March Madness Basketball Tournament

Sabrina Ball and Joe Despres

updated: 2021-04-17

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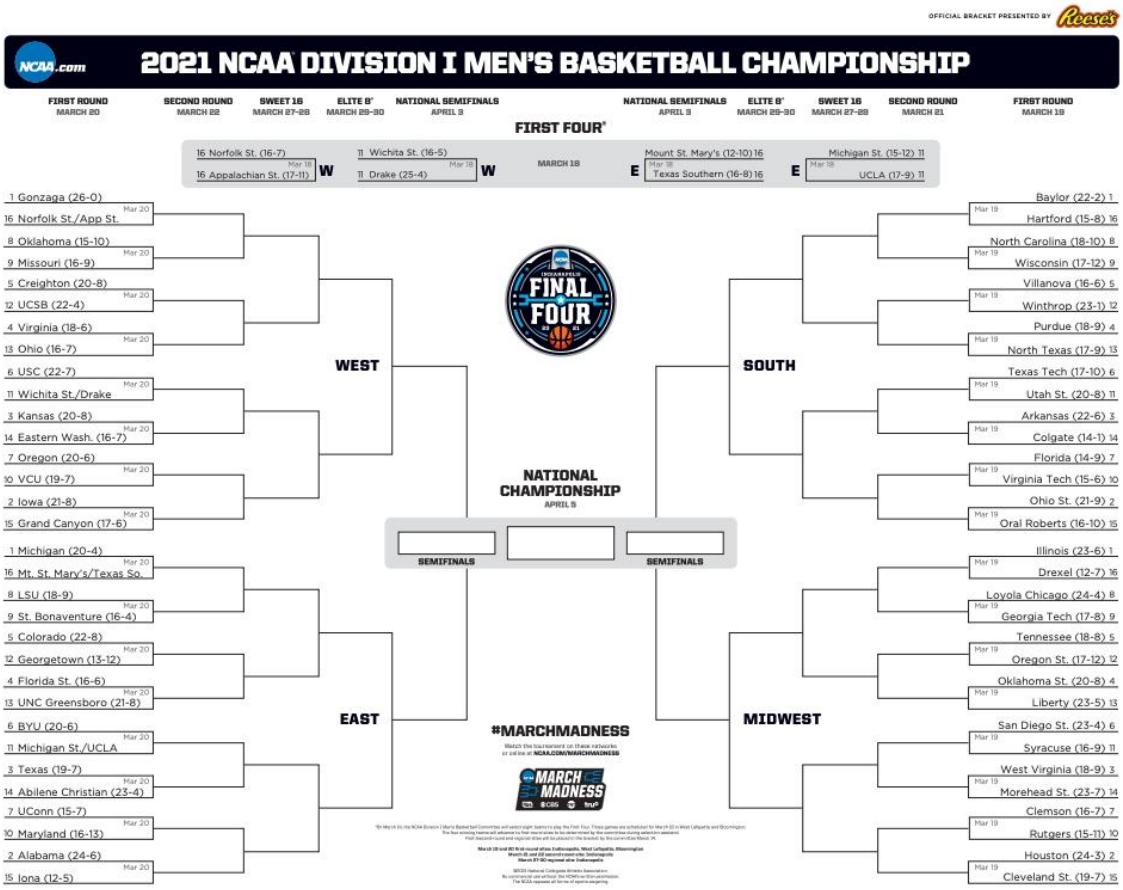
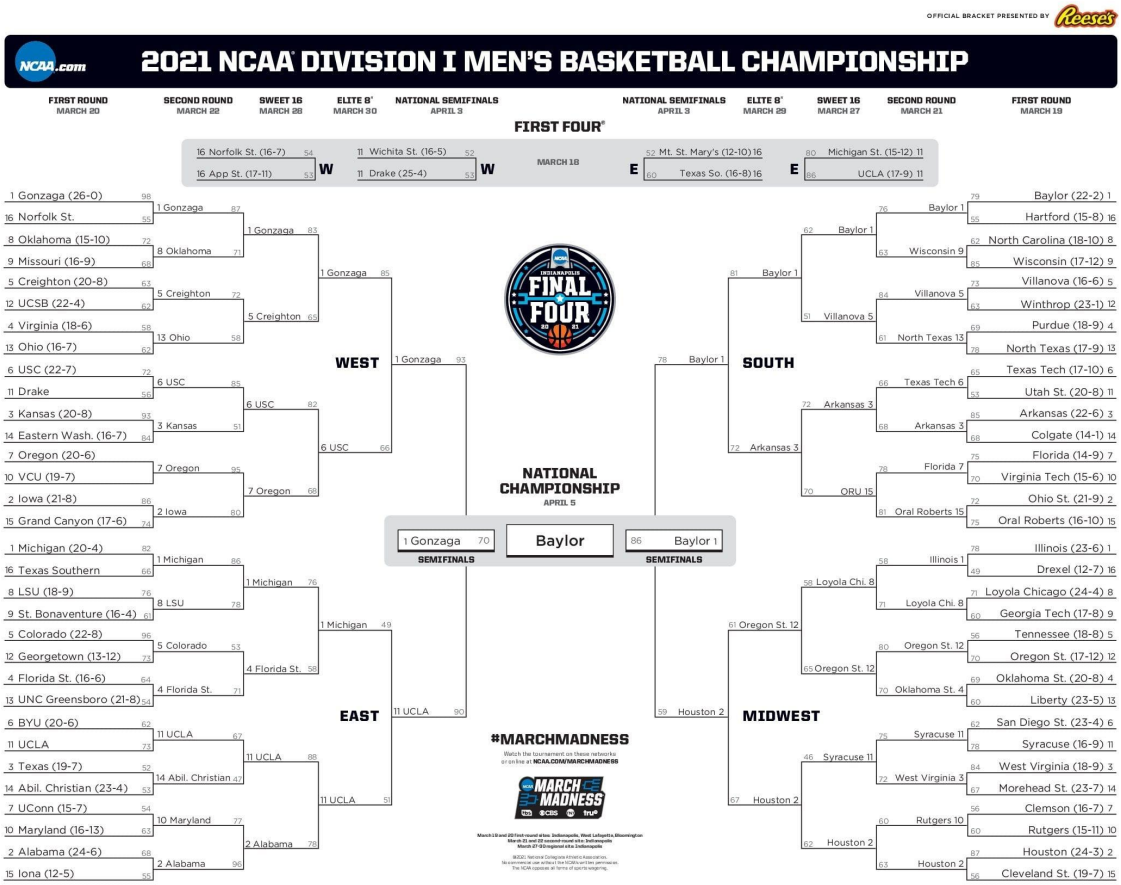
NCAA
MARCH
MADNESS

Background 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
NCAA.com
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
FIRST FOUR
16 Norfolk St. (16-7)
16 Appalachian St. (17-11)
W
11 Wichita St. (16-5)
11 Drake (25-4)
W
MARCH 18
Mount St. Mary's (12-10) 16
Texas Southern (16-8) 16
E
Michigan St. (15-12) 11
UCLA (17-9) 11
E
1 Gonzaga (26-0)
16 Norfolk St./App St.
8 Oklahoma (15-10)
9 Missouri (16-9)
5 Creighton (20-8)
12 UCSB (22-4)
4 Virginia (18-6)
13 Ohio (16-7)
6 USC (22-7)
11 Wichita St./Drake
3 Kansas (20-8)
14 Eastern Wash. (16-7)
7 Oregon (20-6)
10 VCU (19-7)
2 Iowa (21-8)
15 Grand Canyon (17-6)
WEST
1 Michigan (20-4)
16 Mt. St. Mary's/Texas So.
8 LSU (18-9)
9 St. Bonaventure (16-4)
5 Colorado (22-8)
12 Georgetown (13-12)
4 Florida St. (16-6)
13 UNC Greensboro (21-8)
6 BYU (20-6)
11 Michigan St./UCLA
3 Texas (19-7)
14 Abilene Christian (23-4)
7 UConn (15-7)
10 Maryland (16-13)
2 Alabama (24-6)
15 Iona (12-5)
EAST
INDIANAPOLIS FINAL FOUR
NATIONAL CHAMPIONSHIP
APRIL 5
SEMIFINALS
SEMIFINALS
#MARCHMADNESS
MARCH MADNESS
Baylor (22-2) 1
Hartford (15-8) 16
North Carolina (18-10) 8
Wisconsin (17-12) 9
Villanova (16-6) 5
Winthrop (23-1) 12
Purdue (18-9) 4
North Texas (17-9) 13
Texas Tech (17-10) 6
Utah St. (20-8) 11
Arkansas (22-6) 3
Colgate (14-1) 14
Florida (14-9) 7
Virginia Tech (15-6) 10
Ohio St. (21-9) 2
Oral Roberts (16-10) 15
SOUTH
Illinois (23-6) 1
Drexel (12-7) 16
Loyola Chicago (24-4) 8
Georgia Tech (17-8) 9
Tennessee (18-8) 5
Oregon St. (17-12) 12
Oklahoma St. (20-8) 4
Liberty (23-5) 13
San Diego St. (23-4) 6
Syracuse (16-9) 11
West Virginia (18-9) 3
Morehead St. (23-7) 14
Clemson (16-7) 7
Rutgers (15-11) 10
Houston (24-3) 2
Cleveland St. (19-7) 15
MIDWEST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ELITE 8® MARCH 29
SWEET 16 MARCH 27
SECOND ROUND MARCH 21
FIRST ROUND MARCH 19
FIRST FOUR®
MARCH 18
16 Norfolk St. (16-7) 54
16 App St. (17-11) 53
W
11 Wichita St. (16-5) 52
11 Drake (25-4) 53
W
52 Mt. St. Mary's (12-10) 16
60 Texas So. (16-8) 16
E
80 Michigan St. (15-12) 11
86 UCLA (17-9) 11
E
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 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 Gonzaga 87
8 Oklahoma 71
5 Creighton 72
13 Ohio 58
6 USC 85
3 Kansas 51
7 Oregon 95
2 Iowa 80
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 Gonzaga 83
5 Creighton 65
6 USC 82
7 Oregon 68
1 Michigan 76
4 Florida St. 58
11 UCLA 88
2 Alabama 78
1 Gonzaga 85
6 USC 66
1 Michigan 49
11 UCLA 51
WEST
EAST
1 Gonzaga 93
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 truTV
78 Baylor 1
59 Houston 2
SOUTH
MIDWEST
81 Baylor 1
72 Arkansas 3
61 Oregon St. 12
67 Houston 2
Baylor 1 79
Hartford (15-8) 16
North Carolina (18-10) 8
Wisconsin (17-12) 9
Villanova (16-6) 5
Winthrop (23-1) 12
Purdue (18-9) 4
North Texas (17-9) 13
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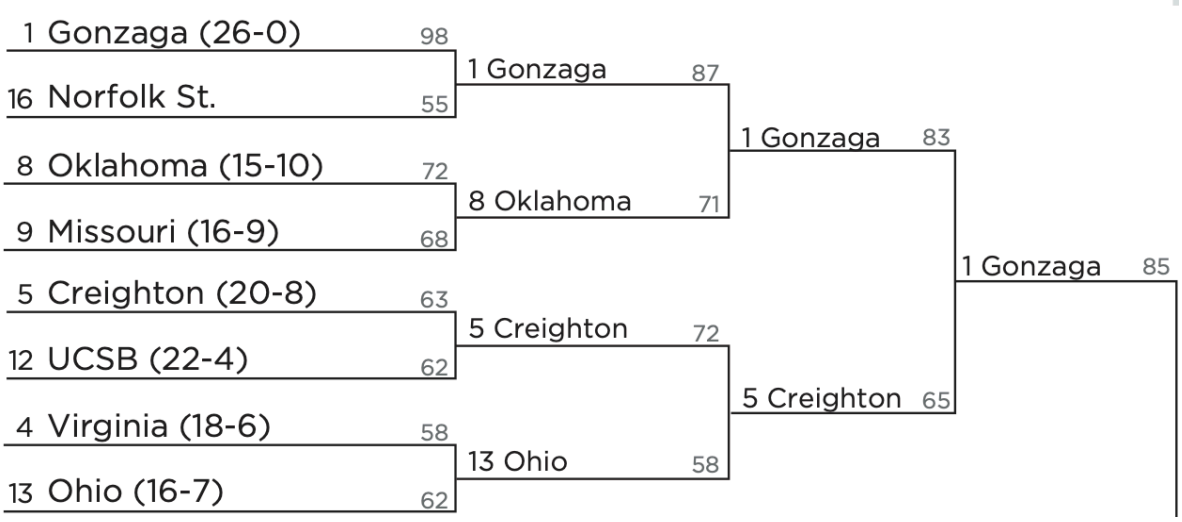
Morehead St. (23-7) 14
Clemson (16-7) 7
Rutgers (15-11) 10
Houston (24-3) 2
Cleveland St. (19-7) 15
76 Baylor 1
55 Hartford (15-8) 16
62 Baylor 1
63 Wisconsin 9
84 Villanova 5
51 Villanova 5
61 North Texas 13
66 Texas Tech 6
53 Utah St. 11
72 Arkansas 3
68 Arkansas 3
78 Florida 7
70 ORU 15
81 Oral Roberts 15
58 Illinois 1
49 Loyola Chi. 8
71 Loyola Chi. 8
60 Oregon St. 12
65 Oregon St. 12
70 Oklahoma St. 4
75 Syracuse 11
46 Syracuse 11
72 West Virginia 3
60 Rutgers 10
62 Houston 2
63 Houston 2

Zoomed in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4 Virginia (18-6) 58
13 Ohio (16-7) 62
1 Gonzaga 87
8 Oklahoma 71
5 Creighton 72
13 Ohio 58
1 Gonzaga 83
5 Creighton 65
1 Gonzaga 85

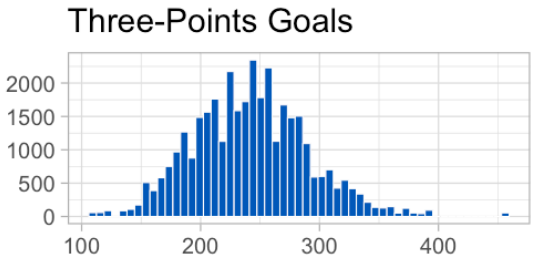
We use basketball season game scores and statistics to predict this year's tournament outcome.

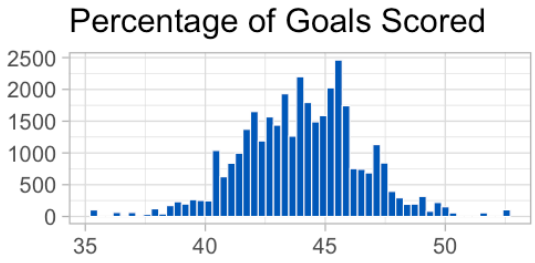
We need to derive a scoring metric.

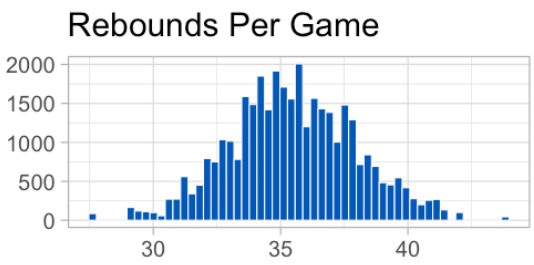
Evaluate and tune the model.

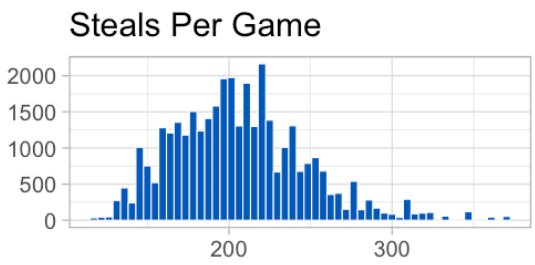
Compare the model's performance.

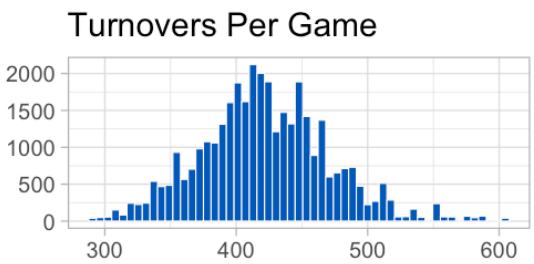
We made several models, in the interest of time we are going to discuss the logistic because its the most straight-forward.

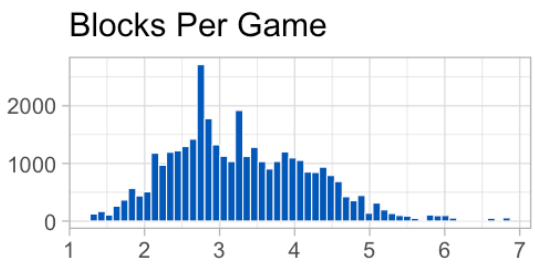

Three-Points Goals
2000
1500
1000
500
0
100
200
300
400


Percentage of Goals Scored
2500
2000
1500
1000
500
0
35
40
45
50


Rebounds Per Game
2000
1500
1000
500
0
30
35
40


Steals Per Game
2000
1500
1000
500
0
200
300


Turnovers Per Game
2000
1500
1000
500
0
300
400
500
600


Blocks Per Game
2000
1000
0
1
2
3
4
5
6
7

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.

Logistic Model

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

$$\log\left[\frac{\hat{P}}{1-\hat{P}}\right] = \beta_0 + \beta_1(\text{x3fg}) + \beta_2(\text{opposingx3fg}) + \beta_3(\text{fg\_percent}) + \beta_4(\text{opposingfg\_percent}) + \beta_5(\text{ft\_percent}) + \beta_6(\text{opposingft\_percent}) + \beta_7(\text{rpg}) + \beta_8(\text{opposingrpg}) + \beta_9(\text{st}) + \beta_{10}(\text{opposingst}) + \beta_{11}(\text{to}) + \beta_{12}(\text{opposingto}) + \beta_{13}(\text{opposingbkpg}) + \beta_{14}(\text{bkpg})$$

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

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

- 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	`$\hat{p}$`	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

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

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
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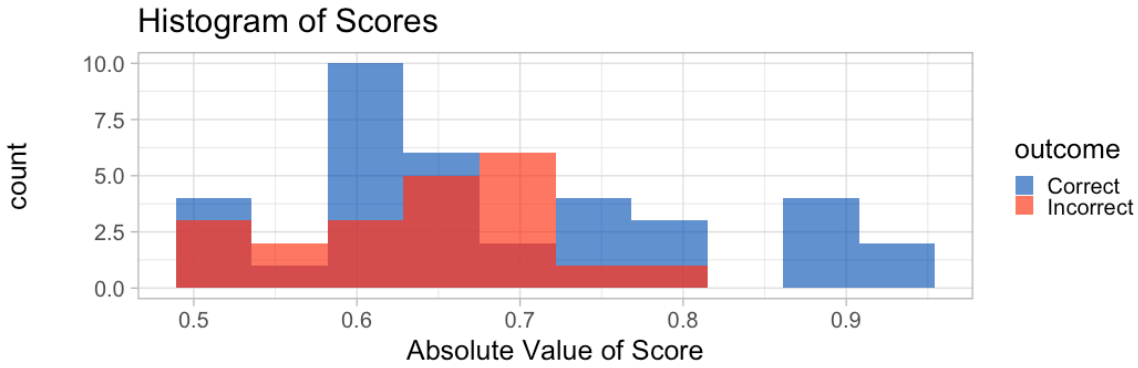
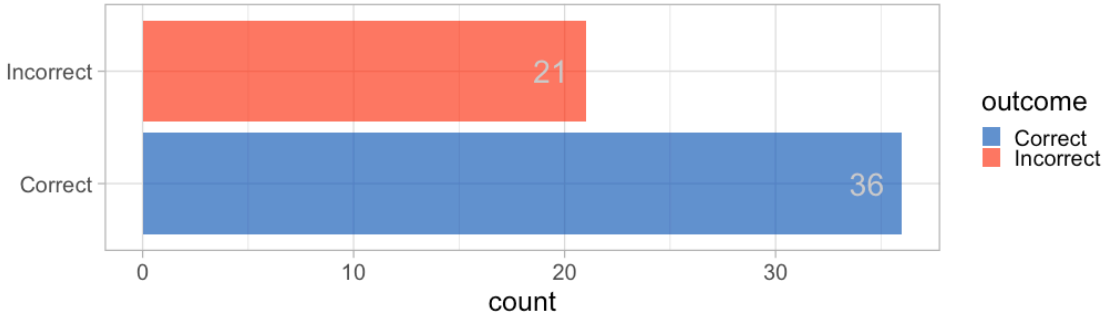
Drexel Vs. Illinois	Illinois	Illinois	0.71	0.71
Easternwash Vs. Kansas	Easternwash	Kansas	0.43	-0.57

`$\sum_i Score$`
Model Score = 1.46

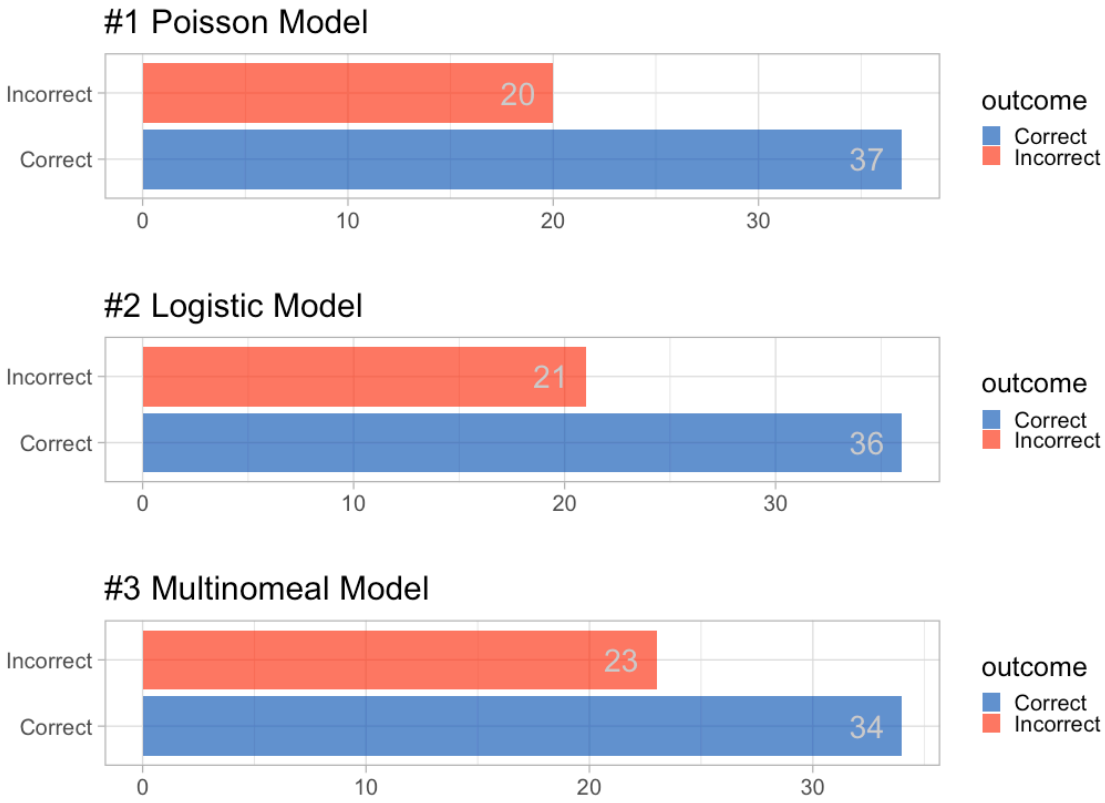




Result	Score
Correct	24.71
Incorrect	-13.47
Total	11.24

Total Score	11.24
Standard Error	0.65
T-Statistic	17.17
P-value	0.00

Model Performance



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.

References

Faraway, Julian James. Extending the Linear Model with R: Generalized Linear, Mixed Effects and Nonparametric Regression Models. Chapman & Hall/CRC, 2016.