Author Contributions Checklist Form

This form documents the artifacts associated with the article (i.e., the data and code supporting the computational findings) and describes how to reproduce the findings.

Part 1: Data

☐ This paper does not involve analysis of external data (i.e., no data are used or the only data are generated by the authors via simulation in their code).

☒ I certify that the author(s) of the manuscript have legitimate access to and permission to use the data used in this manuscript.

Abstract

The dataset comprises game and shot attempt data for three representative NBA players: Michael Jordan during the 2001-2002 NBA season, and Stephen Curry and LeBron James during the 2014-2015 NBA season. For each player, we have collected one file containing game contexts and another file detailing shot attempts for each game.

Availability

☒ Data **are** publicly available.
☐ Data **cannot be made** publicly available.

If the data are publicly available, see the *Publicly available data* section. Otherwise, see the *Non-publicly available data* section, below.

Publicly available data

☐ Data are available online at:

☒ Data are available as part of the paper's supplementary material.

☐ Data are publicly available by request, following the process described here:

☐ Data are or will be made available through some other mechanism, described here:

Description

File format(s)

☒ CSV or other plain text.
☐ Software-specific binary format (.Rda, Python pickle, etc.): pkcle
☐ Standardized binary format (e.g., netCDF, HDF5, etc.):
☐ Other (please specify):

Data dictionary

☒ Provided by authors in the following file(s): `RealDataAnalysis/Data/README_DATA.txt`.
☐ Data file(s) is(are) self-describing (e.g., netCDF files)
☐ Available at the following URL:

Part 2: Code

Abstract

We provide R files that generate the simulation results found in Section 4, located in the `Simulation` folder, as well as the R files for the Shot Charts data analysis in Section 5, located in the `RealData` folder.

Description

Code format(s)

☒ Script files

- ☒ R
- ☐ Python
- ☐ Matlab
- ☐ Other:

☒ Package

- ☒ R
- ☐ Python
- ☐ MATLAB toolbox
- ☐ Other:

☒ Reproducible report

- ☐ R Markdown
- ☒ Jupyter notebook
- ☐ Other:

☐ Shell script
☐ Other (please specify):

Supporting software requirements

Version of primary software used R version 4.3.3

Libraries and dependencies used by the code

Package	Version	Citation
RandomFields	3.3.14	(Schlather et al. 2022)
orthopolynom	1.0.6.1	(Novomestky 2022)
mvtnorm	1.3.2	(Genz et al. 2024)
combinat	0.0.8	(Chasalow 2012)
lattice	0.22.6	(Sarkar 2024)

Package	Version	Citation
Matrix	1.6.5	(Bates, Maechler, and Jagan 2024)
limSolve	1.5.7.1	(Soetaert, Van den Meersche, and van Oevelen 2024)
MCMCpack	1.7.1	(Martin, Quinn, and Park 2024)
truncnorm	1.0.9	(Mersmann et al. 2023)
spatstat	3.3.0	(Baddeley, Turner, and Rubak 2024)
splines	4.3.3	
inlabru	2.12.0	(Lindgren and Bachl 2024)
sf	1.0.18	(Pebesma 2024)
sp	2.1.1	(Pebesma and Bivand 2023)
INLA	24.6.27	(Rue, Lindgren, and Teixeira Krainski 2024)
fields	16.3	(Nychka et al. 2024)
BART	2.9.9	(McCulloch and Sparapani 2024)
ggplot2	3.5.1	(Wickham et al. 2024)
tidyverse	2.0.0	(Wickham 2023)
doParallel	1.0.17	(Corporation and Weston 2022)
foreach	1.5.2	(Revolution Analytics and Weston, n.d.)
readxl	1.4.3	(Wickham and Bryan 2023)
devtools	2.4.5	(Wickham et al. 2022)
dplyr	1.1.4	(Wickham et al. 2023)
ggbasketball	0.1.0	(Xue 2025)
gridExtra	2.3	(Auguie 2017)
grid	4.3.3	
patchwork	1.3.0	(Pedersen 2024)

Parallelization used

- ☐ No parallel code used
- ☒ Multi-core parallelization on a single machine/node
  - Number of cores used: 15
- ☐ Multi-machine/multi-node parallelization
  - Number of nodes and cores used:

License

- ☒ MIT License (default)
- ☐ BSD
- ☐ GPL v3.0
- ☐ Creative Commons
- ☐ Other: (please specify)

Part 3: Reproducibility workflow

Scope

The provided workflow reproduces:

- ☒ Any numbers provided in text in the paper

☐ The computational method(s) presented in the paper (i.e., code is provided that implements the method(s))
☒ All tables and figures in the paper
☐ Selected tables and figures in the paper, as explained and justified below:

Workflow

Location

The workflow is available:

☒ As part of the paper's supplementary material.
☒ In this Git repository: https://github.com/caojiahao13/ShotMapEstimation_2025_ACS
☐ Other (please specify):

Format(s)

☐ Single master code file
☐ Wrapper (shell) script(s)
☒ Self-contained R Markdown file, Jupyter notebook, or other literate programming approach
☐ Text file (e.g., a readme-style file) that documents workflow
☐ Makefile
☐ Other (more detail in *Instructions* below)

Instructions

We provide three Jupyter notebooks with R code and instructions to reproduce all the reported results in the manuscript:

- `Simulation/simulation.ipynb`: Conducts the simulation study in Section 4 and generates the corresponding figures.
- `RealDataAnalysis/GenerateFigures.ipynb`: Generates the main figures for the real dataset and the resulting fitting results. The R code for fitting the model to the dataset (three players) is located in `RealDataAnalysis/ModelFitting`.
- `RealDataAnalysis/ModelComparison.ipynb`: Conducts a model comparison on the real dataset between the proposed method and several competitive models.

Expected run-time

Approximate time needed to reproduce the analyses on a standard desktop machine:

☐ $<$ 1 minute
☐ 1-10 minutes
☐ 10-60 minutes
☒ 1-8 hours
☐ $>$ 8 hours
☐ Not feasible to run on a desktop machine, as described here:

References

Auguie, Baptiste. 2017. *gridExtra: Miscellaneous Functions for "Grid" Graphics*. https://CRAN.R-project.org/package=gridExtra.

Baddeley, Adrian, Rolf Turner, and Ege Rubak. 2024. *Spatstat: Spatial Point Pattern Analysis, Model-Fitting, Simulation, Tests*. http://spatstat.org/.

Bates, Douglas, Martin Maechler, and Mikael Jagan. 2024. *Matrix: Sparse and Dense Matrix Classes and Methods*. https://Matrix.R-forge.R-project.org.

Chasalow, Scott. 2012. *Combinat: Combinatorics Utilities*. https://CRAN.R-project.org/package=combinat.

Corporation, Microsoft, and Steve Weston. 2022. *doParallel: Foreach Parallel Adaptor for the Parallel Package*. https://github.com/RevolutionAnalytics/doparallel.

Genz, Alan, Frank Bretz, Tetsuhisa Miwa, Xuefei Mi, and Torsten Hothorn. 2024. *Mvtnorm: Multivariate Normal and t Distributions*. http://mvtnorm.R-forge.R-project.org.

Lindgren, Finn, and Fabian E. Bachl. 2024. *Inlabru: Bayesian Latent Gaussian Modelling Using INLA and Extensions*. http://www.inlabru.org.

Martin, Andrew D., Kevin M. Quinn, and Jong Hee Park. 2024. *MCMCpack: Markov Chain Monte Carlo (MCMC) Package*. https://CRAN.R-project.org/package=MCMCpack.

McCulloch, Robert, and Rodney Sparapani. 2024. *BART: Bayesian Additive Regression Trees*. https://CRAN.R-project.org/package=BART.

Mersmann, Olaf, Heike Trautmann, Detlef Steuer, and Björn Bornkamp. 2023. *Truncnorm: Truncated Normal Distribution*. https://github.com/olafmersmann/truncnorm.

Novomestky, Frederick. 2022. *Orthopolynom: Collection of Functions for Orthogonal and Orthonormal Polynomials*. https://CRAN.R-project.org/package=orthopolynom.

Nychka, Douglas, Reinhard Furrer, John Paige, Stephan Sain, Florian Gerber, Matthew Iverson, and Rider Johnson. 2024. *Fields: Tools for Spatial Data*. https://github.com/dnychka/fieldsRPackage.

Pebesma, Edzer. 2024. *Sf: Simple Features for r*. https://r-spatial.github.io/sf/.

Pebesma, Edzer, and Roger Bivand. 2023. *Sp: Classes and Methods for Spatial Data*. https://github.com/edzer/sp/.

Pedersen, Thomas Lin. 2024. *Patchwork: The Composer of Plots*. https://patchwork.data-imaginist.com.

Revolution Analytics, and Steve Weston. n.d. *Foreach: Provides Foreach Looping Construct*.

Rue, Havard, Finn Lindgren, and Elias Teixeira Krainski. 2024. *INLA: Full Bayesian Analysis of Latent Gaussian Models Using Integrated Nested Laplace Approximations*.

Sarkar, Deepayan. 2024. *Lattice: Trellis Graphics for r*. https://lattice.r-forge.r-project.org/.

Schlather, Martin, Alexander Malinowski, Marco Oesting, Daphne Boecker, Kirstin Strokorb, Sebastian Engelke, Johannes Martini, et al. 2022. *RandomFields: Simulation and Analysis of Random Fields*. https://www.wim.uni-mannheim.de/schlather/publications/software.

Soetaert, Karline, Karel Van den Meersche, and Dick van Oevelen. 2024. *limSolve: Solving Linear Inverse Models*. https://CRAN.R-project.org/package=limSolve.

Wickham, Hadley. 2023. *Tidyverse: Easily Install and Load the Tidyverse*. https://tidyverse.tidyverse.org.

Wickham, Hadley, and Jennifer Bryan. 2023. *Readxl: Read Excel Files*. https://readxl.tidyverse.org.

Wickham, Hadley, Winston Chang, Lionel Henry, Thomas Lin Pedersen, Kohske Takahashi, Claus Wilke, Kara Woo, Hiroaki Yutani, Dewey Dunnington, and Teun van den Brand. 2024. *Ggplot2: Create Elegant Data Visualisations Using the Grammar of Graphics*. https://ggplot2.tidyverse.org.

Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. https://dplyr.tidyverse.org.

Wickham, Hadley, Jim Hester, Winston Chang, and Jennifer Bryan. 2022. *Devtools: Tools to Make Developing r Packages Easier*. https://devtools.r-lib.org/.

Xue, Yishu. 2025. *Ggbasketball: 'Ggplot2' Based Visualization of Basketball Data*.