**What is the NFL?**

The National Football League consists of thirty-two teams from two equally divided conferences, National Football Conference and the American Football Conference. Each team plays sixteen games per season over a seventeen-week period. Each team has one ‘bye-week’ in which they do not play. In total there are two-hundred-fifty-six games played in the regular season. The NFL also has four pre-season games and twenty-one playoff games, but this study is only concerning itself with the regular season games.

A tie occurs in an NFL regular season game when, after one ten-minute over-time period, both teams have equal scores. The NFL counts a tie as a half-win and a half-loss. For this study, because the prediction models use a binary win or loss to improve their prediction rates, a tie will be counted as a loss.

**What are the betting models?**

Elo, created by Five-Thirty-Eight’s Nate Silver, is one of the prediction models used in this study. Five-Thirty-Eight’s Elo rating system is based on Arpad Elo’s rating system for zero-sum games. American Football and many other major league sports utilize this system to rank teams.

Football Power Index, created by ESPN, is another prediction model used in this study. FPI measures the strength of a team and determines each team’s rating based on a function where the parameters are the offensive, defensive, and special teams’ values. The FPI model has been critiqued in the past for not having a very stable and measurable formula to go by. Instead it appears to change week by week and therefore brings into question how much human involvement there is compared to other prediction models.

Bing’s prediction software for NFL games was created by a small team of computer scientists at Microsoft. Bing Predicts considers many factors down the minute level of turf type. What Bing considers that other models do not is what Microsoft dubs, “the wisdom of the crowd”. Through partnerships with various social media platforms, Bing Predicts can take aggregate data from users posting their thoughts about game results. This adds a human element to the equation, but it is different than the suspected human involvement with ESPN’s FPI because with Bing Predicts, it can be assumed that there is no one or group of individuals that are directly changing the predictions being made. Instead, because Bing Predicts is aggregating the data it collects, its human involvement is limited to how the machine learning algorithm interprets that data.

Amos, created by Trevor Bischoff:

Is a statistical model created to predict the outcomes of each NFL game. Amos takes into account 224 different data points to compute three different probabilities for each game.

First, Amos calculates the probability of each team winning. The dashboard below then displays the team which has the greatest probability of winning. Second, given the spread that has been assigned to a particular game, Amos calculates the probability of that team covering the given spread. Finally, given the Over/Under assigned to a particular game, Amos predicts the probability of both teams’ combined scores to break that threshold.

Compared to the other models used in this report Amos is the most independent since it is not backed by a large corporation like all the other models.

**What data are we working with?**

The initial data that was used for this analysis was provided by Trevor Bischoff, the creator of Amos, which includes all the wins, losses, predictions, and correct predictions for all four models used. The moneyline betting data was sourced from fantasydata.com.

The models that were most successful in making accurate predictions were Bing Predicts and the Football Power Index (FPI) with one-hundred-sixty-five correct predictions. The model that was least successful was Amos with one-hundred-fifty-one correct predictions, which makes the difference between the most successful and least successful model only fourteen predictions. Elo came in third with the most successful predictions with one-hundred-fifty-nine. Below you can each model’s weekly success compared to the average of all of them.

From this data we can point out two specific weekly averages that stood out in the data. One occurred in week seven and the other in week ten. In week seven, Bing Predicts had an overall roughly seventy-nine percent of correct predictions for that week when every other model in that week had only roughly fifty-seven percent of correct predictions. In week ten, Amos had a success percentage of roughly seventy-one percent when all other models had a success rate of roughly fifty-seven percent.

It also important to analyze the success rates for each model based on the ranges of the specific predictions. It would make sense that the models would have the least success for predictions with only a fifty to fifty-nine percent confidence and most success for predictions between eighty and one-hundred percent confidence.

**What is Sports Betting?**

Sports betting is a type of gambling that involves predicting the outcome of specific games. For American Football there are three main types of gambling done for each event, pointspread, moneyline, and over/under. This analysis will be utilizing only the moneyline betting type. Moneyline bets are the simplest form of sports gambling since bettors are only making predictions on who will win the game. In a moneyline bet there is the favourite and the underdog, but sometimes there can be two favourites and no underdog. The favourite bet is listed with a minus (-) sign and the underdog bet is listed with a plus (+) sign. If a bettor chooses to place a bet on the favourite to win, they must pay the bet listed with the minus sign and if they are correct then they are paid out one hundred dollars. If a bettor chooses to place a bet on the underdog to win, they must pay on hundred dollars and if they are correct then they are paid out whatever the amount listed beside the plus sign is.

To demonstrate this, we will be using the game played on September 9, 2018 where the Baltimore Ravens played the Buffalo Bills. The moneyline bet would have been displayed as follows:

Baltimore Ravens -340  
 Buffalo Bills +310

In this case if you were to make bet choosing the Baltimore Ravens to win you would pay the amount of three hundred forty dollars, whereas if you were to make the bet for the Buffalo Bills to win then you would pay the amount of one hundred dollars. Because the Baltimore Ravens did win this game, if you had selected them, you would be given back your three hundred and forty dollars and you would be given a payout of one hundred dollars. If you had selected the Buffalo Bills, you would not receive anything and will have lost your one hundred dollars.

**How does the simulation work?**

For this analysis, we decided to build a simulation that would take all the prediction models and determine which one would have the highest return on investment if you ran a formulaic betting system based on each one. It is important to point that the dataset, for each model, only showed what the home-team-win-prediction is. This means that if a model predicted the away team to win with a sixty-four percent confidence, the dataset would show the home team confidence for winning to be forty-six percent.

The initial simulation was required to simply apply the moneyline betting to each model individually for every game. Below you can see the pseudocode used for the simulation to deduct the betting amounts for every game.

for (all games) {

// we began the simulation with a total of 5000 as a comfortable buffer

if (prediction > 0.5) { // if the model prediction is greater than 50%

if (homeMoneyline < 0) { // if the Home team moneyline is less than zero (favourite)

total += homeMoneyline; // add the Home team moneyline (a negative number) to the total

} else { // if them model prediction is greater than zero

total -= 100; // deduct 100 from the total

}

} else { // if the model prediction is less than 50%

if (awayMoneyline < 0) { // if the Away team moneyline is less than zero

total += homeMoneyline; // add the Away team moneyine (a negative number) to the total

} else { // if the model prediction is greater than zero

total -= 100; // deduct 100 from the total

}

}

}

**What are the results of the simulation?**