Predicting UFC Fight Outcomes with Machine Learning: A Case Study

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Purpose

- Predictive modelling was used to find the likelihood of a match being by KO/Submission or by Judge Decision between two fighters.

- Target Audience:
  - Betting agencies can adjust their odds accordingly
  - Individuals can use this information when betting

Background

- The UFC (Ultimate Fighting Championship) is a mixed martial arts organization that features highly skilled fighters from around the world competing against each other in a variety of weight classes.
- Data was taken from the last 10 years of the Lightweight category and assessed to predict the likelihood of a match resulting in a KO/Submission or Judge Decision.

Data Overview and Data Pre-processing

Overview of Data

- Data was obtained from Kaggle
  - https://www.kaggle.com/datasets/fatismajli/ufc-data
- UFC Events Data
  - Data on each event and their results
  - *771 rows x 11 cols*
- UFC Fighter Data
  - Data on each UFC fighter and their attributes
  - *1692 rows x 8 cols*

Overview of Data – UFC Fighter Data

	First Name	Last Name	Nickname	Height	Weight	Reach	Stance	Wins	Losses	Draws
0	Tom	Aaron	NaN	--	155 lbs.	--	NaN	5	3	0
1	Danny	Abbadi	The Assassin	5' 11"	155 lbs.	--	Orthodox	4	6	0
2	Nariman	Abbasov	Bayraktar	5' 8"	155 lbs.	66.0"	Orthodox	28	4	0
3	David	Abbott	Tank	6' 0"	265 lbs.	--	Switch	10	15	0
4	Hamdy	Abdelwahab	The Hammer	6' 2"	264 lbs.	72.0"	Southpaw	5	0	0

Overview of Data – UFC Event Data

	Event Name	Event Date	Result	Fighter1	Fighter2	KD	Strikes	TD	Sub	Weight Class	Method	Round	Time
11	UFC 286: Edwards vs. Usman 3	2023-03-18	Justin Gaethje	Justin Gaethje	Rafael Fiziev	0-0	103-97	1-0	0-0	Lightweight	M-DEC	3	5.000000
16	UFC 286: Edwards vs. Usman 3	2023-03-18	Chris Duncan	Chris Duncan	Omar Morales	0-0	53-47	5-0	0-0	Lightweight	S-DEC	3	5.000000
17	UFC 286: Edwards vs. Usman 3	2023-03-18	Yanal Ashmouz	Yanal Ashmouz	Sam Patterson	0-0	15-2	1-0	0-0	Lightweight	KO/TKO-Punches	1	1.250000
23	UFC 286: Edwards vs. Usman 3	2023-03-18	Draw	Jai Herbert	Ludovit Klein	0-0	43-47	1-2	0-0	Lightweight	M-DEC	3	5.000000
41	UFC 285: Jones vs. Gane	2023-03-04	Mateusz Gamrot	Mateusz Gamrot	Jalin Turner	0-1	29-40	4-0	0-0	Lightweight	S-DEC	3	5.000000

Overview of Data – Data Cleaning

Object (string)

Integers & Floats

	First Name	Last Name	~~Nickname~~	Height	Weight	Reach	~~Stance~~	Wins	Losses	Draws
0	Tom	Aaron	~~NaN~~	--	155 lbs.	--	~~NaN~~	5	3	0
1	Danny	Abbadi	~~The Assassin~~	5' 11"	155 lbs.	--	~~Orthodox~~	4	6	0
2	Nariman	Abbasov	~~Bayraktar~~	5' 8"	155 lbs.	66.0"	~~Orthodox~~	28	4	0
3	David	Abbott	~~Tank~~	6' 0"	265 lbs.	--	~~Switch~~	10	15	0
4	Hamdy	Abdelwahab	~~The Hammer~~	6' 2"	264 lbs.	72.0"	~~Southpaw~~	5	0	0

Overview of Data – Data Cleaning

Target variable

	~~Event Name~~	Event Date	Result	Fighter1	Fighter2	KD	Strikes	TD	Sub	Weight Class	Method	Round	Time
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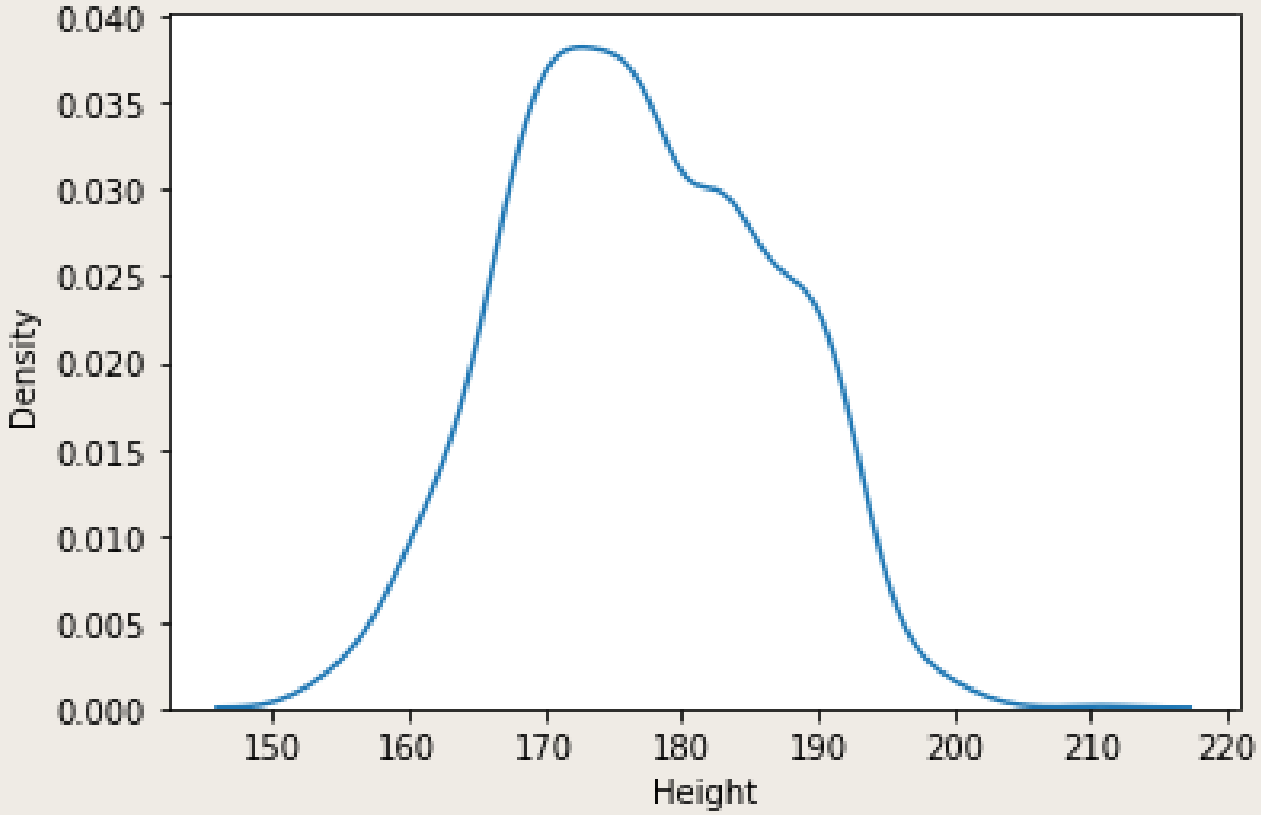
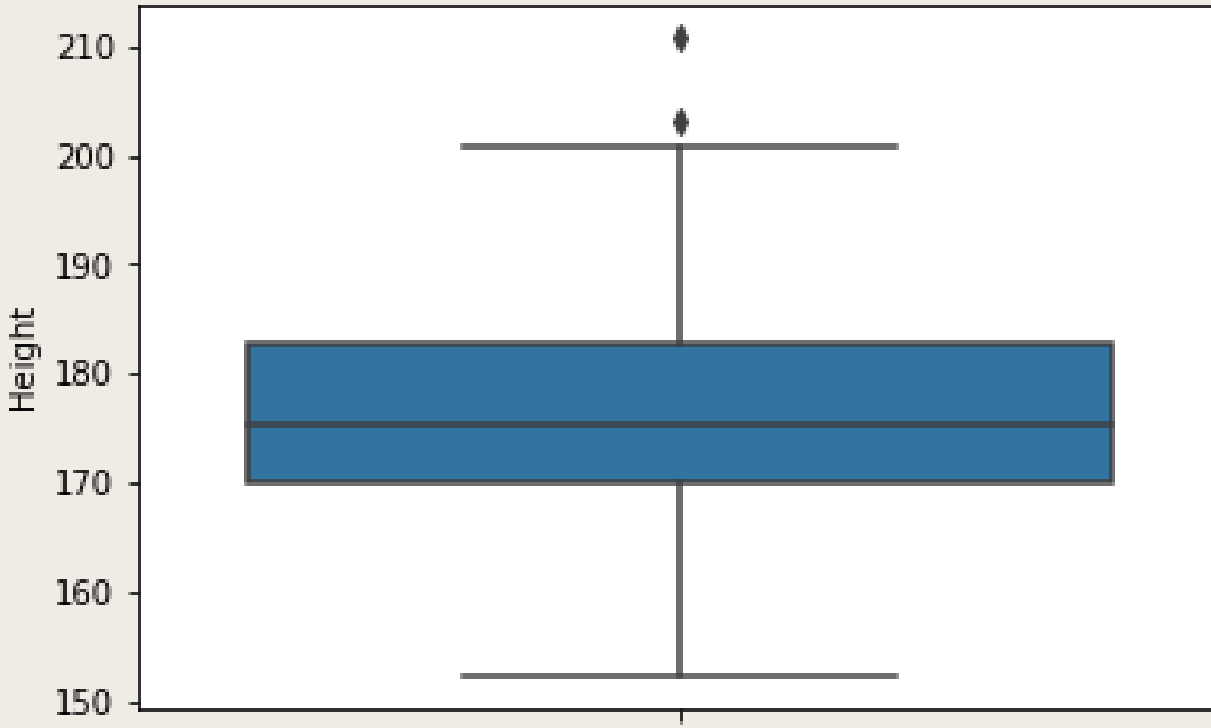
Overview of Data – Summary Statistics
UFC Fighter Summary Statistics





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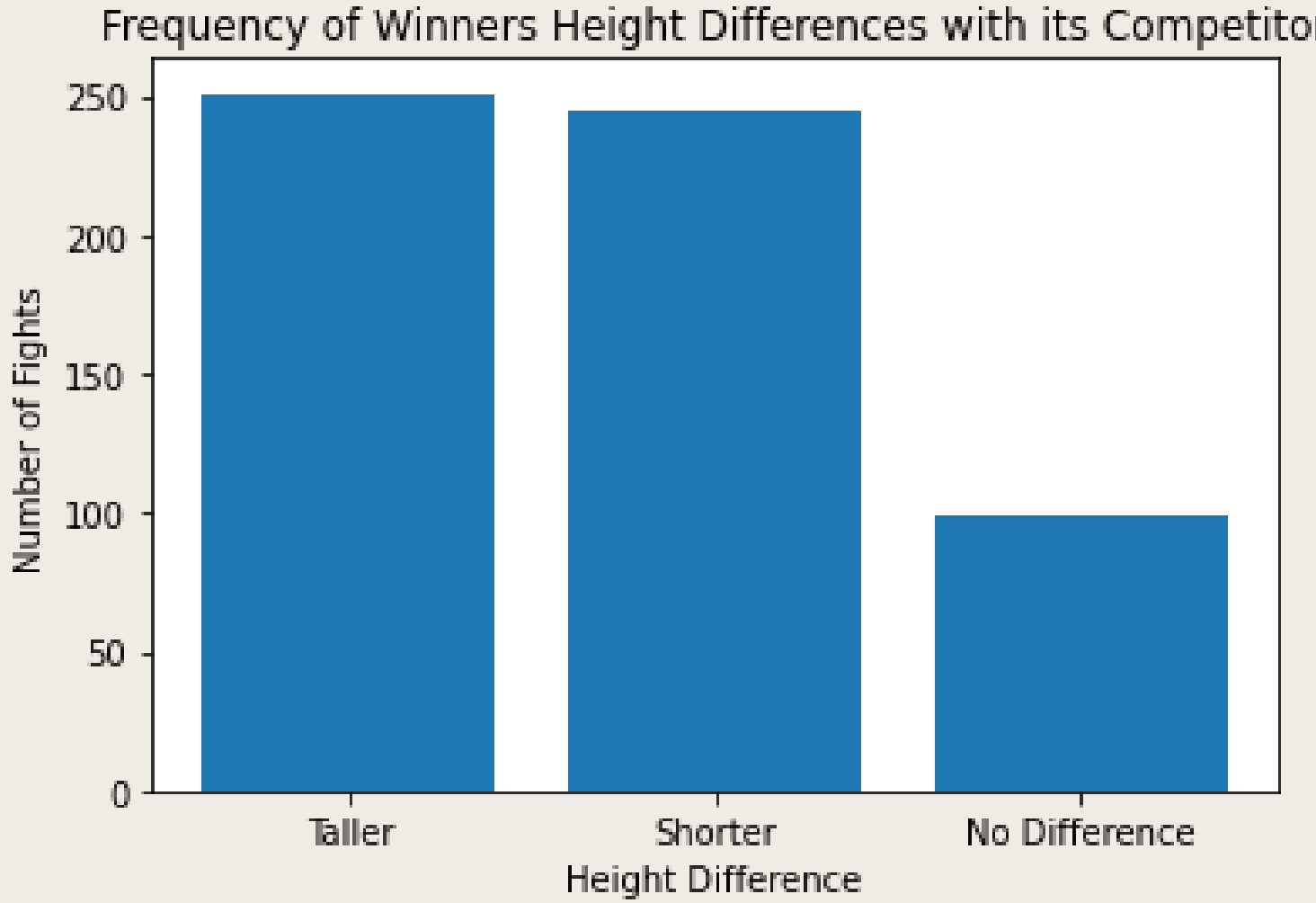
UFC Fighter Summary Statistics



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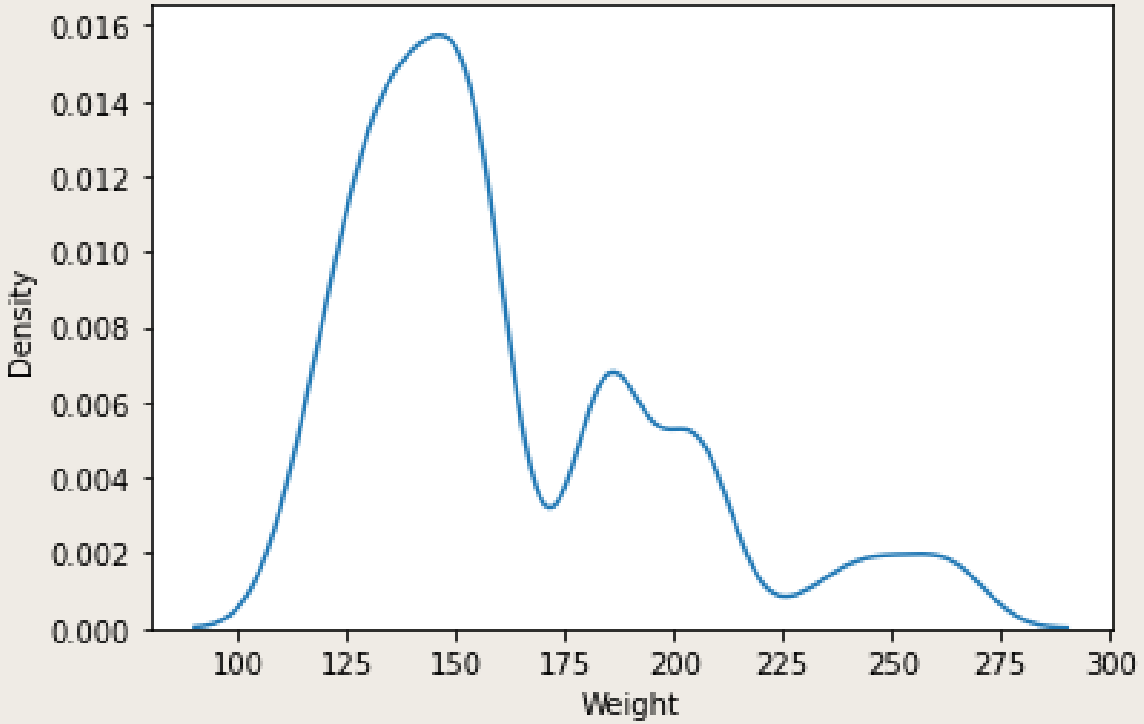

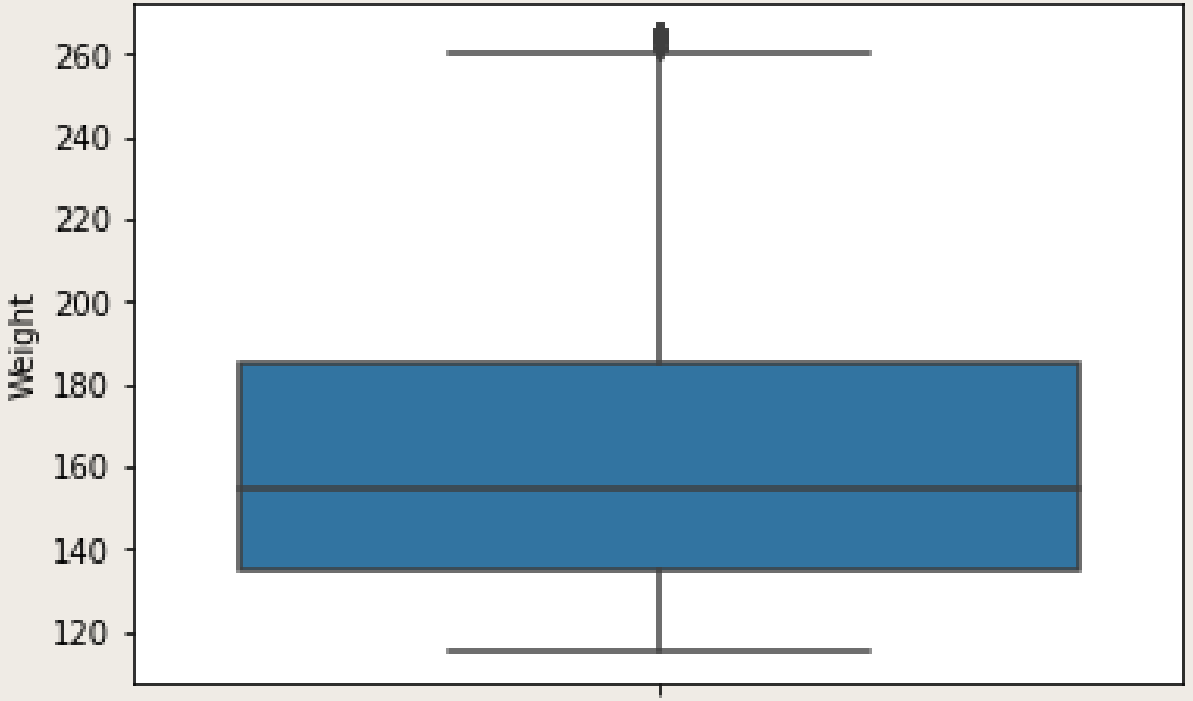

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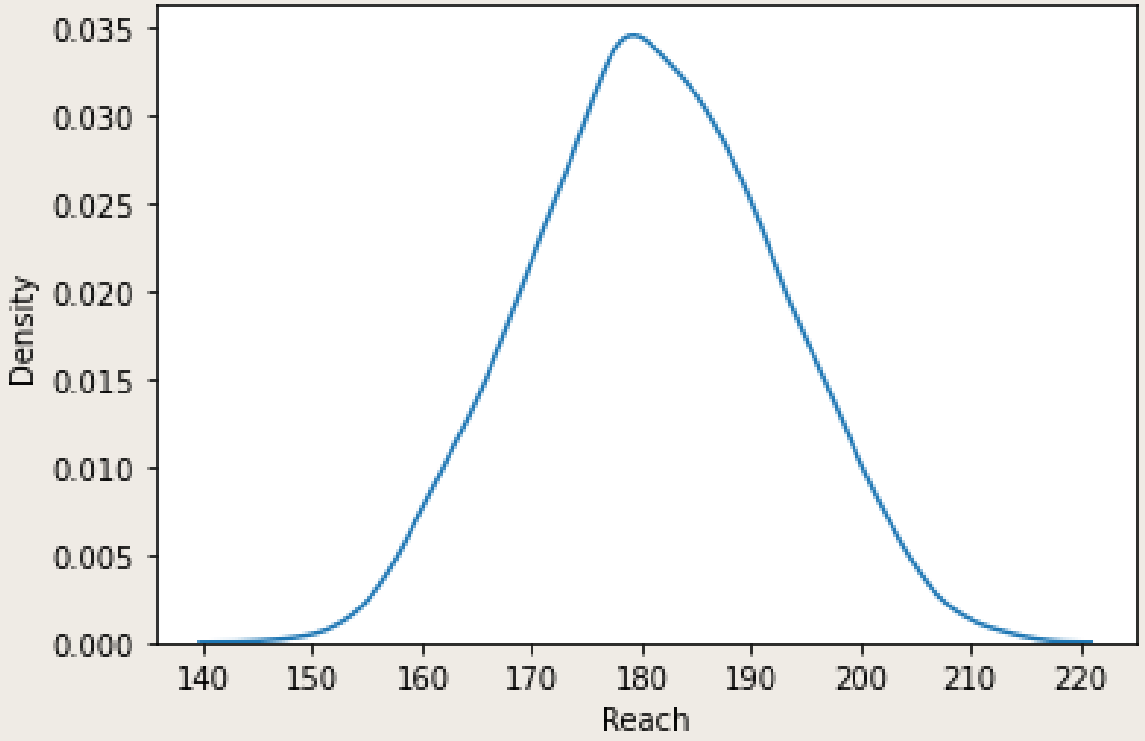

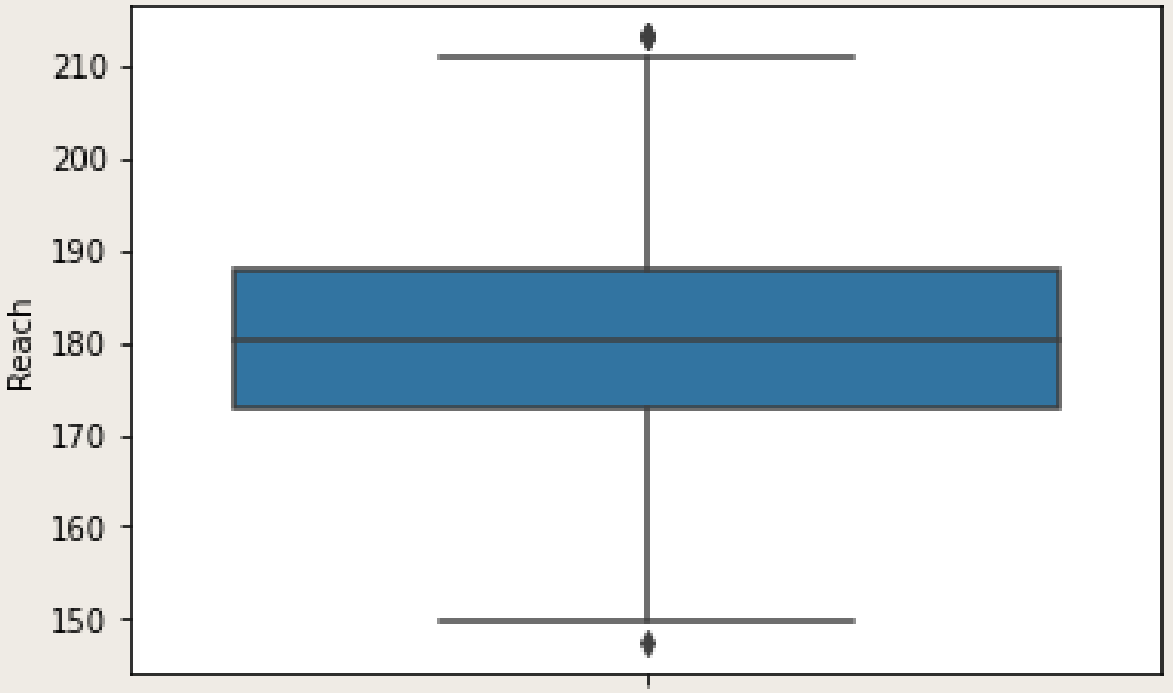

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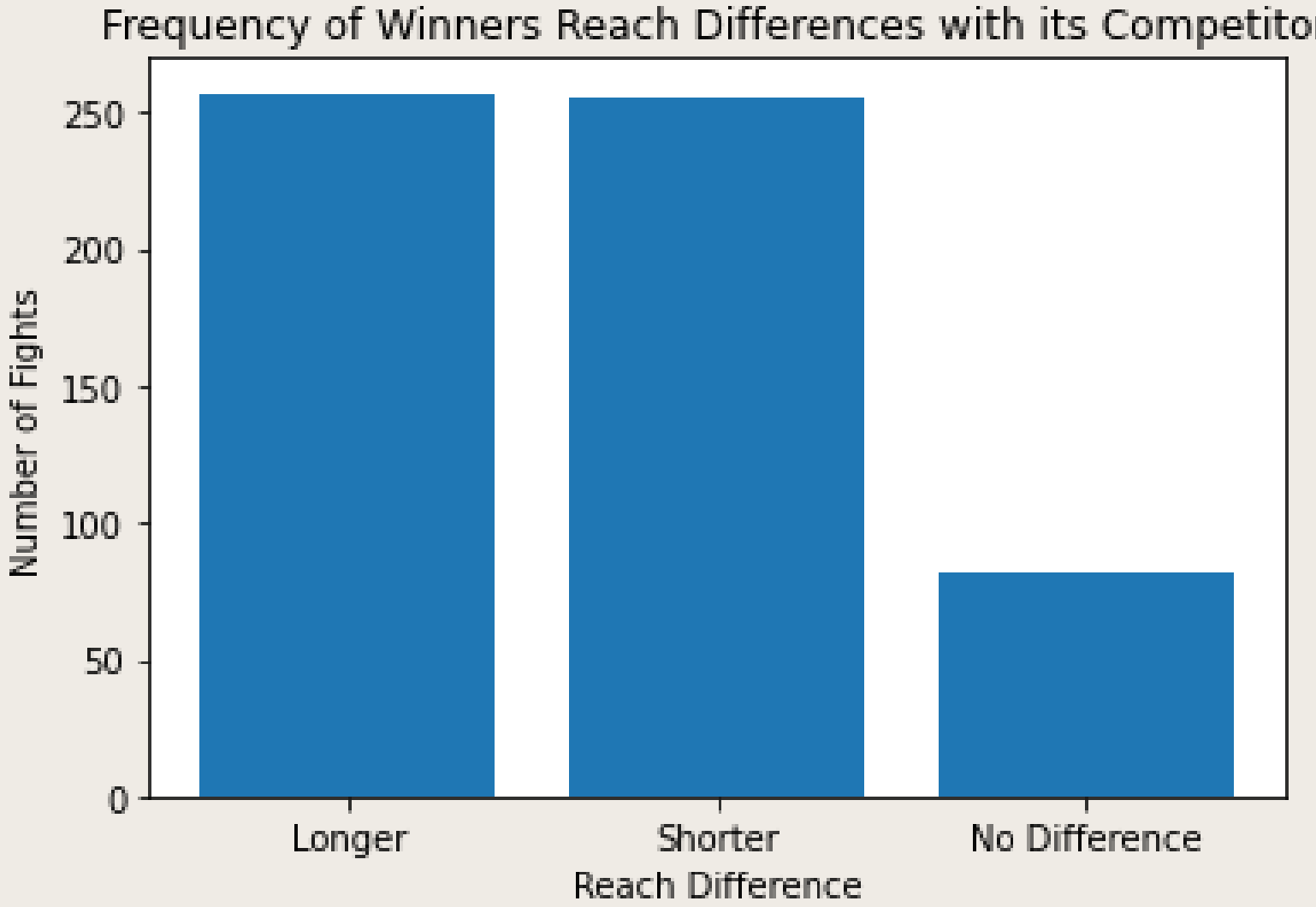

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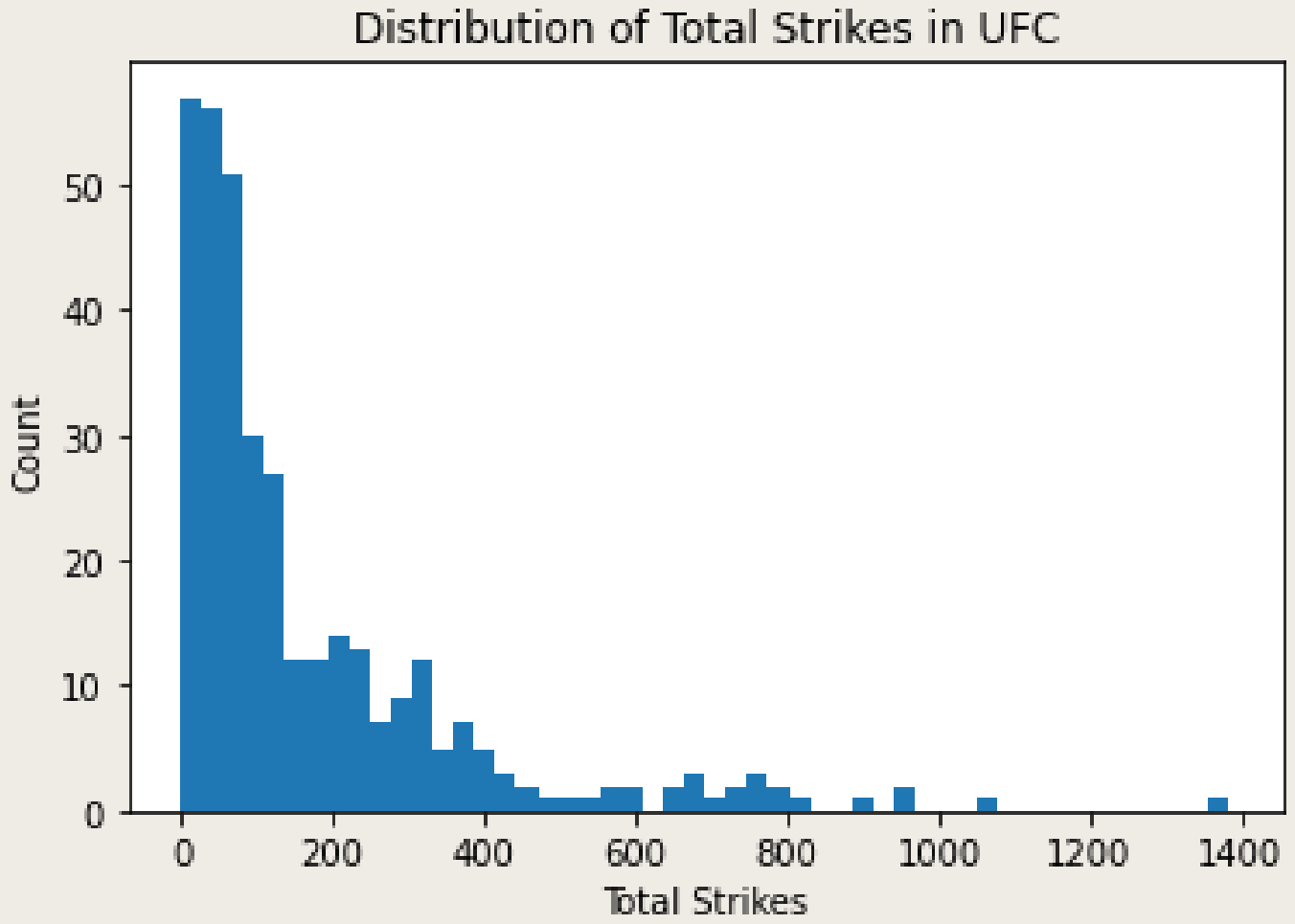

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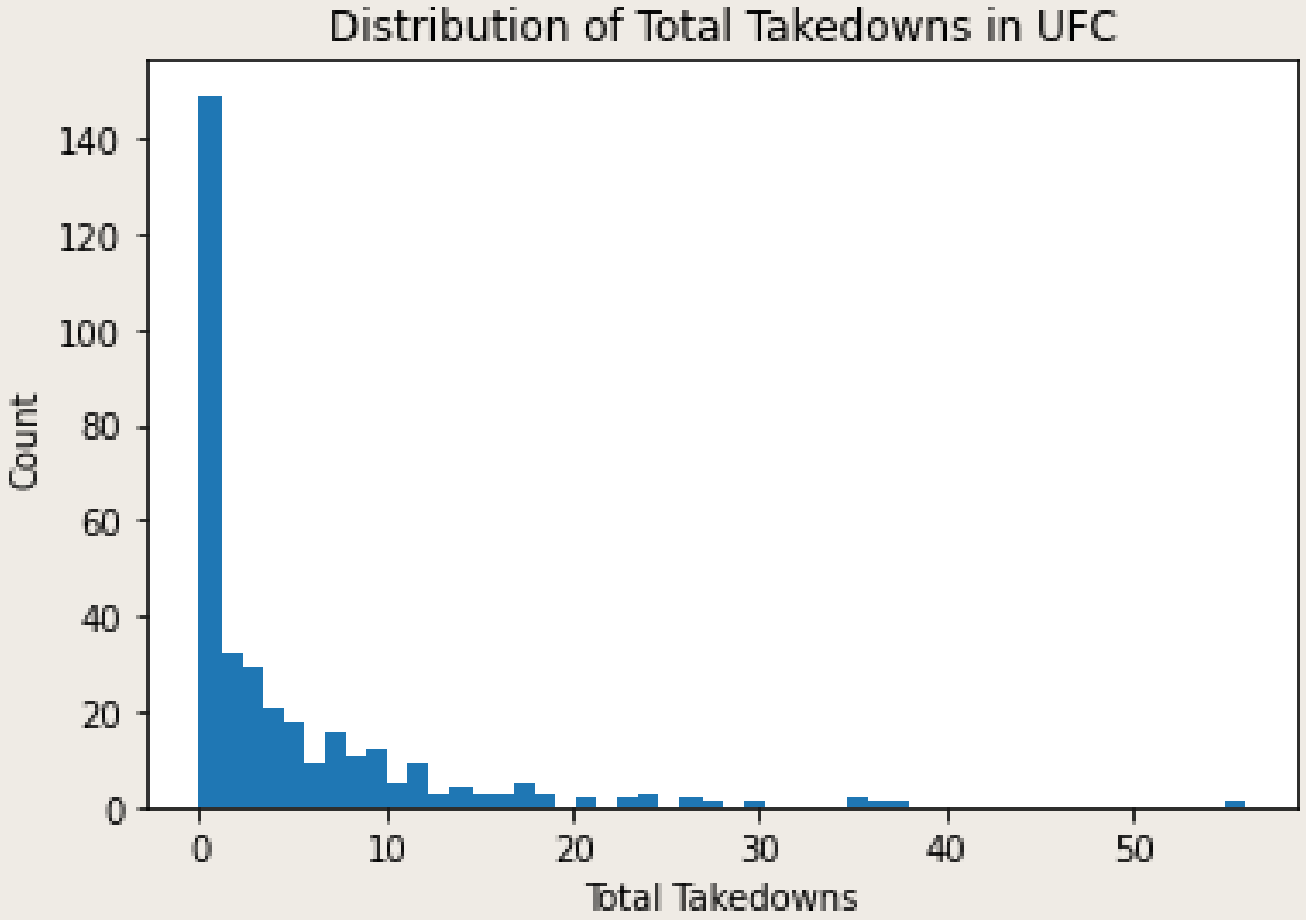

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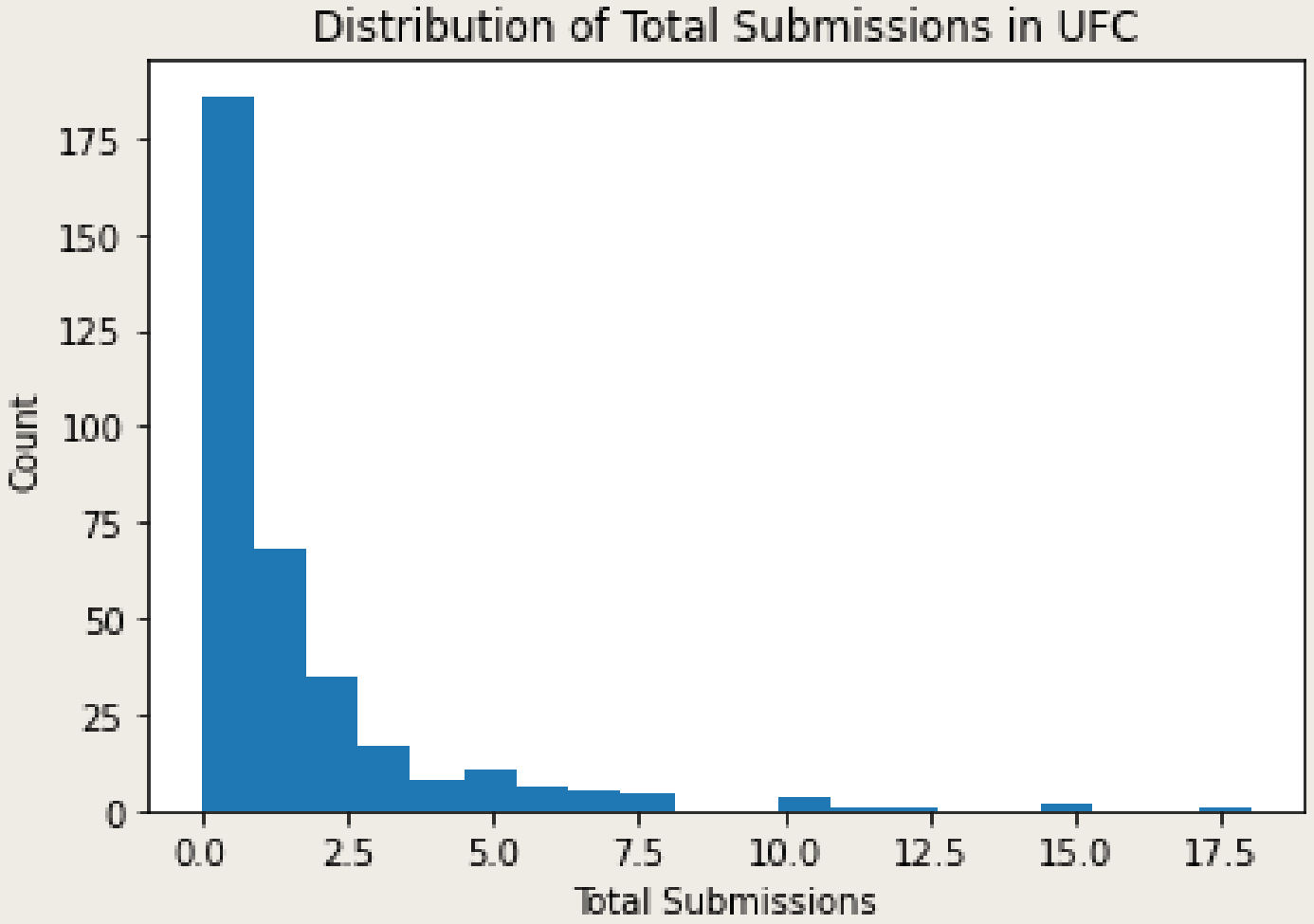

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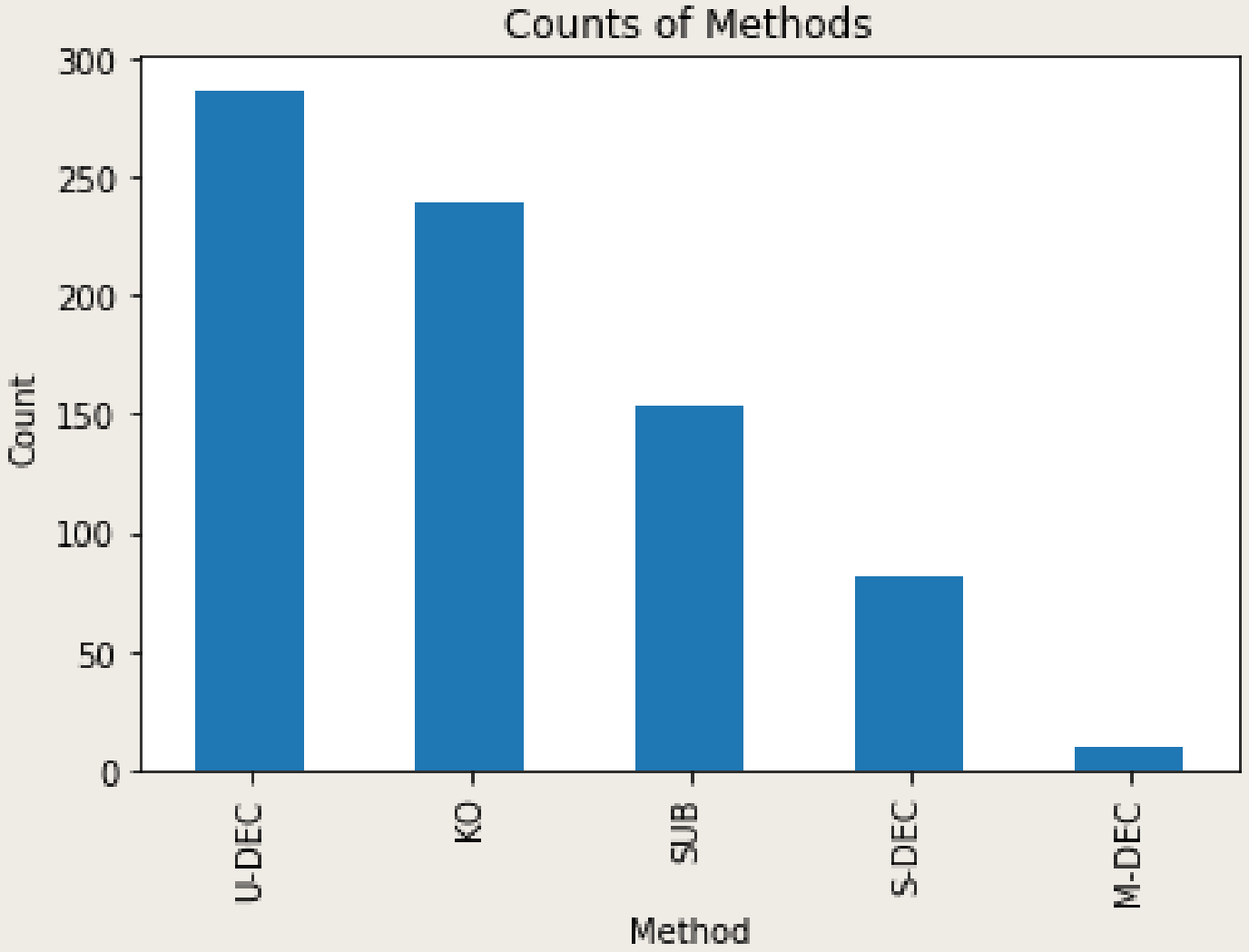

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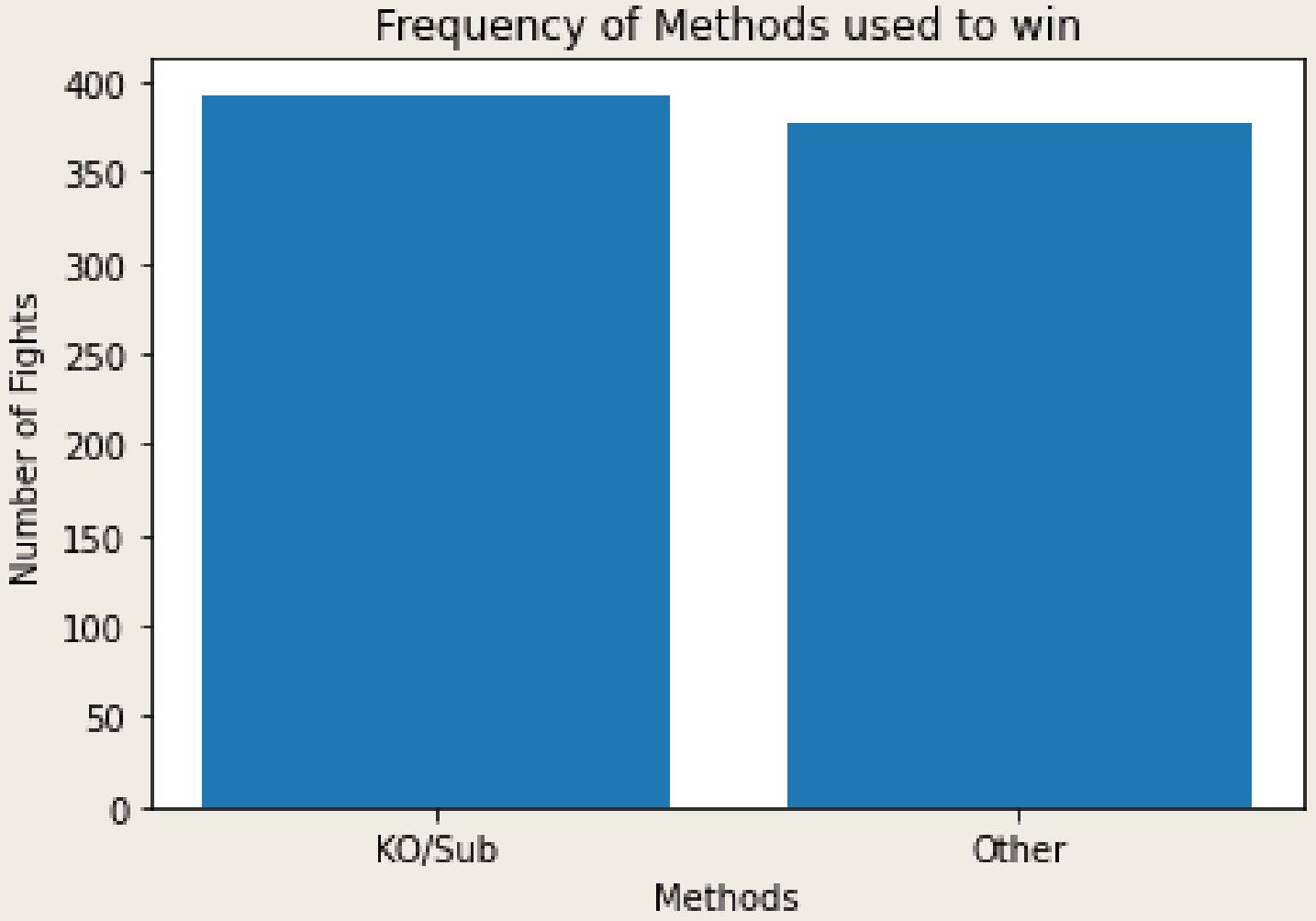


Feature Selection

Most relevant features for the Predictive Model

- Fighter1 and Fighter2 Match
  - Method of Win – **Predictor Variable**
    - KO/Sub vs Anything Else
  - Total **Strike Difference** between fighters (For the last 10 years)
  - Total **Takedown Difference**
  - Total **Submission Difference**
  - Total **Height Difference**
  - Total **Reach Difference**
  - Total **# Wins Difference**
  - Total **Experience Difference** (Number of fights in the last 10 years)
  - Average **Fight Time Difference**
  - Total **# KO wins Difference**

Most relevant features for the Predictive Model

	strike_diff	td_diff	sub_diff	Height_Diff	Reach_Diff	Wins_Diff	Exp_Diff	avg_fighttime_diff	ko_diff
0	323	-1	0	7.62	-2.54	12	14	1.37	5
1	-122	4	0	-2.54	-5.08	-1	-4	-2.21	-1
2	13	1	0	-15.24	-25.40	-3	-6	-0	0
3	41	24	-5	-12.70	-17.78	9	5	-5.35	-1
4	-26	11	-1	2.54	0.00	6	10	-0	0
...	...	...	...	...	...	...	...	...	...
589	146	-1	0	-2.54	-7.62	-26	-41	-5.15	-2
590	-373	-9	3	-7.62	-2.54	-12	-19	0.51	-5
591	-40	-1	0	0.00	10.16	5	0	4.30	-1
592	561	55	7	7.62	0.00	8	0	-9.34	3
593	729	4	1	-2.54	7.62	3	11	-8.14	6

Most relevant features for the Predictive Model

	Method
Method	1.00
strike_diff	-0.018
td_diff	-0.027
sub_diff	0.15
Height_Diff	0.026
Reach_Diff	0.045
Wins_Diff	0.037
Exp_Diff	0.029
avg_fighttime_diff	-0.129
ko_diff	0.058

Model Selection and Training

Different Models Used

- For the predictive modelling problem of classifying UFC fights as ending in a KO/Sub or by Decision, three popular binary classification algorithms were selected:
  - Logistic Regression
  - Support Vector Machine
  - Naïve Bayes (Gaussian)
- The performance of models was compared based on:
  - Accuracy Score
  - AUC - ROC
  - F1-Score
- The models were trained on historical fight data (the last 10 years)

Results and Analysis

Model Comparison

Model	Accuracy Score	AUC – ROC	F1-Score
Logistic Regression	67.2%	69%	67%
Support Vector Machine	69.7%	71%	67%
Naive Bayes	63.9%	67%	61%

Model Limitations

- Limited Data:
  - My data was only on the last 10 years
  - If there is few data of a certain fighter the model may not be able to make accurate predictions for those cases
- Combat Sport Unpredictability:
  - Combat sports are known for their unpredictability as it just takes one hit to knock someone out.
- Binary Classified:
  - In this project I only looked at whether it was a KO/Sub or Decision. However, it would be better to look at it as a multi-class problem.
- Interpretability:
  - SVM's (The model I chose as the best) are black box, therefore its difficult to interpret how the model is making its predictions

Conclusion

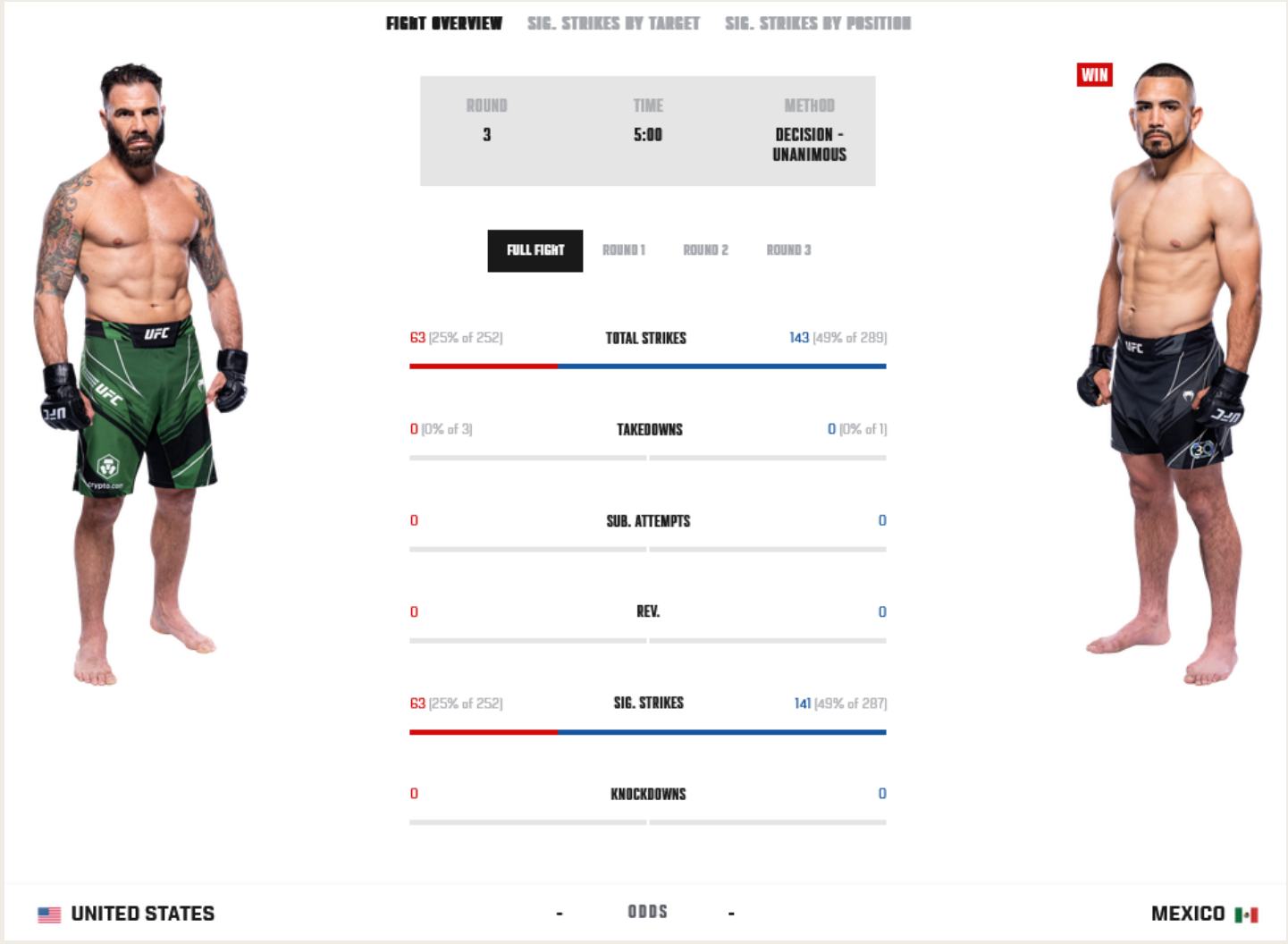
- In summary, I have demonstrated the power of predictive modelling in the context of UFC fights, showing how a combination of data pre-processing, feature engineering, and model selection can yield accurate predictions of fight outcomes.

- This approach has important implications not just for UFC but also for other sports, where accurate predictions can inform everything from betting odds to training strategies.

Tested on recent Fight

- Fighter1 = Clay Gaudia
- Fighter2 = Rafa Garcia
- Model Predicted that the result would be “0”
    - Predicting that the match would be by Decision.

Tested on recent Fight



Thank you!