Exploring the Crossroads of Societal Dynamics and Game Theory in the Vacuum of CBS Survivor

Leonard Marshall, Matt Tsang, and Monroe Farris
Georgetown University - Graduate School of Arts and Sciences

Abstract

This study aims to better understand game evolution and social dynamics through the lens of CBS's hit reality TV show *Survivor*, and how these concepts can be extrapolated beyond just a reality TV environment. With 42 seasons of the show successfully airing over the past 20 years, many say that *Survivor* can be seen as a representation of society as a whole. With this in mind, the following research looks to see how applications of network analysis concepts can be applied to this hit reality competition show, looking specifically at game evolution, alliance theory, and voting theory. It is predicted that elements of how players vote, who they are aligned with, as well as external factors such as race, gender, or age, all impact the formation and progression of the social networks amongst these individuals. Beyond just this research, the findings below are applicable to many different aspects of social theory seen in day-to-day lift. The premise that *Survivor* is a microcosm for the real world suggests that insights derived in this study regarding alliances and social dynamics can be applicable well beyond the television screen.

Keywords: Alliance Theory, Voting Theory, Survivor, Network Analytics, Graph Theory, Multiplayer games, Betrayal, Competition, Cooperation, Coopetition, Survivor, Final Jury

1   Introduction

1.1   Background

Since the early 1990's, television networks began to exploit a market that has since boomed: reality television. The massive appeal of these shows is that audiences around the world can observe the behaviors of celebrities and strangers in very niche situations. One type of reality television that has lasted for years is reality competition shows, which extends the observation of individuals to a group of individuals all competing for a grand prize. What rapidly gained the audience's attention were the various aspects of social, physical, and mental pressures that cooperative competition, or coopetition, affects human social behavior.

In 2000, CBS produced *Survivor*, a television show that still currently airs, wherein a random group of everyday Americans volunteers to be artificially marooned in a remote location and filmed. Each week, an episode airs that typically spans three days of real-time filming. The castaways are required to build their own shelter, catch and collect their own food, and survive as best they can.

The competition starts at the outset of a season, the entire cast is split into two or three teams, or 'tribes', with who they will live and compete with. Within each episode, the tribes compete in an immunity challenge. The winning tribe gains 'immunity', or is safe from being eliminated, and

continues to compete for the grand prize. The losing tribe is required to go to 'Tribal Council', where they would anonymously vote one of their own out of the game.

After approximately half of the original group of castaways are voted out of the game, the remaining original tribes merge into a single tribe. It is at this important juncture where the game traditionally changes from a cooperative tribal dynamic to a more competitive individual dynamic. From this point, the format of each episode remains the same: the castaways still compete in challenges, but now as individuals. The sole winner of the immunity challenge gains immunity while the remaining cast is eligible for elimination at tribal council. Additionally, any subsequent castaways voted out of the game would be placed on a jury or the 'Final Tribal Council'. When there are just two or three castaways remaining, the jury of recently eliminated castaways would vote a final time. However, this time they would be voting to crown a winner, rather than to eliminate someone from the game, and the winner returns home with one million dollars.

The program has had enough success to still be airing today, more than twenty years later, and to have also inspired a number of game variations as well as international spinoffs. It draws an audience because it juxtaposes two motifs. On the one hand, there exists the typical cut-throat qualities as a by-product of the competitive game theory, encouraging self-preservation tactics and behaviors to ultimately win the money and the title of 'Sole Survivor'. On the other hand, all action across the duration of the competition is filmed and televised nationally, and so there exists a contrasting dynamic wherein people want to portray themselves as morally 'good' or 'selfless'. Thus the social challenge comes from a castaway's ability to balance the duality to eliminate the competition at all costs while appearing genuine and worthy to be voted the winner by said competition.

To that end, it is also important to acknowledge one external factor that greatly impacts the audience's perception of the competition: the producer's cut. The raw 24 hour footage is highly processed and cut to fit three days into one hour of television. As a result, the final product of the show is simply what the network wills the audience to see, and as a byproduct, accept as truth. While this does not affect the challenge outcomes, a producer's cut can steer general sentiment towards competitors, causing the masses to root for a certain castaway to win or to fail.

There have been other publications that have focused on CBS *Survivor*, though few if any leverage network analytics. Yet the show naturally lends itself for a network analysis, as each week necessitates the building, assessing, and destroying of social networks. A main purpose of this study is to assess the validity of assertions made by other researchers from the perspective of graph theory, wherein each castaway is a node within the network. Edges can manifest either based on the target of a vote in a directed network, or based on the various alliances formed from one vote to the next in an undirected network.

1.2   Related Literature

This paper relates closely with several different key topics well documented in current literature: game theory, alliance theory, and voting theory. There is also value in the added color and

context of current literature with regards to the evaluation of reality television.

1.2.1 Alliance Theory

Cranmer, Desmarais, and Kirkland assert in *Toward a Network Theory of Alliance Formation* [1] that network structure plays a larger role in alliance formation than previously understood in documented literature. This will be an interesting concept to explore in how it applies to networks observed in the show *Survivor*. Given that the structure of the networks changes from season to season, it is an interesting concept to keep in mind to see if differences in alliance formation can be attributed to these changes in network structure.

Another concept related to alliance theory is that of the "elusive ensemble." Van Der Merwe, Pitt, and Berthorn in *Elucidating Elusive Ensembles: The Strategic Value of Informal Internet Networks* [2] expand upon this idea of elusive ensembles and explain their importance in networks, using internet networks as the example in their research. They assert that there are many key alliances that are constructed via informal means, but contain a lot of social capital. The idea is that these alliances may be overlooked due to their "elusive" nature, but that these alliances could actually hold significant impacts on the network at large due to the level of social capital contained in the alliance. While the specific methodology for evaluating these elusive alliances is not what this paper will be focusing on, having an understanding of how alliances may form from non-traditional means helps us to better formulate our research questions and analysis.

Glenn Snyder provides a succinct overview of alliances with regards to alliance management in *Alliance Theory: A Neorealist First Cut* [3]. In the context of conflicting powers of states, Snyder establishes that the basic economic transactional nature of an alliance plays into the negotiation of the terms. What each partner brings to the alliance, needs from an alliance, and the relative bargaining power each partner brings can largely dictate the relationship in the alliance. If a partner does not fill the need or an outside partner provides a better option, then the alliance runs the risk of disintegrating. From a management standpoint, Snyder points out that in a multipolar situation, there is a distinctive trade-off of abandonment and entrapment that each partner attempts to balance. Abandonment is the fear that the partner will leave the alliance and entrapment is the fear of being over-invested and entangled in the partner's agenda.

In *Alliance Group Formation: Enabling and Constraining Effects of Embeddedness and Social Capital in Strategic Technology Alliance Networks*, [4] Geert Duysters and Charmainne Lemmens discuss how embeddedness, or the structure of a network of social relations, can sometimes dictate how partners in a business alliance behave. One main point is that alliances are largely based on previous experiences and activities. They posit that tight cliques in a network are formed when partners solely rely on existing ties to form collaborative relationships. These relationships can be built based on a number of characteristics: shared values, norms, and trust. If previous relationships built on these values were successful, the new successful relationships can be built on them as well. In the beginning, partners will create a local search, to loosely find those that are similar to previous relationship outcomes. Once these ties are formed, they can be reinforced and strengthened by activities such as face-to-face contact or increase in mutual trust. As a result, the clique can retain any information it has, allowing it to

act more homogenous in behavior and values. However, this investment closes off any opportunities to create new bonds with those outside, which in turn removes avenues of new information and knowledge.

1.2.2 Voting Theory

Voting theory is another key area related to our work. Understanding key research and takeaways related to this topic better informs the study at hand. Bragg, in *Surviving Survivor: How Alliances Persevere in Survivor,* provided a quantitative methodology to assess impacts of voting with or against an alliance on that alliance's ability to remain together [5]. This work took a probabilistic approach and found that for a 10% increase in a player voting outside their alliance decreases the probability that the alliance will remain together by 6.7%. While the specific quantitative results most likely will not be leveraged in this analysis, having a quantitative framework to refer back to will be helpful in designing our analysis.

In *Survivor - Innovation: Dynamism and instability in networks*, Pia Hurmelinna-Laukkanen looks to see how a network behaves when removed nodes are reentered into the system [6], specifically in the context of *Survivor*. This paper looks to see how the outcome of the final vote is determined in part by how certain contestants are ejected from the Survivor tribal network. When looking at the type of ejection, there are some different types: chosen, forced, natural, and other-oriented. A "chosen" ending is when a unilateral or bilateral decision was made; "forced" is when an external event occurs, such as a contestant injury. A "natural" ending refers to a simple decrease in involvement to a natural ending of a relationship. Finally, "other-oriented" is a way to remove a party under the rationale that the party in question no longer belongs. This is interesting as it works to preserve the ejected member's dignity while not incurring any personal grudges. The second major factor is time. The idea is that through time, those who are sent to the jury early on have more time to process their experience and relationships. Increased amount of time tends to yield a milder reaction at the end, or "time heals all". In contrast, those who were just recently eliminated feel the rejection the freshest, thus can use that raw emotion to dictate the voting habits. A third aspect is also the temperament of the contestant, or "relationship characteristics". Simply put, it is easier to deal with a council member who does not hold grudges than one who does. This can be seen in Season 5, when the female contestants orchestrated the removal of Roger before the formation of the jury. This was to prevent the women's perceived notion that Roger would never vote a female to win the final two.

In *Socializing Economic Theories of Discrimination: Lessons from Survivor*, authors Dilks, Thye, and Taylor review voting patterns across several seasons of Survivor in order to measure and define the presence or absence of discrimination [7]. There are two types of discrimination they test: taste-based discrimination and information-based discrimination. Models of taste-based discrimination assume that "people discriminate due to various tastes and distastes for certain types of individuals", whereas information-based models, "assume, not that individuals have animus toward certain types of people, but that individuals possess imperfect information and thus make decisions based on what they believe about group characteristics." Dilks, Thye and Taylor conclude that the discrimination that typically manifests on *Survivor* is information-based, rather than taste-based. They find that any discrimination in voting patterns is, "the result of inferences about ability and competency based on an individual's status characteristics…

Females, minorities, and contestants over 40 receive significantly more votes for elimination in the early episodes when conditions favor keeping the strongest tribal members. As the incentives shift in the later episodes of the game so too do the voting patterns. In these episodes, males and whites receive more votes for elimination given strategic considerations to eliminate one's strongest competition"

In *Valuing Play in Survivor: A Constructionist Approach to Multiplayer Games*, Carter assesses voting patterns by the various juries over several seasons of Survivor at the final 'Tribal Council' [8]. The final Tribal Council takes place during the season finale and differs from all other Tribal Councils. The jury is made up of the last 6-12 castaways who have been voted out and eliminated from the show. As a group, they vote not to eliminate another castaway, but instead to reward a winner one million dollars. Therefore, these votes are entirely different from every other vote throughout the season. Rather than eliminating a fellow tribemate seen as a liability, or a rival seen as a competitive threat, at this stage of the game it is simply a matter of deciding who most merits victory. Carter cites several common themes that each jury member may or may not value in making their final vote. These themes include how strategic a finalist is, how 'active' their play is (e.g., work ethic, overcoming obstacles versus 'riding on coattails'), how well they perform physically, and how well they perform socially (e.g., volume of betrayals of alliances).

1.2.3 Assessing Reality Television

In *Welcome to the Jungle of the Real: Simulation, Commoditization, and Survivor*, Christopher J. Wright details the degree to which reality television, and, specifically, CBS *Survivor* deviates from reality [9]. Wright maintains that, "[Survivor] is not 'real', but rather a contrived construction". Wright posits that there are four phases in the progression of an image into simulacra. First, the image reflects a basic reality; second, it masks and perverts a basic reality; third, it masks the absence of a basic reality; and finally, it bears no relation to any reality whatsoever. Upon completing the fourth phase, an image or an entity can be considered simulacra. However, Wright admits it is difficult to define Survivor as simulacra, but does reference executive producer Mark Burnett's label for the program as "dramality".

While *Survivor* - and reality television at large - is not the most valid representation of reality, there is still intrinsic value in referring to the program for analytic purposes. In *Socializing Economic Theories of Discrimination: Lessons from Survivor*, authors Dilks, Thye, and Taylor also refer to CBS *Survivor*. Prior to detailing their analysis, they first evaluate the merit in using data and observations from reality television at all whatsoever. Ultimately, they find that Survivor introduces a "quasi-experimental setting that is aptly suited to testing… key theoretical questions". Ultimately, this manifests in a setting in which, "predictions from theorizing can be explicitly tested on participants who have known abilities at the game and a powerful financial incentive to act on their true feelings".

2   Methodology

The below sections walk through the three different datasets leveraged in this analysis, the

network-based approach to evaluate the topics of voting and alliance theory, as well at metrics measured for evaluation of our models.

2.1   Datasets Utilized

This analysis leverages three different datasets, each of which capture different quantitative and qualitative values relevant to the show *Survivor*. Three datasets are as follows:

- Player-specific characteristic data obtained from *Survivor* super-fan Jeff Pitman which provides metrics related to each player's performance in challenges, Tribal Council, and Jury (link)
- Voting Data is obtained from the *Survivor* Wiki Fandom site, providing episode by episode voting metrics for each player (link)
- Episode Transcripts are also obtained from the *Survivor* Wiki Fandom site, allowing for analysis of metrics such as sentiment and player mentions (link)

Additionally, three specific seasons were chosen for this study. Season 1 *Survivor: Borneo* was selected as it is the pioneer season, with the most basic and essential game format and twists established. Since the subsequent seasons would then incorporate the game format into their behavior and actions, Season 1 provides the best baseline analysis for the show.

Survivor: Samoa and *Survivor: Ghost Island*, seasons 19 and 36 respectively, were selected for two specific reasons. The first is that both these seasons start out the same as the first season, in that each season had brand new players and all were initially separated into two different tribes, not decided based on any particular quality. This provided the closest means to replicate the initial conditions of season 1. The second reason is to view any shifts in season characteristics. Currently, there are 42 aired seasons of the franchise. Selecting seasons 1, 19, and 36 provide a fairly distributed amount of time to pass in between seasons.

2.1.1 Data Preprocessing

Data from Pitman was manually pulled for all three seasons. For each season, each episode's account of events were compiled at the contestant level, such as the contestants in each episode, which contestant participated and won the immunity challenge, and who voted for who in each tribal council. Additionally, contestant information provided by the Wiki site was appended to the data sets: age, sex, home town, occupation, initial tribe name, and merged tribe name. Across the three seasons, three data sets were produced. Additional columns were engineered for ease of use, such as the episode in question and whether or not the initial tribes had merged.

For data consistency, there were several adjustments when compiling Pitman's data. In cases of multiple Immunity Challenges and Tribal Council's in one episode, the episode's information was multiplied accordingly and reflects each contestant's departure as a sub-episode (i.e. Episode 14.1 and Episode 14.2). For cases of an initial tie in tribal council voting, a second round of voting was conducted. For simplicity of analysis, only the tie breaking round of votes were considered in the data set.

Contestant interviews were pulled from a repo of transcripts by season. For the season, each contestant's individual interview was gathered and compiled as speaker and text, respectively. Additional attributes were engineered for ease of use, such as season and episode.

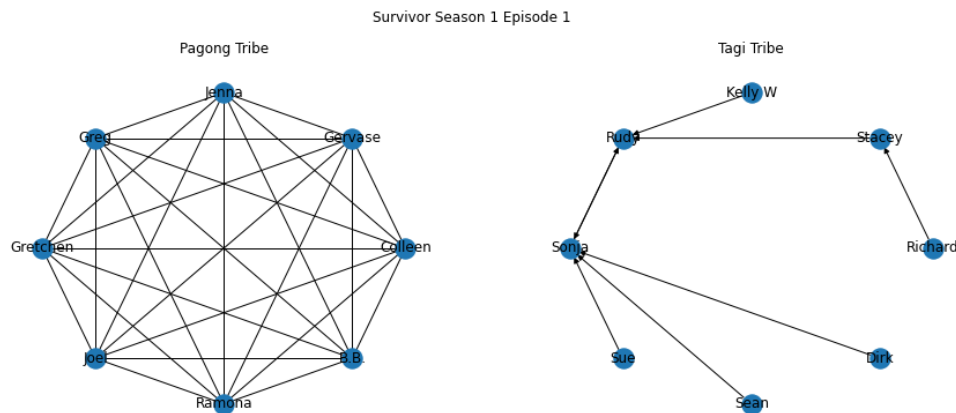## 2.2 NetworkX Approach

2.2.1 Graph networks

Figure 2.1: Season 1 Episode 1 immunity challenge results

Figure 2.1 shows the network method applied for the first episode of the first season. The network on the left shows the completed network of the Pagong Tribe, who won the episode's Immunity Challenge. The network on the right is the directed network showing the voting habits of the Tagi Tribe.
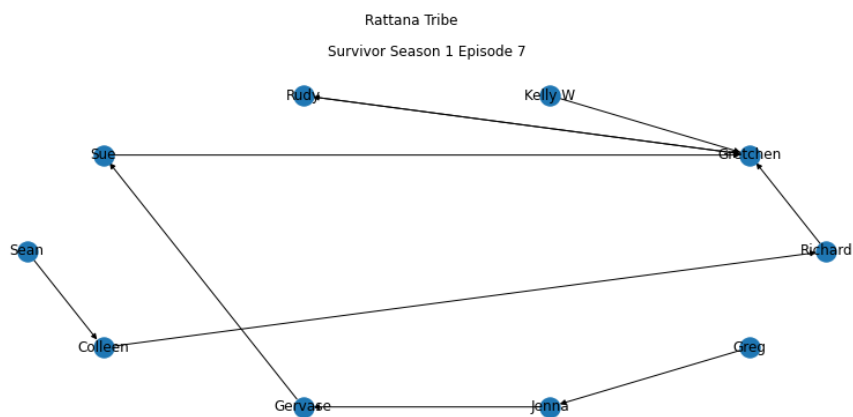

Figure 2.2: Season 1 Rattan tribe's first tribal council voting

Figure 2.2 shows the network method applied for Season 1 Episode 7 which is the first episode where the two initial tribes merged into one tribe, Rattana Tribe. The network is the directed network showing the voting habits of the Tagi Tribe.

For each season, networks of the contestants are generated, one figure per episode. For the first several episodes, there are two initial tribes created. During this period, only one tribe wins immunity and one tribe votes in tribal council to eliminate one contestant from the overall game. To accommodate the two tribes, for each episode, the tribe that wins immunity is represented as a complete network. The tribe that loses immunity is represented as a directed graph, which indicates who voted for who to leave the tribe. During the second portion of the season, when the initial tribes merge into one, only one network is produced per episode: a directional graph that shows who voted for who in tribal council. Nodal color is applied by specifying one of a few known characteristics such as sex, age, and initial tribe.
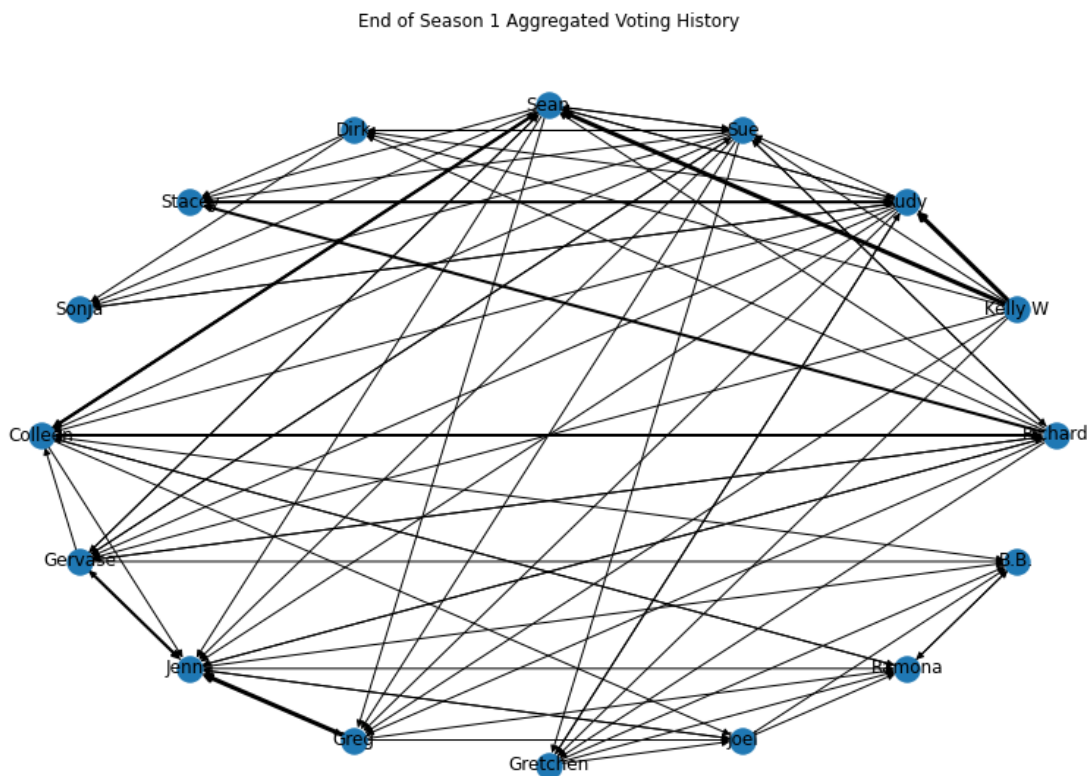

Figure 2.3: Season 1 aggregated view of all votes cast

Figure 2.3 is a culmination of all votes casted over the entire first season. In this network, each node represents a contestant, each edge direction represents a voting direction, and each edge width represents multiple instances of that voting direction.

For an aggregated season level view, a directed graph is created, one that plots all contestants in the season and the edges are the distinct votes that occurred over the season. So if one contestant votes for another contestant more than once, only one edge is shown. The width of the edge

reflects any instances of repeated voting directions. The thicker the edge, the more times a particular contestant voted for another contestant to exit the competition.
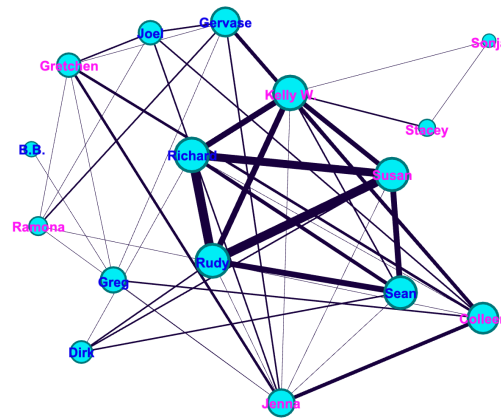

Figure 2.4: Season 1 aggregated view of alliances

Figure 2.4 is a culmination of all votes casted over the entire first season. In this network, each node represents a contestant, each edge direction represents an alliance, and each edge width represents multiple instances of that alliance pairing.

At the aggregate level, an undirected graph is also created for each season. Rather than concentrating on vote targeting, this undirected graph focuses on alliances. Each edge (and its thickness) represents the number of times two contestants vote together, and the node size is representative of the contestant's tenure in the game. The juxtaposition of this aggregate view versus the aggregate view based on targeting, is that this focuses on who a contestant allies with rather than who they treat as a threat.
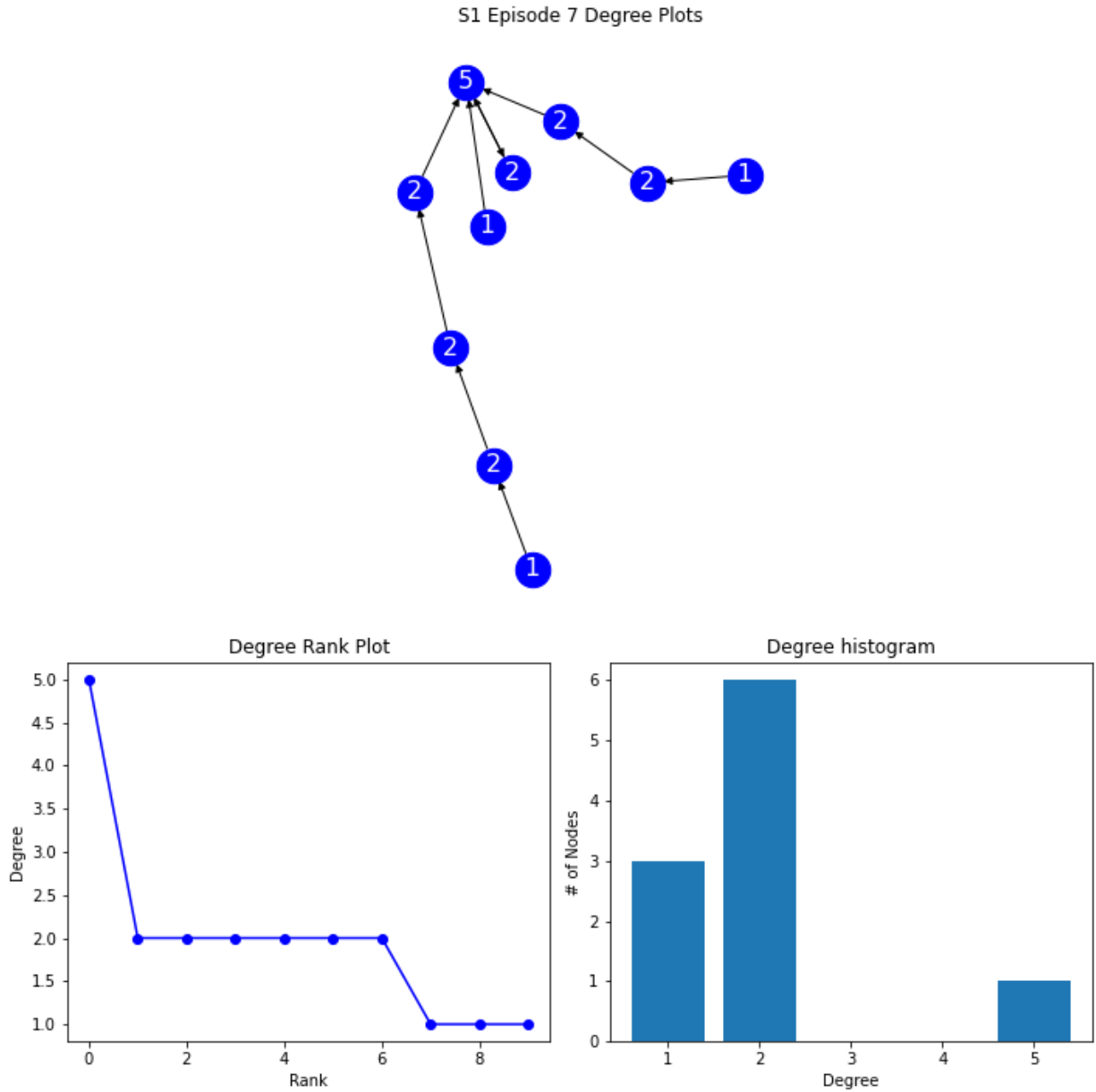
2.2.3 Degree Plots

Figure 2.5: Degree plot for Rattana's first tribal council voting

Figure 2.5 displays the network of degree ranks, degree rank plot, and degree histogram for each merged episode for each season.

For each merged episode a method was created to capture the nodal qualities. For each figure, the merged tribe network is plotted, with each node signifying the node's rank and the direction of voting. In the lower left subplot is a degree ranking plot, with the rank on the x-axis and the frequency of that rank on the y-axis. The lower right subplot is a histogram depicting the frequency of node degrees.

2.3 Metrics

2.3.1 Measures of Centrality
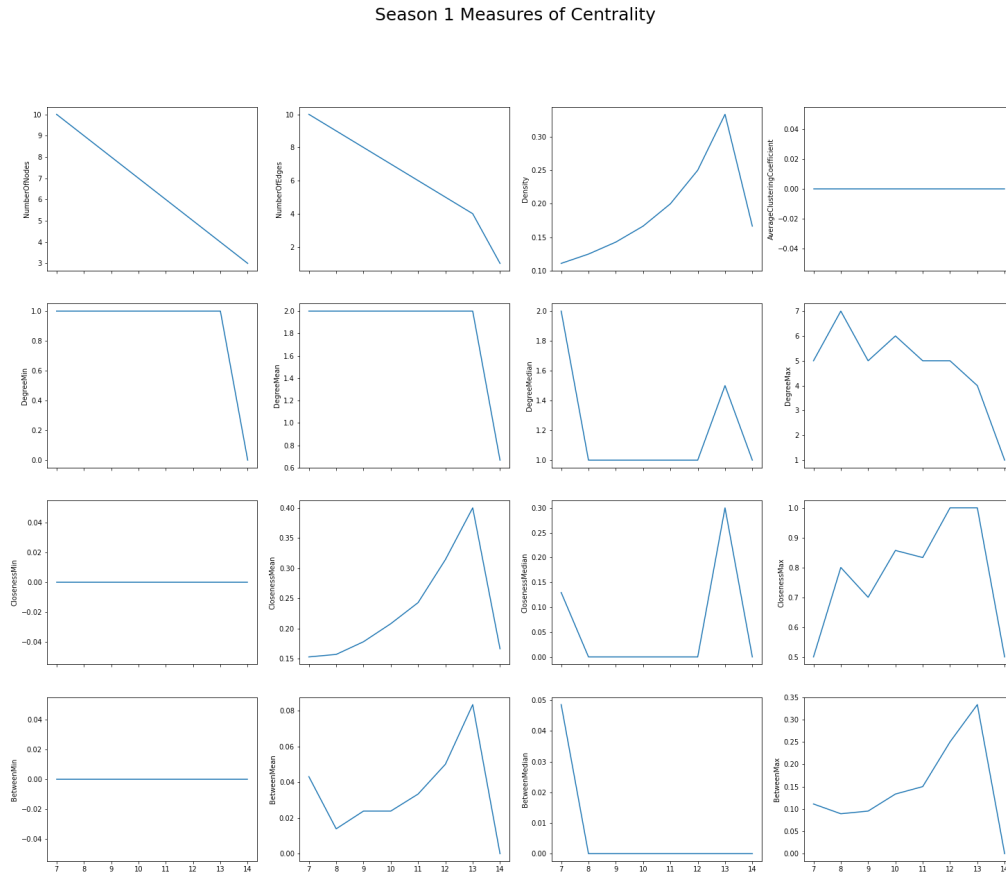

Season 1 Measures of Centrality

Figure 2.6: Season 1 measures of centrality of Rattana's tribal council directional networks

Figure 2.6 contains the recorded measures of centrality, where each subplot is one measure tracked over the merged tribe portion of the season. (Top row, from left to right: number of nodes, number of edges, density, average clustering coefficient. Second row, from left to right: degree min, degree mean, degree median, degree max. Third row, from left to right: closeness min, closeness mean, closeness median, closeness max. Fourth row, from left to right: betweenness min, betweenness mean, betweenness median, betweenness max)

To record the measures of centrality, only the networks from the merged episodes were used, as it provides a singular network to consider. The network centrality methods of degree_centrality, closeness_centrality, and betweenness_centrality were used to get the minimum, average, median, and maximum values of each method. Additionally, other network characteristics such as number of nodes, number of edges, density, average clustering, and degree assortativity were recorded. These measures were compiled over the season and consist of a subplot in the figure.

Based on these centrality measures, not much information can be gleaned. The most interesting

aspect is noted when looking at the max centralities over time. The degree max graphs the maximum number of votes an eliminated contestant receives. That said, any fluctuations of this graph indicates a non-uniform tribal council voting, showing different voting factions are at play. As for the maximum closeness and betweenness centralities, the upward trend for both reflects how the gradual shrinking network increases the closeness and betweenness. Only at the end, where the graph is a total of 3 to 4 nodes with generally unanimous voting off the last player before the finale, the values for the max plummets.

2.3.3 Voter Custom Metrics

In addition to typical categorical variables that can be measured, such as sex or age, it was decided to create custom metrics that could potentially better inform individuals about the dynamics between participants on the show. Two metrics were created in this analysis: a gossip score and a popularity score. Each of these metrics were applied to the analysis via a representation with node size, where the larger the node size, the higher the score in either of the custom metric categories.

The gossip score measures the amount of times a player mentions other players in their confessionals. The assumption is that if a player is mentioning several other players, this behavior could be equated to gossip for the purposes of this analysis. The counts of other player mentions are normalized by the number of times the speaking player goes to the confessional, meaning that players aren't penalized for appearing in the confessional more or less times than the other players.

The popularity score measures the amount of times a player is mentioned by other players in the confessionals. With this metric, it is assumed that if a player is being spoken about by other players, then the player being mentioned is being referenced in a positive manner. While people could very well be referring to players in a negative manner, for the purposes of this research, the assumption is positive in nature. Again this score is normalized by the number of episodes the player mentioned appears in. This way players that appear in more episodes don't overwhelm the results just due to the quantity of their appearances.

3 Results

3.1 Voting Analysis

3.1.1 Final Jury

As it relates to voting behaviors and how game play leading up to the final tribal council, it is interesting to analyze the final jury votes. In the final immunity challenge, the immunity winner essentially picks between the other two in the final three to face off in the final jury vote. The decision provides the last immunity winner the power to pick the player s/he believes has the ebay chance to garner favorable votes from the jury. From looking at the three final jury votes, there are no conclusive patterns that unite the three seasons in the same way. However, sex does seem to play a significant role.
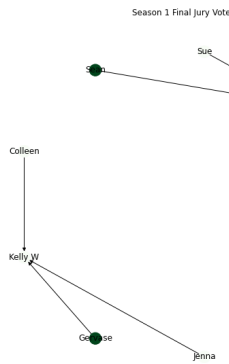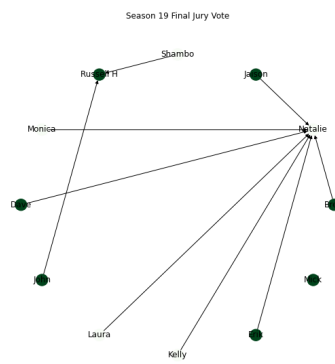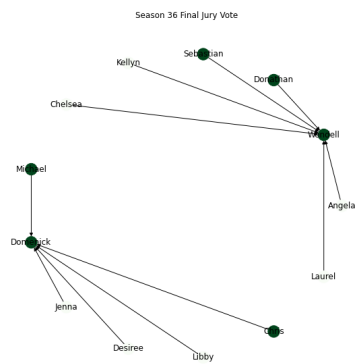
Figure 3.1   Figure 3.2   Figure 3.3

Figures 3.1 - 3.3 show the final jury voting by sex for seasons 1, 19, and 36 respectively

At a glance, the final jury voting does not reveal an obvious pattern. Based on age and initial tribe does not seem to come into any type of play as there is a wide distribution of players across ages that vote independent of another player's age. With respect to the initial tribes, it is conditional that a relatively equal number of contestants from both tribes enter the merged tribe and are equally removed from the game. This is thrown out the window with the first season, because even though an equal number of Pagong and Tagi tribe members made it to the merge, the former Pagong members showed a unified strategy to systematically remove Tagi members. As such, the jury consisted of the majority of the opposite tribe; therefore, the initial tribe does not consistently come into play.

What does come into play is sex, though just not in a consistent manner. Looking at the final juries of Seasons 1 and 19 in Figures 3.1 and 3.2, the majority of the female jurors vote for the female final tribe member. At face value, it would appear in Figure 3.3 that sex does not factor in the final jury for Season 36. However, the network only shows the final votes. In reality, there were three finalists, two males and one female: Domenick, Wendell, and Laurel. In the initial final vote, the 10 jury members split evenly with a 5-5 vote between Domenick and Wendell, giving the only female finalist 0 votes. With this tie, Laurel was removed as a finalist and acted as the tie-breaking vote between the two men. So while the female votes were not in Laurel's favor whatsoever, it is clear that the female jurors have more say in the fate of a female finalist.

3.1.2 Custom Metrics

Figure 3.4 illustrates the impacts of the gossip score on the node size of the season 1 network, and Figure 3.5 highlights the same for the popularity scores. From Sonja in the bottom left clockwise shows the order in which players exited the game. Some interesting insights can be observed from the above figures. Sean has both high gossip and popularity scores, meaning that while he talks about many players, he is also talked about by many other players. In addition to seeing similarities in these scores for players, there are also some key observed differences. Kelly has a high popularity score but a low gossip score, meaning she is mentioned quite often, but doesn't choose to mention many players in her confessionals.
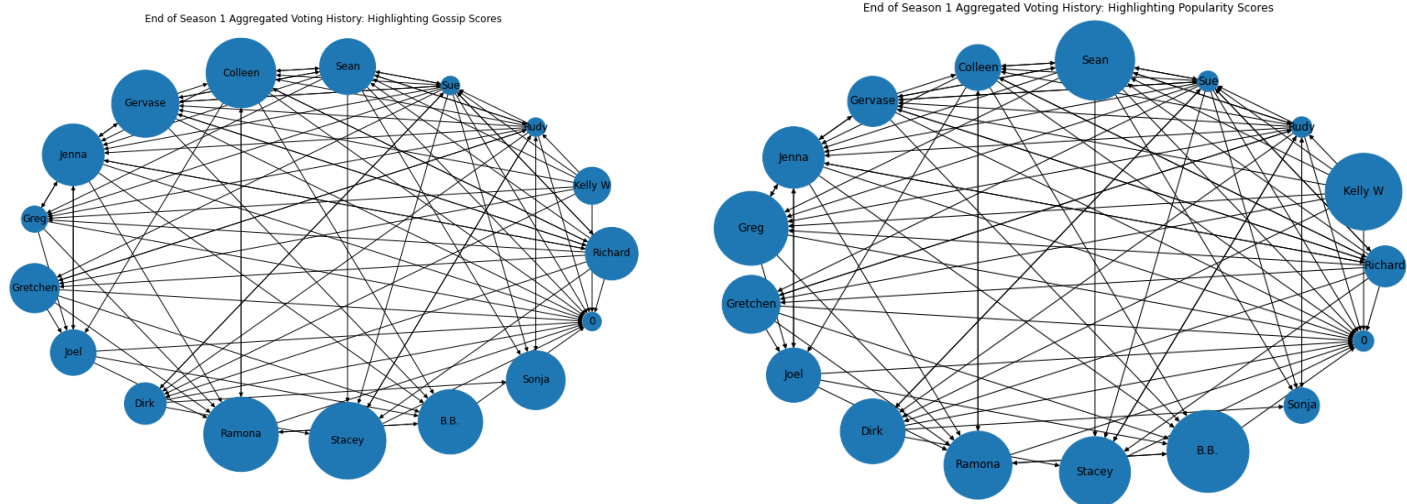
Figure 3.4 and Figure 3.5: Season 1 Network - Impact of Custom Metrics

Another thing to note is that the final two contestants Richard and Kelly have some of the lower gossip scores, which indicates that out of all the contestants, the finalists tended to not to name other players in their confessionals. On the other side of things, of the two finalists, Richard has a much lower popularity score while Kelly has one of the highest. Assuming Kelly was mentioned in a positive manner, it did not seem to benefit her when it came down to the final vote. These are just some of the many insights that can be derived from the custom metrics created for this analysis. These metrics allowed for increased understanding as to how the players were perceived throughout the season and how those perceptions impact voting patterns.

3.2   Alliance Analysis

3.2.1 Alliance by Physical Attribute

With the initial theory that alliances are created between similar parties, physical attributes can be a good gauge to identify potential alliances. Looking across episodes and in all three seasons, viewing the networks by age and sex do not appear to shed any light on any allegiance in the voting. A possible explanation as to why physical attributes do not play a significant role in agreed voting behavior might be due to the physically brutal living conditions.

Being marooned on an island or a deserted land subjected to extreme weather conditions and dependent on the group's ability to make fire and hunt for food shifts the focus away from traditional markers of alliance such as sex and age and towards utilitarian relationships. Contestants who can prove their usefulness in the wilderness had a higher chance of bargaining their longevity. Activities such as fishing, hunting, and fire-making all positively add to an individual's status in the game.

An additional layer is the mental toll the games take on the contestants. The longer the players live together, the more important it is for them to get along with each other. Once a conflict between any two or more players arises, that is often an easy deciding reason to vote someone out of the competition.

3.2.2 Alliance by Initial Tribe

One common strategy is to enter the merged tribe with the agreement that the members of the two initial tribes would support each other to ensure their respective tribe members would make it to the end. This follows the idea that alliances are formed based on previous experiences and interactions. At face value, once the initial tribes merge into one, the game shifts from a group immunity to an individual immunity, forcing players to fend for themselves. However, many contestants opt for a pact to help fellow initial tribe members as a safety in numbers.

This can be seen clearly for *Survivor: Borneo* and *Survivor: Samoa.* In Borneo, the merged Rattana tribe comprised equally of former Pagong and Tagi members. After the first merged tribal council, it became clear that Pagong members systematically worked together to eliminate the Tagi members. As a result the final five consisted solely of Pagong members. In Samoa, the merged Aiga tribe consisted of 8 former Galu tribe members and 4 former Foa Foa tribe members. Despite being outnumbered 2 to 1, the former Foa Foa members managed to systematically eliminate all the former Galu tribe members until the final three consisted only of Foa Foa members.

Despite these two clear strong cases for initial tribe alliances, it is less clear for *Survivor: Ghost Island.* While there were two initial tribes at the onset of the season, Naviti and Malolo, for a short time before the merge, a third tribe, Yanuya, was created taking members from both tribes. Looking at the lens of the three tribes, there is not a clear initial tribe alliance. Contestants from each tribe seemed to leave the show at an almost equal rate. Yet looking at this merged Lavita tribes voting through the lens of the two initial tribes, the two that existed the longest, former Malolo tribe members were systematically removed, leaving the final five Lavita members to all come from the former Naviti tribe.

4   Conclusions

Based on the data collected, much progress in investigating the themes introduced at the beginning of the study were addressed. While it was not quite possible to readily obtain more nuanced information that might be better predictors, such as work ethic or hunger tolerance, this study was able to preliminarily address patterns seen in the tribal council voting. This study was also able to observe how the specialized case of returning ousted contestants had to vote for the winner of each season, a winner who had a hand in eliminating them.

As for further analysis on the progression of reality television, the data collected thus far wasn't able to address those concepts all too well. It is likely that a widening of season scope would be the next step, processing all 42 seasons in the same manner. Even though the scope of this study was three seasons, we are confident that changes in gameplay can be seen over time, as seen in the observation with the node rank plots.

The below sections outline our overall conclusions, broken down by the two key topics of

interest: alliance theory, and voting theory.

4.1 Voting Theory Conclusions

Three categorical variables related to the contestants were analyzed to determine if any of the three made a significant impact on the final jury voting results. The three variables of interest were age, sex, and initial tribal group. Of the three variables, only sex was deemed to have an impact on the voting in the final jury; however, even with there being an observed impact of player sex on how one voted, this impact was not seen consistently across the three seasons researched in this analysis. In seasons 1 and 19, there was a clear pattern of female jurors voting for the female finalist; however, in season 36 the exact opposite effect occurred. Overall, it is observed that sex can impact the voting pattern observed in the final jury, especially for a femail finalist. The question still stands to what extent this impact is seen.

We also looked at the custom metrics we created, gossip scores and popularity scores, to see if there were any observed trends between those scores and corresponding voting patterns. Overall, we did not see any clear trends linking the custom metrics to observed voting patterns. Those players with high gossip or popularity scores were not finalists in the show and when looking just at the finalists, it was actually the player with the lower popularity score who won. While we aren't able to take away any key observed patterns between the scores and the voting patterns, it was still an interesting process to analyze the network dynamics through a new lens of our choosing.

4.2 Alliance Theory Conclusions

When observing possible patterns and characteristics with regards to aligned voting patterns in tribal council over the course of merged tribal councils, it does not appear that physical characteristics such as sex and age play any factor. Across all three seasons, the results showed that contestants would vote regardless of these traits.

In accordance with [4], alliances can be formed based on previous relationships and shared goals. As such, a strong pattern emerged when observing the merged tribal council voting as it relates to the initial tribes. Across all seasons, former members of one tribe would systematically remove all former members of the other initial tribe, until the final four or five contestants all originated from the same initial tribe. This is especially clear in Borneo and Samoa. In the case of Ghost Island it is slightly different, as the two initial tribes were split into three tribes for a very short period of time before the merge. Interestingly, the formation of the third tribe held no significant value to the contestants, as tribal council voting alliances held to the first two initial tribal groups. This further supports ideas from [4] as the longer the relationship, the stronger the bond; so the camaraderie during the brief existence of the third tribe held less value than the camaraderie within the original tribes.

Author Contributions

Leonard Marshall: This co-author contributed to the literature review, focusing on alliance theory and reality television. He gathered much of the background data (specifically, the Pitman database for descriptive statistics, the wiki fandom page for voting history as direct inputs to all analysis, and the confessionals, NLP data) and helped to narrow down the vision and approach for the research. He co-wrote and proofread the introduction and background sections. Finally, LM also contributed to section 2.2 focusing on the Gephi applications of aggregate, alliance-level networks. To do so, he collected and wrote all code for these networks (see iPython notebook: *Alliance Level Analysis.ipynb*).

Matthew Tsang: This co-author contributed to the literature review, focusing on alliance theory and voter theory. He co-wrote and proofread introduction and background sections. MT co-wrote section 2.1 on data sets and data preprocessing and conducted said preprocessing for data used for all the Networkx methods. MT wrote and coded for Networkx methods and generated all figures in section 2.2, focusing on all episode by episode analysis. MT coded and wrote section 3.1.1 analyzing final jury as it relates to voter theory. Lastly, MT contributed to sections 3.2.1 and 3.2.2 on alliance theory and co-wrote section 4.2.

Monroe Farris: This co-author contributed to the literature review, focusing on alliance theory and voter theory. She co-wrote and proofread the introduction and background sections. MF wrote the abstract and co-wrote section 2.1 on methodology, datasets utilized, and custom voter metrics. MF wrote section 3.1.2 focusing on results observed from custom voter metrics and developed the subsequent code, methodology, and visualizations for this portion of the analysis. Lastly, MF wrote section 4.1 conclusions on voting theory.

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