Evaluating plate discipline in Major League Baseball with Bayesian Additive Regression Trees

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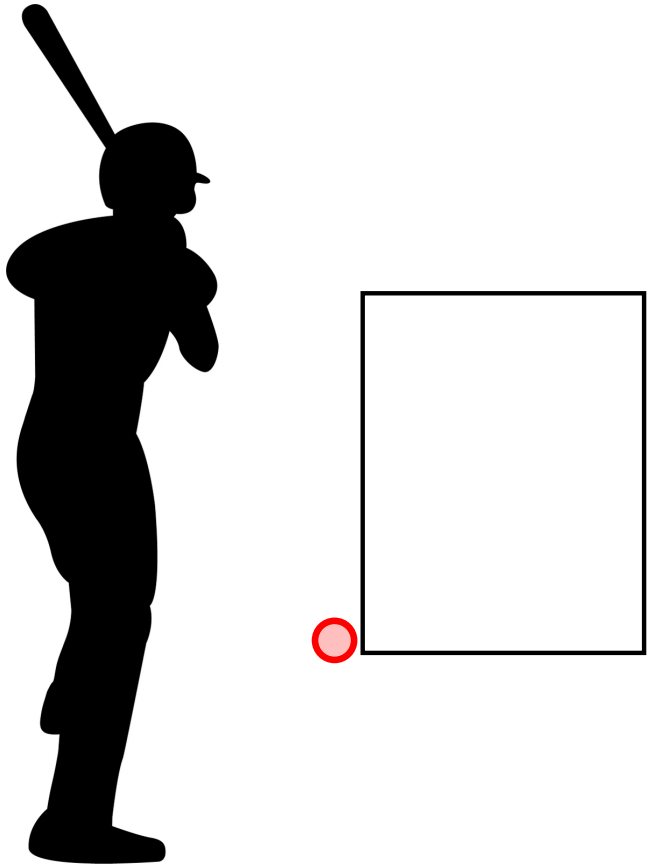
What is the optimal decision?



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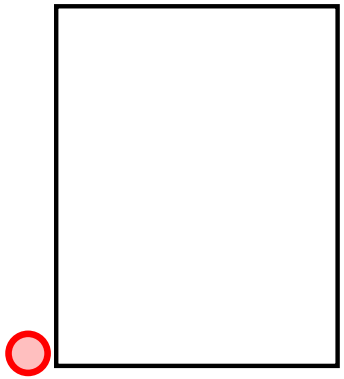

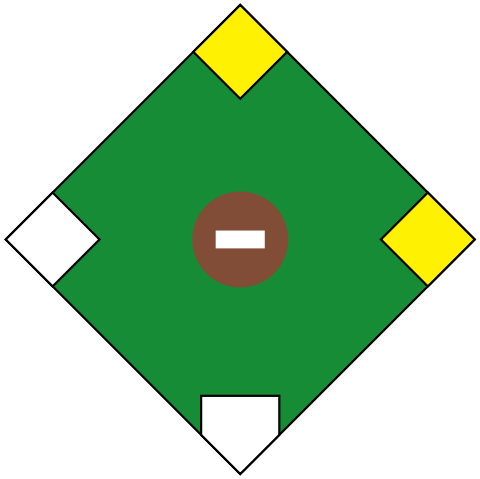

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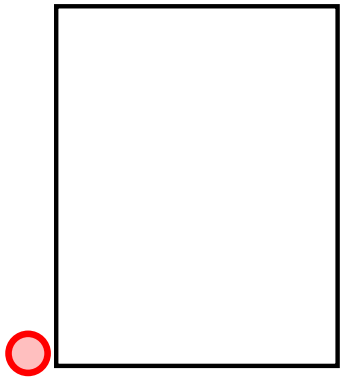

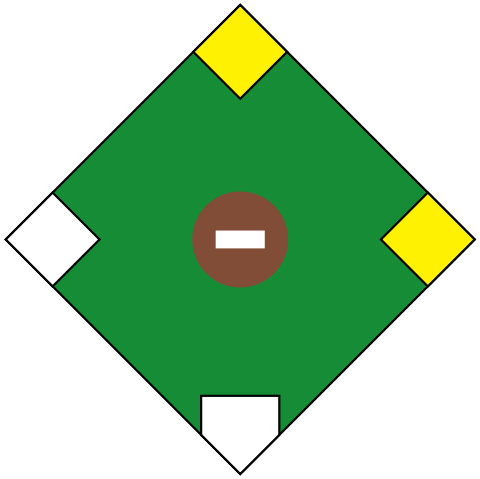

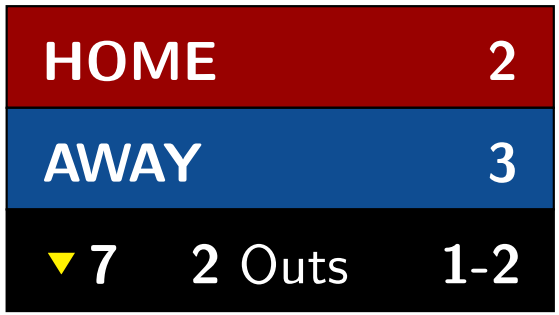

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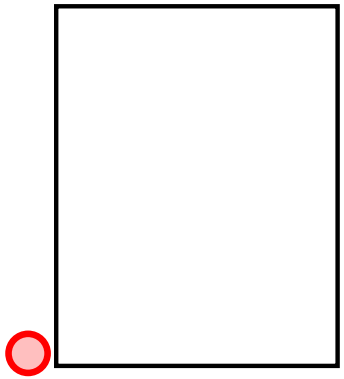

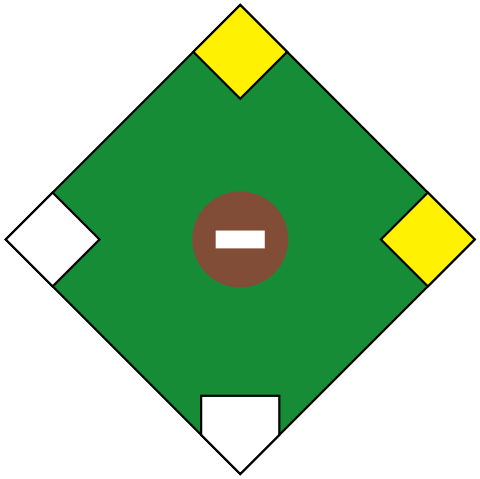

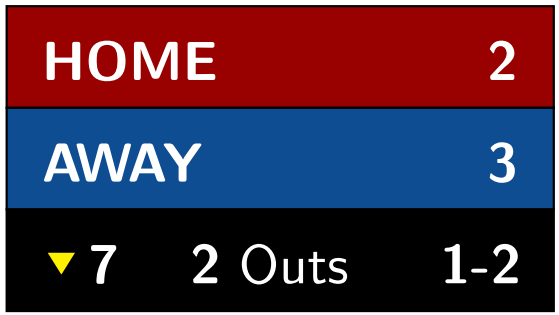

Batter: Shohei Ohtani

Umpire: Ángel Hernández

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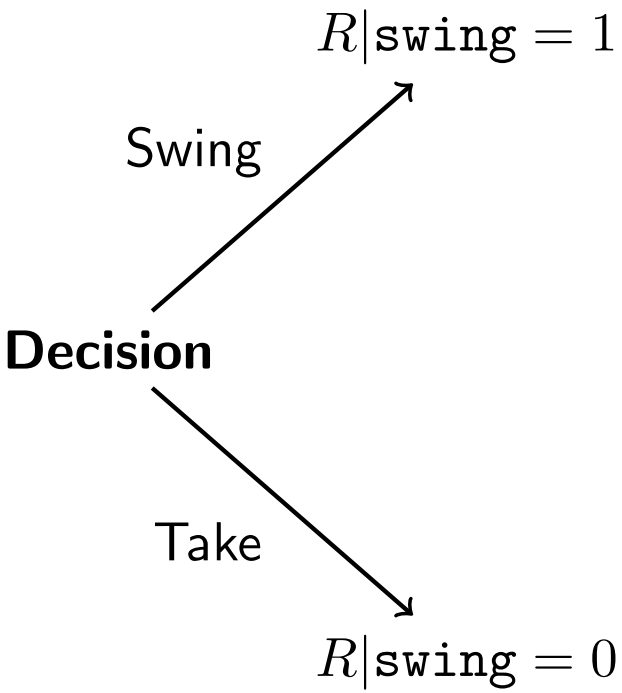
- Traditional plate discipline metrics: `O-Swing%`, `Z-Swing%`
  - Analysis relies solely on the location of the pitch
  - Treats every pitch inside (outside) the strike zone the same
- Our Contribution
  - Introduce framework for evaluating plate discipline which accounts for contextual factors in addition to location
  - Framework facilitates uncertainty quantification in evaluations

Framework



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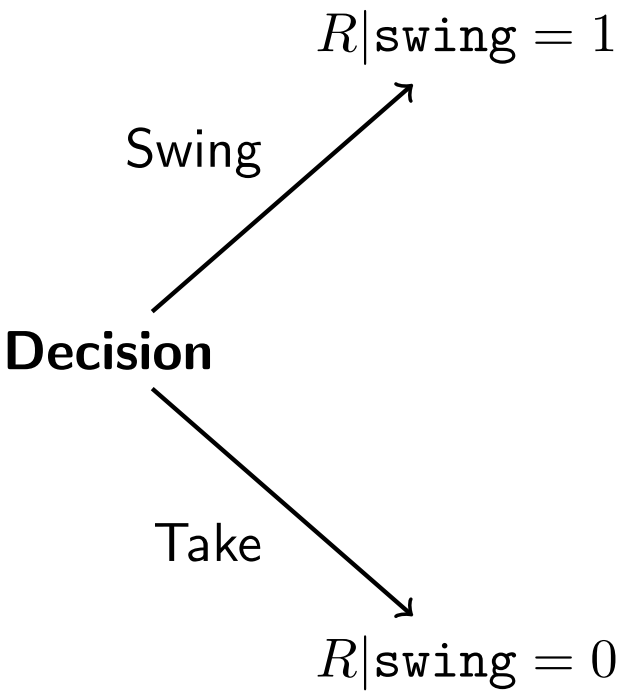

The optimal decision is to swing if $R|\texttt{swing} = 1 > R|\texttt{swing} = 0$

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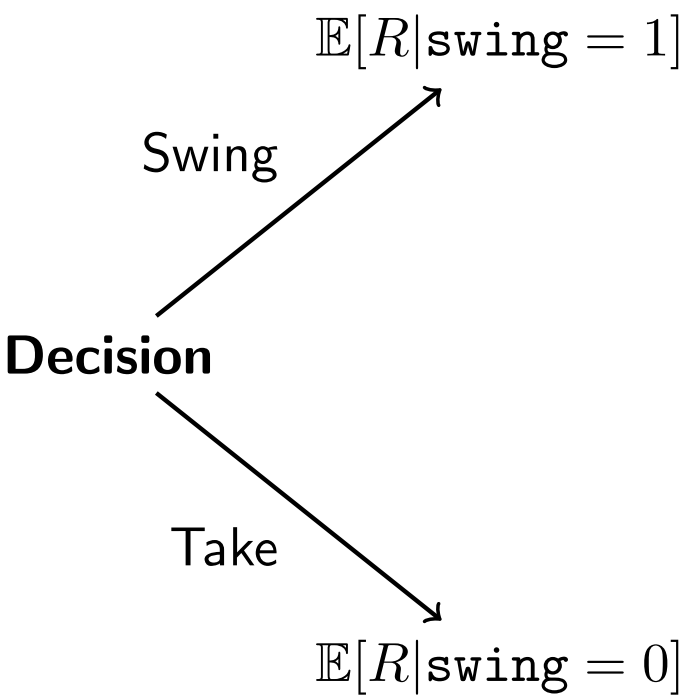

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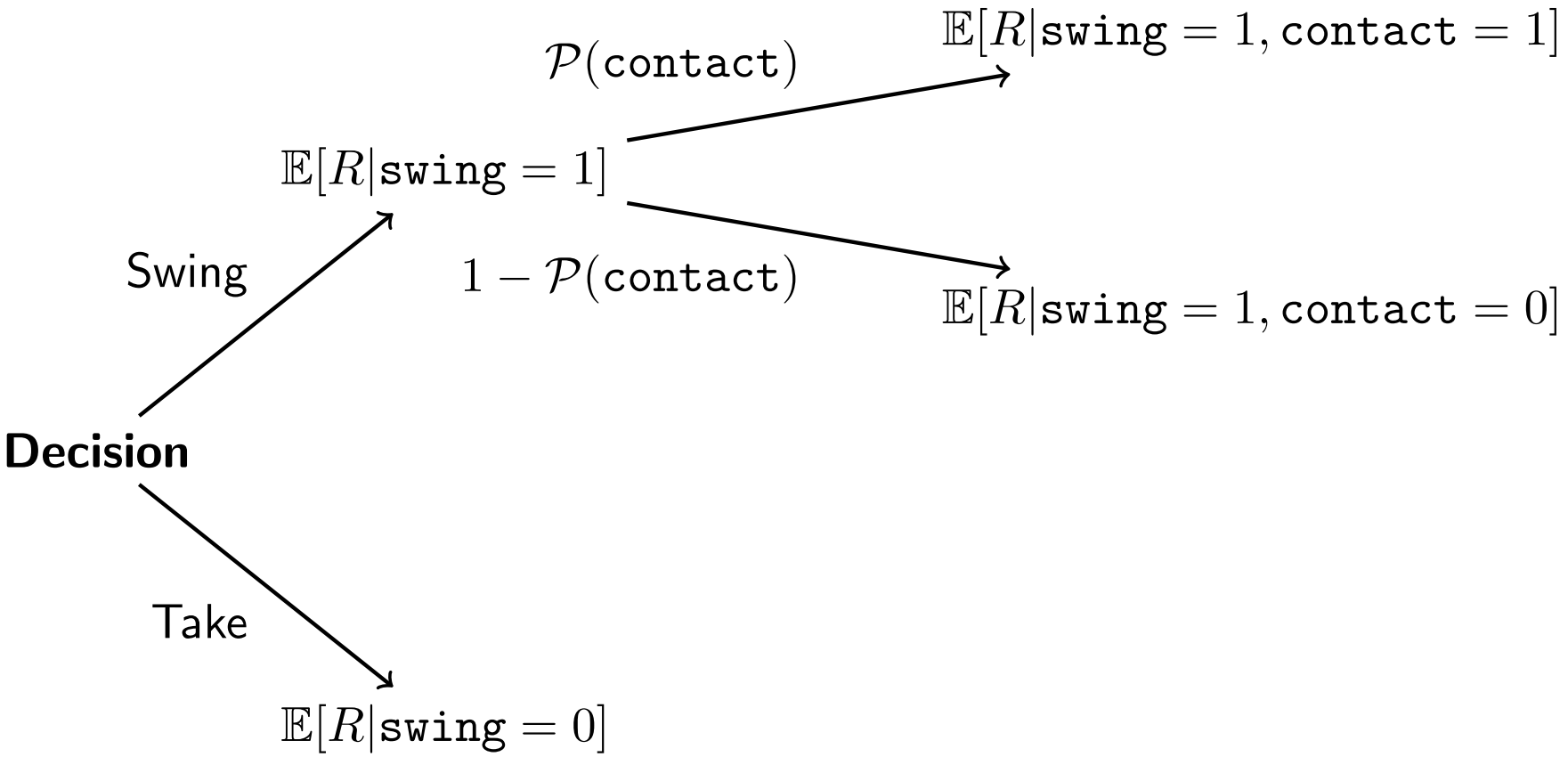

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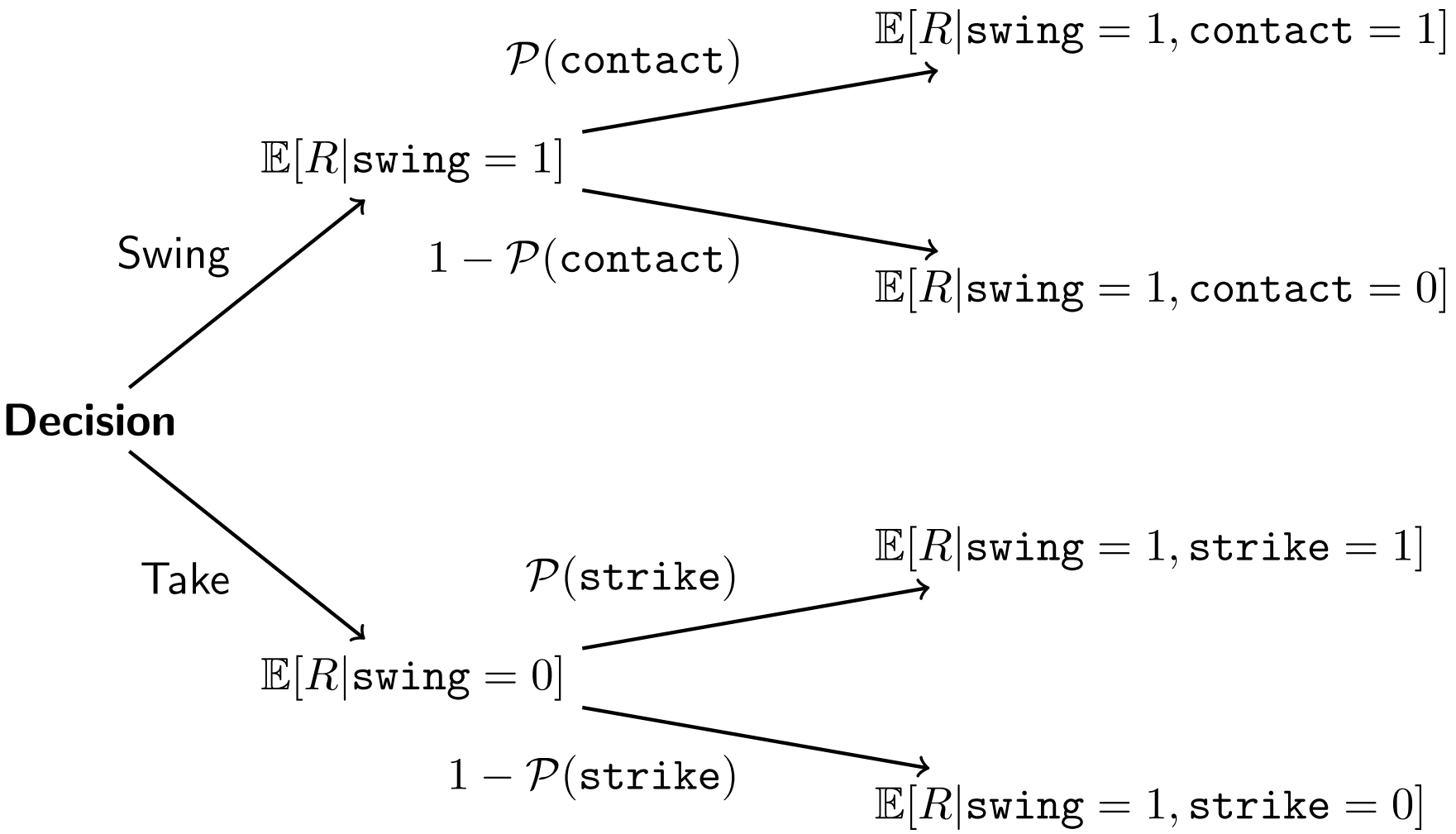

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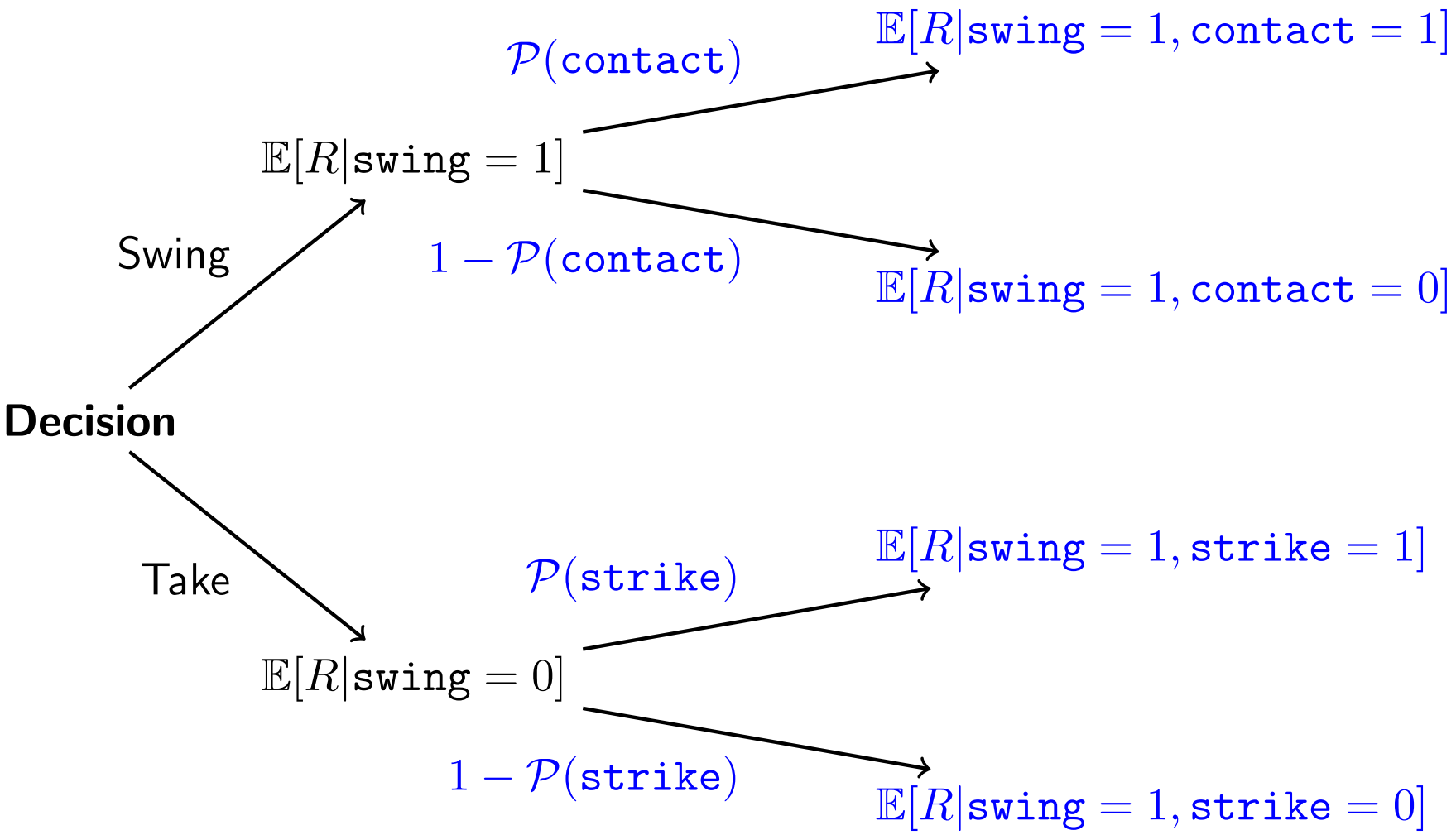

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Estimation

- Desiderata: estimate each intermediate quantity as functions of their conditioning variables

$$\mathcal{P}(\texttt{strike}) = f(\texttt{game state, personnel, location, ...})$$

  - Nonlinear
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  - Nonparametric Bayesian model that approximates the target function through an ensemble of piecewise constant step functions
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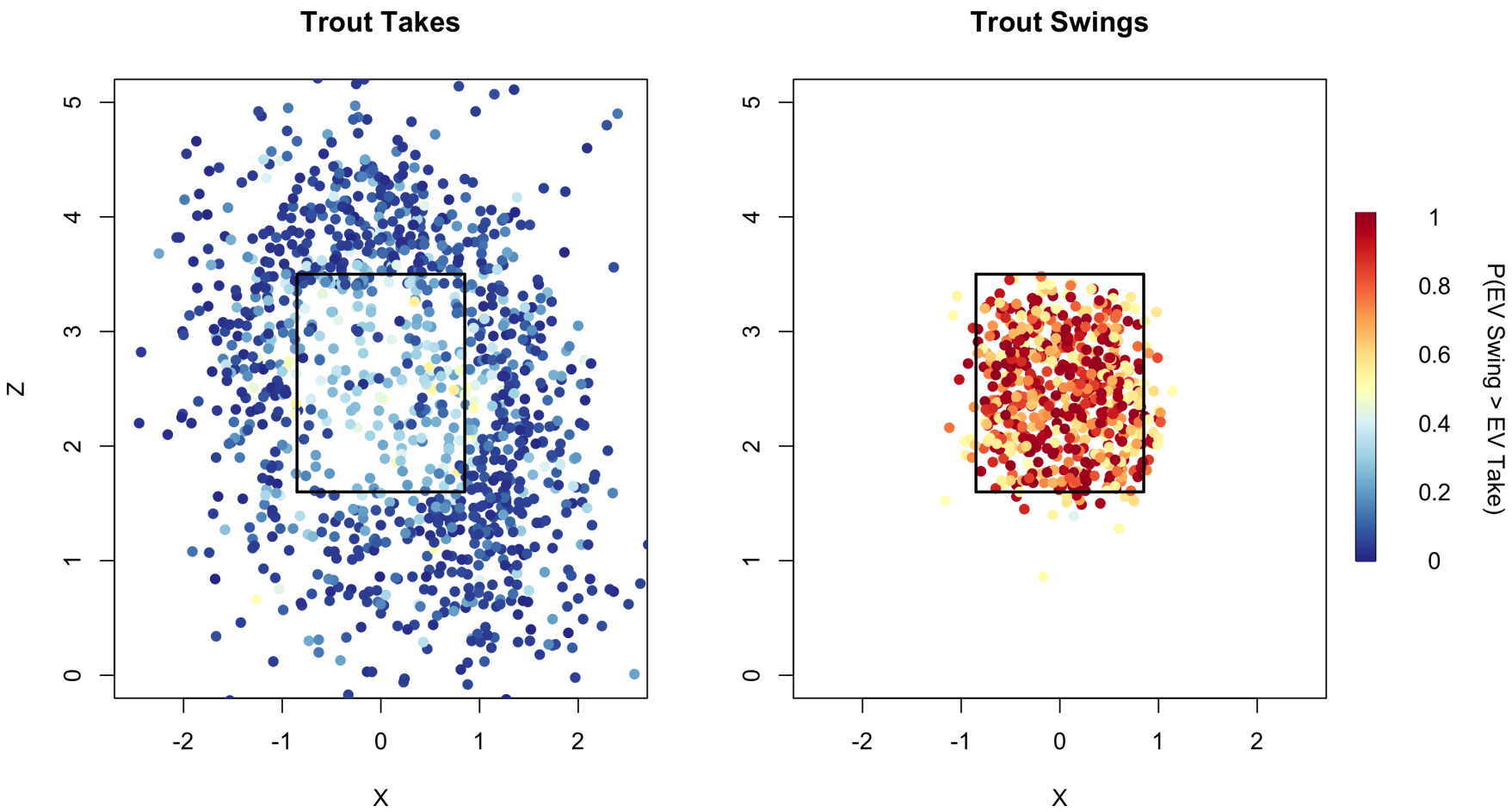
- Use same approach for modeling $\mathcal{P}(\texttt{contact})$ and $\mathbb{E}[R|\texttt{swing}, \texttt{outcome}]$

Results

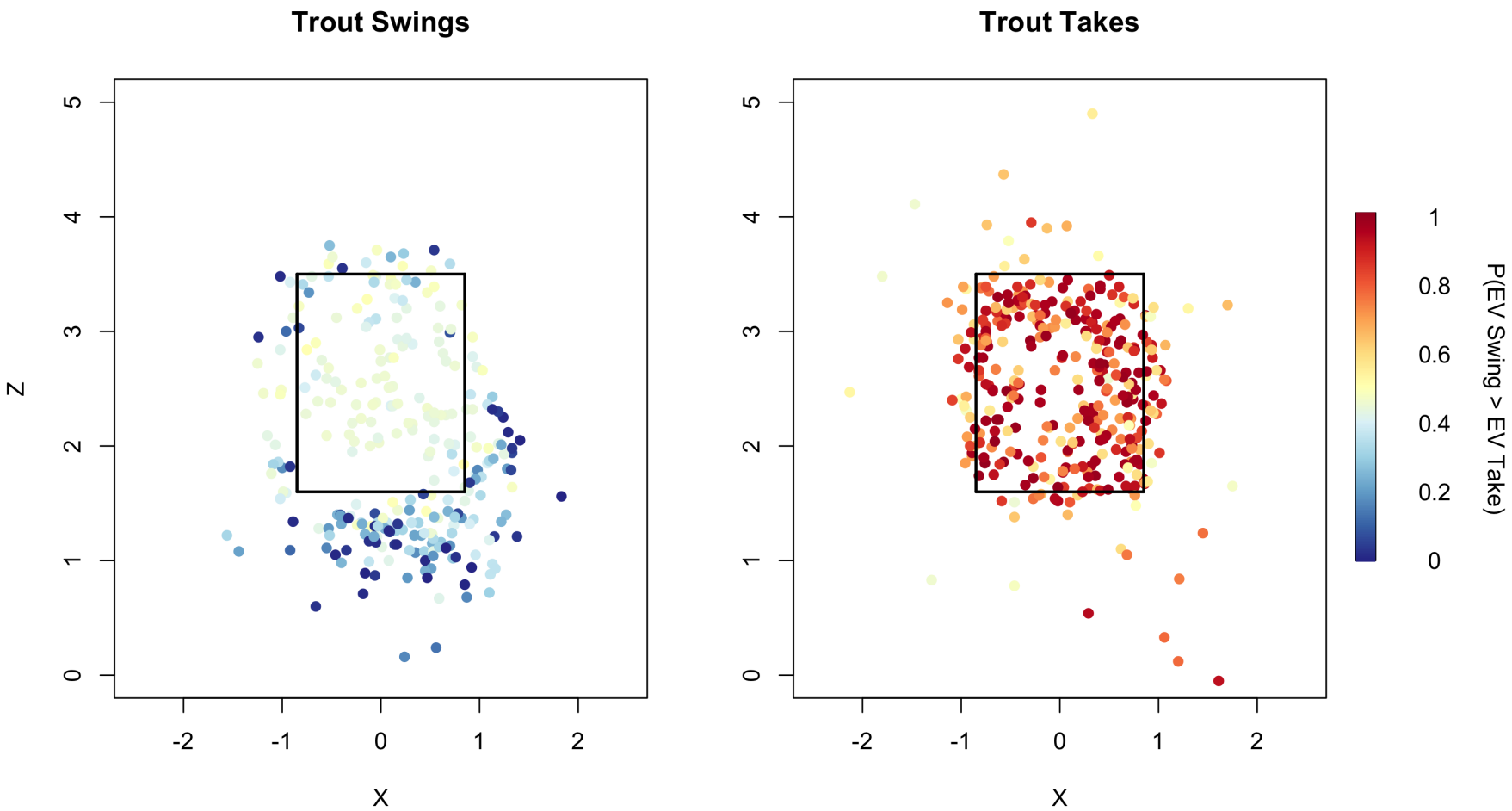
Pitches where Trout made the optimal decision



Note: Pitches shown from umpire's perspective (Trout stands to the left)

Results

Pitches where Trout made the sub-optimal decision



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Takeaways

- Introduced framework for determining the optimal swing decision which utilizes contextual information about the game when the pitch was thrown
- Bayesian approach facilities uncertainty propagation from constituent models to our determination of the optimal swing decision
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✉ Email: ryan.yee@wisc.edu

☞ Website: https://ryanyee3.github.io

Pre-print

Rshiny app

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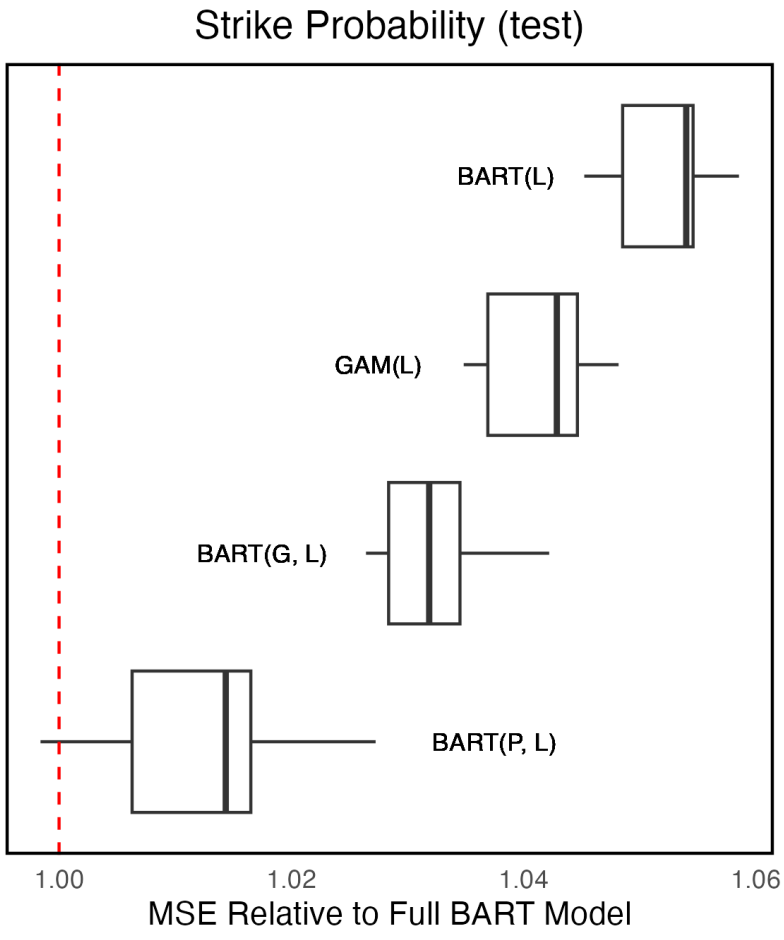
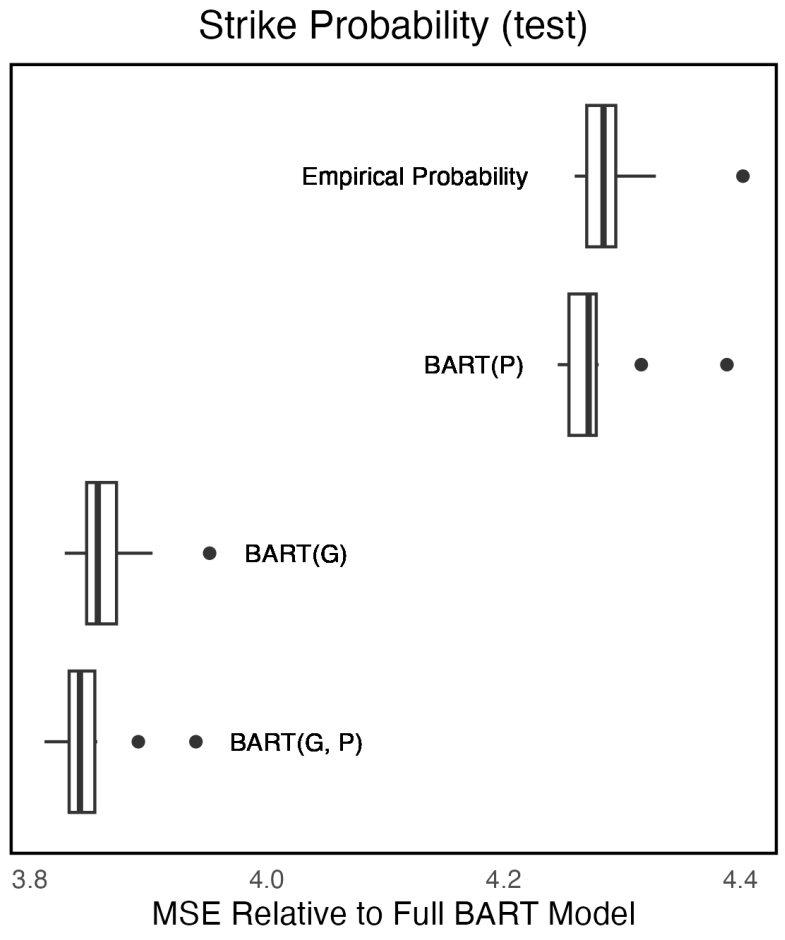
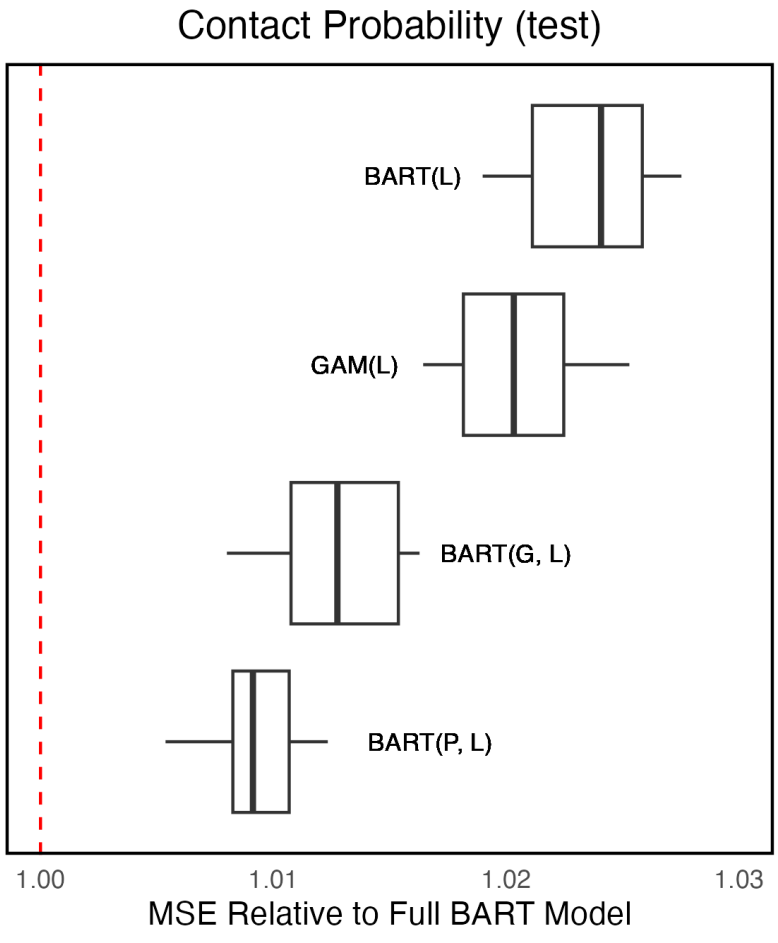
- Thank you!!

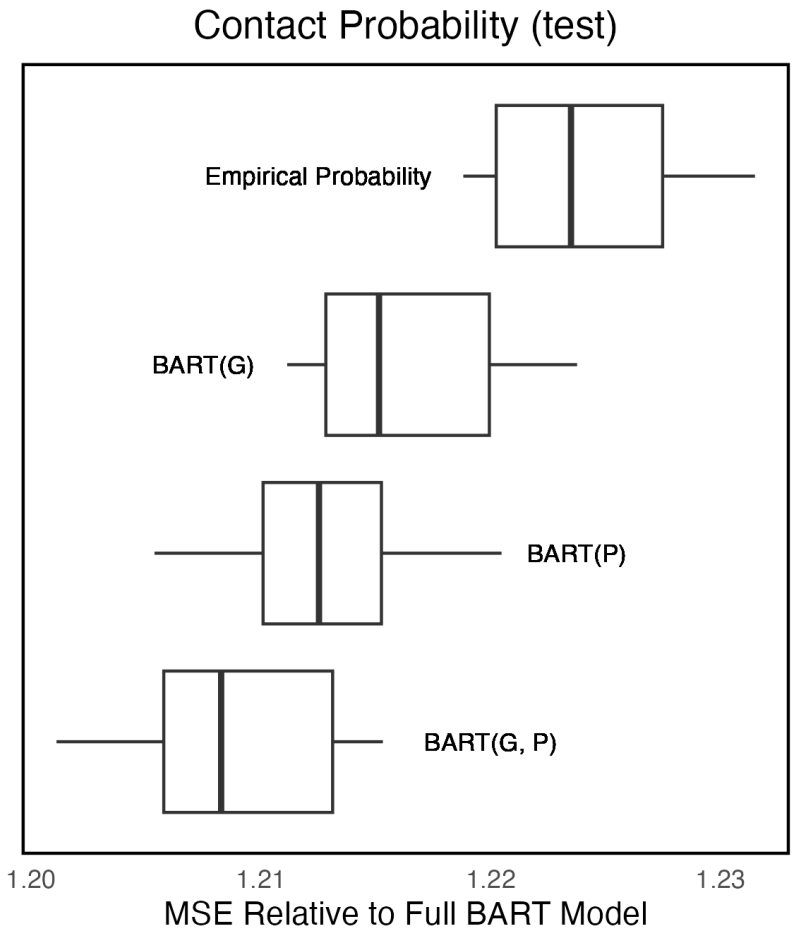
Appendix – Strike Model Validation



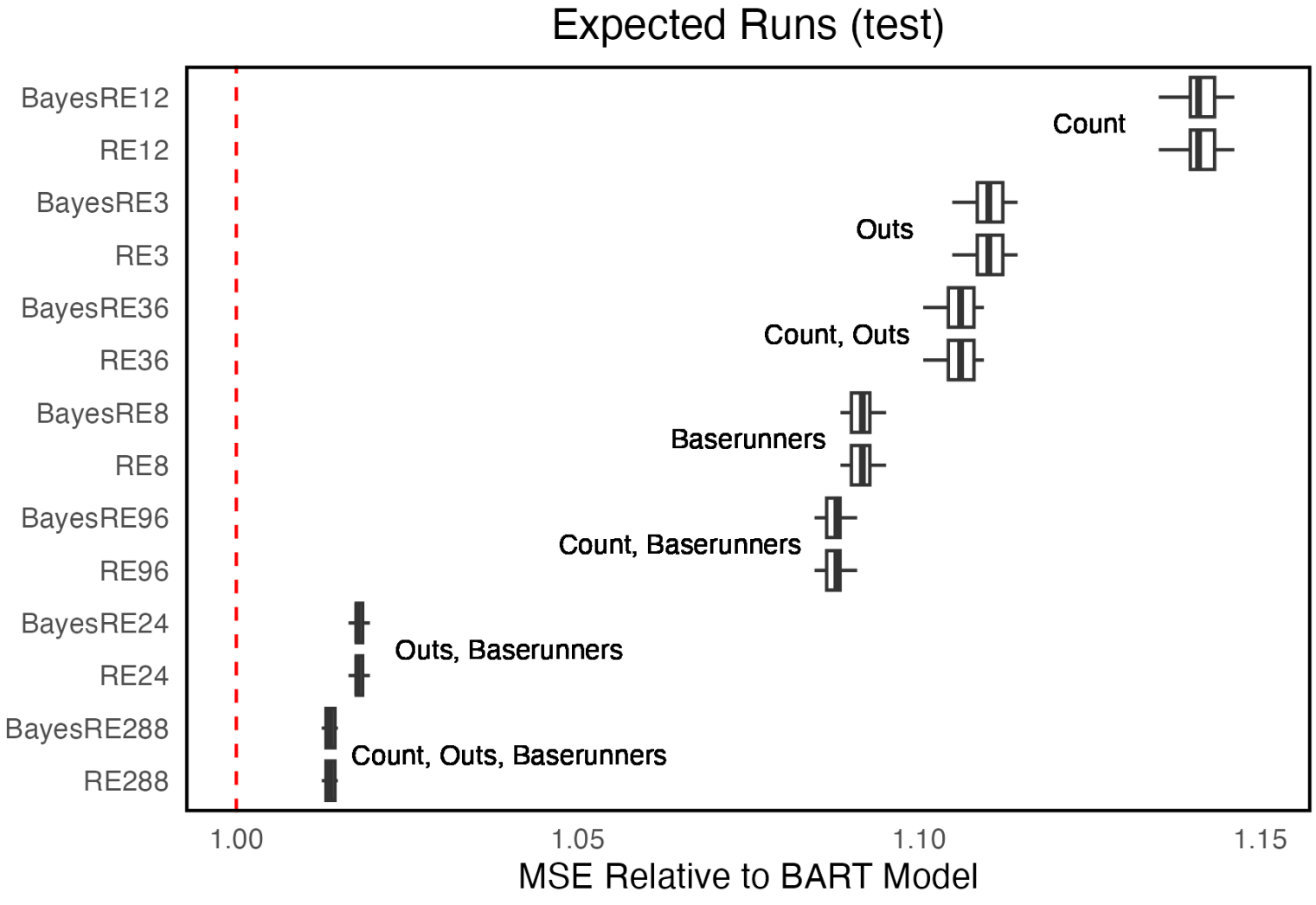
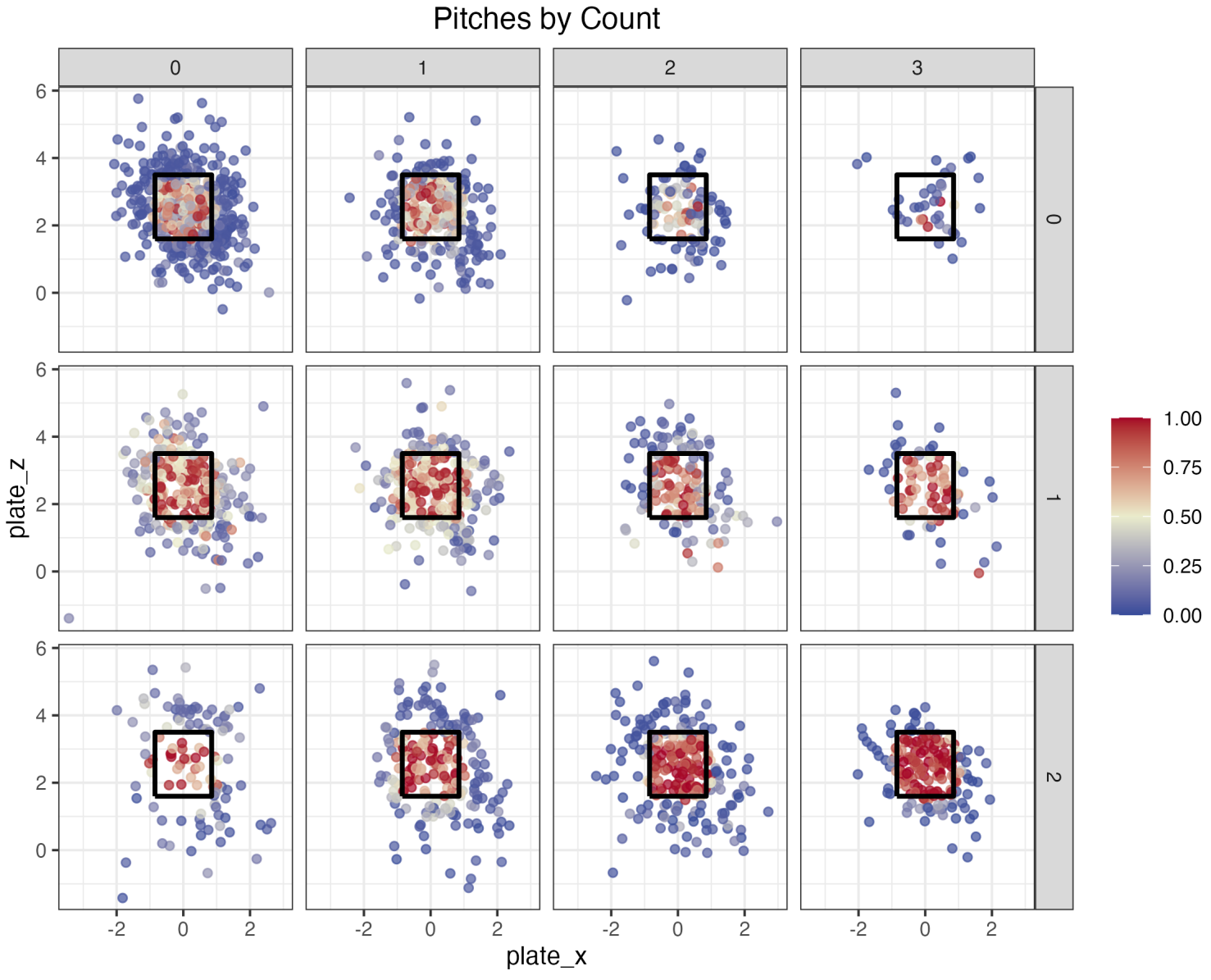


Appendix – Contact Model Validation





Appendix – Expected Runs Model Validation



Appendix – Additional Figures