

# District Points Analysis

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## 1. What Is It?

In the district system, teams within each district are ranked each season. This ranking is used to determine which teams advance to the District Championship (DCMP), and from there to their World Championship (CMP). Points are assigned at each of a team's first two in-district events, where a team's score is supposed to represent how well they did at the event. The sum of a team's points is used to determine which teams advance to DCMP. For teams going to DCMP, their DCMP event score is multiplied by three, added to their previous score, and that new score is used to rank the teams for the purpose of determining the teams to send to CMP.

Conveniently, the district ranking points system can be applied to any competition, not just district competitions. Since the scores for each individual event represent the team's performance at that event, a combination of all of their scores across the season should reasonably resemble their season performance. Expanding that across multiple seasons therefore gives a representation of a team's performance along that whole time span.

## 2. Terminology

Below is some terminology you will see in this whitepaper and their definitions:

- District Points: points used for district ranking at a single event as calculated according to §10.12.3 of the 2018 FRC Game Manual<sup>1</sup>
- Average District Points: the average of a team's district points for all events in a predefined time period
- Adjusted District Points: Average District Points, adjusted by the number of events being considered. See Section 3.2
- Inter-Season Score: a score that follows a team between seasons, used to help make predictions before all teams have played in the current season. See Section 3.4

## 3. How Is It Calculated?

### 3.1 District Points

A team's District Points at an event are calculated according to the §10.12.3 of the 2018 FRC Game Manual<sup>Error! Bookmark not defined.</sup>. District Points are comprised of the sum of four elements: qualifications (qual/quals), alliance selection, playoffs, and awards.

#### 3.1.1 Qualification Points

Qualification points are calculated according to this formula, where R is the team's rank, N is the number of teams attending the event, and  $\alpha$  is a scaling constant, equal to 1.07. This formula returns somewhere between 4-22 points, depending on the team's qualification rank.

$$\text{QualificationPoints}(R, N, \alpha) = \left\lceil \text{InvERF}\left(\frac{N - 2R + 2}{\alpha N}\right) \left(\frac{10}{\text{InvERF}\left(\frac{1}{\alpha}\right)}\right) + 12 \right\rceil$$

<sup>1</sup> <https://firstfrc.blob.core.windows.net/frc2018/Manual/2018FRCGameSeasonManual.pdf>

### 3.1.2 Alliance Selection Points

Alliance selection points are assigned based on the team's pick position in the alliance selection draft. If a team is not picked for an alliance in the draft, they get 0 points. If a team is an alliance captain or first pick, they get  $17-n$  points, where  $n$  is their alliance number. If a team is a second pick, the number of points they get is equal to their alliance number. In events with third picks, the third picks get 0 points. For example, the captain and first pick of alliance 2 get 15 points, and their second pick gets 2 points.

### 3.1.3 Playoff Points

Playoff points are added every time a team wins a level in the playoff tournament. For every level advanced (quarterfinals, semifinals, finals), the team gets additional points equal to 5 times the number of matches they played and won. Under normal circumstances, this means that teams get 10 points for every level they win. Therefore a quarterfinalist (qf) team gets 0 playoff points because they won 0 levels, semifinalists (sf) gets 10 points because they won qf, finalists (f) get 20 because they won qf and sf, and winners get 30 points because they won qf, sf, and f. This changes if the alliance must call on a backup team mid-tournament. Teams only get points for matches they play, so the team pulled out gets the points for the matches until they were replaced, and the backup team gets the points for matches after that.

### 3.1.4 Awards Points

Award points are given for winning judged awards at competition. Chairman's Award winners get 10 points. Engineering Inspiration and Rookie All Star winners get 8 points. All other judged award winners get 5 points. Winners of non-judged awards (e.g. highest rookie seed) or awards not judged by FRC judges (e.g. Gracious Professionalism award or Pit Safety award) do not get points. Depending on the application, some applications do not take into account award points in order to focus on on-field competitive performance.

## 3.2 Adjusted District Points

Adjusted District Points is calculated by taking the Average District Points across all events, and then multiplying that by  $(\# \text{ events})^{0.3}$ . By using this scaling factor, teams that consistently did well at multiple events are prioritized over teams that did well at the one event they attended. In most cases, Adjusted District Points is the metric used for analysis. Other metrics can also be adjusted in this manner, to get metrics such as Adjusted Qualification Points, Adjusted Award Points, etc.

## 3.3 Finals Event Adjustment

A unique problem arises for events with divisions, the winners of which advance to a separate finals competition. This includes District Championships in large districts and Championship events. Treating the finals event as a new individual event is inadequate, since the event does not have the same qualification-alliances-playoff-awards format as a standard event. However, ignoring the event altogether would be to disregard the performance of teams at the most competitive levels of competition all season. As a solution, the playoff points of the finals event are added to those of the division event and they are calculated together as one event. This method provides a bonus for performing well in the finals event, while not disadvantaging a team that doesn't do well.

### 3.4 Inter-Season Score

To be able to predict early-season events where not all teams have played previous events in the season in question, we need a metric that tracks teams' performance across multiple seasons. That inter-season score is defined to be:  $\sum_n a \cdot DP_n \cdot e^{-b \cdot n}$ , where n is the number of years since the season in question,  $DP_n$  is the team's Adjusted District Points for the nth previous season, and a and b are scaling constants. With scaling constants of  $a=1.7$ ,  $b=0.993$ , which were found to give the best predictive power for the 2016-2018 seasons, the previous year corresponds to 63% of the final score, 23% for two years previous, 9% for 3 years, and 5% for the rest of the years, continuing the exponential trend.

## 4. Performance Analysis

### 4.1 What Is It?

The most straightforward use of District Points and associated metrics is for measuring performance after the competition(s) in question have taken place. Since the District Points model takes into account qualification performance, alliance selection position, playoff performance, and awards won, a team's district points score is generally indicative of their performance at the event.

### 4.2 Why Is It Useful?

Using District Points as a post-competition performance metric is useful because calculating District Points is computationally simple (as compared to metrics like OPR which need to simultaneously solve equations to compute), relatively easy to understand, and already used for district ranking in FRC. Since these metrics do not inflate/deflate with changes in average score in different seasons, they are convenient for comparing teams' performance across seasons.

Using District Points, we can analyze many different variables to see how they correlate to team performance. Some examples of variables that can be compared against DISTRICT POINTS metrics include: regional vs district system, number of competitions attended, team location, etc.

## 5. Predictions

### 5.1 Why Is It Useful?

We can use a team's past District Points earnings to predict their performance at future competitions. While these predictions are far from perfect, they can help predict match winners, which matches to watch, and other metrics. This works, to a degree, both within the official season, in the offseason, and between seasons.

### 5.2 Late-Season Predictions

Late-season predictions use teams' Adjusted District Points from earlier in the season to predict their performance at other events in the same season. This prediction method only works at District Championships, Championships, and off-season competitions where all teams have already competed at one or more competitions that season. This is necessary to ensure that each team has an Adjusted District Points score for that season, which can be compared and evaluated to form a prediction.

### 5.3 Inter-Season Predictions

This prediction method uses the Inter-Season score described in Section 3.4 to predict competitions where not all teams have attended at least one previous competition in the same season. This method works in a similar way to late-season predictions, described in Section 5.2, but using the Inter-Season score in place of the Adjusted District Points for that season. Since this method does not use information from this season rather than previous seasons, and FRC teams can swing wildly between seasons for a variety of reasons, this is a less precise prediction model than late-season predictions.