins Official Athletics Site.
http://www.hopkinssports.com/bluejays-unlimited/.
Accessed: 10/12/2012.

[2] Homewood Field.
http://en.wikipedia.org/wiki/Homewood_Field.
Accessed: 10/12/2012.

Questions?

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