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In order to determine how likely a given pitch is affected by a high dew point, we first need to figure out when and how a high dew point can affect a pitch's flight. While dew point is not believed to affect velocity or spin rate, some pitchers believe it can influence breaks, especially on non-fastballs.[1] For this project, we will use the following theory regarding dew point and pitch movement:

1. A higher dew point enhances the downward trajectory of a pitch with topspin

A higher dew point reduces the density of the air, which results in reduced carry and increased drop. It also reduces air resistance, which permits the ball to continue on the downward path imposed on it by its spin direction for longer. As a result, a pitch with topspin in a high dew point environment might come in at a steeper approach angle than an identical pitch with a low dew point.

2. A higher dew point boosts horizontal movement of a pitch with sidespin

Similarly, the decreased air resistance permits the ball to continue on the horizontal path imposed on it by its spin direction for longer, resulting in a more extreme horizontal approach angle.

Backspin pitches are not included in the theory because the effects of reduced air density and resistance could cancel each other out. While the former could diminish ride, the latter could sustain it by allowing the ball to maintain the upward path forced onto it by its spin.

With these assumptions in mind, we can build a model to predict approach angle from the factors that contribute to it, and attribute any unexplained variation to dew point.

Vertical approach angle is a product of:
- **Velocity:** The faster the pitch comes in, the less time gravity has to bring it down
- **Vertical Release Height:** Pitches released higher will be steeper, and pitches released lower will be flatter
- **Induced Vertical Break:** Pitches with more carry will come in at a flatter angle
- **Pitch Location:** The higher the pitch is, the flatter it will be. The lower it is, the steeper it will be

I built a multiple linear regression model between these factors and VAA. The correlation between the predicted values and the actual values was above 0.99, indicating that dew point's effect on the ball is incredibly subtle, but still present. From there, I standardized the residuals of

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[1] https://housethathankbuilt.com/2019/05/04/atlanta-braves-fact-checker-how-does-humidity-impact-pitching/

each point, determined the probability of observing a value more negative than the actual outcome under the model, and used that value as the probability that a topspin pitch was affected by dew point in the vertical direction.

Horizontal approach angle is a product of:

- Release Side: Pitches released wider will approach from wider
- Horizontal Break: Pitches with more horizontal movement will come in at a more extreme angle
- Pitch Location: The further the pitch location from the release side, the more extreme the approach angle will be

I utilized the same process as with topspin pitches to find the probability that a pitch was affected by dew point in the horizontal direction. However, instead of examining the probability of observing values more negative than the actual values, I used a two-tailed solution, as dew point can affect movement both left and right.

All backspin pitches were assigned a probability of being affected by dew point in the vertical direction of 0.5 to minimize error in the face of inconclusive evidence.

After generating the probability that each pitch was affected by dew point in both the vertical and horizontal planes, I determined the overall probability. Since a pitch only needs to be influenced in one direction to be affected, I used the formula $P(A \text{ OR } B) = 1 - P(A \text{ AND } B)^C$ for my final calculations.