POWER IN USA SUPREME COURT

ABSTRACT

Two power indices are commonly used to measure power in voting systems. Both count the number of situations in which a voter is pivotal: a change in his vote will change the outcome. The Shapley-Shubik index considers each ordering of the voters as equally likely while the Banzhaf index considers each coalition of voters as equally likely. Since each U.S. Supreme Court Justice has one vote for each decision, both power indices assign each of the nine justice's one-ninth of the voting power. Because of their different viewpoints and the specificity of the cases to be decided, actual Justices do not have equal voting power. For example, if the Justices could be placed on a line from liberal to conservative and all cases had clear liberal and conservative outcomes, then the Justice in the middle of the liberal to conservative line would be pivotal all the time, and therefore have all of the voting power. This research explores different ways of redefining the Shapley-Shubik and Banzhaf power indices to take into account unequal chances of voter orderings and coalitions. These new definitions are applied to specific terms of the Supreme Court and compared.

WEIGHTED VOTING SYSTEMS

A Weighted voting system is a voting situation in which the desire of certain voters may have more significance than other. It is often thought that the more votes an individual has the more power they have. In some cases this is not true, like when a person owns more than half the shares in a company, it does not matter how many people vote a certain way that individual has all the voting power. The voting situation that is going to be explored is the U.S Supreme Court. The U.S Supreme Court consists of 9 justices who each have a weighted vote of one and in order for a decision to pass a minimum of 5 votes is required. Part 1 of this paper will talk about the notation used in the different power indices that are going to be explored. Part 2 of this paper will talk about how existing literature has thought about which individuals have the most power in a voting system. Part 3 of this paper will focus on the ways that existing literature has assigned power to the Justices of the Supreme Court. Part 4 of this paper will talk about how sensitive the data is to changes and whether the Edelman and Chen Power Index is a good model.

PART 1

$\{q: w_1, w_2, w_3, \ldots, w_N\}$

In the game above the numbers of voters that are available are n voters and the weight of the voters is assigned to w, the weight of each voter is greater than zero. A winning coalition is described to be the sum of voters whose weights is greater than or equal to the quota which is described by the letter q.* The games below describe some simple games(1,page 186).

	POWER	POWER	POWER	
GAME	VOTER 1	VOTER 2	VOTER 3	
[52;27,27,23]	3/6 or (50%)	3/6 or (50%)	0/6 or (0%)	Dummy Players
[3:3,1,1]	6/6 or (100%)	0/6 or (0%)	0/6 or (0%)	Dictatorship

FIGURE 1

Figure 1 shows two weighted voting systems. In the first voting system it can be seen that removing player 3 from any winning coalition does not make the winning coalition a losing coalition and therefore they have zero power, and are called a dummy Player. In the second voting game player 1 has all the power because removing them from any winning coalition results in the coalition becoming a losing coalition, therefore player 1 called a dictator (1, page 187-188)

PART 2

SHAPLEY- SHUBIK INDEX

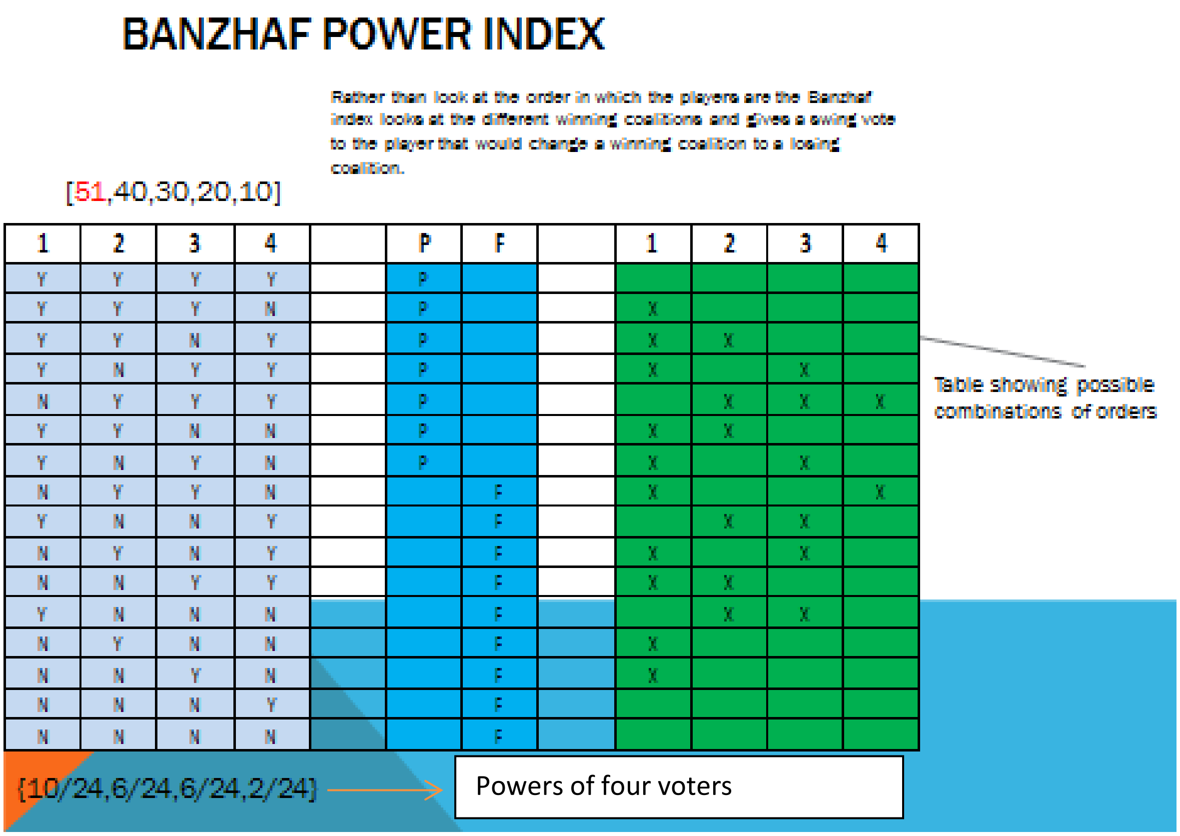
[6; 4,3,2,1]

P1	P2	P3	P4
1	2 *	3	4
1	2 *	4	3
1	3 *	2	4
1	3 *	4	2
1	4	2 *	3
1	4	3 *	2
2	1 *	3	4
2	1 *	4	3
2	3	1 *	4
2	3	4 *	1
2	4	1 *	3
2	4	3 *	1
3	1 *	2	4
3	1 *	4	2
3	2	1 *	4
3	2	4 *	1
3	4	1 *	2
3	4	2 *	1
4	1	2 *	3
4	1	3 *	2
4	2	1 *	3
4	2	3 *	1
4	3	1 *	2
4	3	2 *	1

PLAYER	Number of times the Player is the Pivot	Power of Player/Probability
PLAYER 1	10	10/24 (42%)
PLAYER 2	6	6/24 (25%)
PLAYER 3	6	6/24 (25%)
PLAYER 4	2	2/24 (8%)
TOTAL	24	
TOTAL NUMBER OF ORDERS OF PLAYERS	24	

FIGURE 2

The weighted voting game that is explored in figure 2 is {6:4, 3, 2, 1}, and this is a four player game. The Shapley – Shubik Index looks at all the possible orderings in which the players can vote and there are n!, possible permutations. In the game used to show an example in figure 2, there are four players and so twenty four possible permutations and these are shown in the matrix in figure 2. The asterisk in the matrix in figure 2 shows when a player makes a losing coalition a winning coalition. The first ordering in the matrix shows that player 1 votes first, then player 2 votes second and so on. Player 1 has a weighted vote of four and so when player 2 joins this coalition they add three weighted votes, when the two weighted votes are summed up and they are greater than the quota of 6 and so a losing coalition becomes a winning coalition. The player that makes a losing coalition become a winning coalition is assigned an asterisk in each ordering, and this signifies that they are the pivot or decisive vote. It is assumed that all the possible orderings are equally possible (1, page 189). The Probability/Power of each voter is then found by summing each time a player is a pivot and dividing that by the number of possible orderings, which in this case is twenty four. The probability of each player is shown in figure 2. One observation that stands out is that player 2 and player 3 have different weights of votes but still have the same power which clarifies the idea that it doesn't necessarily mean the more weights of votes an individual has the more power that individual has(1, page 189)



1	2	3	4		P	F		1	2	3	4
Y	Y	Y	Y		P						
Y	Y	Y	N		P			X			
Y	Y	N	Y		P			X	X		
Y	N	Y	Y		P			X		X	
N	Y	Y	Y		P				X	X	X
Y	Y	N	N		P			X	X		
Y	N	Y	N		P			X		X	
N	Y	Y	N			F		X			X
Y	N	N	Y			F			X	X	
N	Y	N	Y			F		X		X	
N	N	Y	Y			F		X	X		
Y	N	N	N			F			X	X	
N	Y	N	N			F		X			
N	N	Y	N			F		X			
N	N	N	Y			F					
N	N	N	N			F					

FIGURE 3

The Banzhaf Power Index is another way of measuring power that exists in the literature. The Bhanzhaf Power Index looks at all the possible combinations of yes /no. The total number of these combinations is 2^n , where n is the number of voters. The voting game used in the example to in figure 3 is {51: 40, 30, 20, 10}. This is a four player game and so the total number of combinations is sixteen. The Banzhaf Index looks at a coalition as a whole and each player is removed from the coalition and if a players removal results in the winning coalition becoming a losing coalition then that particular player is given a swing vote (1, page 193). An assumption made is that if every player votes the same way then no player is a swing vote, because removing any player from this winning coalition will not result in the winning coalition becoming a losing coalition. Another assumption made is that if a coalition is tied, then the motion is failed and so the two players who voted no are given the swing vote (1 page 194). For example if the first three players voted yes and player 4 voted no, then the motion is said to pass. The winning coalition of the first three players has a total weight of ninety, so the only way for this coalition to become a losing coalition is if player 1 defects because they have a vote weight of forty and so if they leave the winning coalition the total weight of vote will reduce to fifty which is less than the quota of fifty one. If either player 1 or player 2 is removed from this winning coalition it will still be a winning coalition. This process is developed for all the possible combinations and the power of each player is calculated by summing up the number of times they are a swing vote and dividing that by the total number of combinations which in this case is sixteen. The probabilities are shown at the bottom of figure 3. Again player 3 and player 4 have different weights of votes have the same power.

PART 3

Edelman and Chen Power Index

[3; 1,1,1,1,1]

CASE	OPINION/OBSERVED DATA
1	{1,2,3},{4,5}
2	{1,2},{4},{3,5}
3	{1,2,4},{5}

EXPLAINING OPINIONS ON EACH CASE

FIGURE 4

The Shapley-Shubik index and Banzhaf Power indices both assume that all possible permutations and combinations of voters are equally likely. The U.S Supreme Court consists of 9 Justices but for simplicity and to explain the model we create a Supreme Court that only has 5 justices. The ideology of the justices makes it impossible for each possible permutation and combination to be equally likely. Some justices are more inclined to vote one way because of their ideologies and are more likely to vote with other justices with similar ideologies. The Edelman and Chen Power index attempts to take into consideration these ideologies. Figure 4 describes three cases and how the justices voted in each case. The justices are grouped in subsets of opinions, which would describe the logic they used to vote a certain way. A minimum of three votes is required to pass a motion, or fail a motion. In the case 1, justice 1, 2 and 3 formed an opinion and voted one way and justices 4 and 5 formed another option and voted another way. In case 1 justice 1, 2 and 3 formed the majority. In case 2 three opinions were formed as shown in figure 4. An important observation to note here is that justice 4 formed their own opinion but voted with justice 1 and 2 to form a majority. Justice 4 might have agreed with parts of the opinion that justice 1 and 2 wrote but disagreed with some parts and wrote their own opinion but they still voted with justice 1 and 2. In case 3, two opinions where formed and justice 3 did not vote, which happens in the supreme court for reasons such as sickness etc.

Opinion and Feasible Coalitions

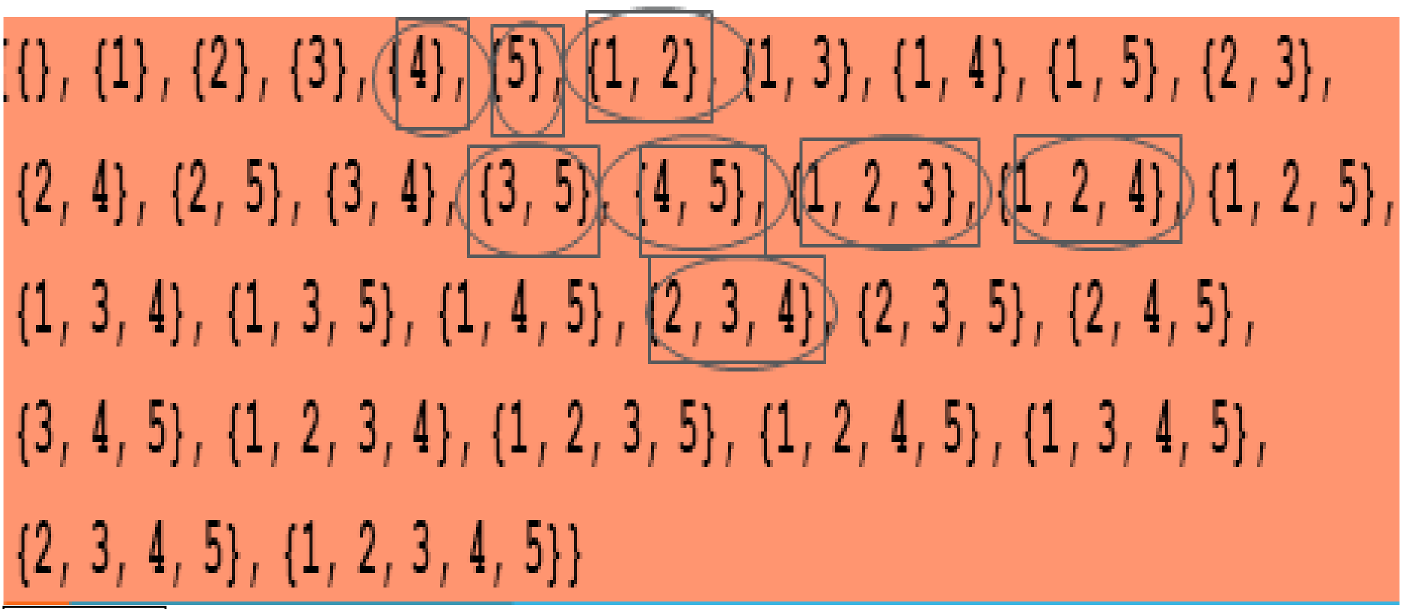


FIGURE 5

Figure 5 shows that there are thirty two possible subsets of opinions that can form from a 5 justice court. The observed opinions, which are the opinions subsets that actually happened, are the subsets that are circled. These form the opinion set and are taken from the opinions in figure 4. The Feasible coalitions are all the possible opinions that can be formed from the observed opinions of the actual court. These are found by intersecting the observed opinion subsets between each other. In the figure 5 the feasible coalitions are boxed. The Feasible coalitions just give us the actual opinion sets that could have been formed from the observed data (2, page 85)

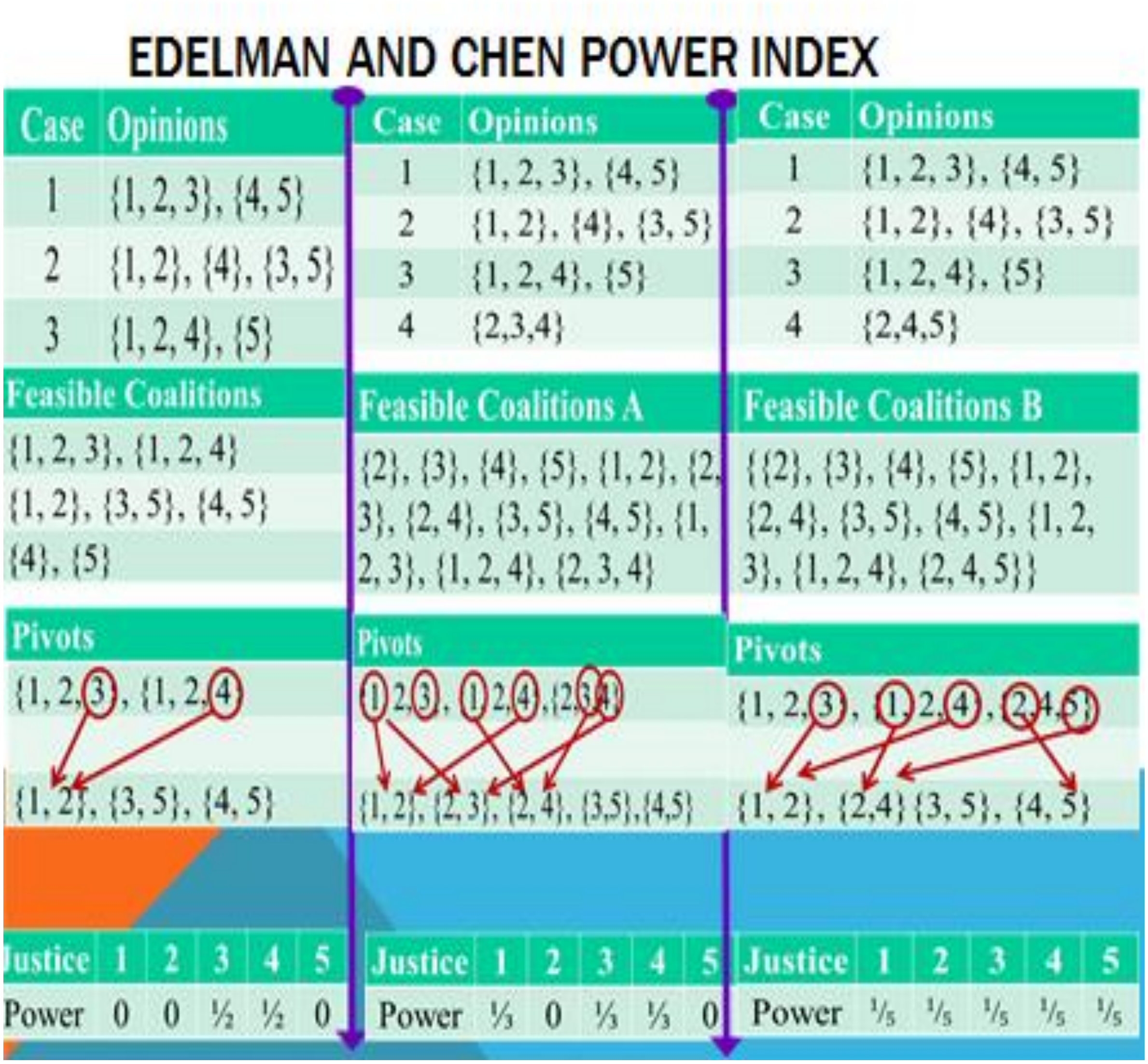


FIGURE 6

Once the feasible coalitions have been established, the opinion sets of size two are compared to the opinion sets of size three in order to determine who could have been the pivot vote because that would most likely come from the opinion set of size three(2, page 86). In figure 6 the first example is the opinion set that was established in figure 4. The diagram clearly shows that when the subset of {1, 2} is compared to the subsets of three judges, the subset of {1, 2} appears in both and so pivot votes are given to justice 3 and justice 4. The other subsets of two justices do not appear in the opinion sets of three justices. Therefore justice 3 and justice 4 are each awarded half of the power. The observed data will change and so therefore the feasible coalitions might change and this generates different powers for the judges. The next step was to figure out how adding sets to the observed data by adding more cases would change the power of the justices or subtracting cases.

PART 4 - SENSITIVITY ANALYSIS

Powers of the 5 Justices

	Justice 1	Justice 2	Justice 3	Justice 4	Justice 5	Opinion Sets Added or Subtracted from Observed Data
1	0	0	1/2	1/2	0	{}
2	0	0	1/2	1/2	0	{1}
3	0	0	1/2	1/2	0	{2}
4	0	0	1/2	1/2	0	{3}
5	0	1/3	1/3	1/3	0	{1,3}
6	0	1/3	1/3	1/3	0	1,4}
7	0	0	1/2	1/2	0	{1,5}
8	1/3	0	1/3	1/3	0	{2,3}
9	1/3	0	1/3	1/3	0	{2,4}
10	0	0	1/2	1/2	0	{2,5}
11	0	0	1/2	1/2	0	{3,4}
12	0	0	1/3	1/3	1/3	{1,2,5}
13	0	1/3	1/3	1/3	0	{1,3,4}
14	1/5	1/5	1/5	1/5	1/5	{1,3,5}
15	1/5	1/5	1/5	1/5	1/5	{1,4,5}
16	1/3	0	1/3	1/3	0	{2,3,4}
17	1/5	1/5	1/5	1/5	1/5	{2,3,5}
18	1/5	1/5	1/5	1/5	1/5	{2,4,5}
19	0	0	1/2	1/2	0	{3,4,5}
20	0	0	1/2	1/2	0	{1,2,3,4}
21	0	0	1/2	1/2	0	{1,2,3,5}
22	0	0	1/2	1/2	0	{1,2,4,5}
23	0	1/2	1/4	1/4	0	{1,3,4,5}
24	1/2	0	1/4	1/4	0	{2,3,4,5}
25	0	0	1/2	1/2	0	{1,2,3,4,5}
26	0	0	0	1	0	{1,2,3}
27	0	0	1/2	1/2	0	{4,5}
28	0	0	1/2	1/2	0	{1,2}
29	0	0	1/2	1/2	0	{4}
30	0	0	1/2	1/2	0	{3,5}
31	0	0	1	0	0	{1,2,4}
32	0	0	1/2	1/2	0	{5}

Added Opinion sets, which can come as a result of more cases

Subtracted opinion subsets which can come as a result of removing certain cases

FIGURE 7

Figure 7 shows how adding different opinions to the original data set changed the powers of the judges. The aim of the sensitivity analysis was to investigate how important the opinion and feasible coalitions were in calculating the Edelman and Chen power index.

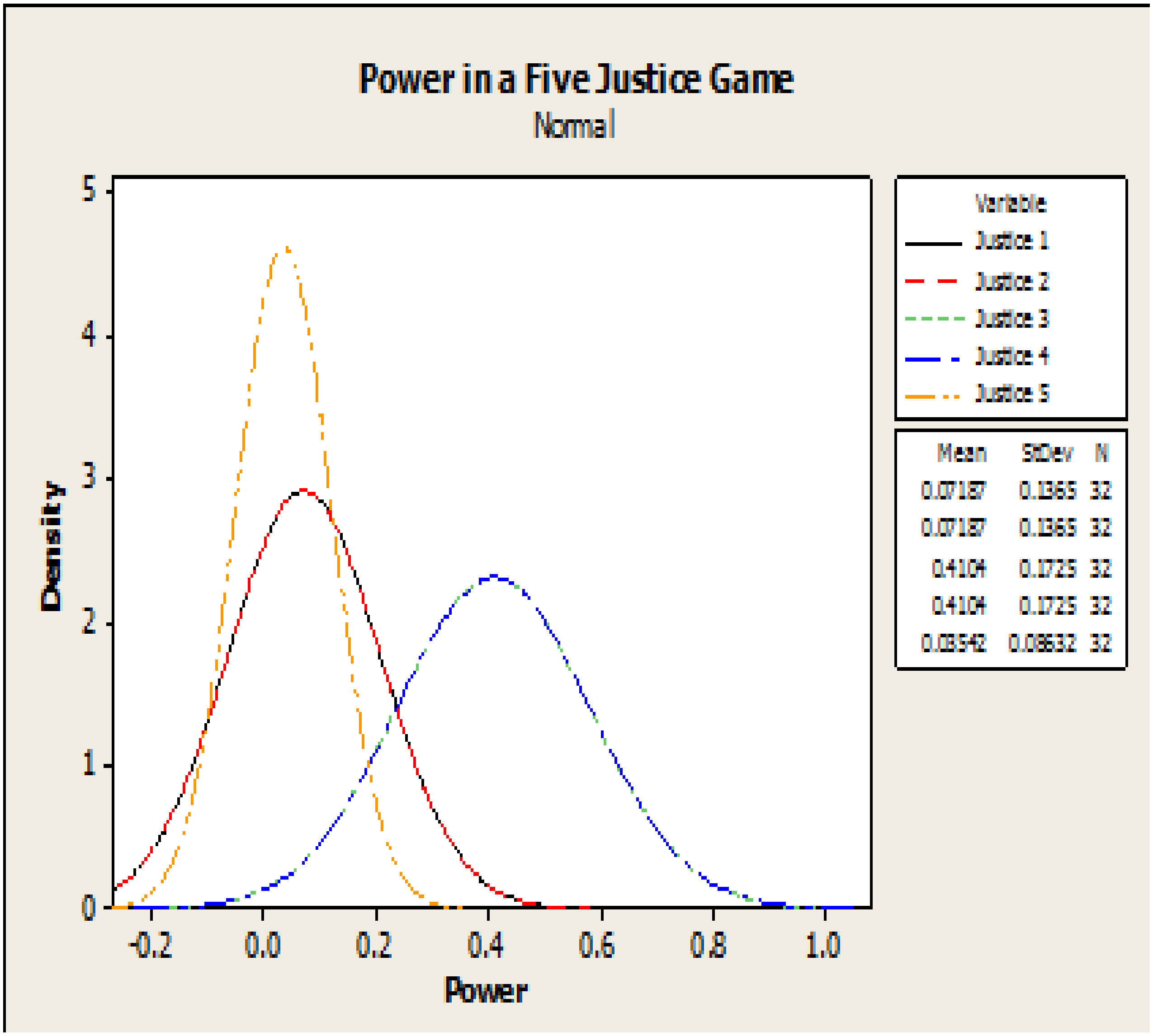


FIGURE 8

Figure 8 shows the different justices mean powers and a histogram drawn around those means using the standard deviation of the powers of each judge as well. It is important to notice that Justice 4 seems to show a high sensitivity to additions of subtractions of opinion sets, but this is not conclusive as the data sample is small. Justice 4 has the highest average in terms of power so it would seem in this case that they are the most powerful. Again a lot of overlapping may appear because the sample size is not large enough.

USA SUPREME COURT 1994 TERM

Using a similar approach the opinion set was generated from the Havard Law Review (2, page 79) of the 1994 term of the US Supreme Court and the generalized Banzhaf Index in the form of the Edelman and

Chen Power Index was used to calculate the powers and then a sensitivity analysis followed up. There are 512 possible opinion subsets that can be formed but only 308 were feasible coalitions from the observed data. Figure 9 shows the results of the sensitivity analysis from the opinion set generated by Edelman and Chen and figure 10 shows the results of the sensitivity analysis generated from the Spaith data set. The first observation is that both data sets are not sensitive to changes in the opinion sets and feasible coalitions and there is not too much overlap which would suggest that the model is a good one. The only concern is that the two different opinion sets give relatively different results and it is for the same Supreme Court term which brings to light a problem. The people doing the research decide what the observed data was which is the opinions of the justices. The interpretation of opinions in the US Supreme court can be different and that could mean different results. Figure 11 summarizes the results.

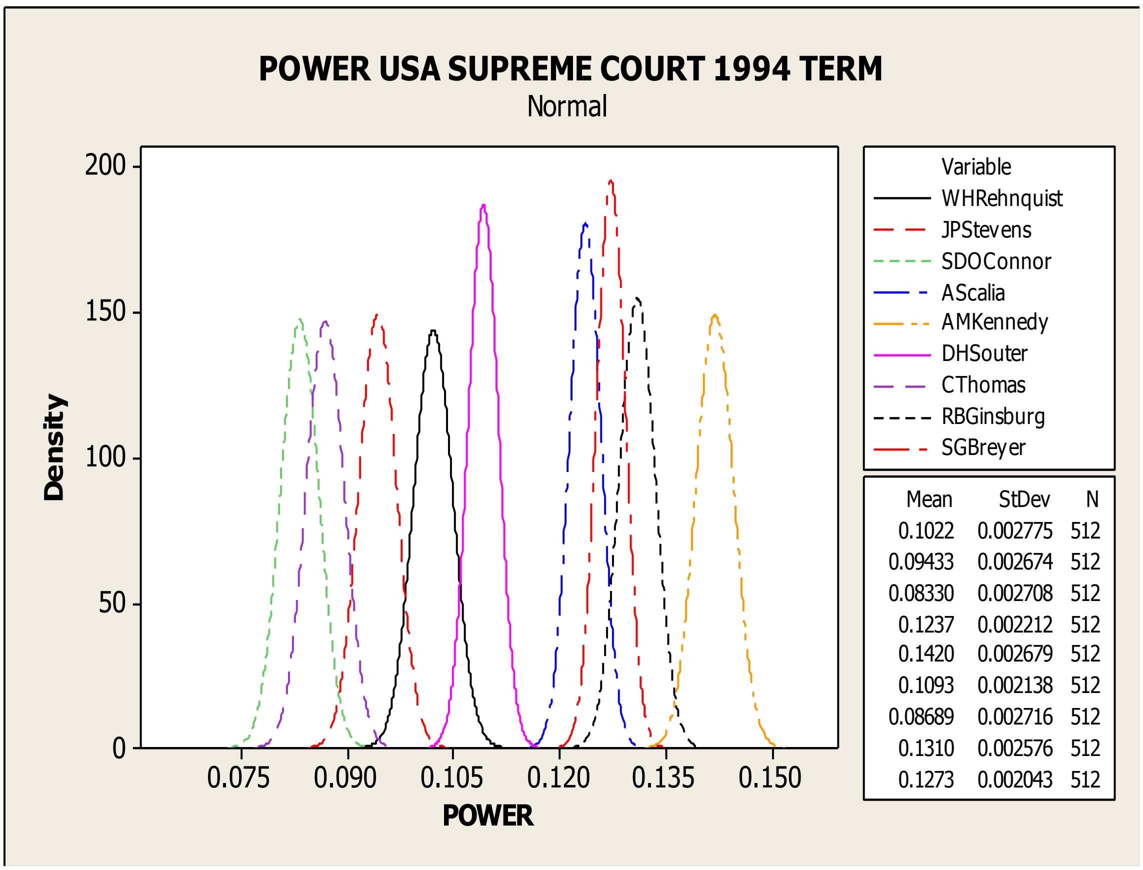


FIGURE 9

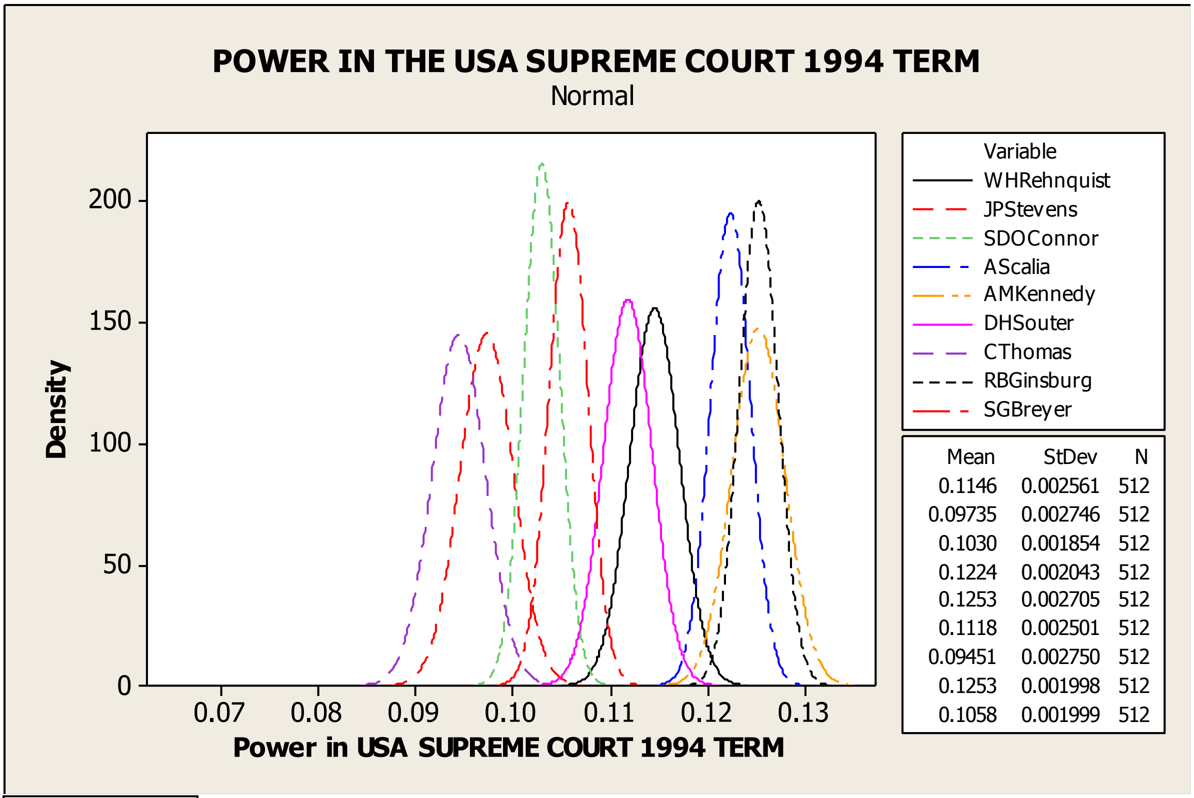


FIGURE 10

JUSTICE	Edelmen and Chen Dataset	Spaith Data set	Edelman and Chen Rank	Spaith Data Rank
WHRehnquist	10.2%	11.4%	6	4
JPStevens	9.4%	9.7%	7	8
SDOConnor	8.3%	10.3%	9	7
AScalia	12.4%	12.3%	4	3
AMKennedy	14.3%	12.6%	1	1
DHSouter	10.9%	11.1%	5	5
CThomas	8.6%	9.4%	8	9
RBGinsburg	13.2%	12.6%	2	1
SGBreyer	12.8%	10.6%	3	6

FIGURE 11

Acknowledgments

I would like to thank David Housman for his mentoring and guidance.

I would also like to thank Goshen College and its Maple Scholars program which provided funding for this project.

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