NHL Realignment Effects on Playoff Qualification

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Motivation

Before the 2013-14 National Hockey League (NHL) season, the league made changes to the number of teams in each of the two conferences. The Winnipeg Jets moved from the Eastern Conference to the Western Conference which created an imbalance in the conference numbers giving the Eastern Conference sixteen teams and leaving the Western Conference with only fourteen teams. Since eight teams from each conference qualify for the playoffs, this imbalance created a "conference gap" that affected the probability of a team being selected for the playoffs.

How much would this change affect the outcome of the playoff selection process? This question was researched by Pettigrew1 in 2014 using a Monte Carlo approach and found the conference gap to be on average 2.74 points, meaning that teams in the Eastern Conference will have to win 1-2 games more than teams in the Western Conference in order to make the playoffs. For our research we validate Pettigrew's paper as well as extend it by using a similar approach to compare this 2013-2014 season to another season with a similar balance shift in the conferences to see how the changes compare statistically.

The season we chose was the recent expansion draft season of 2017-18. Before the start of the season, the NHL added a new franchise in the Las Vegas Golden Knights which was set to join the Western conference. This added a team to the Western conference and resulted in a team split of fifteen to sixteen between East and West. Our goal was to see if the change in a team's probability of making the playoffs was statistically significant when comparing between a year with even team distribution and the conference gap year from our tested 2013-14 and 2017-18 seasons.

Introduction

In 2011 the Atlanta Thrashers of the Eastern Conference became the Winnipeg Jets. This presented a problem as Winnipeg is a considerable distance from the east coast. Because of this and how the season game schedule is set up, the average travel time for teams playing Winnipeg from the Eastern Conference would have been fairly large. So, just before the start of the 2013-14 season, the league offices for the NHL decided to move the Winnipeg Jets from the Eastern Conference to the Western Conference and in return the Eastern Conference acquired the Columbus Blue Jackets and the Detroit Redwings. This left the two conferences with a different number of teams. The Eastern Conference then had sixteen teams while the Western Conference only had fourteen teams. This presented a curious problem since both conferences had eight teams advance to the playoffs at the end of the season.

The goal of our analysis and the paper we based our ideas off of and partially replicated1, was to discover how this impacted a team's chances of making the playoffs. We did this based on the average points and wins necessary to make the playoffs for both conferences.

To further our study, we also looked at the 2017-18 season. This season is important because it gave the introduction of a new team in the league known as the Vegas Golden Knights. This team was introduced into the Pacific division of the Western conference, which meant that the balance between the number of teams in the East and West was more equal than the 2013-2014 split. Our goal for this was to investigate how this new conference structure could affect the conference gap. We used the same process to investigate this new season's structure as our previous analysis of the 2013-14 season. Given that the difference in the number of teams between conferences is less severe we suspected that our estimated conference gap under this setup

(3 Divisions of 8 teams, 1 Division of 7 teams) would lie somewhere around the halfway point between the estimate for the pre 2013-2014 structure (6 Divisions of 5 teams each) and the 2013-2014 season (2 Divisions of 8 teams, 2 Divisions of 7 teams).

Pre 2013-2014 NHL Conference Structure

2011–12 to 2012–13 NHL teams

	Atlantic	Northeast	Southeast
East	New Jersey Devils	Boston Bruins	Carolina Hurricanes
	New York Islanders	Buffalo Sabres	Florida Panthers
	New York Rangers	Montreal Canadiens	Tampa Bay Lightning
	Philadelphia Flyers	Ottawa Senators	Washington Capitals
	Pittsburgh Penguins	Toronto Maple Leafs	Winnipeg Jets
West	**Central**	**Northwest**	**Pacific**
	Chicago Blackhawks	Calgary Flames	Anaheim Ducks
	Columbus Blue Jackets	Colorado Avalanche	Dallas Stars
	Detroit Red Wings	Edmonton Oilers	Los Angeles Kings
	Nashville Predators	Minnesota Wild	Phoenix Coyotes
	St. Louis Blues	Vancouver Canucks	San Jose Sharks

2013-2014 NHL Conference Structure

2013–14 NHL teams

East		West	
Atlantic	**Metropolitan**	**Central**	**Pacific**
Boston Bruins	Carolina Hurricanes	Chicago Blackhawks	Anaheim Ducks
Buffalo Sabres	Columbus Blue Jackets	Colorado Avalanche	Calgary Flames
Detroit Red Wings	New Jersey Devils	Dallas Stars	Edmonton Oilers
Florida Panthers	New York Islanders	Minnesota Wild	Los Angeles Kings
Montreal Canadiens	New York Rangers	Nashville Predators	Phoenix Coyotes
Ottawa Senators	Philadelphia Flyers	St. Louis Blues	San Jose Sharks
Tampa Bay Lightning	Pittsburgh Penguins	Winnipeg Jets	Vancouver Canucks
Toronto Maple Leafs	Washington Capitals		

2017-2018 NHL Conference Structure

2017–18 to 2019-20 NHL teams

East		West	
Atlantic	**Metropolitan**	**Central**	**Pacific**
Boston Bruins	Carolina Hurricanes	Chicago Blackhawks	Anaheim Ducks
Buffalo Sabres	Columbus Blue Jackets	Colorado Avalanche	Arizona Coyotes
Detroit Red Wings	New Jersey Devils	Dallas Stars	Calgary Flames
Florida Panthers	New York Islanders	Minnesota Wild	Edmonton Oilers
Montreal Canadiens	New York Rangers	Nashville Predators	Los Angeles Kings
Ottawa Senators	Philadelphia Flyers	St. Louis Blues	San Jose Sharks
Tampa Bay Lightning	Pittsburgh Penguins	Winnipeg Jets	Vancouver Canucks
Toronto Maple Leafs	Washington Capitals		Vegas Golden Knights *

Methodology

Basic Idea

The basic idea behind the model is that all of the teams have a base "skill level" that they play at or near during any given game throughout the season. Each game is competitive because we aren't sure how well either team will play, and even a team with a higher skill level can be beaten by another team for any number of reasons. We keep track of this skill level and draw other metrics based off of it, then use the metrics to compute a team's score for the season. This score is used to calculate the team's seed in their respective conference and division.

Creating the Model

To start out, we first need to make sure that we calculate the game-to-game performance levels given by τ and the standard deviation of the team's talent levels given by σ. These are related to the following ratio, where p is the probability that the worst team in the league beats the best team in the league.

$-\frac{2.8854}{\Phi^{-1}(p)} = \frac{\tau}{\sigma}$

Based on the data from all of the seasons with 30 teams, we can calculate that the team with the worst record in the league beat the team with the best team about a quarter of the time. We choose to set p equal to 0.25 for this reason, making the ratio $\tau/\sigma = 4.28$. This means that there are four times the variability in the team's performances in game than there is in the talent levels of the teams. The actual values of τ and σ don't matter, just the ratio, but for simplicity we will set τ equal to 4.28 and σ equal to 1.

We then want to simulate a skill level metric for each of the thirty teams. We create the metric from the following distribution, with team i being equal to μ_i.

$\mu_i \sim N(0, \sigma^2)$

We draw the values from a normal distribution because in sports the overall performace of the teams is generally normally distributed. That is, there are a few really good teams, a few really bad teams, and a lot of teams in between.

We hold the team skill levels constant throughout the season, this make intuitive sense, because there are very seldom large changes to the team's rosters or strategies throughout a season, but after each season teams often make at least some change.

When drawing the season schedule for each simulation we chose just to use the same schedule as the real world NHL for that year. If we had taken into account some sort of measure of the performance of real world teams into our model this may have influenced the results to our research question. However since team skill is a random variable drawn at the start of each simulation with no relation to the real world skill of these teams this should not bias our results.

For each game that is played in the season we draw a performance metric for both competing teams. This metric is drawn from a normal distribution with the mean being equal to the team's skill level and the standard deviation being equal to τ^2. This is based on the idea that a team with any skill level will play somewhere around their skill level, rarely playing much worse and rarely playing much better. This metric is calculated as such, with i indicating the home team and j indicating the away team.

$\gamma_i \sim N(\mu_i, \tau^2)$

$\gamma_j \sim N(\mu_j, \tau^2)$

Logically, the winner of each game would be decided by the higher value of γ, but in hockey it is possible for the game to go into overtime. This happens in about 22.4% of the games that were played over the past 15 seasons, so we must solve the following equasion for α:

$Pr(|\gamma_i - \gamma_j| < \alpha) = 22.4\%$

Solving this equasion gives us a value of $\alpha \approx 1.769$.

If there is a game in which $|\gamma_i - \gamma_j| \geq \alpha$, the team with the higher γ value is awarded a win and is therefore given two points while the team with the lower γ value is given 0 points. For games in which $|\gamma_i - \gamma_j| < \alpha$, the game is considered a tie.

In the case of a tie we linearly resale the γ values with the following formula:

$\zeta = \frac{(\gamma_i - \gamma_j) - a}{b}$

Where a is the mean and b is the maximum of all $\gamma_i - \gamma_j$ values from that season.

Using the resulting value of ζ we use a Bernoulli distribution to simulate a weighted coin flip, with a success meaning that the home team wins and a failure meaning the away team wins.

Winner ~ $Bernoulli(\zeta_{ij})$

The winning team receives two points while the losing team receives one point.

For each team the sum of points accumulated over the season was taken and teams were then sorted into conference and division. The qualifications for making the playoffs under each of our 3 seasons were then applied to the point totals for teams to determine seeding. Conference gap was then calculated by finding the difference in points between the 8th seed in the West and the 8th seed in the East. This process represents simulating a single season.

We simulated 10,000 seasons for both the 2013-2014 and 2017-2018 analysis. We then calculate the conference gap for both the old and the new ruleset as the average conference gap across all simulations. We also save the number of points earned by each seed to do analysis on later.

Additional model details

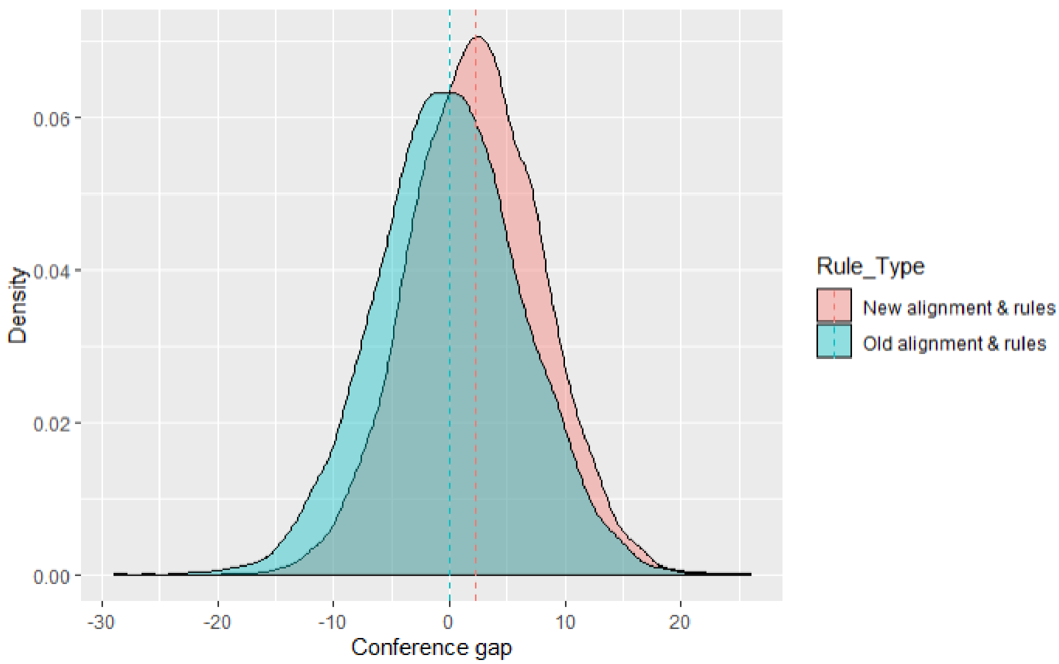
Our model does not account for the real-world skill of teams, but because we are not doing any inference on specific team performance depending on rule changes this is not relevant. Because we are interested in the difference in scores of the 8th seeds we actually don't even need any real-world teams and can instead replace them with placeholders or just numbers. The lack of a need for real world data was also an advantage to our analysis as it meant our results may be expressed as a general representation of the "fairness" of these conference structures since they are not related to the skill of real world teams.

An alternative choice we could have made is that in the event of a tie we could have given either team a 50% chance of winning instead of linearly rescaling the values and using a weighted coin flip, but we don't know exactly how the outcome of NHL overtime games usually end up skewing – whether it be in favor of the better team or if it is distributed more randomly.

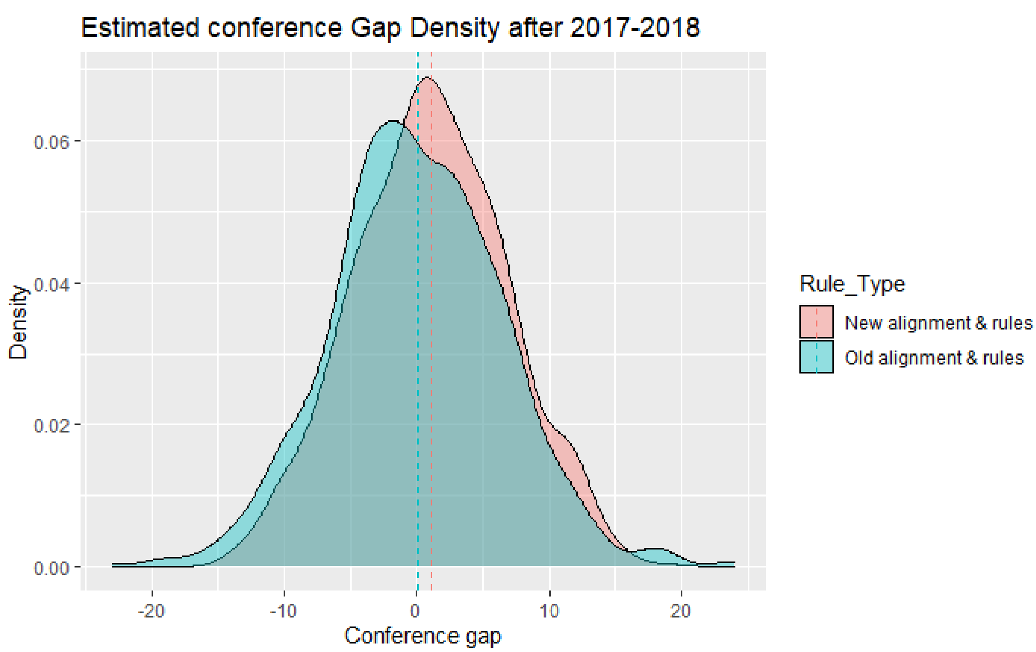
When performing analysis on the 2017-2018 conference structure we chose to hold our parameters p, τ and σ to be the same as stated above in the 2013-2014 analysis since we are talking about a reasonable small amount of time passing between these two seasons we thought it would be unreasonable to think that they would alter all that much. The same number of simulations were run also to make results more easily comparable.

Results

After doing 10,000 simulations of full NHL seasons using the Monte Carlo simulation methods detailed above, the results can be seen in the figures below. The red shaded graph represents the gap between the East and West 8th seeds (conference gap) under the conference and division alignment in the 2013-14 NHL season while the blue graph represents the gap between the East and West 8th seeds (conference gap) under the conference and division alignment in the 2012-2013 NHL season. The mean conference gap for the new alignment (2013-2014) is 2.30 points while the mean conference gap for the old alignment (2012-2013) is practically zero at -0.02 points.



When looking at the 2017-2018 season we can see something close to what we hypothesized in our introduction, our conference gap does indeed lie somewhat close to halfway between the estimate for the 2013-2014 season and 2012-2013. When rerunning the analysis for 2017-2018 our estimate for conference gap under the 2012-2013 structure was 0.038 which is close to what was estimated above and makes sense as we expect the conferences to be equal in terms of likliehood of making the playoffs under these rules. The mean conference gap across our simulations for the 2017-2018 season was 1.091 which is approximately halfway between 0 and 2.3. It should be noticed that visually it can be seen that the density for the 2017-2018 season conference gap more closesly resembles the 2012-2013 density than the 2013-2014 density did.



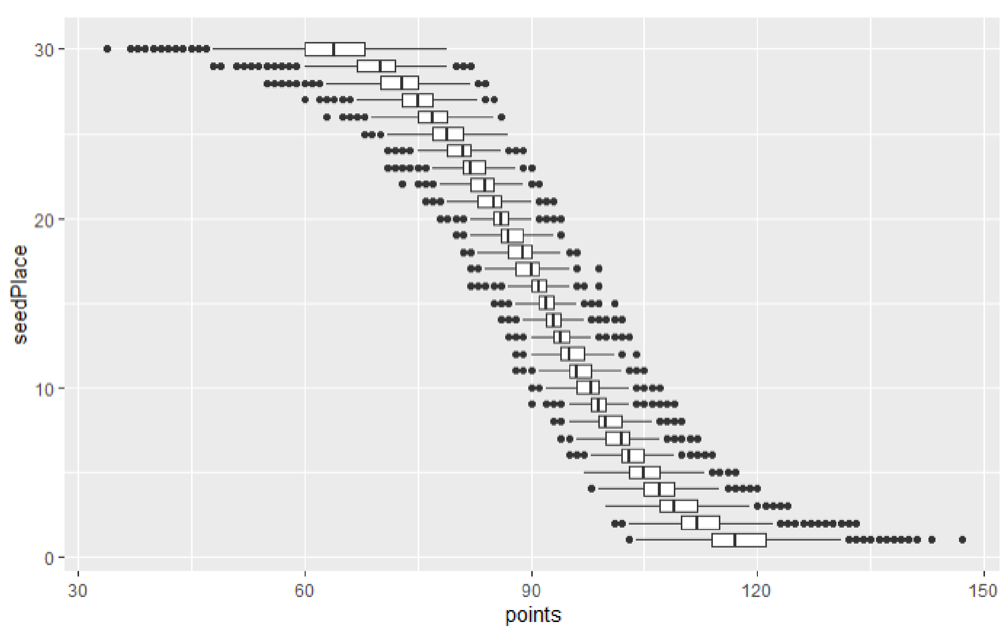
Looking at these results, the numbers fall in line with what would be the logical expectation under these circumstances. The 2013-2014 structure moves the balance of teams over towards the East with 16 teams while the West sits at 14 teams. With more teams in the East, it makes sense that the East would have more teams with higher number of total points from the season. To look at these results in a different light, it is key to translate these numbers to the point scoring system of the NHL. On average, the difference between the conference gaps of the two division alignments (2012-2013,2013-2014) comes out to be 2.32 in favor of the 2013-2014 alignment/structure. Under the 2017-2018 analyis our difference in conference gap between alignments comes out to be 1.053 (1.091-0.038). This result makes sense since the conferences are still unbalanced with the East having more teams than the West (16 and 15 respectively) but less unbalanced than 2013-2014 (16 and 14 respectively) The conference gap has been calculated as:

East 8th Seed Season Total Points - West 8th Seed Season Total Points

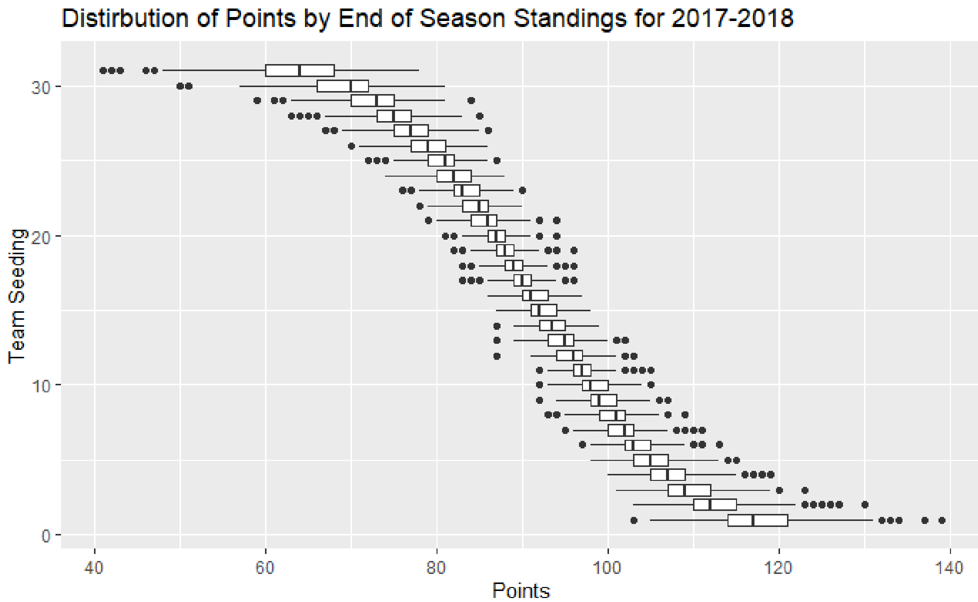
The mean conference gap, in terms of total points, means that the East's 8th seeded team has on average 2.30 more points than the West's 8th seeded team for 2013-2014, similarly we expect the 8th seed in the Eastern conference to have 1.091 more points than their Western conference counterpart under the 2017-2018 structure. In the NHL, a team earns 2 points for a win, 1 point for an overtime loss, and 0 points for a loss. With this point system,under the 2013-2014 alignment the East's 8th seeded team on average needs to win one more game during the season or exchange two losses for two losses in overtime. This favors Western conference teams in the way they have to earn less total points throughout the season to make the playoffs than Eastern conference teams. This same bias towards Western conference teams to make the playoffs is present under the 2017-2018 bias but the practical effects of a one point difference is not even worth a single win in an 82 game season, so although this effect is present it's not as drastic.

Not only were the 8th seeds from each conference calculated but each seed for the whole NHL. These box and whisker plots show a wide range of information for the total points for each seed across the 10,000 simulated seasons for both the 2013-2014 and 2017-2018 alignemnts. The endpoints of the whiskers represent the outlier point totals earned by each seed. The sides of the box represent the 2.5% and 97.5% quantiles. The line within the box represents the mean. The structure of this plot makes sense with the curve of less points the lower seed and more points the higher seed the team achieves. The higher the number on the x axis the lower seed of the team; 30 being the worst team in the league (31 for 2017-2018 simulation) and 1 being the best team in the league. Interesting feautures of these plots are a tight spread of simulated points for teams seeded around the middle of the league. This makes sense given that these point values are probably closer to the mean point total for a season and thus more likely under the model we defined. Another note is that the overall range of point totals is greater in the 2013-2014 simulation than it is under the 2017-2018 simulation. This has been compared with real NHL data and the shape lines up in a similar fashion.

2013-2014 Points by Seed



2017-2018 Points by Seed



Conclusion

Since the change to the conference structure of the NHL to be unbalanced, there have been questions on whether these structures are giving an unfair advantage for one of the conferences: more specifically the Western Conference. With the West having two less teams under the 2013-2014 alignment, it was inferred that each of those teams would have a better chance of making the playoffs. They wouldn't need to earn as many points to secure a playoff spot as teams in the Eastern Conference. After running 10,000 Monte Carlo simulations of the 2013-2014 NHL season, the results support the case that the Western Conference has a noticeable advantage over the Eastern Conference. The 8th seed in the east on average has an end of season point total of 2.3 (1.091 for 2017-2018) points higher than the 8th seed in the west. This can cause problems because a statistically worse team can make the playoffs in the Western Conference while a better team might miss out in the Eastern Conference. This is support of the idea that these rules introduce a bias agaisnt teams in the Eastern conference which goes agaisnt the league being "fair" to all teams.

References

- Pettigrew, Stephen. "How the West Will Be Won: Using Monte Carlo Simulations to Estimate the Effects of NHL Realignment." Journal of Quantitative Analysis in Sports, vol. 10, no. 3, 1 Jan. 2014, 10.1515/jqas-2013-0125. Accessed 10 Dec. 2020.
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