Is Float Queen?

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1. Project Purpose

This thesis will attempt to determine what factors go into performing the most effective women's collegiate volleyball serve. Factors of interest include float, speed, and end location. Coaches generally have the belief that getting the ball to float, i.e. hitting the ball in such a way that spin is minimized causing unpredictability in the ball's movement in the air, is the aspect that makes the ball most difficult to pass. In other words, "float is queen." I will attempt to determine if this is a correct assumption and if there are other factors that contribute to an optimal serve in women's collegiate volleyball.

2. Project Importance

A serve is what begins each rally in the sport of volleyball. It is the first offensive opportunity for the serving team and does not involve the influence of an opponent. It is a self-controlled skill that can lead to immediate points (service ace) gained for the serving team. Alternatively, service errors lead to an immediate loss of points for the serving team. Additionally, the quality of the serve plays a crucial role in the success of subsequent rallies as it determines how well the opponent can put the ball in play. Further, the focus on scoring points through a player's serve is increasing across the sport of volleyball.[1,2] MacKenzie et al. and Huang et al. have shown that a jump float serve combines two characteristics, height of initial contact and float, that distinguish the jump float from a standing float serve and a jump spin serve.[3,4] Altavilla and Denny have analyzed optimum training techniques within professional men's volleyball to improve

[1] Yiannis, L.; Panagiotis, K. Evolution in men's volleyball skills and tactics as evidenced in the Athens 2004 Olympic Games. *Int. J. Perform. Anal. Sport* 2005, *5*, 1–8.

[2] Hawkins, N. , G. W. Fellingham, G.L.. Page, "Point-by-point Volleyball Win Probability Model", submitted to Journal of Quantitative Analysis in Sport, 2023.

[3] MacKenzie, Sasho, Kyle Kortegaard, Marc LeVangie, and Brett Barro. "Evaluation of Two Methods of the Jump Float Serve in Volleyball", *Journal of Applied Biomechanics* 2012, 28, 5, 579-586, accessed Apr 25, 2023, https://doi.org/10.1123/jab.28.5.579

[4] Huang, Chenfu, and Lin-Huan Hu. "KINEMATIC ANALYSIS OF VOLLEYBALL JUMP TOPSPIN AND FLOAT SERVE." *ISBS 25*, (2007). Accessed April 25, 2023. https://ojs.ub.uni-konstanz.de/cpa/article/view/476.

the jump float serve.[5][6] Moras et al. analyze the disparity between jump float, jump spin, and standing float in professional men's volleyball, but fail to consider location as a factor that could impact the effectiveness of a serve.[7] Currently, there is a dearth of research analyzing float serves within women's collegiate volleyball to determine an optimum serve based on location, float, and speed.

3. Project Overview

3.1 Data Overview

Data for this project have been provided by Hudl, a U.S. based company that provides statistical and video analysis tools for teams at all levels of American football, basketball, volleyball, soccer, and lacrosse. Data were collected during the 2018 NCAA Women's Volleyball season and include over 90 variables. Variables include skill type (pass, set serve, attack), skill grade description (error, ace, pass rating), time stamps when each touch occurred, and the location on the court in which the touch happened recorded in x and y coordinates.

I will first sort the data to include only serves made to BYU during the 2018 season to eliminate team-to-team variability. I will further filter the serves to include only those when the same three passers receive the serve to eliminate as much player-to-player variability as possible. Each row of the dataset will represent a serve and columns in the table will include speed, location, float, and pass grade. Speed will be a numerical variable estimated by subtracting the time stamp provided by Hudl for the pass from the time stamp for the serve. The location of the serve will be determined by the x, y coordinates provided in the data by Hudl. Float will be a binary variable that I will determine through video review. Float will be determined based on the rotation of the ball. Serves where the ball rotates less than 180° will be called float serves. The pass grade is provided by Hudl and is scored on a 4-point scale as seen in the diagram below.

[5] Altavilla, Gaetano. "Physical and Motor Tests to Estimate the Improvement of the Jump Float Serve." *IRIS: Universita Del Salento 3*, no. 2 (2019). Accessed April 25, 2023. https://hdl.handle.net/11587/478353.

[6] Denny, Vickie Grooms. "Where to Focus Attention When Performing the Jump Float Serve in Volleyball", *Journal of Coaching Education* 3, 1 (2010): 56-68, accessed Apr 25, 2023, https://doi.org/10.1123/jce.3.1.56

[7] Moras, G., B. Buscà, J. Peña, S. Rodríguez, L. Vallejo, J. Tous-Fajardo, and I. Mujika. 2008. "A Comparative Study between Serve Mode and Speed and its Effectiveness in a High-Level Volleyball Tournament." *Journal of Sports Medicine and Physical Fitness* 48 (1) (03): 31-6. https://byu.idm.oclc.org/login/?url=https://www.proquest.com/scholarly-journals/comparative-study-between-serve-mode-speed/docview/202690058/se-2.

A 4 corresponds to a perfect pass, a 3 is a good pass, a 2 is a medium pass, a 1 is a poor pass, a 0.5 is an overpass, and a 0 is an error.
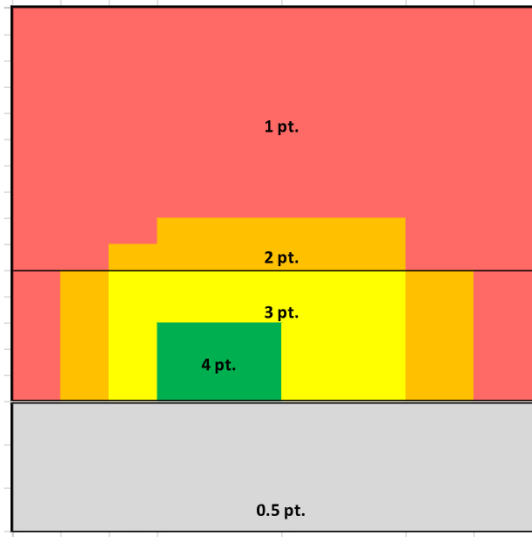
3.2 Methodology Overview

The analysis will be done using the Product Partition Model (PPMx).[8] PPMx is a random partition model that clusters based on selected covariates (in this instance, speed, location, and float) and is found in the R package ppmSuite. This method of clustering makes the model particularly well suited for prediction as it naturally accommodates interactions between covariates, allowing us to see optimal combinations of different factors. Further, PPMx is not constrained to only consider linear functions and allows for flexibility in the response variable. The number of clusters is treated as an unknown allowing clusters to form where partitions in the data exist. The Salso R package will then be used to select an optimal cluster based on a loss function.[9] This enables us to see what levels of each factor of interest correspond with the various pass ratings. This clustering will be used to draw conclusions regarding serve effectiveness.

4. Qualifications for Thesis Committee

Faculty Advisor: Dr. Gilbert W. Fellingham

Dr. Fellingham received a B.A. in Mathematics from Occidental College, two M.S.s in Physical Education and Statistics from BYU, another M.S. in Biostatistics from the University of Washington, and a Ph.D. in Biostatistics from the University of Washington. He is a professor at BYU and was previously an assistant coach for BYU

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[8] Page, G. L. (2021). ppmSuite: A Collection of Models that Employ a Prior Distribution on Partitions. R package version 0.1.8.

[9] Dahl, D. B., Johnson, D. J., and Müller, P. (2021b). salso: Search Algorithms and Loss Functions for Bayesian Clustering. R package version 0.3.0.

Men's Volleyball, a consultant for USA men's and women's national volleyball teams, a consultant for the Philidelphia Eagles, and the volunteer assistant coach for BYU's nationally recognized women's volleyball team. With 111 publications focused on applications of parametric and nonparametric Bayesian models in health, sports, and human performance, Dr. Fellingham is an invaluable resource for this project. I became acquainted with Dr. Fellingham through my job with BYU Women's Volleyball and have recently been part of his student research team.

Faculty Reader: Coach David Hyte
Coach Hyte is the BYU Women's Volleyball Associate Head Coach. He has been a member of BYU's coaching staff since 2014 and specializes in training middle blockers and serving. Hyte heads up scouting efforts and serves as the team's recruiting coordinator. In his 8 seasons with BYU Women's Volleyball, Coach Hyte has won 7 West Coast Conference titles and has been to the NCAA tournament every year. Hyte's teams have progressed to the Sweet 16 or further 7 out of his 8 seasons. Hyte was part of BYU's men's volleyball team that won the national championship in 2004 and the runner-up team in 2003. In my role with the women's volleyball team, I work closely with Coach Hyte and ultimately got the inspiration for this project from him.

Honors Coordinator: Dr. Del T. Scott

5. Project Timeline

April 28th: Submit thesis proposal
June 1-August 31: Collect float data
August 31-September 15: Compile and clean completed dataset
September 16-September 30: Run clustering tests and analyze findings
October 1-October 15: Write first draft and adjust model as necessary
October 16-October 31: Edit and finalize thesis
November 1: Submit thesis defense information form (Deadline November 10th)
November 1-15: Design poster and submit for printing
November 15: Defend thesis (Deadline December 1st)
December 1: Submit thesis submission form (Deadline December 4th)
December 4: Submit thesis final pdf (Deadline December 7th)

6. Culminating Experience

I intend to present my findings in a professional conference setting as well as to the BYU volleyball coaching staff. If my findings prove to be sufficiently groundbreaking, I will look for publishing opportunities in related journals such as the Journal for Quantitative Analysis in Sport.