March Madness Basketball Turniment
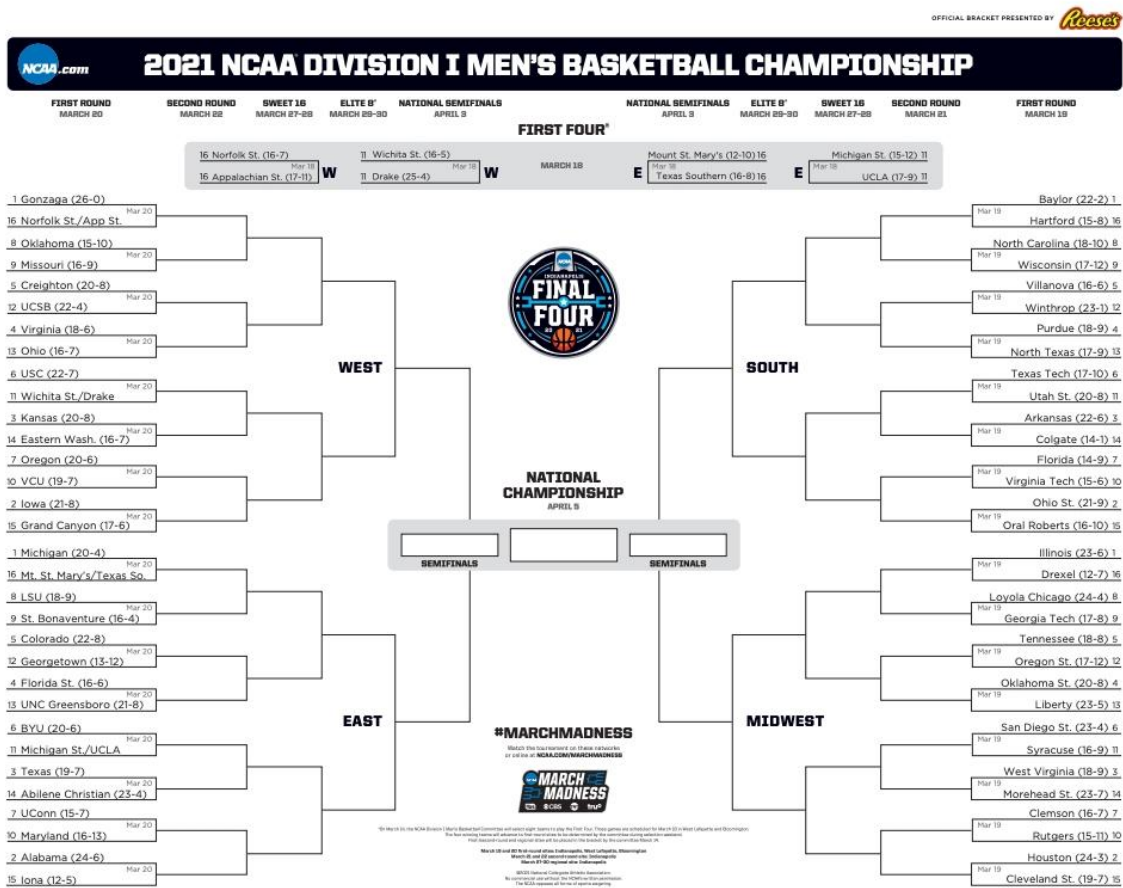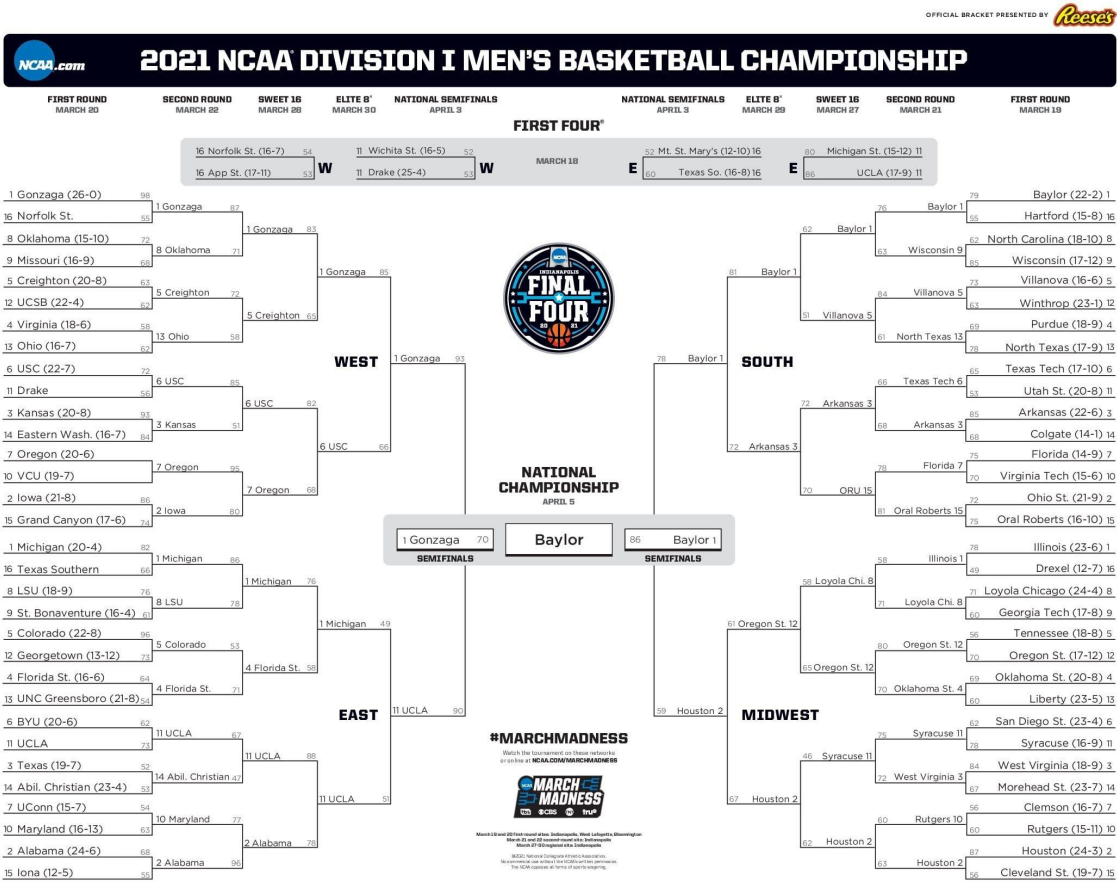
Sabrina Ball and Joe Despres

updated: 2021-04-15

Backround on March Madness Tournament

- First hosted in 1939 with 8 participating teams.

- Now, restricted to the top 64 qualifying NCAA division I teams.

- Currently 16.9 million viewers.

- Michigan State won in 1979 and 2000.

- Offices, organizations, and friend groups make and submit a total of 40 Million predictions each year.

- At the beginning small groups form and gamble on the outcomes by selecting winners and losers.

- Nobody has ever made a perfect bracket prediction and there are 2^{63} possible outcomes.

OFFICIAL BRACKET PRESENTED BY Reese's

2021 NCAA DIVISION I MEN'S BASKETBALL CHAMPIONSHIP

FIRST ROUND MARCH 20	SECOND ROUND MARCH 22	SWEET 16 MARCH 27-28	ELITE 8' MARCH 29-30	NATIONAL SEMIFINALS APRIL 3		NATIONAL SEMIFINALS APRIL 3	ELITE 8' MARCH 29-30	SWEET 16 MARCH 27-28	SECOND ROUND MARCH 21	FIRST ROUND MARCH 19

FIRST FOUR'

MARCH 18

16 Norfolk St. (16-7)
16 Appalachian St. (17-11)   Mar 18 **W**

11 Wichita St. (16-5)
11 Drake (25-4)   Mar 18 **W**

Mount St. Mary's (12-10) 16
Texas Southern (16-8) 16   Mar 18 **E**

Michigan St. (15-12) 11
UCLA (17-9) 11   Mar 18 **E**

WEST

1 Gonzaga (26-0)
16 Norfolk St./App St.   Mar 20
8 Oklahoma (15-10)
9 Missouri (16-9)   Mar 20
5 Creighton (20-8)
12 UCSB (22-4)   Mar 20
4 Virginia (18-6)
13 Ohio (16-7)   Mar 20
6 USC (22-7)
11 Wichita St./Drake   Mar 20
3 Kansas (20-8)
14 Eastern Wash. (16-7)   Mar 20
7 Oregon (20-6)
10 VCU (19-7)   Mar 20
2 Iowa (21-8)
15 Grand Canyon (17-6)   Mar 20

EAST

1 Michigan (20-4)
16 Mt. St. Mary's/Texas So.   Mar 20
8 LSU (18-9)
9 St. Bonaventure (16-4)   Mar 20
5 Colorado (22-8)
12 Georgetown (13-12)   Mar 20
4 Florida St. (16-6)
13 UNC Greensboro (21-8)   Mar 20
6 BYU (20-6)
11 Michigan St./UCLA   Mar 20
3 Texas (19-7)
14 Abilene Christian (23-4)   Mar 20
7 UConn (15-7)
10 Maryland (16-13)   Mar 20
2 Alabama (24-6)
15 Iona (12-5)   Mar 20

SOUTH

Baylor (22-2) 1
Hartford (15-8) 16   Mar 19
North Carolina (18-10) 8
Wisconsin (17-12) 9   Mar 19
Villanova (16-6) 5
Winthrop (23-1) 12   Mar 19
Purdue (18-9) 4
North Texas (17-9) 13   Mar 19
Texas Tech (17-10) 6
Utah St. (20-8) 11   Mar 19
Arkansas (22-6) 3
Colgate (14-1) 14   Mar 19
Florida (14-9) 7
Virginia Tech (15-6) 10   Mar 19
Ohio St. (21-9) 2
Oral Roberts (16-10) 15

MIDWEST

Illinois (23-6) 1
Drexel (12-7) 16   Mar 19
Loyola Chicago (24-4) 8
Georgia Tech (17-8) 9   Mar 19
Tennessee (18-8) 5
Oregon St. (17-12) 12   Mar 19
Oklahoma St. (20-8) 4
Liberty (23-5) 13   Mar 19
San Diego St. (23-4) 6
Syracuse (16-9) 11   Mar 19
West Virginia (18-9) 3
Morehead St. (23-7) 14   Mar 19
Clemson (16-7) 7
Rutgers (15-11) 10   Mar 19
Houston (24-3) 2
Cleveland St. (19-7) 15

FINAL FOUR
INDIANAPOLIS

NATIONAL CHAMPIONSHIP
APRIL 5

SEMIFINALS | | SEMIFINALS

#MARCHMADNESS
Watch the tournament on these networks or online at NCAA.COM/MARCHMADNESS

MARCH MADNESS
CBS TBS truP

OFFICIAL BRACKET PRESENTED BY Reese's

2021 NCAA DIVISION I MEN'S BASKETBALL CHAMPIONSHIP

| FIRST ROUND MARCH 20 | SECOND ROUND MARCH 22 | SWEET 16 MARCH 28 | ELITE 8 MARCH 30 | NATIONAL SEMIFINALS APRIL 3 | | NATIONAL SEMIFINALS APRIL 3 | ELITE 8 MARCH 29 | SWEET 16 MARCH 27 | SECOND ROUND MARCH 21 | FIRST ROUND MARCH 19 |

FIRST FOUR

| 16 Norfolk St. (16-7) 54 | | 11 Wichita St. (16-5) 52 | | MARCH 18 | E | 52 Mt. St. Mary's (12-10) 16 | | 80 Michigan St. (15-12) 11 |
| 16 App St. (17-11) 53 | W | 11 Drake (25-4) 53 | W | | | 60 Texas So. (16-8) 16 | E | 86 UCLA (17-9) 11 |

1 Gonzaga (26-0) 98
16 Norfolk St. 55
8 Oklahoma (15-10) 72
9 Missouri (16-9) 68
5 Creighton (20-8) 63
12 UCSB (22-4) 62
4 Virginia (18-6) 58
13 Ohio (16-7) 62
6 USC (22-7) 72
11 Drake 56
3 Kansas (20-8) 93
14 Eastern Wash. (16-7) 84
7 Oregon (20-6)
10 VCU (19-7)
2 Iowa (21-8) 86
15 Grand Canyon (17-6) 74

1 Gonzaga 87
8 Oklahoma 71
5 Creighton 72
13 Ohio 58
6 USC 85
3 Kansas 51
7 Oregon 95
2 Iowa 80

1 Gonzaga 83
5 Creighton 65
6 USC 82
7 Oregon 68

1 Gonzaga 85
6 USC 66

WEST

1 Gonzaga 93

FINAL FOUR

1 Michigan (20-4) 82
16 Texas Southern 66
8 LSU (18-9) 76
9 St. Bonaventure (16-4) 61
5 Colorado (22-8) 96
12 Georgetown (13-12) 73
4 Florida St. (16-6) 64
13 UNC Greensboro (21-8) 54
6 BYU (20-6) 62
11 UCLA 73
3 Texas (19-7) 52
14 Abil. Christian (23-4) 53
7 UConn (15-7) 54
10 Maryland (16-13) 63
2 Alabama (24-6) 68
15 Iona (12-5) 55

1 Michigan 86
8 LSU 78
5 Colorado 53
4 Florida St. 71
11 UCLA 67
14 Abil. Christian 47
10 Maryland 77
2 Alabama 96

1 Michigan 76
4 Florida St. 58
11 UCLA 88
2 Alabama 78

1 Michigan 49
11 UCLA 51

EAST

11 UCLA 90

NATIONAL CHAMPIONSHIP
APRIL 5

| 1 Gonzaga | 70 | Baylor | 86 | Baylor 1 |
| SEMIFINALS | | | | SEMIFINALS |

#MARCHMADNESS
Watch the tournament on these networks
or online at NCAA.COM/MARCHMADNESS

MARCH MADNESS
🅣ⓑ⊛CBS ⓣⓣⓥ truᴛⱽ

March 18 and 20 first-round sites: Indianapolis, West Lafayette, Bloomington
March 21 and 22 second-round site: Indianapolis
March 27-30 regional site: Indianapolis

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The NCAA opposes all forms of sports wagering.

1 Gonzaga 70

78 Baylor 1

SOUTH

81 Baylor 1

72 Arkansas 3

79 Baylor (22-2) 1
55 Hartford (15-8) 16
62 North Carolina (18-10) 8
85 Wisconsin (17-12) 9
73 Villanova (16-6) 5
63 Winthrop (23-1) 12
69 Purdue (18-9) 4
78 North Texas (17-9) 13
65 Texas Tech (17-10) 6
53 Utah St. (20-8) 11
85 Arkansas (22-6) 3
68 Colgate (14-1) 14
75 Florida (14-9) 7
70 Virginia Tech (15-6) 10
72 Ohio St. (21-9) 2
75 Oral Roberts (16-10) 15

76 Baylor 1
63 Wisconsin 9
84 Villanova 5
61 North Texas 13
66 Texas Tech 6
68 Arkansas 3
78 Florida 7
81 Oral Roberts 15

62 Baylor 1
51 Villanova 5
72 Arkansas 3
70 ORU 15

86 Baylor 1

59 Houston 2

MIDWEST

61 Oregon St. 12

67 Houston 2

78 Illinois (23-6) 1
49 Drexel (12-7) 16
71 Loyola Chicago (24-4) 8
60 Georgia Tech (17-8) 9
56 Tennessee (18-8) 5
70 Oregon St. (17-12) 12
60 Oklahoma St. (20-8) 4
60 Liberty (23-5) 13
62 San Diego St. (23-4) 6
78 Syracuse (16-9) 11
84 West Virginia (18-9) 3
67 Morehead St. (23-7) 14
56 Clemson (16-7) 7
60 Rutgers (15-11) 10
87 Houston (24-3) 2
56 Cleveland St. (19-7) 15

58 Loyola Chi. 8
71 Loyola Chi. 8
80 Oregon St. 12
70 Oklahoma St. 4
75 Syracuse 11
72 West Virginia 3
60 Rutgers 10
63 Houston 2

58 Illinois 1
65 Oregon St. 12
46 Syracuse 11
62 Houston 2

Zoomed in

```
 1 Gonzaga (26-0)      98
                            1 Gonzaga      87
16 Norfolk St.         55
                                                1 Gonzaga      83
 8 Oklahoma (15-10)    72
                            8 Oklahoma     71
 9 Missouri (16-9)     68
                                                                1 Gonzaga   85
 5 Creighton (20-8)    63
                            5 Creighton    72
12 UCSB (22-4)         62
                                                5 Creighton    65
 4 Virginia (18-6)     58
                           13 Ohio         58
13 Ohio (16-7)         62
```

We use basketball season game scores and statistics to predict this year's tournament outcome.

We need to derive a scoring metric.

Evaluate and tune the model.

Compare the model's performance.

We made several models, in the interest of time we are going to discuss the logistic because its the most straight-forward.

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file:///Users/josephdespres/Documents/MSU/STT-864_Statistical_Methods_II/March-Madness/slides/slides.html#1   Page 7 of 26

Three-Points Goals

Percentage of Goals Scored
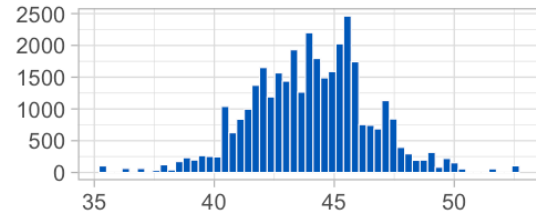
Rebounds Per Game
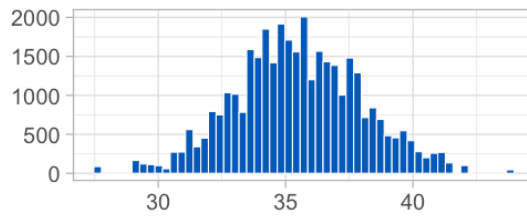
Steals Per Game
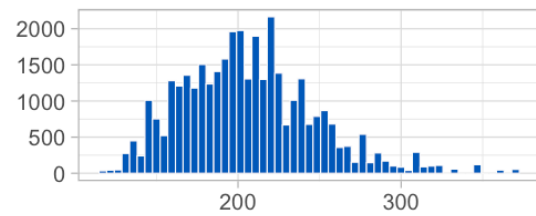
Turnovers Per Game
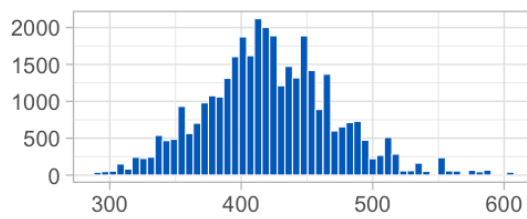
Blocks Per Game
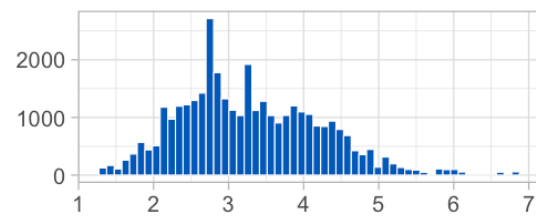
Real Quick Descriptive Statisticcs

	Mean	Median	Std. Dev	Min	Max
Field Goal Percentage	44.03	44.10	2.46	35.4	52.60
Free Throw Percentage	70.65	70.60	3.73	58.0	80.20
Rebounds Per Game	35.48	35.35	2.49	27.6	43.81
Steals	206.34	202.00	40.59	116.0	369.00
Turnovers	421.84	419.00	49.01	290.0	604.00
Blocked Shots Per Game	3.30	3.20	0.94	1.3	6.80

Games Played	Teams	Turniment
35248	343	64

- Normal-ish distributions.

- No catastrophic skews or heavy tails.

- Ideally we would have had steaks and turn-overs per game rather than season total. Not all played the same game.

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Logistic Model

$$\text{win} \sim \textit{Bernoulli} \left(\text{prob}_{\text{win}=1} = \hat{P} \right)$$

$$\log\left[\frac{\hat{P}}{1-\hat{P}} \right] = \beta_0 + \beta_1(\text{x3fg}) +$$

$$\beta_2(\text{opposingx3fg}) + \beta_3(\text{fg\_percent}) +$$
$$\beta_4(\text{opposingfg\_percent}) + \beta_5(\text{ft\_percent}) +$$
$$\beta_6(\text{opposingft\_percent}) + \beta_7(\text{rpg}) +$$
$$\beta_8(\text{opposingrpg}) + \beta_9(\text{st}) +$$
$$\beta_{10}(\text{opposingst}) + \beta_{11}(\text{to}) +$$
$$\beta_{12}(\text{opposingto}) + \beta_{13}(\text{opposingbkpg}) +$$
$$\beta_{14}(\text{bkpg})$$

Summary

Term	Estimate	Std. Error	T-Stat	P-Value
Intercept	-0.333	0.523	-0.636	0.52498
Three Pointers	0.002	0.000	8.832	0.00000
O* Three Pointers	-0.003	0.000	-9.161	0.00000
Field Goal Percentage	0.183	0.005	33.439	0.00000
O* Field Goal Percentage	-0.176	0.005	-32.748	0.00000
Free-throw percentage	0.032	0.004	9.106	0.00000
O* Free-throw percentage	-0.031	0.004	-8.718	0.00000
Rebounds	0.143	0.005	26.359	0.00000
O* Rebounds	-0.145	0.005	-26.736	0.00000
Steals	0.007	0.000	19.885	0.00000
O* Steals	-0.006	0.000	-19.700	0.00000
Turnovers	-0.006	0.000	-21.856	0.00000
O* Turnovers	0.006	0.000	21.558	0.00000
Blocks	-0.143	0.014	-10.188	0.00000
O* Blocks	0.165	0.014	11.652	0.00000

Where O* is the Mertric associated with their opposing team

	LRT	DEViance
Stat	8194.126	40659.49
P Value	0.000	0.00

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Scoring

$$\sum_{i=1}^{n} \left[\mathbf{1}_{\{correct\ prediction\}} \hat{p}_i - \mathbf{1}_{incorrect\ perdiction} \hat{p}_i \right] = Model\ Score$$

- Basketball games are often quite close and odds in betting markets are often close to 1:1.

- Our goal is to weight correct prediction higher when it assigns a higher probability. Conversely, a lower score to an incorrect prediction.

- If our predictions are no better than randomly guessing $E(Model\ Score) = 0$.

Scoring

$$\sum_{i=1}^{n} [\mathbf{1}_{\{correct\ prediction\}} \hat{p}_i - \mathbf{1}_{incorrect\ perdiction} \hat{p}_i] = Model\ Score$$

Minimal Example

Game	Predicted Winner	Winner	$\grave{}\hat{p}\grave{}$	Score
Abilenechristian Vs. Texas	Abilenechristian	Abilenechristian	0.52	0.52
Abilenechristian Vs. Ucla	Abilenechristian	Ucla	0.39	-0.61
Arkansas Vs. Baylor	Baylor	Baylor	0.53	0.53
Baylor Vs. Gonzaga	Gonzaga	Baylor	0.30	-0.70
Clevelandst Vs. Houston	Houston	Houston	0.87	0.87
Colgate Vs. Arkansas	Colgate	Arkansas	0.28	-0.72
Colorado Vs. Floridast	Floridast	Floridast	0.63	0.63
Creighton Vs. Gonzaga	Gonzaga	Gonzaga	0.80	0.80
Drexel Vs. Illinois	Illinois	Illinois	0.71	0.71
Easternwash Vs. Kansas	Easternwash	Kansas	0.43	-0.57

Scoring

$$\sum_{i=1}^{n} [\mathbf{1}_{\{correct\ prediction\}}\hat{p}_i - \mathbf{1}_{incorrect\ perdiction}\hat{p}_i] = Model\ Score$$

Correct Predictions

Game	Predicted Winner	Winner	`$\hat{p}$`	Score
Abilenechristian Vs. Texas	Abilenechristian	Abilenechristian	0.52	0.52
Abilenechristian Vs. Ucla	Abilenechristian	Ucla	0.39	-0.61
Arkansas Vs. Baylor	Baylor	Baylor	0.53	0.53
Baylor Vs. Gonzaga	Gonzaga	Baylor	0.30	-0.70
Clevelandst Vs. Houston	Houston	Houston	0.87	0.87
Colgate Vs. Arkansas	Colgate	Arkansas	0.28	-0.72
Colorado Vs. Floridast	Floridast	Floridast	0.63	0.63
Creighton Vs. Gonzaga	Gonzaga	Gonzaga	0.80	0.80
Drexel Vs. Illinois	Illinois	Illinois	0.71	0.71
Easternwash Vs. Kansas	Easternwash	Kansas	0.43	-0.57

Scoring

$$\sum_{i=1}^{n}[\mathbf{1}_{\{correct\ prediction\}}\hat{p}_i - \mathbf{1}_{incorrect\ perdiction}\hat{p}_i] = Model\ Score$$
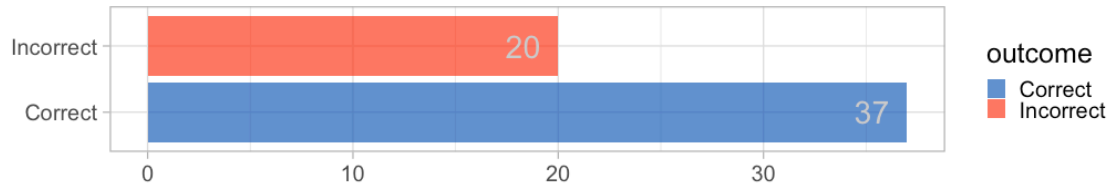
Incorrect Predictions

Game	Predicted Winner	Winner	`$\hat{p}$`	Score
Abilenechristian Vs. Texas	Abilenechristian	Abilenechristian	0.52	0.52
Abilenechristian Vs. Ucla	Abilenechristian	Ucla	0.39	-0.61
Arkansas Vs. Baylor	Baylor	Baylor	0.53	0.53
Baylor Vs. Gonzaga	Gonzaga	Baylor	0.30	-0.70
Clevelandst Vs. Houston	Houston	Houston	0.87	0.87
Colgate Vs. Arkansas	Colgate	Arkansas	0.28	-0.72
Colorado Vs. Floridast	Floridast	Floridast	0.63	0.63
Creighton Vs. Gonzaga	Gonzaga	Gonzaga	0.80	0.80
Drexel Vs. Illinois	Illinois	Illinois	0.71	0.71
Easternwash Vs. Kansas	Easternwash	Kansas	0.43	-0.57

Scoring

$$\sum_{i=1}^{n} [\mathbf{1}_{\{correct\ prediction\}}\hat{p}_i - \mathbf{1}_{incorrect\ perdiction}\hat{p}_i] = Model\ Score$$

Score

| Game	Predicted Winner	Winner	$\hat{p}$	Score
Abilenechristian Vs. Texas	Abilenechristian	Abilenechristian	0.52	0.52
Abilenechristian Vs. Ucla	Abilenechristian	Ucla	0.39	-0.61
Arkansas Vs. Baylor	Baylor	Baylor	0.53	0.53
Baylor Vs. Gonzaga	Gonzaga	Baylor	0.30	-0.70
Clevelandst Vs. Houston	Houston	Houston	0.87	0.87
Colgate Vs. Arkansas	Colgate	Arkansas	0.28	-0.72
Colorado Vs. Floridast	Floridast	Floridast	0.63	0.63
Creighton Vs. Gonzaga	Gonzaga	Gonzaga	0.80	0.80
Drexel Vs. Illinois	Illinois	Illinois	0.71	0.71
Easternwash Vs. Kansas	Easternwash	Kansas	0.43	-0.57

$\sum_i Score$

Model Score = 1.46

Histogram of Scores
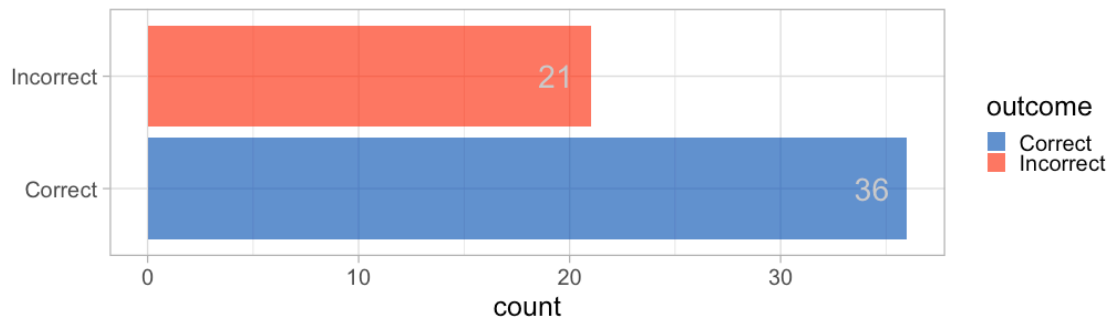
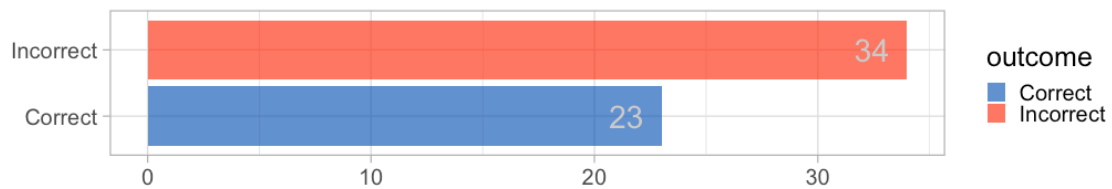| Result	Score			
Correct	24.71	Total Score	11.24
Incorrect	-13.47	Standard Error	0.65
Total	11.24	T-Statistic	17.17
		P-value	0.00

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Model Performance

#1 Poisson Model

#2 Logistic Model
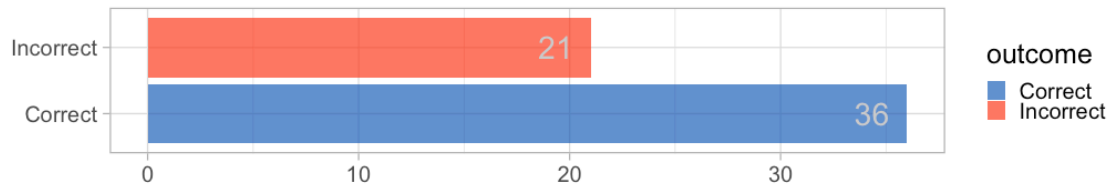
#3 Multinomeal Model

Conclusion

Both Logistic and Poisson Regression perform well.

However, we are scoring the model based on independent predictions. While real-world predictions are made dependent on the previous round.

These predictions are not wildly different than betting markets and seeds because they use similar statistics to derive their predictions.