Adjusting Double Poisson Models to Predict the NCAA Division I Softball Championship

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Abstract

While its viewership has surged in recent years, college softball remains an under-researched sport in the domain of sport analytics, partially due to a lack of a longstanding major professional league. However, the postseason format of major college softball - a four-stage layout with two four-team double elimination phases and two best-of-three series - presents an intriguing challenge for predictive models. Primarily focusing on the first of these four stages, we evaluate the effectiveness of a Double Poisson model in predicting the outcome of this competition. This model, previously developed and advanced for use in predicting the outcome of soccer matches, posits that a team's number of runs scored takes a Poisson distribution, with a mean based on its own offensive strength and its opponent's defensive strength, with strengths expressed in terms of scoring averages. Using game-by-game results for runs scored and runs against, we construct two additional pairs of factors used in constructing the means of these Poisson random variables for each team that account for a team's strength of schedule and conference membership. From these additional factors, we construct an adjusted model that aims to account for these factors, and assess both the unadjusted base model and the adjusted model's ability to predict the 2024 NCAA Division I Softball Tournament through simulation, with the aim of better understanding factors associated with success in this compelling tournament format.

1 Introduction

The eight team Women's College World Series (WCWS), held in Oklahoma City, is the culmination of each edition of the NCAA Division I Softball Tournament. In recent years, both in-person attendance and television viewership for the event has surged. In the best-of-three finals of the 2024 WCWS, in which Oklahoma defeated rival Texas to win its fourth consecutive national title, television viewership on the ESPN family of networks reached the highest levels on record, with two million viewers tuning in (Callahan, n.d.). The 2022 edition of the finals, also between Oklahoma and Texas, eclipsed the corresponding series of the Men's (Baseball) College World Series (MCWS), with an average of 1.7 million viewers tuning into the softball event, whereas the most-viewed game of the MCWS finals between Ole Miss and Oklahoma averaged 1.63 million viewers (Staff, n.d.). Meanwhile, a recent expansion of the host stadium for the WCWS has enabled continued growth in attendance. Whereas the event hosted an average of 72,747 fans in the 2010s, it averaged 112,123 between 2021 and 2023, the first three seasons of increased seating capacity in Oklahoma

City, an increase of over 54 percent (National Collegiate Athletic Association, 2024b).

Despite this live and televised success, college softball - with its compelling, multi-level postseason format - remains an under-researched sport in analytics literature. In this paper, we adjust a model, the Double Poisson, that has previously been used to predict the outcomes of soccer matches by constructing two sets of adjustment factors based on teams' conference affiliation and performance relative to schedule. We build an adjusted model that incorporates these factors into the computation of the mean of the Poisson random variables and evaluate the adjusted model against a base implementation of the Double Poisson (using only runs scored and allowed averages) in predicting the outcomes of the 2024 NCAA Division I Softball Championship, beginning at the regional phase and progressing through the Women's College World Series.

1.1 NCAA Division I Softball Tournament Structure

The first NCAA Division I Softball Tournament was held in 1982 with a 16-team structure and culminated in a championship held in Omaha, Nebraska. Over time, the number of participants has grown to the current 64-team setup, with 31 teams earning automatic bids by winning their respective conferences, and 33 teams being selected by a committee to receive at-large bids. Of these 64 teams, 16 are chosen to host four-team double elimination tournaments, termed *regionals*, on the first round of competition; the Tuscaloosa Regional from the 2024 edition of the tournament is shown below as an example. In this example, the "if necessary" game was not required because the undefeated team (Alabama) defeated the team with one loss (Southeastern Louisiana), thereby eliminating Southeastern Louisiana with the Lions' second loss.

The winners of these sixteen regionals move on to a best-of-three series against another regional winner,

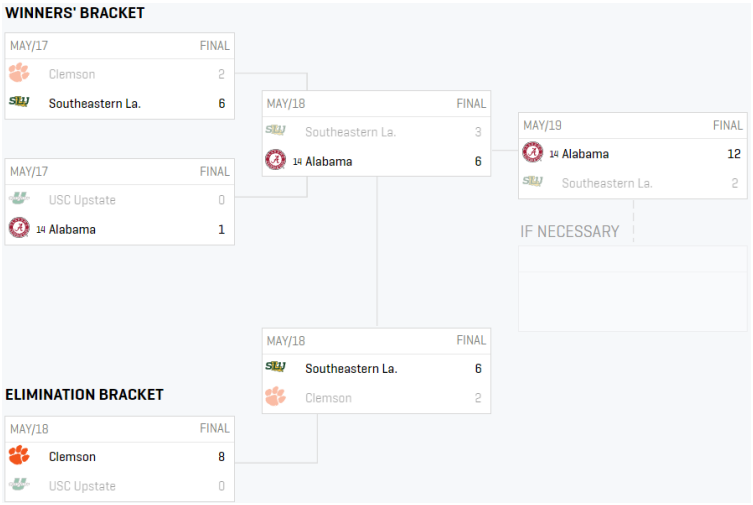

Figure 1: 2024 Tuscaloosa Regional Bracket

held at the higher seed's ballpark on the second weekend of the tournament and termed the *super regionals*. The eight super regional winners advance to the Women's College World Series (WCWS) in Oklahoma City. In WCWS play, the eight teams are split into two four-team double elimination brackets and essentially repeat the first two rounds over the course of nine days, culminating in the best-of-three WCWS Finals. The only difference is that the loser of the winner's bracket championship in each four-team bracket moves to the other four-team bracket instead of remaining in its own bracket (National Collegiate Athletic Association, 2024b). The complexity of this multistage tournament format, as well as the variation in team quality due to all conferences receiving at least one bid, make this a challenging format to build predictive models for.

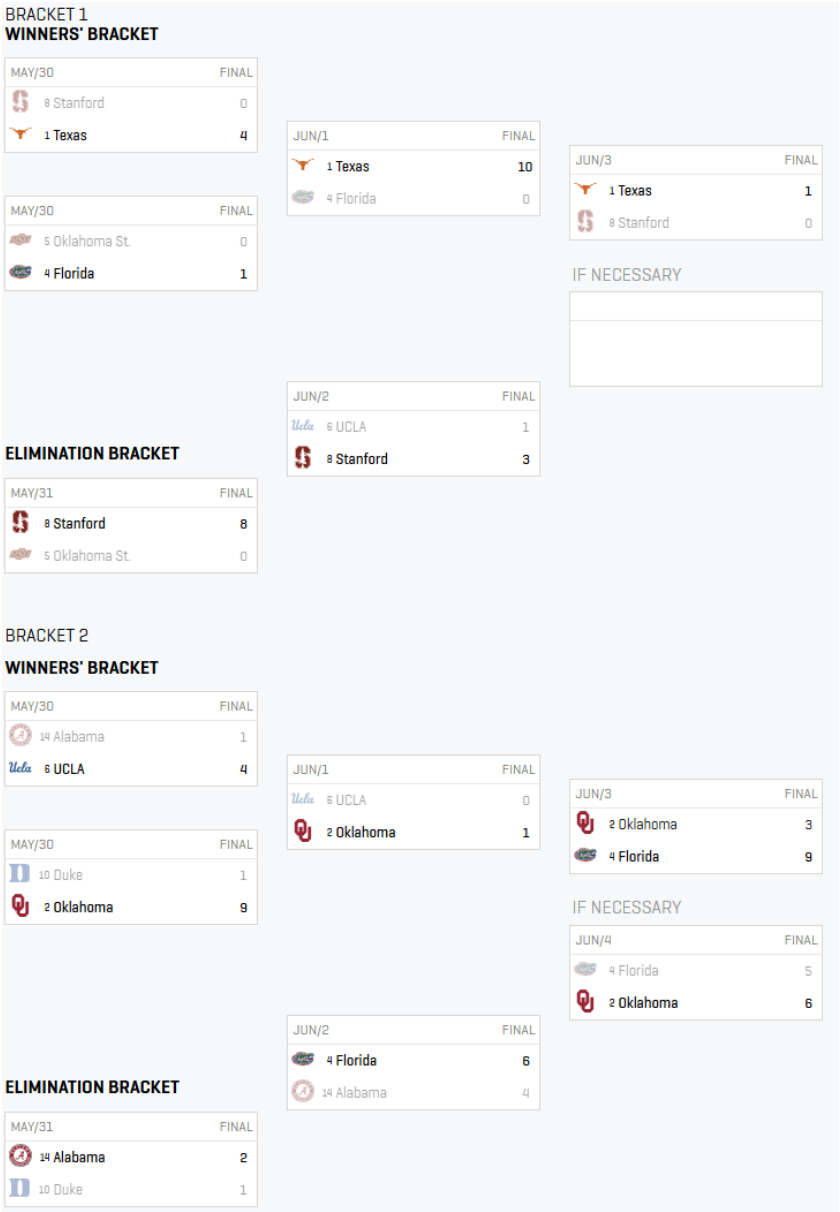

Figure 2: 2024 Women's College World Series Bracket

1.2 Double Poisson Models

Using Poisson random variables to model outcomes in English soccer was first proposed by M.J. Maher in 1982, under the justification that a team has many individual chances to score over the course of a match, but that the probability of any individual opportunity being successful was relatively low. In such a model, the number of goals scored by team i against team j, X_{ij}, is assumed to be Poisson distributed with a mean determined based on the offensive strength of team i and defensive vulnerability of team j, where the strengths are measured in expressions related to the number of goals scored and allowed (Maher, 1982)(Wackerly, Mendenhall III, & Scheaffer, 2008). Under this model, the probability that team i defeats team j with X_{ij} as defined above is $P(X_{ij}) > P(X_{ji})$.

More recently, Penn and Donnelly have advanced this work, using a Double Poisson model to predict the results of the 2020 Euro soccer team tournament between European national teams. In their analysis, attacking (offensive) strengths and defensive vulnerability values are calculated using maximum likelihood estimation, and matches against teams with exceedingly large defensive vulnerability values were removed prior to recalculating such values (Penn & Donnelly, 2022). In their work, issues with including teams with poor defensive quality were noted often; whereas their work removed such teams from the dataset, we include such teams, as even a team with a weak defensive strength may still win its conference and advance to NCAA tournament play, and attempt to construct adjustment variables to properly situate these teams.

When attempting to use the same algorithm and starting values used by Penn and Donnelly to solve the system of equations for offensive strength and defensive vulnerability, the system did not converge beyond a reasonable threshold, possibly due to a much larger number of teams in the dataset or additional sparsity in the team-versus-team competition matrices, as teams in college softball played roughly ten percent of the overall 296 team dataset in 2024 (mpenn114, 2022). In this work, rather than using the previously-built maximum likelihood estimation methods for determining the mean of the Poisson distributions corresponding to run scoring, we build a base formulation and use adjustment factors to determine whether these factors, build from the structures inherent to college softball, can build an implementation of the model to appropriately predict postseason competition.

2 Materials and Methods

2.1 Data

The dataset for this model includes all regular-season games from the 2024 NCAA Division I softball season. Game-by-game data was scraped from stats.ncaa.org using a purpose-built scraper in Python for each team (National Collegiate Athletic Association, 2025). For the purposes of this work, only games between *full* Division I member schools were considered; games against member schools transitioning to Division I or those in Division II, III, or the NAIA were not considered as such schools may operate under different association-imposed scholarship restrictions and thus be inherently competitively imbalanced.

2.2 Base Model

For all Double Poisson models in this work, we consider the offensive strength (O_{x_i}) and defensive vulnerability (V_{x_i}, where V_{x_iu} is the unscaled version) of team x_1 (out of a set of m full member institutions $x_1, x_2, ..., x_m$) in the following way. Given a team's set of n games prior to the NCAA tournament indexed by g, (g, f, a), where f represents the number of runs for (scored by) team x_i in game g, and a represents the number of goals against team x_i in game g, we have:

$$O_{x_i} = \frac{\sum_{g=1}^{n} f}{n}, \qquad V_{x_iu} = \frac{\sum_{g=1}^{n} a}{n}, \qquad V_{x_i} = \frac{V_{x_{1u}}}{\frac{1}{m}\sum_{j=1}^{m} V_{x_{ju}}}.$$

Thus, O_{x_i} is the average number of runs scored in a particular year by team x_i across all games prior to the tournament, and V_{x_iu} (unscaled defensive vulnerability) is the average number of runs allowed in a particular year by team x_i across all games prior to the tournament. The V_{x_i} value is then taken by dividing the unscaled defensive vulnerability by the average of all unscaled defensive vulnerabilities.

This definition of O_x and V_x differs significantly, however, from the derivation of those values in the previous work of Penn and Donnelly. In their work, offensive strength and defensive vulnerability parameters were estimated, using the maximum likelihood estimator, as the solutions to a system of equations. The objective function for such a system involved, for m teams, two square matrices of dimension m. In the matrix used for games played, here denoted G, the entry g_{ij} denoted the number of international games played between countries i and j in their dataset. The number of goals scored by country i against country j was recorded similarly in a score matrix, here denoted S. (Penn & Donnelly, 2022).

However, there are situational differences between the work of Penn and Donnelly and the challenge of applying this model to college softball. In this work, we seek to understand how the inherent structure of

college softball in the form of conferences and the inherent imbalance in team scheduling can be leveraged to adjust a base model to create better predictions, so we propose a naïve base model to use as a standard of comparison in which team strengths are expressed purely in terms of scoring averages. In addition, this model aims to solve a problem found by Penn and Donnelly introduced by teams with large defensive vulnerabilities; whereas their work fixed the largest V value at 1, we scale our V values relative to the mean so that a single weak defensive team has less impact on the remaining teams' V values.

From these offensive and defensive vulnerabilities, we calculate the mean of the Poisson random variables representing the predicted number of runs scored by team a against team b and vice versa. Letting $\mu_{a,b}$ represent the mean of $R_{a,b}$, the predicted number of runs scored by a, and $\mu_{b,a}$ represent the mean of $R_{b,a}$, the predicted number of runs scored by b, these are expressed as follows in the base Double Poisson model:

$$\mu_{a,b} = (O_a)(V_b), \qquad \mu_{b,a} = (O_b)(V_a), \qquad R_{a,b} \sim Poisson(\mu_{a,b}), \qquad R_{b,a} \sim Poisson(\mu_{b,a}).$$

Therefore, the probability of team a defeating team b, $p_{a,b}$ is given by the following for the case where ties are possible:

$$p_{a,b} = P(R_{a,b} > R_{b,a}).$$

However, a significant difference between predictive modeling in soccer matches versus college softball is the issue of ties. In soccer, a game may end after regulation is played in a tie. However, ties are extraordinarily rare - and usually the result of weather-related interruptions, as was the case between Auburn and Virginia Tech in 2024. In that situation, the game concluded in a 5-5 tie due to unplayable field conditions following an extended rain delay near the end of the game (Virginia Tech, 2024). Because the Poisson distribution is discrete, $P(R_{a,b} = R_{b,a}) \neq 0$, so we must consider the situation of ties.

Ties in softball at the end of regulation play are, except in these rare cases, settled with extra innings. We assume that the strengths that a team has during the seven innings of regulation play carry over to extra innings, so the relative probabilities of victory should remain constant. While this assumption may not be true in select cases, such as a player becoming injured or otherwise unable to continue, it is likely not a major source of error, as softball teams routinely play more than seven innings per day, especially during early-season non-conference tournaments - and even the NCAA tournament. Under this assumption, we eliminate the possibility of ties by maintaining this proportionality and define $p_{a,b}$, the probability that team a defeats team b, in the following manner for the remainder of this work:

$$p_{a,b} = \frac{P(R_{a,b} > R_{b,a})}{P(R_{a,b} > R_{b,a}) + P(R_{b,a} > R_{a,b})}$$

To account for the vast difference in team quality between college softball teams and correct some of the errors associated with the above "base" model, we propose two pairs of factors to account for this: the conference adjustment factors and schedule adjustment factors. Each factor is constructed such that a "theoretically average" team would have a value equal to 1, and each pair of factors contains one factor adjusting the team's offensive strength and one factor adjusting the team's defensive vulnerability with respect to the attribute under study.

2.3 Conference Adjustment Factors

The underlying assumption of the **conference-adjustment factors** is that teams compete in conferences that contain teams of relatively similar quality, so a team's conference affiliation provides some information about its expected performance. Because of this, non-conference games may be used to construct an approximate judgment of the conference's quality. For instance, Marist, a member of the MAAC, was within the top 20 in overall runs per game in 2024. However, the MAAC's schedule-adjusted defensive vulnerability, as defined below, was roughly 1.35, meaning that teams in the MAAC allowed non-conference opponents to score 35 percent more than their season-long averages in the typical game, adding context to Marist's high run-scoring totals.

Let the set (g, f, a, x_i) be the set of G non-conference games played by teams in conference C_1, indexed by $g \in \{1, 2, 3, ..., G\}$, in which teams in conference g scored f runs and allowed a runs against team x_g. Then the schedule-adjusted offensive strength, O_{C_1}, and schedule-adjusted defensive vulnerability, V_{C_1} are defined as follows:

$$O_{C_1} = \frac{\sum_{g=1}^{G}(\frac{f}{V_{x_{g_u}}})}{G} \qquad V_{C_1} = \frac{\sum_{g=1}^{G}(\frac{a}{O_{x_g}})}{G}$$

Essentially, a conference's offensive strength is the average, over all non-conference games, of the ratio between the number of runs scored by that conference's team to the season-long average runs allowed by the team's opponent. Conversely, the conference's defensive vulnerability is the average, over all non-conference games, of the ratio between the number of runs given up by that conference's team to its opponent's season-long average number of runs scored. We would expect a "theoretically-average" conference to have teams that give up as many runs as their opponents typically score, so this "theoretically average" conference would have $O_C = 1$ and $D_C = 1$. The top five and bottom five conferences in schedule-adjusted offensive strength and schedule-adjusted defensive vulnerability are shown below for the 2024 season. As may be expected, this set of variables primarily benefits schools in "Power" conferences:

Conference	2024 O_C Value	Conference	2024 V_C Value
SEC	1.655	SEC	0.440
Big 12	1.634	Pac-12	0.594
ACC	1.482	Big 12	0.679
Pac-12	1.365	ACC	0.705
Big Ten	1.284	Sun Belt	0.797
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MAAC	0.7412	America East	1.333
NEC	0.7161	MAAC	1.346
MEAC	0.6406	Horizon	1.464
Horizon	0.6159	MEAC	1.584
SWAC	0.5409	SEAC	1.679

Table I: Top and Bottom Five Conference Offensive Strength, Defensive Vulnerability Values

2.4 Schedule Adjustment Factors

Meanwhile, the underlying assumption of the **schedule-adjusted factors** is that strong teams will score more than their opponents usually allow - and conversely allow fewer runs than their opponents typically score, and that these quantities can shed light on the quality of a team's offense and defense. This can serve as a testament to the success of even the most successful offenses: Oklahoma's 8.1 runs per game in the 2024 season ranked near the top of college softball, but their offensive dominance becomes clear when their schedule-adjusted offensive strength value is examined as defined below: the Sooners scored 96 percent more runs, on average, than their opponents' average number of runs allowed.

Let the set (g, f, a, x_g) be the set of games played by team x_i over the course of a season, indexed by $g \in \{1, 2, 3, ...G\}$, where team x_i scores f runs and allows a runs against team x_g. Then the schedule-adjusted offensive strength of team x_i, denoted O_{S_i}, and schedule-adjusted defensive vulnerability of team x_i, denoted V_{S_i}, are given by:

$$O_{S_i} = \frac{\sum_{g=1}^{G} \frac{f}{V_{x_{g_u}}}}{G} \qquad V_{S_i} = \frac{\sum_{g=1}^{G} \frac{a}{O_{x_g}}}{G}$$

Essentially, a team's schedule-adjusted offensive strength is the average, over all games played, of the ratio between its number of runs scored in the particular game and the average number of runs allowed by its opponent. Conversely, a team's schedule-adjusted defensive vulnerability is the average, over all games played, of the ratio between its number of runs allowed in the game to the average number of runs scored by its opponent over the course of the season. We propose that a "theoretically average" team would score as much as each of its opponents usually allows - and give up as many runs as its opponents usually score - thereby having $O_S = V_S = 1$. The following gives the top five and bottom five schedule-adjusted offensive strength and defensive vulnerability values for the 2024 season:

Team	2024 O_S Value	Team	2024 V_S Value
Florida	2.194	Boston	0.296
Miami-Ohio	2.083	Duke	0.322
Florida State	1.999	Oklahoma	0.333
Oklahoma	1.962	Tennessee	0.340
Texas	1.919	Stanford	0.413
...	...	...	...
Arkansas Pine Bluff	0.483	UMES	1.882
Alcorn State	0.476	Detroit-Mercy	1.907
FDU	0.453	Alabama A-M	1.964
Detroit-Mercy	0.401	St. Bonaventure	2.100
Lafayette	0.399	Mississippi Valley State	2.131

Table II: Top and Bottom Five Schedule-Adjusted Offensive Strength, Defensive Vulnerability Values

2.5 Adjusted Model

The adjusted Double Poisson aims to incorporate both factors associated with stronger conference membership and strength of schedule into its predictions. Using the same notation for $\mu_{a,b}$ and $R_{a,b}$ as before with team a in conference i and team b in conference j, we define:

$$\mu_{a,b} = (O_a)(V_b)(O_{C_i})(V_{C_j})(O_{S_a})(V_{S_b}), \qquad \mu_{b,a} = (O_b)(V_a)(O_{C_j})(V_{C_i})(O_{S_b})(V_{S_a}),$$

$$R_{a,b} \sim Poisson(\mu_{a,b}), \qquad R_{b,a} \sim Poisson(\mu_{b,a}).$$

The probability of team a defeating team b is defined in the same manner as in the base model in section 2.2, so as to account for the fact that ties are not permitted at any stage of the tournament under consideration.

3 Results

3.1 High-Level Overview

To assess the performance of the adjusted model against its base counterpart, the 2024 edition of the NCAA Division I Softball Championship was simulated in its entirety 2000 times from the starting 64-team bracket, with the winners noted on both a game-by-game and stage (e.g., the winner of a particular regional) level. In our analysis of results, we assess the models' performance based on their ability to predict winners at a stage level, rather than a game-by-game level, as there are multiple paths to stage-level victory for a team due to the double-elimination nature of the tournament.

The following shows the model success at the conclusion of three of the four stages: regional, super regional, and Women's College World Series finals play. Outside of the finals, in which there is one series to predict, model success is defined as the average, over all competitions within a stage, of the number of trials in which the winner was correctly chosen at that stage. As may be expected, model success decreases over the course of the tournament because a round's results in a given trial are dependent on the prior simulations within that trial.

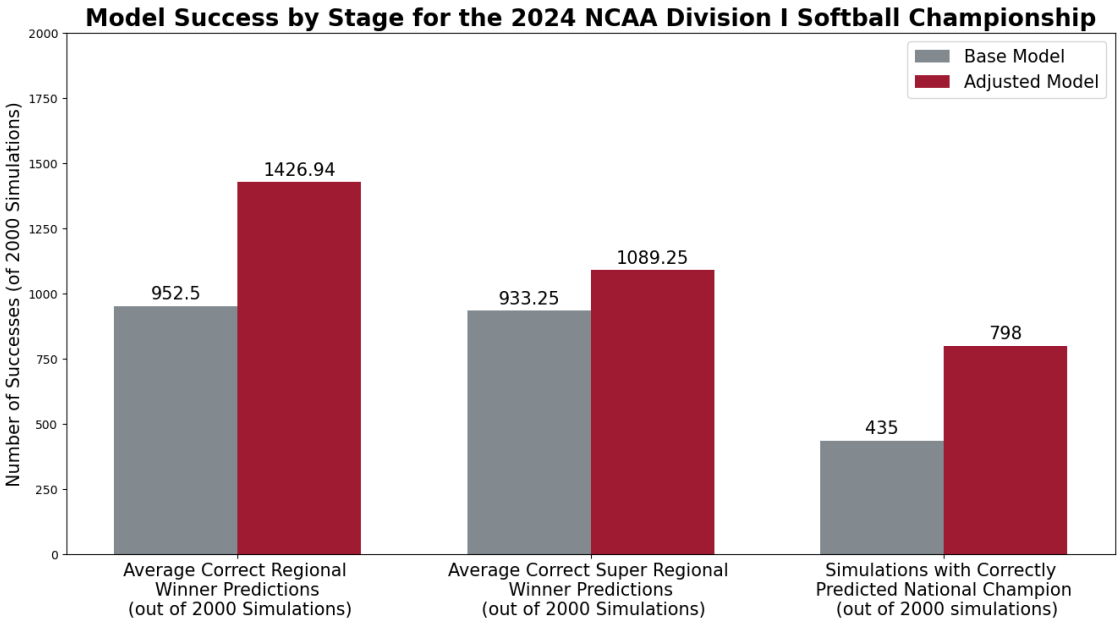

Figure 3: Model Success in Regionals, Super Regionals, and Women's College World Series for 2024

As shown below, the adjusted model performed better at each stage of the competition compared to the base model. This demonstrates the adjusted model's ability to discriminate between teams of both similar quality and vastly different quality, as teams become more evenly-matched over the course of the tournament.

3.2 Regional Results

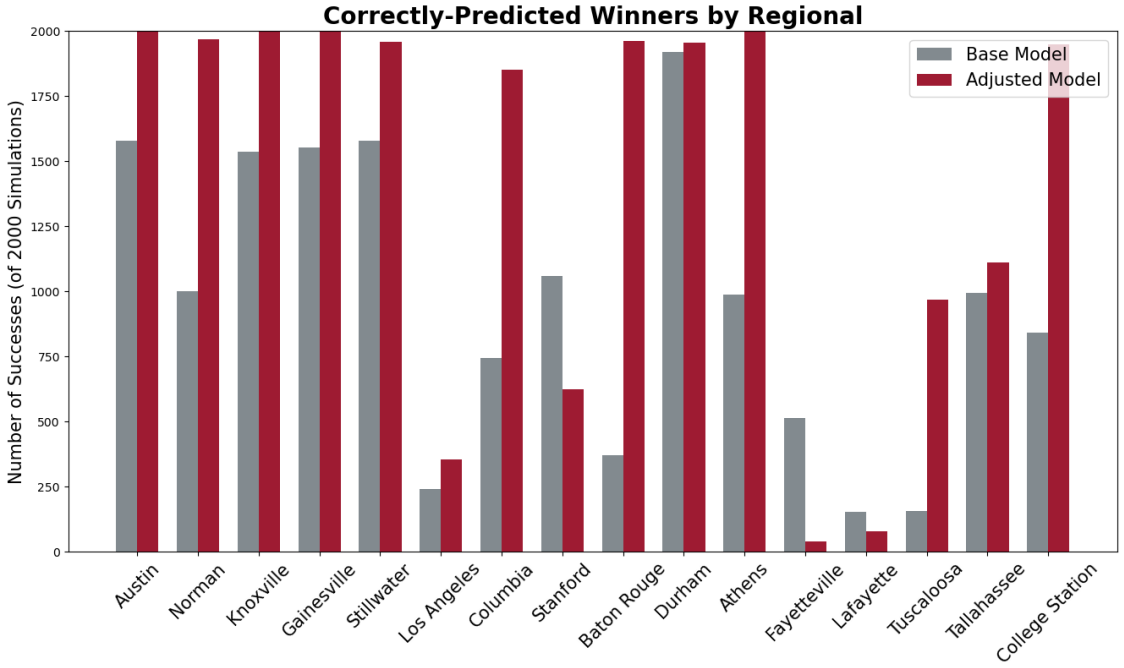

Figure 4: Number of Trials Correctly Predicting Winner by Regional

In 13 of the 16 regionals in 2024, the adjusted model outperformed the base model, with the adjusted model correctly predicting the regional winner in all 2000 trials for four regionals. In the Norman regional, then-three-time defending national champion (and second overall seed) Oklahoma was chosen to advance from its regional correctly in just 1001 of 2000 trials under the base model, whereas the adjusted model chose the Sooners to advance in 1969 trials. Proportionally, the largest increase in model performance occurred in the Tuscaloosa Regional, hosted by Alabama. As shown in the bracket in the introduction, the Crimson Tide advanced easily from its regional, but was chosen to advance from the regional round in just 7.9% of trials, whereas the adjusted model chose the Crimson Tide to advance in 48.5% of trials.

Because the regional round is not dependent on the result of any prior rounds, we may directly investigate differences between the models that explain the adjusted model's increased rate of success through tables describing the probability that, under a given model, one team defeats another. The following tables give the probability, for the 2024 Tuscaloosa Regional (won by Alabama), that the team in a given row defeats the team in a given column under both models.

2024 Tuscaloosa Regional (under base model)	Alabama	Clemson	Southeastern Louisiana	USC Upstate
Alabama		0.298	0.260	0.494
Clemson	0.702		0.437	0.712
Southeastern Louisiana	0.740	0.563		0.753
USC Upstate	0.506	0.288	0.247	

2024 Tuscaloosa Regional (under adjusted model)	Alabama	Clemson	Southeastern Louisiana	USC Upstate
Alabama		0.479	0.792	0.989
Clemson	0.521		0.870	0.999
Southeastern Louisiana	0.208	0.130		0.951
USC Upstate	0.012	0.001	0.049	

Table III: Probability Tables for 2024 Tuscaloosa Regional

As shown above, the base model does not favor Alabama, which was seeded 14th in the nation by the selection committee, in any of its matchups against regional opponents, which is unlikely to be the case. The adjusted model largely corrects for this, as the Crimson Tide are favored against two of three opponents; as shown in the regional bracket in the introduction, Alabama did not face Clemson in regional play.

3.3 Super Regional Results

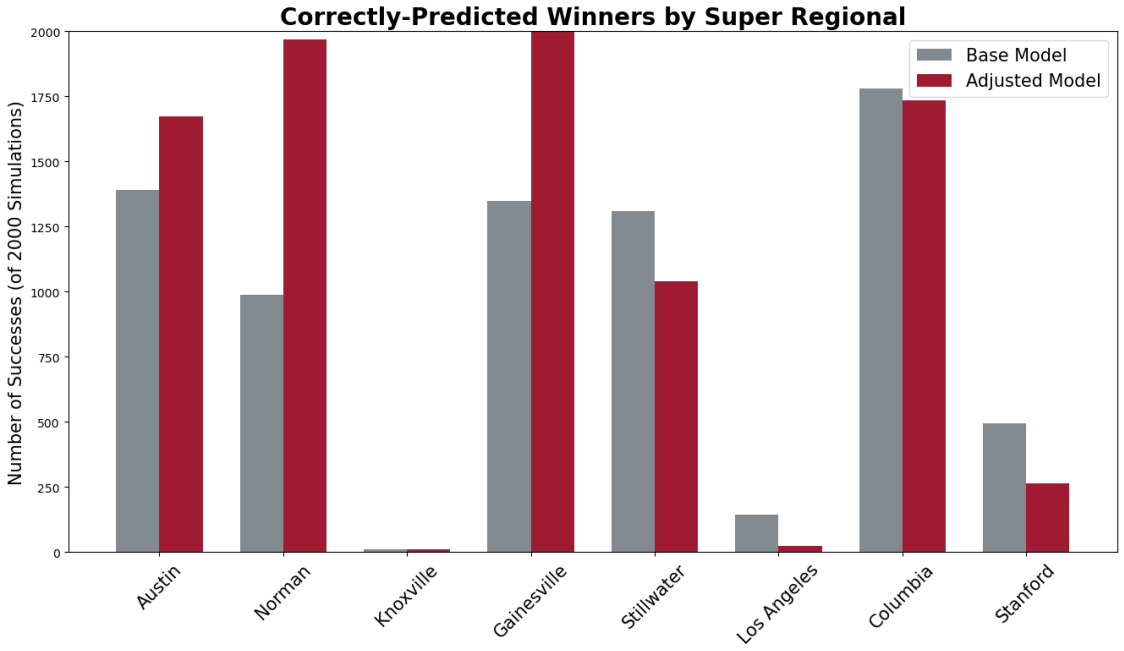

Figure 5: Number of Trials Correctly Predicting Winner by Super Regional

Unlike the regional round, the majority of super regionals in 2024 were correctly predicted by the base model, as the adjusted model correctly predicted just three super regionals correctly more often than the base model. However, the difference in performance for these three super regionals (Austin, Norman, and

Gainesville) is much greater than the difference in model performance for the five correctly predicted more often by the base model. The Knoxville Super Regional, in which Alabama defeated host Tennessee, was correctly predicted in the fewest number of trials. This can be understood in the context of regional results; Alabama advanced to the super regional round in relatively few trials under the adjusted model and especially in the base model, whereas Tennessee advanced to the super regional round in each of the 2000 trials under the adjusted model and in over three-quarters of trials in the base model.

3.4 Women's College World Series Results

As shown below, the adjusted model correctly predicted Oklahoma to win the national championship in nearly twice the number of trials as compared to the base model. Furthermore, the predictions made by the base model were far more egalitarian than those made by the adjusted model, as Oklahoma and Tennessee finished as national champions in over three-quarters of trials under the adjusted model, whereas the most common national champion choice under the base model accounted for under one quarter of trial results.

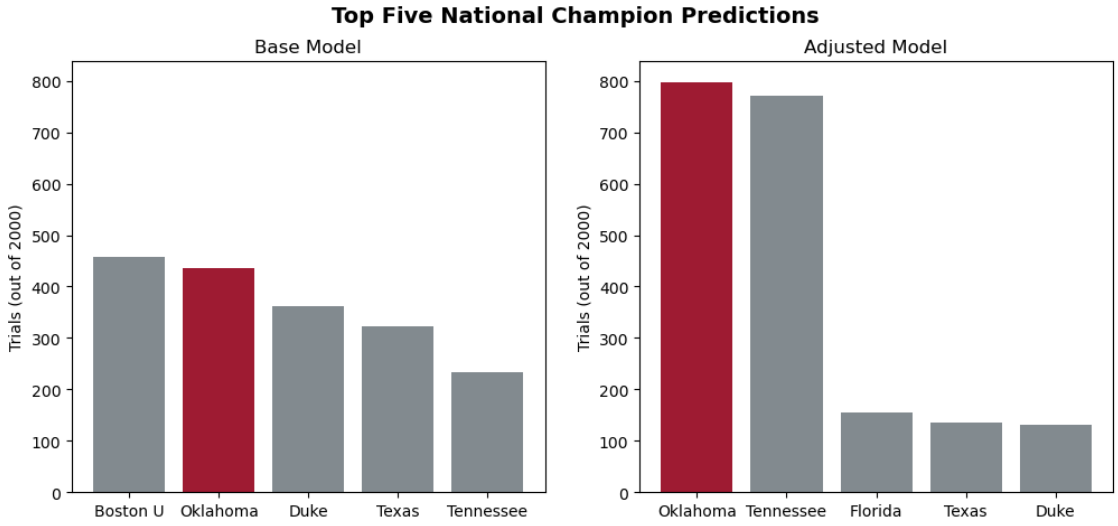

Figure 6: Comparison of National Champion Predictions

These results also point to another fundamental flaw of the base model: overestimating the strength of teams that performed well against weaker competition. The most common national champion among trials simulated under the base model was Boston University, which performed well in the regular season against a weaker conference schedule and was eliminated in the regional round (National Collegiate Athletic Association, 2024a).

4 Discussion and Conclusion

4.1 Discussion

The performance of the adjusted model both indicates that conference affiliation and performance relative to schedule, as measured by the ratio of single-game results to season-long averages, are associated with success in the college softball postseason, and that the factors constructed in this work are effective ways to account for these as opposed to relying solely on run scoring and allowance averages. In addition, this work provides a framework for future work to construct additional adjustment factors and determine the proper weighting of adjustment factors to accurately predict team success, as well as the ability to better quantify the extent of an upset in the early rounds of the tournament.

While the adjusted model does consider several key factors associated with success, there are limitations inherent to the implementation of these factors, primary among which is the effect of the model on teams with abilities significantly different than their conferences' strength, as it overestimates the strength of weaker teams in strong conferences and likewise underestimates the strength of strong teams in weak conferences. Because roughly half of the tournament field qualifies for the tournament by winning their respective conferences, this may be considered in future implementations. Similarly, there is no consideration in this model for home field advantage, the phenomenon in which teams tend to perform better when playing at home; because these regionals are hosted by the top team competing in them, this factor may be considered in the future.

Besides predicting the outcomes in major college softball, this modeling serves two broader purposes. First, it provides a conceptual framework (leveraging the nature of the sport itself) to use in other cases where the traditional implementation of the Double Poisson alone runs into similar problems. On a broader level, however, it serves to build the very limited amount of analytics research done specifically on college softball, providing a baseline for further work, which may include refining models to eliminate some of the previously discussed limitations to this implementation, in this sport, with a goal of increasing long-term quantitative interest in this under-researched sport.

4.2 Conclusion and Future Work

In this paper, we have proposed a base model that estimates the parameters of the Double Poisson for a setting in which team-versus-team matrices are sparse and evaluated the performance of the model against alternatives that take into account attributes of strength of schedule and conference affiliation. We have

found that these alternative models bring with them greater accuracy, on average, but also greater variance in the distribution of those accuracy values. Future work in this area could involve assessing the relative performance of these models in the second (Super Regional) round of the NCAA Division I Softball Tournament, as well as the Women's College World Series, and constructing an algorithm to predict which of the four models would work best given a set of input teams. These investigations would serve to advance quantitative approaches to this under-researched, yet quickly growing, sport.

In addition to adding adjustment factors and modifying their weights, future work in this area can include assessing the accuracy of the model in predicting the remainder of the regular season after a given date - and how this accuracy changes with changes to the given cutoff date. Other work could involve attempting to implement the traditionally-defined Double Poisson model with strengths calculated via maximum likelihood estimation on a conference-versus-conference level then on a team-by-team level within conferences to avoid issues related to sparse matrices.

4.3 Acknowledgments

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References

Callahan, K. (n.d.). *Espn viewership clears the bases during 2024 division i ncaa softball season.* ESPN Press Room. Retrieved 2024-08-31, from https://espnpressroom.com/us/press-releases/2024/06/espn-viewership-clears-the-bases-during-2024-division-i-ncaa-softball-season/

Maher, M. (1982). Modelling association football scores. *Statistica Neerlandica*, *36*, 109–118. doi: https://doi.org/10.1111/j.1467-9574.1982.tb00782.x

mpenn114. (2022). *Euro 2020 predictor.* Retrieved from https://github.com/mpenn114/Euro_2020_Predictor

National Collegiate Athletic Association. (2024a). *2024 ncaa division i softball official bracket.* Retrieved 2024-09-01, from https://www.ncaa.com/brackets/softball/d1/2024

National Collegiate Athletic Association. (2024b). *2024 women's college world series® records book.* National Collegiate Athletic Association. Retrieved 2024-08-31, from http://fs.ncaa.org.s3.amazonaws.com/Docs/stats/softball_wcws_rb/FullBook.pdf

National Collegiate Athletic Association. (2025). *Ncaa statistics database.* Retrieved from https://www.stats.ncaa.org

Penn, M. J., & Donnelly, C. A. (2022). Analysis of a double poisson model for predicting football results in euro 2020. *PLOS One*. doi: https://doi.org/10.1371/journal.pone.0268511

Staff, T. A. (n.d.). *Women's college world series final outgains men's final, averages 1.7 million viewers.* The Athletic. Retrieved 2024-08-31, from https://www.nytimes.com/athletic/4169889/2022/06/29/womens-college-world-series-final-outgains-mens-final-averages-1-7-million-viewers/

Virginia Tech. (2024). *Peck rips grand slam to give hokies 9-5 lead, before play was suspended in top of the seventh.* Retrieved from https://hokiesports.com/news/2024/02/10/peck-rips-grand-slam-to-give-hokies-9-5-lead-before-play-was-suspended-in-top-of-the-seventh

Wackerly, D. D., Mendenhall III, W., & Scheaffer, R. (2008). *Mathematical statistics with applications.* Thomson.