



Team McQuarantine Milton
IDS 6916 — Final PPT



Introduction

- COVID is reshaping our lives from daily human interaction to the economy
- COVID transmission mitigation strategies vary by
 - Government
 - Location
 - Profession
 - Organization
 - Individual risk tolerance
- Who makes the mitigation decision?
- Is it based on data?
- Are decisions balancing risk vs reward?



Purpose

The purpose of the research is to determine if UCF football game attendance COVID countermeasures are appropriate in minimizing virus spread potential while maximizing attendance revenue.

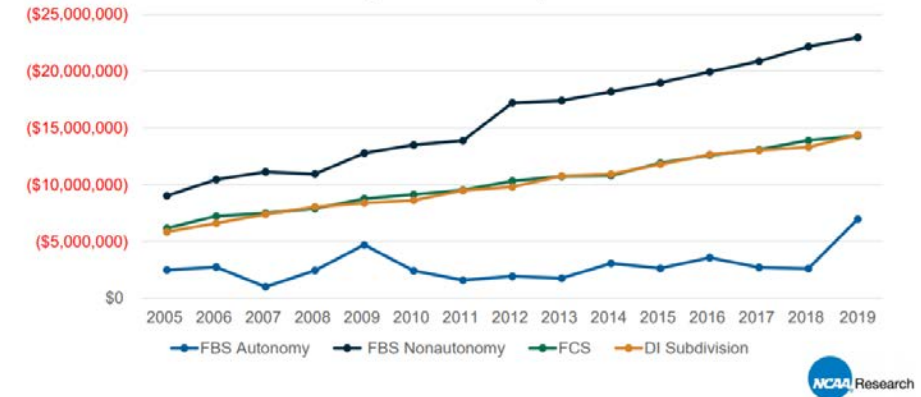
Using an agent-based model, the study will determine predicted COVID transmission under current UCF football countermeasures and investigate higher attendance numbers under current mitigation strategies to determine if higher revenue is possible with nominal risk.



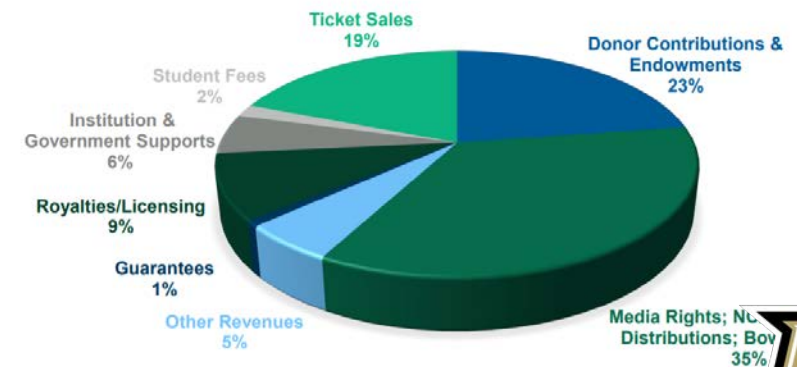
Context

- At 25% capacity, reduced ticket sales will equate to a \$3,719,552 loss in revenue for UCF (out of a 70m budget).
- Our research suggests the 25% capacity limitation is not driven by data or science.

**Division I Net Operating Results
Excluding Allocated Support
(2005-2019)**

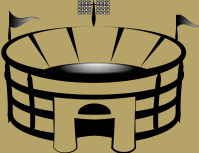




**FBS Autonomy Schools:
Where the Money Comes From**



Research Question ??

Are current COVID football attendance limitation and social distancing strategies appropriate for maximizing attendance and minimizing transmission risk, while controlling for the masked COVID transmission rate?

VARIABLES		
Independent	Dependent	Control
Stadium capacity and social distancing (group size), group strategy 	transmission rate, number of contacts 	Masked interpersonal transmission rate 





Hypothesis

The number of expected infections proportional to the squared value of the attendance.

The group size does affect the number of infections (or number of contacts).

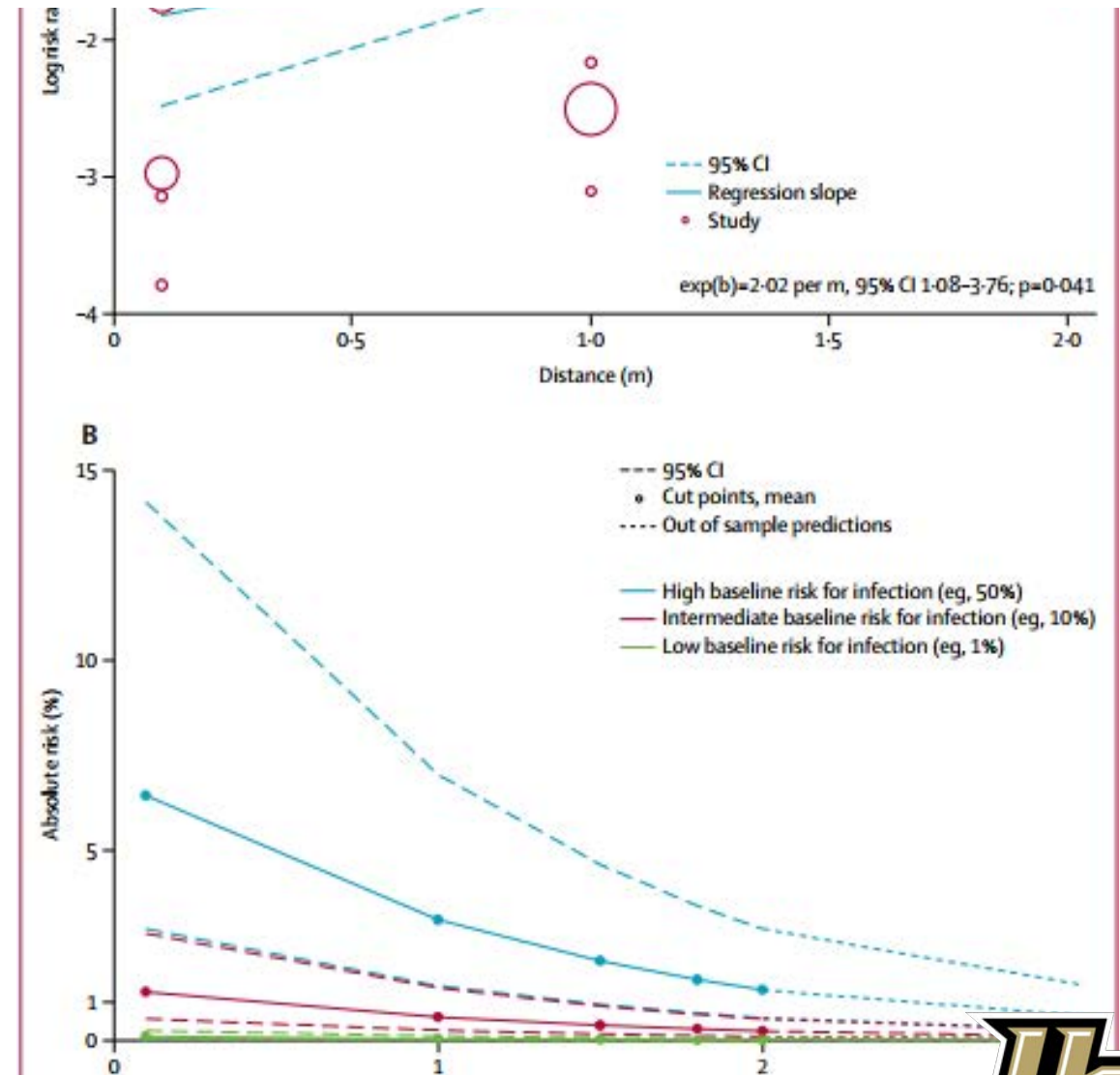
The number of expected infections is proportional to the group size.

The number of infections is not proportional to attendance capacity



Lit Highlights

- Chu et al. (2020) - large meta-analysis paper identifying 172 observational studies across 16 countries, six continents, with no randomized controlled trials and 44 relevant comparative studies in health-care and non-healthcare settings.
 - 25,697 patients
 - Transmission of viruses was lower with physical distancing of 1 m or more, compared with less than 1 m
 - In the figure – across 29 unadjusted and nine adjusted studies : shows strong association was found between proximity of exposed individual with risk of infection



- Estimation of R_0 (Jarvis, et al.) in the United Kingdom (UK)
- R_0 is the potential of transmission of a disease
 - $R_0 < 1$ – each existing infection causes less than one new infection
 - $R_0 = 1$ – each existing infection causes one new infection
 - $R_0 > 1$ – each existing infection causes more than one new infection. May cause an outbreak or epidemic.
- Participation data: survey data
 - 1356 UK participants
 - Recorded 3849 contacts
- R_0 prior to lockdown = 2.6
- Current R_0 estimation (under current social distancing measures) – 0.62
 - 95% Confidence Interval [CI] 0.37 – 0.89)
 - Based on all types of contact

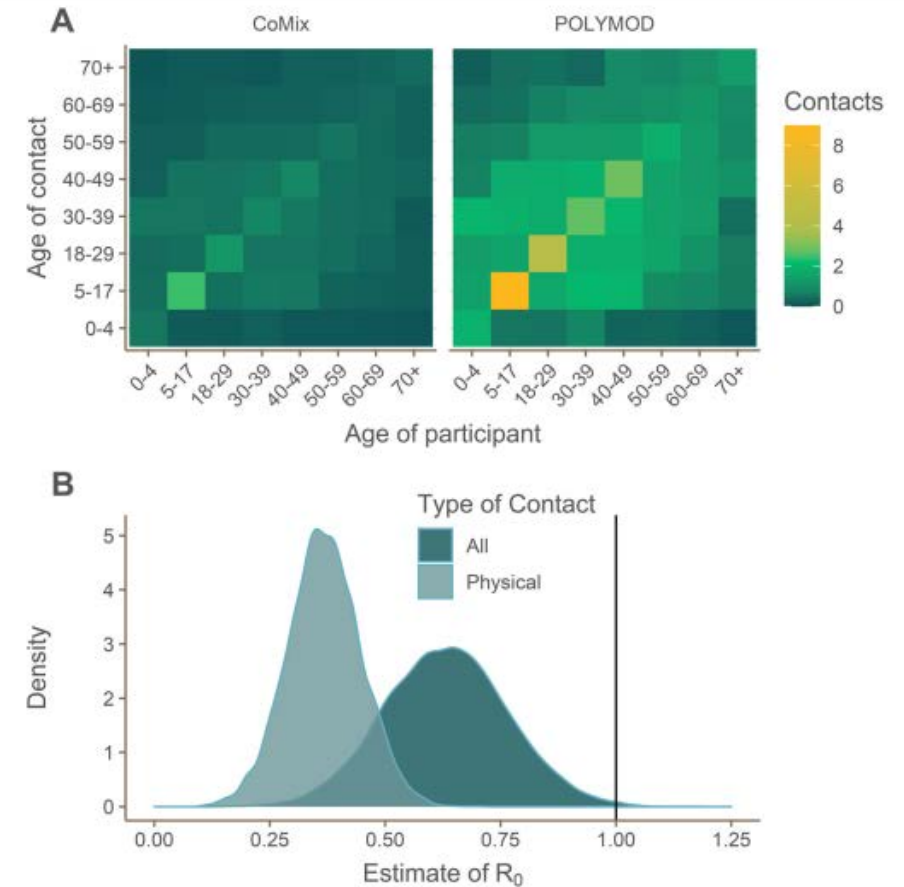
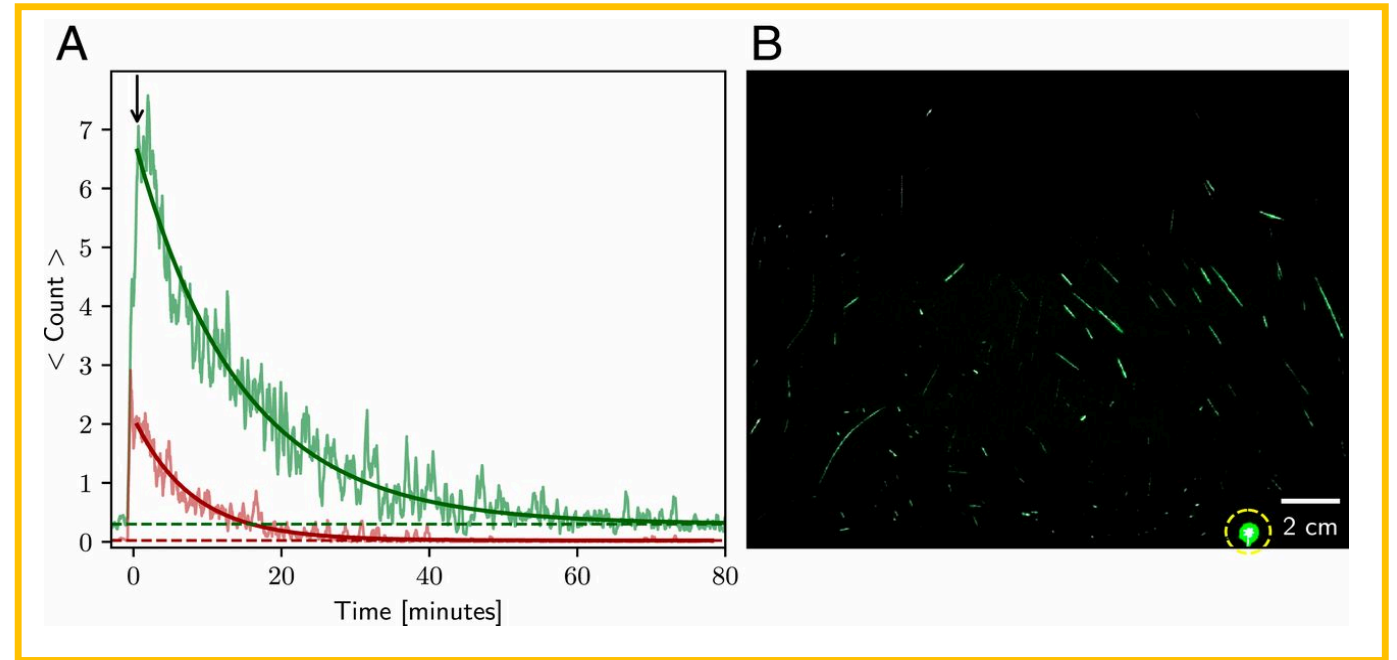


Fig. 1 Comparison of CoMix and POLYMOD contact matrices and estimated reduction in reproduction number due to physical distancing for all and physical (skin to skin) contacts separately. **a** Social contact matrices showing the average total number of daily reported contacts made by participants in different age groups with individuals in other age groups, with results shown for all contacts reported in the CoMix and POLYMOD data. Participants' contacts in CoMix for age groups 0–4 and 5–17 are imputed using the POLYMOD data. **b** The estimated value of R_0 at the time of the survey, assuming values of $R_0 \sim \text{Norm}(2.6, \text{SD} = 0.54)$ prior to physical distancing reducing all contacts for all and physical (skin to skin) contacts

Persistence of SARS-CoV-2 genetic material in air (Stadnytskyi, Bax. C., Bax. A., and Anfinrud, 2020)

- Infections with higher viral load in upper respiratory tract (throat, mouth, nose) more likely to come out as droplet spread.
- Normal breathing: 80-90% of droplet sizes are less than 1 micrometer and subject to aerosol transport.
- The average viral load in oral fluid = 7×10^6 copies per milliliter
 - At this average, 1 minute of loud speaking can produce thousands of oral droplets per second.
 - Of these droplets, at least 1000 virus-containing droplets can remain airborne for more than 8 minutes.



Methodology

Participants

- 1,342 agents (full Capacity of student section)
- 6' contact zone
- Grouping behaviors
- 1st Quarter behaviors (enter, sit)



Materials / Apparatus

- Anylogic agent model
- R
- Real World Observation



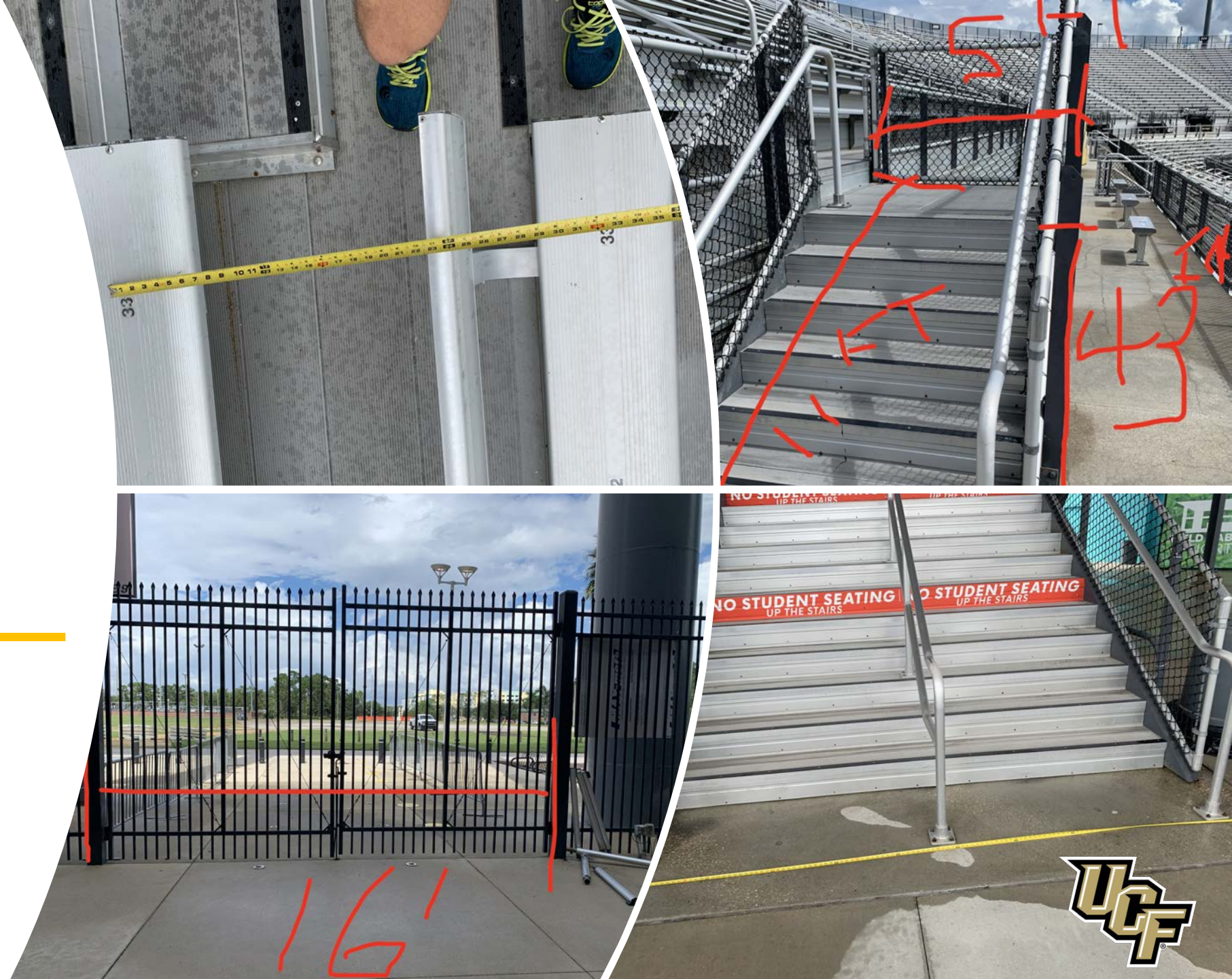
Design

- Independent Variables
 - Seat gap (social distancing)
 - Ro
 - Group Size (Max/Min)
 - Infected Initial Value
 - Contact Distance
 - Attendance Capacity
- Dependent Variables
 - Inter-Group Exposed (walking/sitting)
 - Extra-Group Exposed (walking/sitting)
 - Inter-Group Contacts (walking/sitting)
 - Extra-Group Contacts (walking/sitting)
 - Exposure Time (walking/sitting)



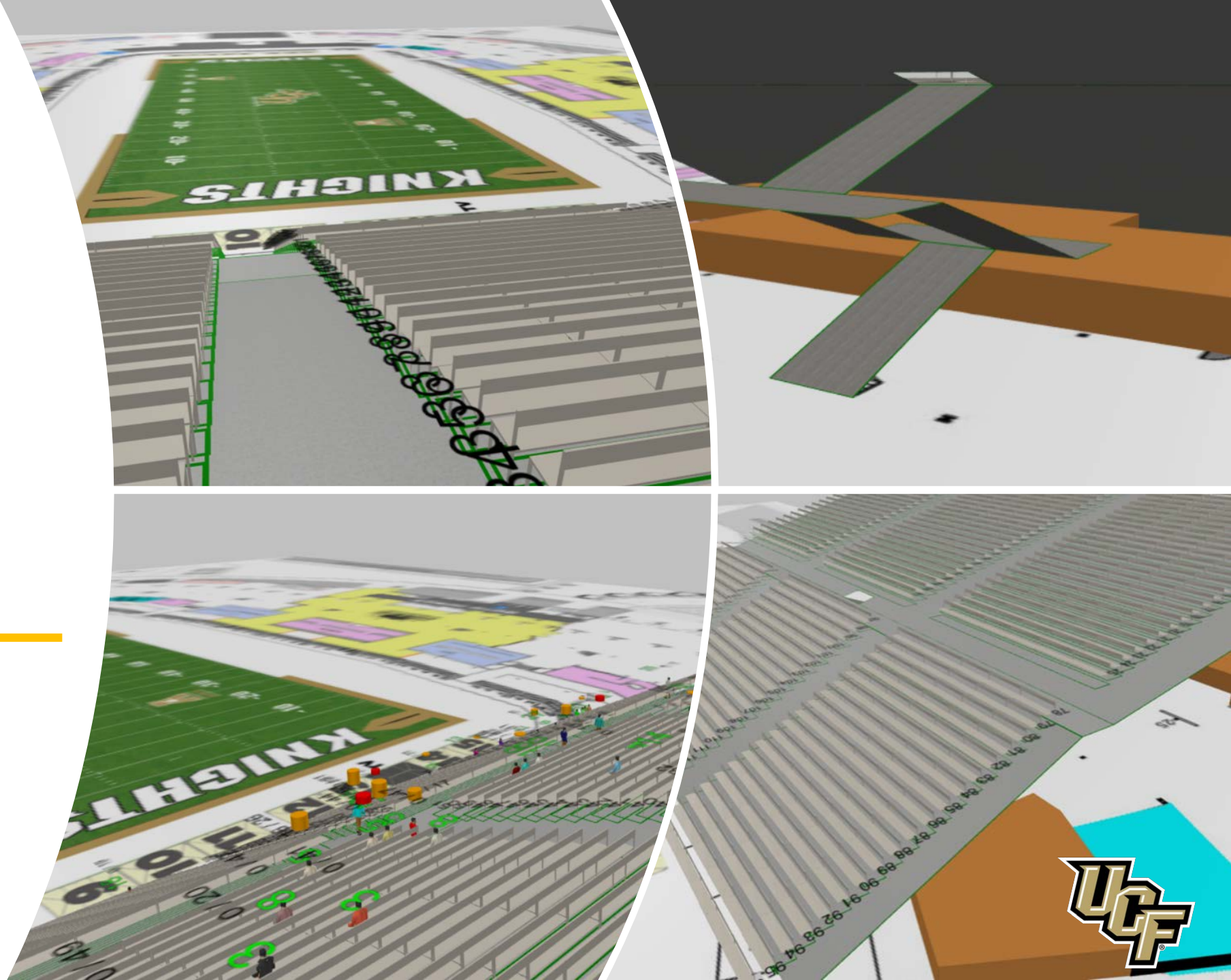
Building the Model

Goal: Spatial
Accuracy



Building the Model

Goal: Spatial
Accuracy



Stadium Simulation

Demo



Experiment: 60 Simulations

Constants

- Initial infected (10)
- Contact distance (1m)
- Simulation run time (1h)

• Parameters

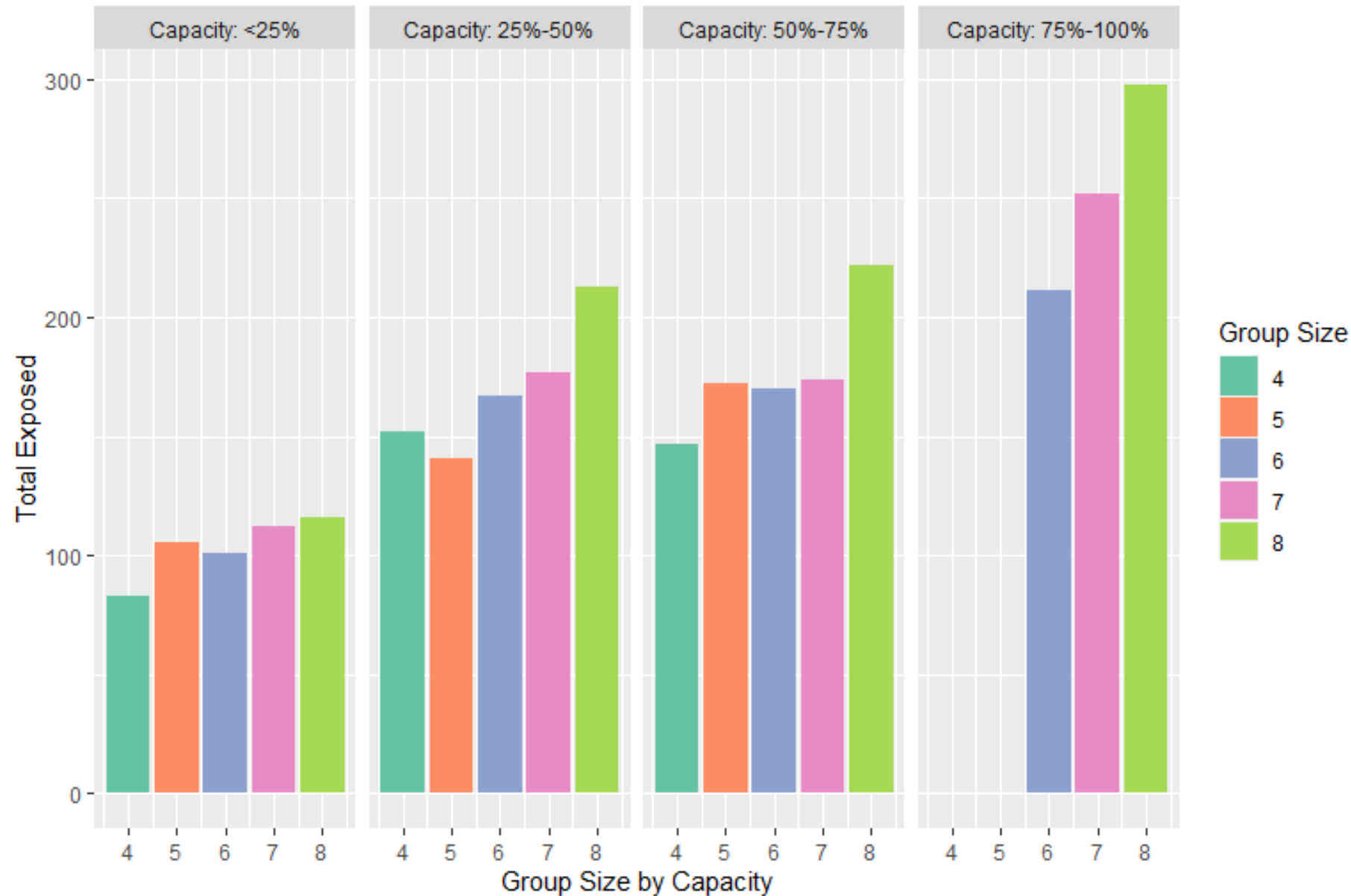
- Attendance (cont.)
- Max Group size (4 – 8)
- Number of groups (50 – 300)
- Seat spaces (0, 4)

* Step size for Number of groups was 50

* Attendance dependent on randomly generated *Sizes of Groups* and Number of Groups :
$$\text{Attendance} \approx \text{NumberOfGroups} \times (1 + \text{MaxGroupSize}) / 2$$



Total Exposures by Capacity and Group Size

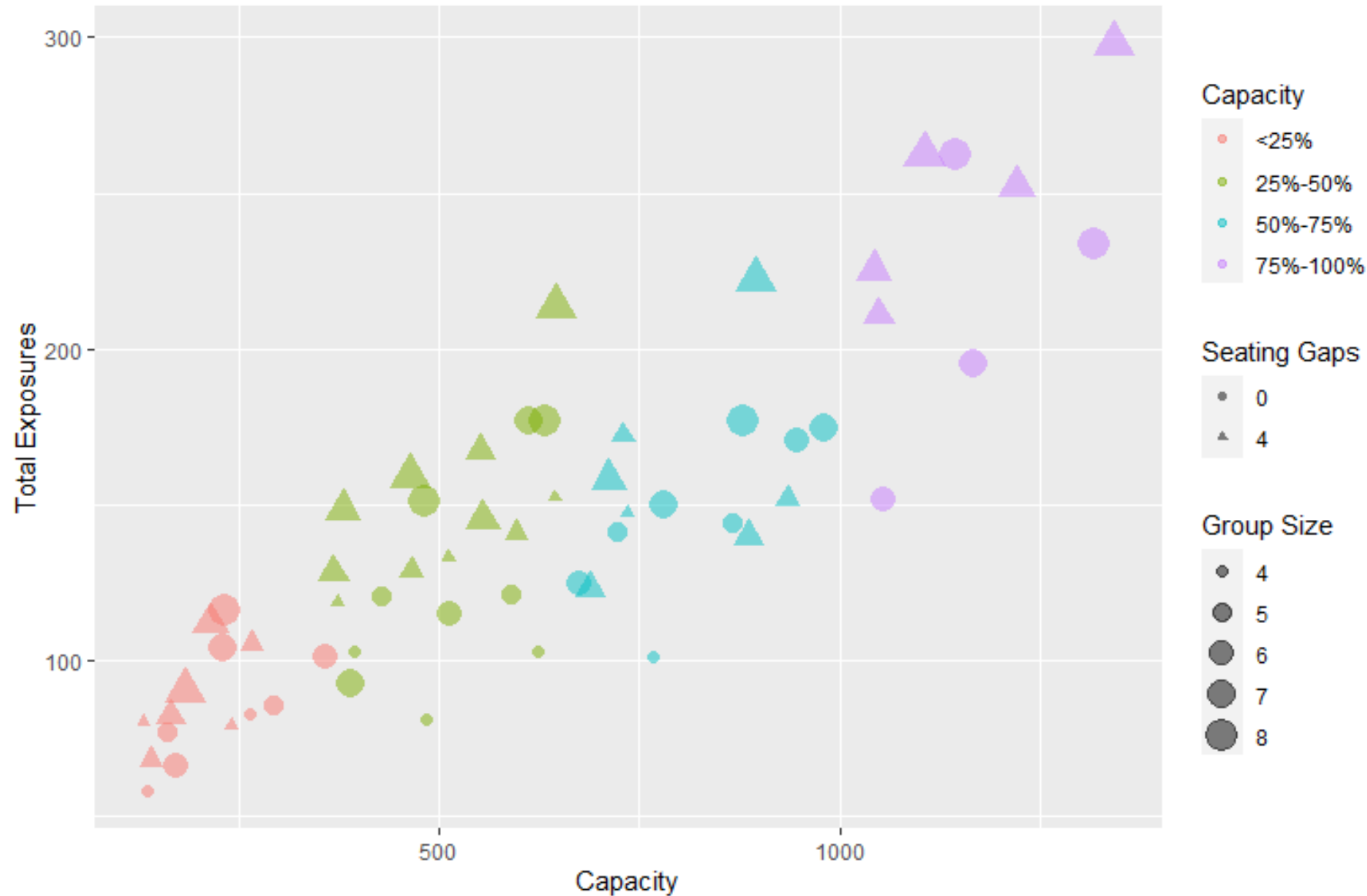


Findings

- Higher attendance capacity and group size resulted in more infected exposures



Total Exposures by Seating Gaps (Social Distanced Seating)

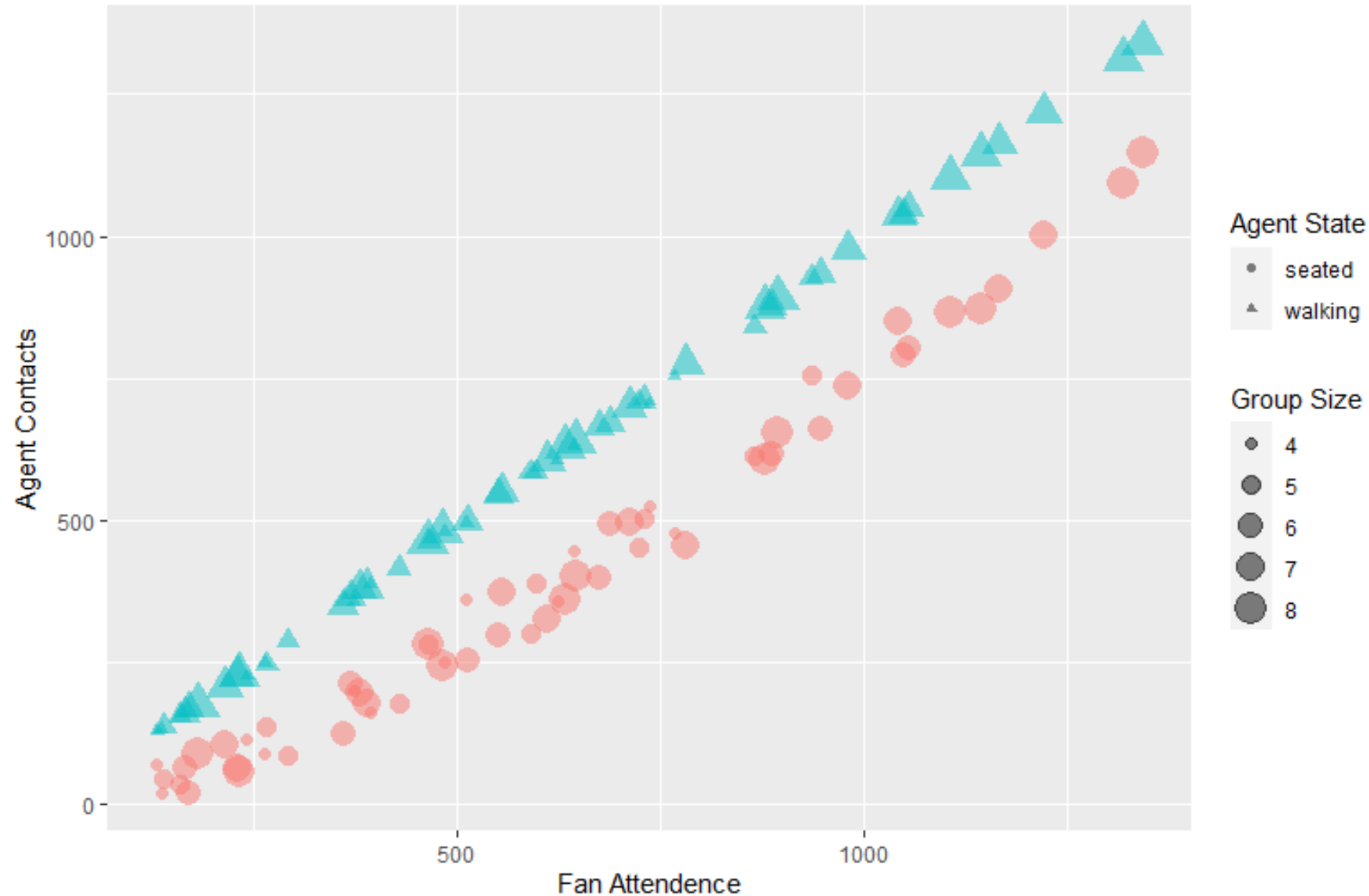


Findings

- Higher attendance capacity and group size resulted in more infected exposures
- Mandatory seat gaps led to highest exposures in each attendance category



Agent State Contact Risk

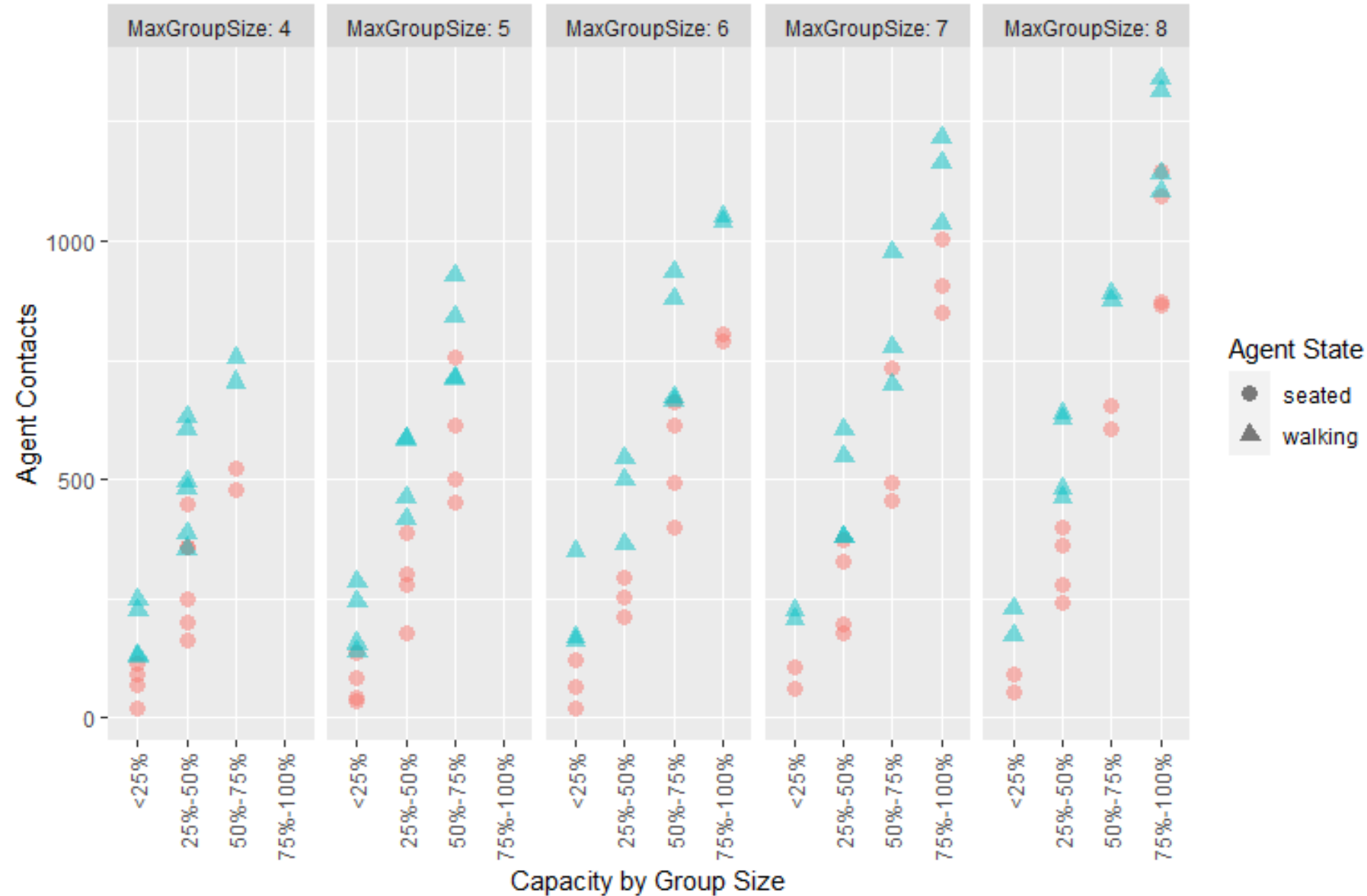


Findings

- Walking resulted in a higher number of agent contacts when compared to sitting at all attendance levels and group sizes.



Agent State Contact Risk by Group Size & Capacity

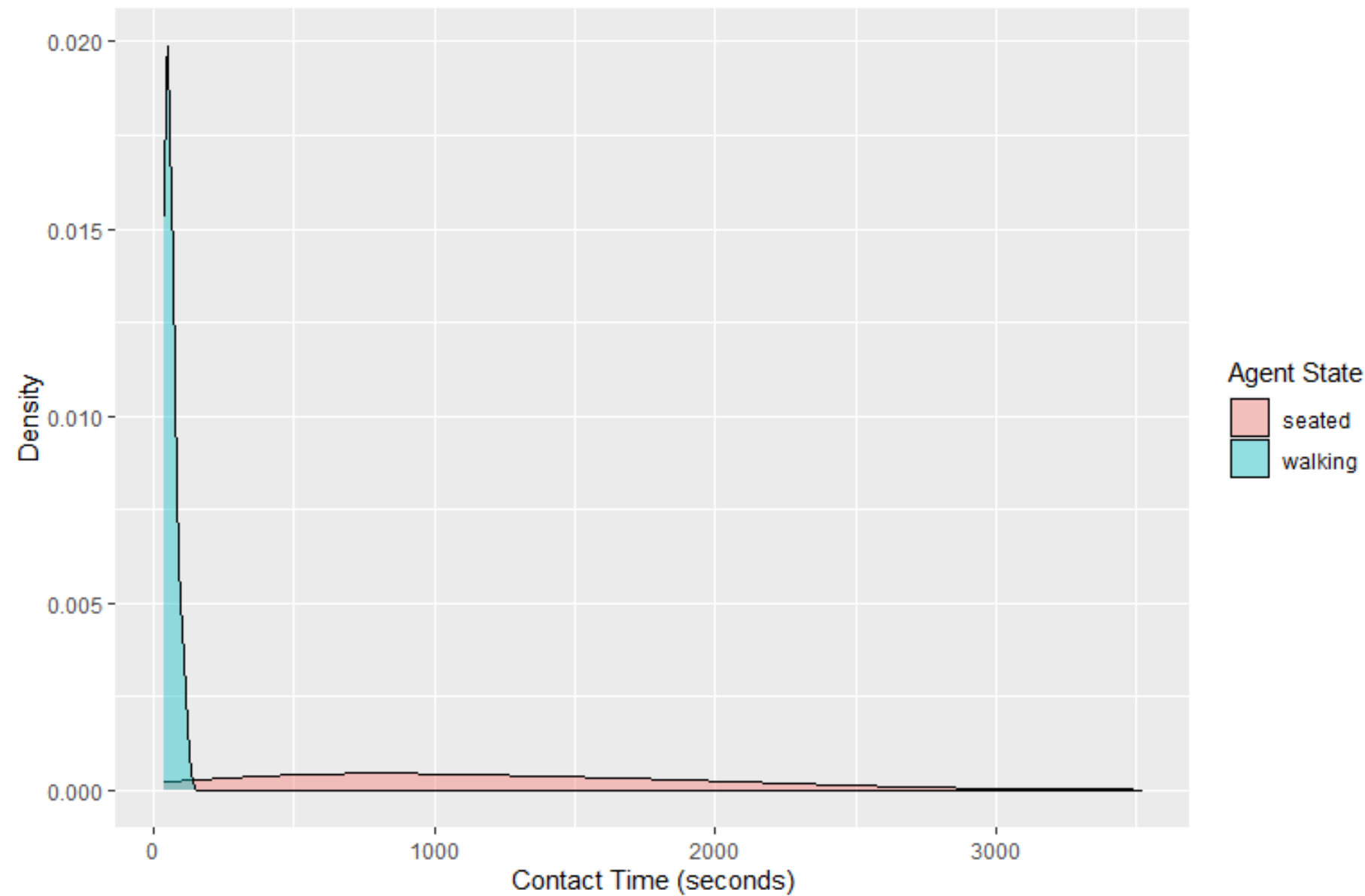


Findings

- Contact risk is positively correlated with group size and attendance capacity.



Agent Contact Time by State

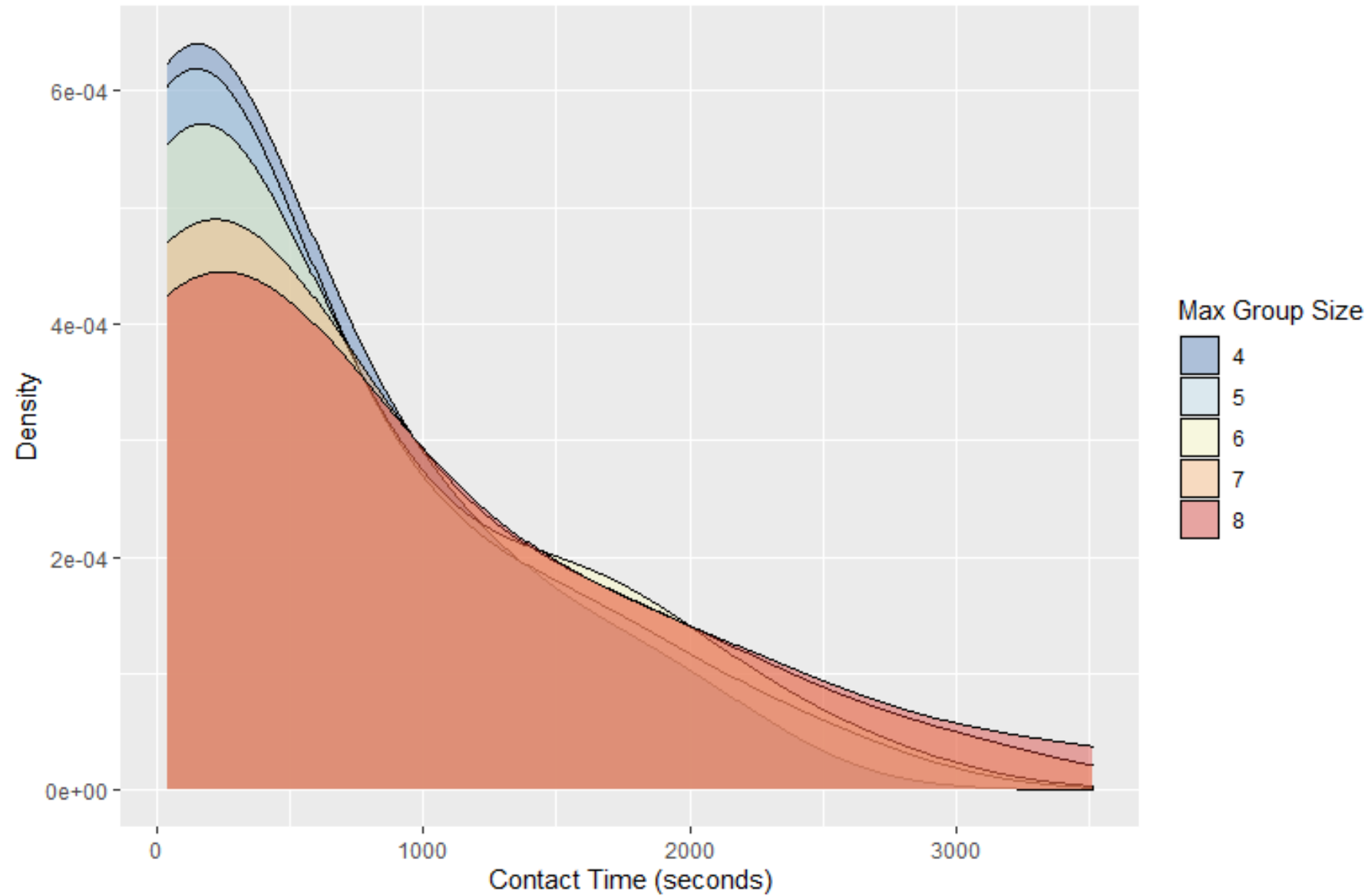


Findings

- Agents spend significantly more time in contact while seated.



Agent Contact Time by Group Size

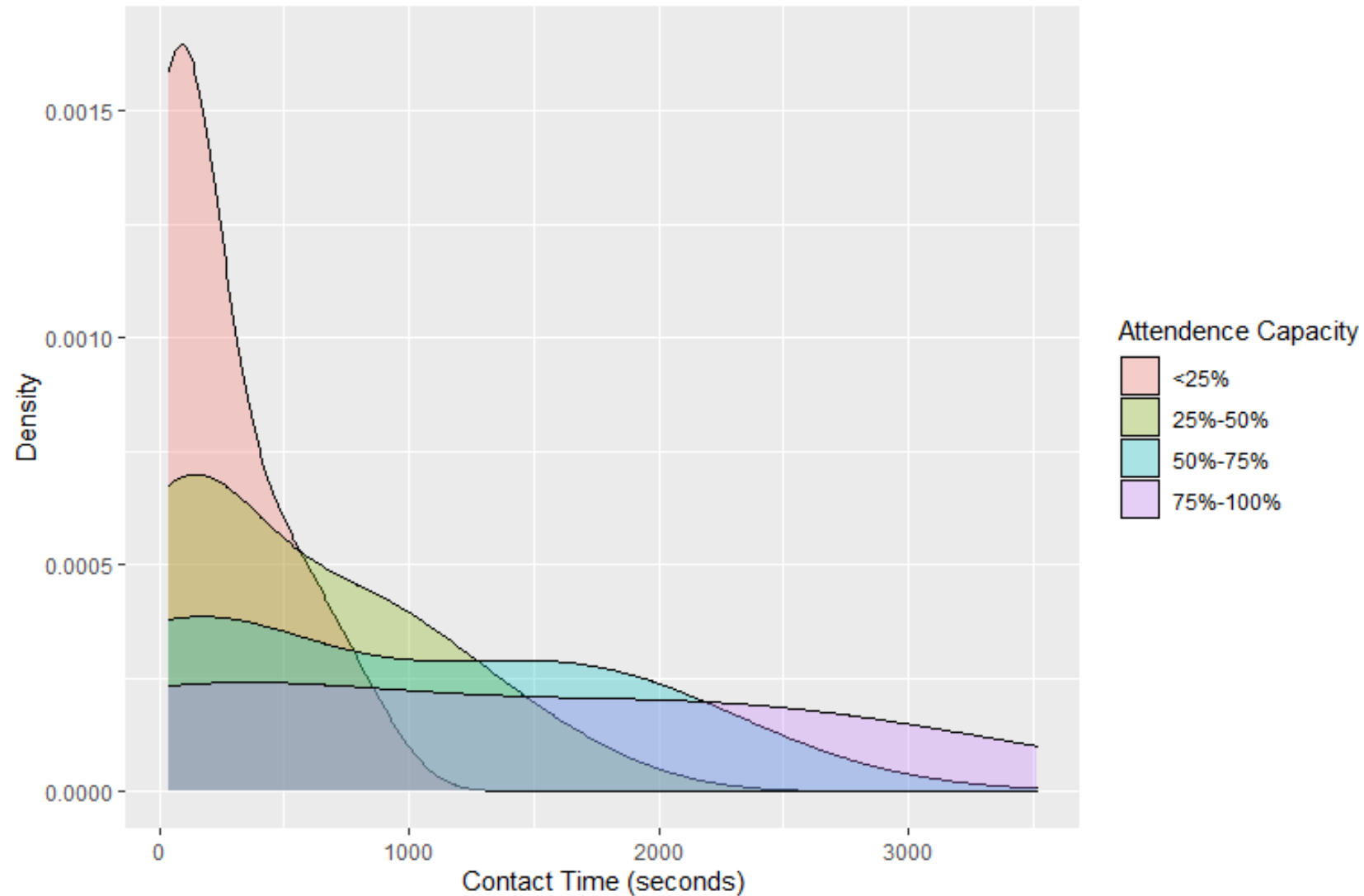


Findings

- Agent contact time is higher in larger groups



Agent Contact Time by Capacity



Findings

- Agent contact time positively correlates with attendance capacity



Recommendations

- Limit diversity of contacts (walking)
 - Stadium Entrance "Boarding Groups"
 - Uni-directional movement
- Limit spectating contact time (sitting)
 - Group size 6 or below
 - Spaced seats staggered by row
- Limit Io and Ro
 - Temperature checks
 - Masks mandatory
- If Enforced:
 - Increase capacity to 25% - 50% range
 - **Possible increase in \$1,239,000 ticket revenue**

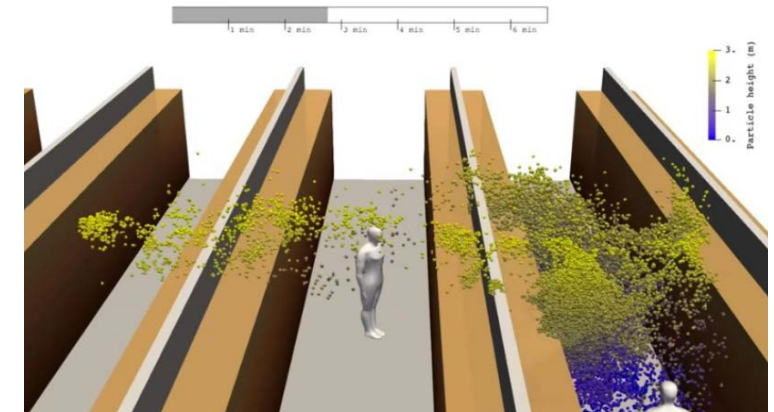
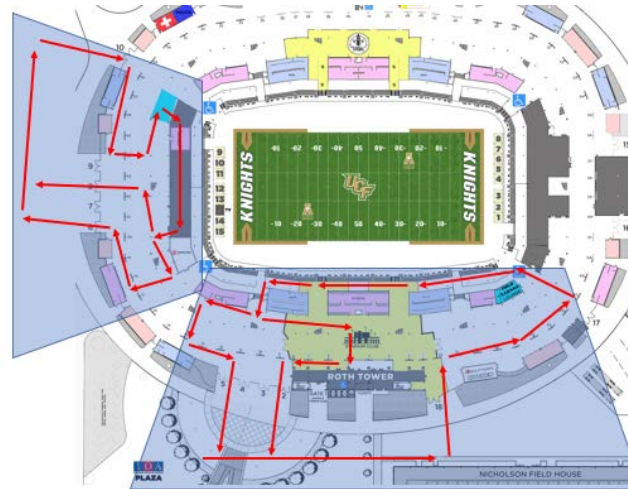
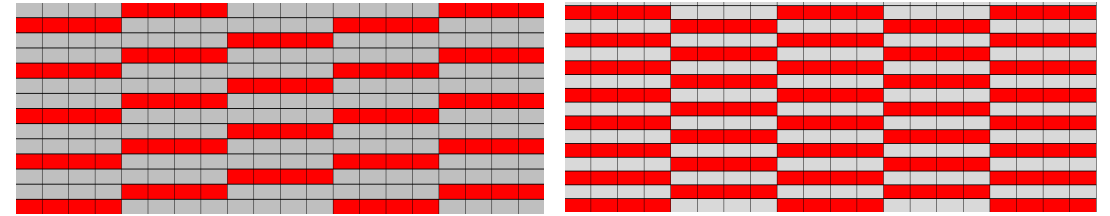


Image Credit: UCF Today (<https://www.ucf.edu/news/no-3-ucf-story-of-the-decade-is/>)



Future Research

- COVID Aerosol modeling
- Seat spacing optimization
- Unidirectional traffic pattern efficacy
- Bigger scale (whole stadium, add more behaviors)
- Implement weather conditions (rain vs sunny day)



Thank You!

QUESTIONS?
