A Simple Bayesian Game Prediction Model

By: Jake Flancer

The Motivation

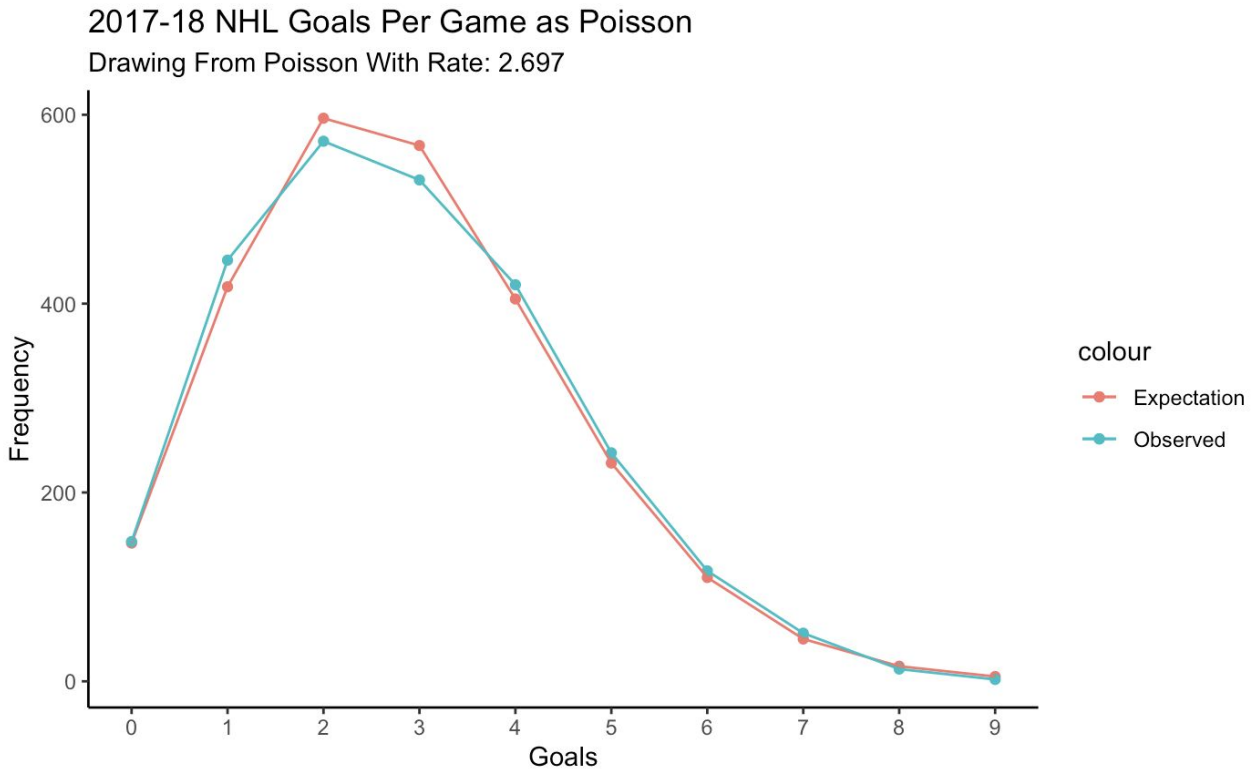
Quantify Team Performance With Uncertainty Estimates

Using Limited Data

Bayesian Statistics

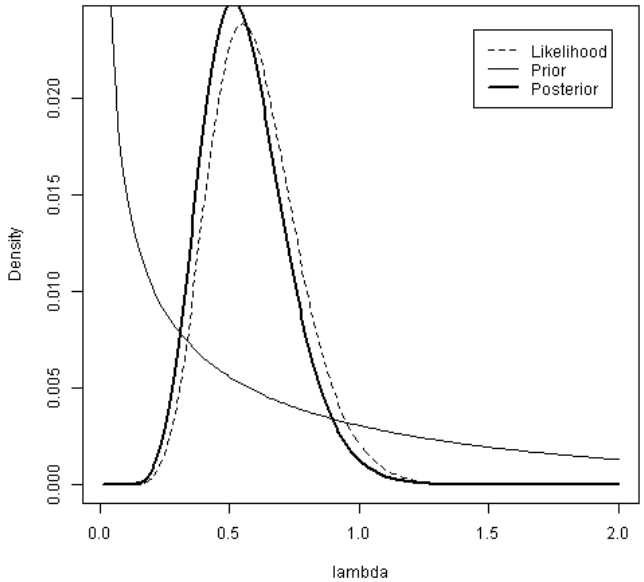
- Incorporating beliefs not “in” data
- Prior “padding” data + Observed data = Estimate
- Parameters under uncertainty

Using the Poisson Distribution



Poisson-Gamma Conjugacy

- Prior: Gamma(α, β)
- Data: Goals Scored = Poisson
- Posterior: Gamma(α+Goals, β+GP)



https://www4.stat.ncsu.edu/~reich/st590/code/PoissonGamma

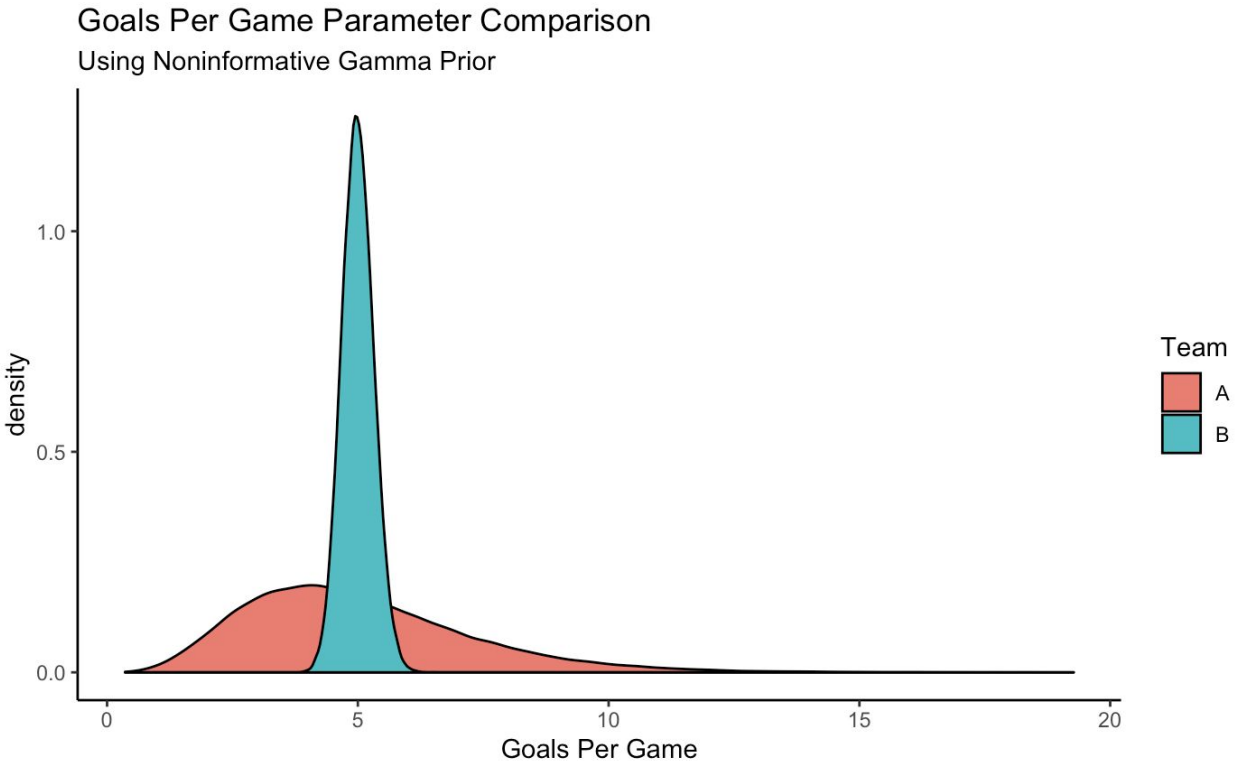
How does this help?

Team A: 1 Game / 5 Goals Scored

Team B: 50 Games / 250 Goals Scored

Which team is better at scoring?

How does this help?



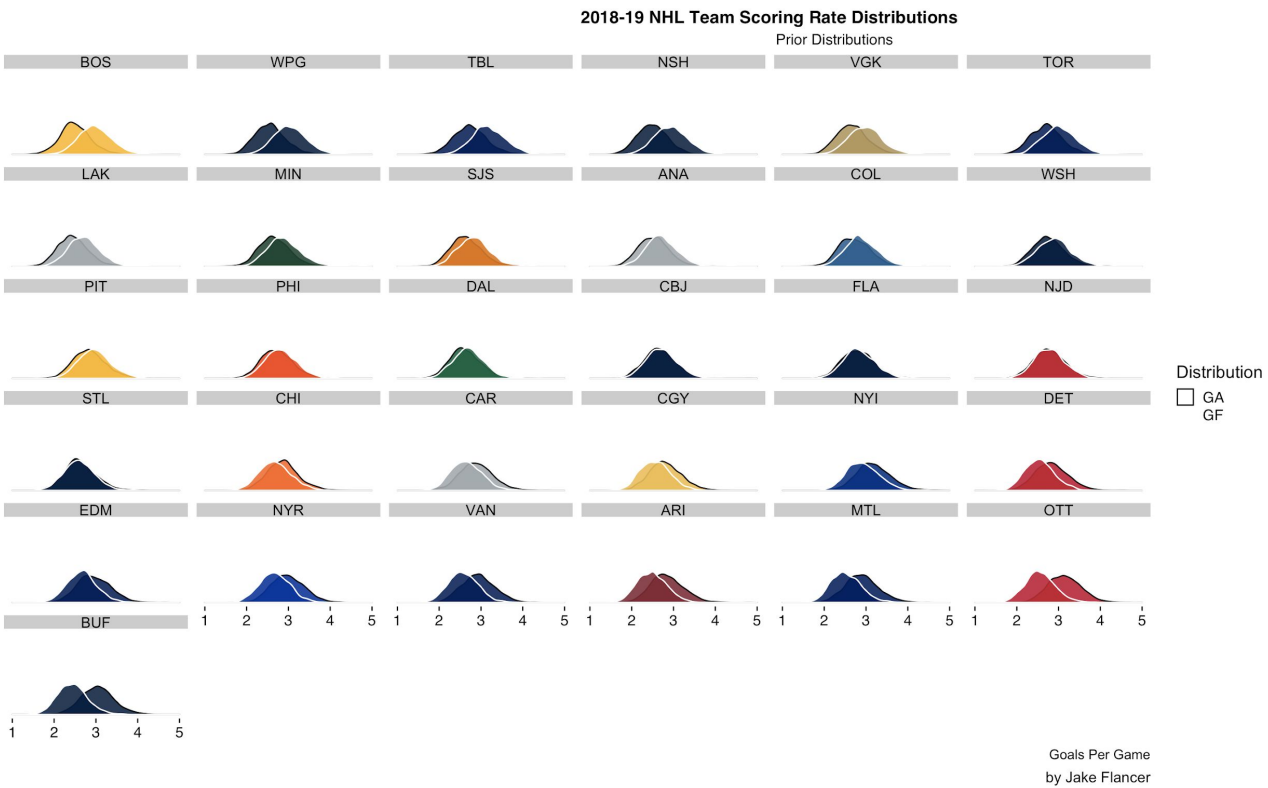
Translating to Hockey...

- Using two team specific parameters
- Goals For Per Game (GF Rate)
- Goals Against Per Game (GA Rate)

Prior Distribution

- Gamma(“Prior GF”, “Prior GP”)
- Previous Season Regressed to League Average
- 20 Games of “Padding”

Prior Distribution

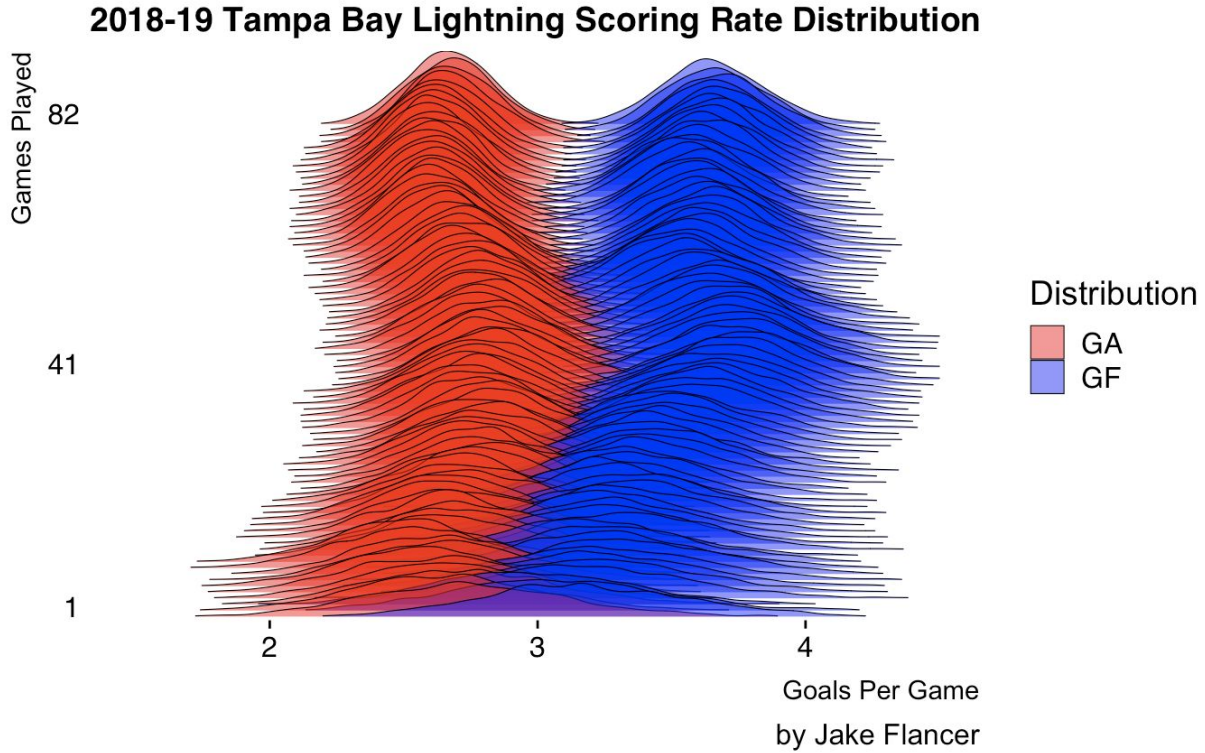


Posterior Distribution

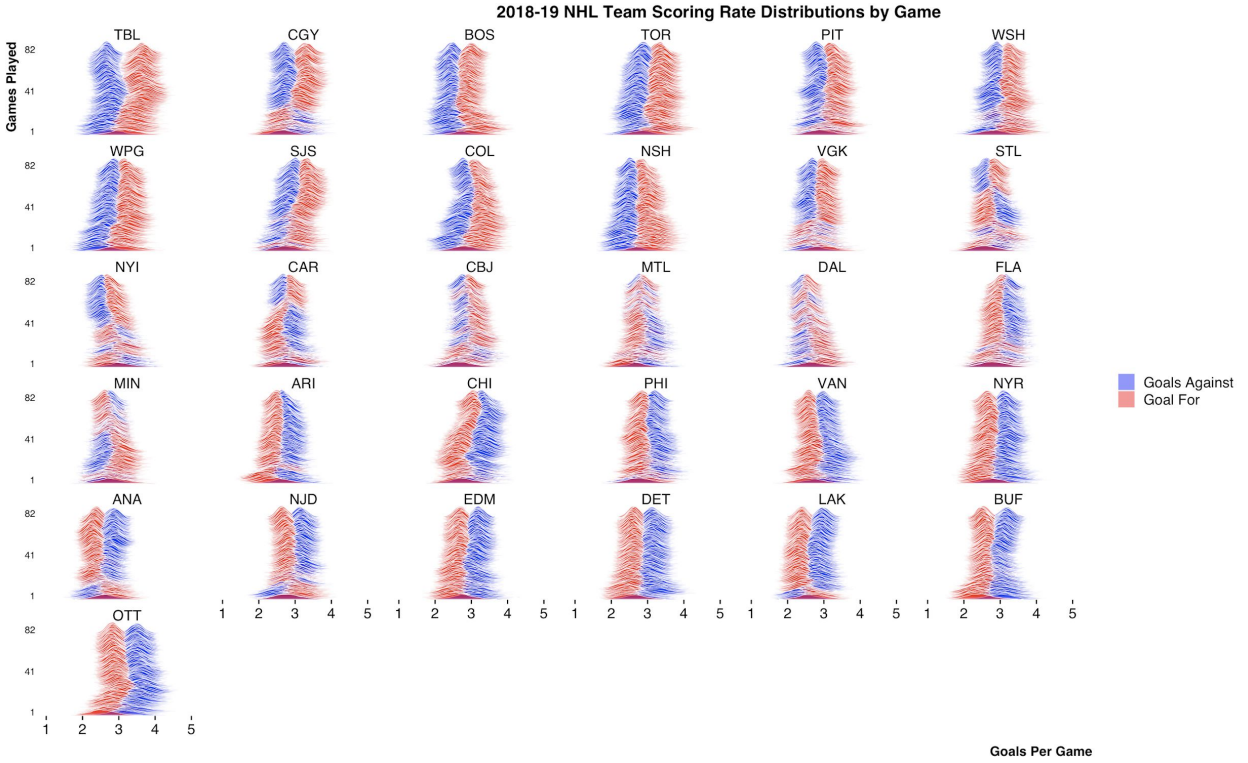
- Gamma(“Prior GF” + Cumulative GF, “Prior GP” + Total GP)

- Game 0 (Prior): Gamma(60 + 0, 20 + 0)
- Game 10: Gamma(60 + 30, 20 + 10)
- ...
- Game 82: Gamma(60 + 246, 20 + 82)

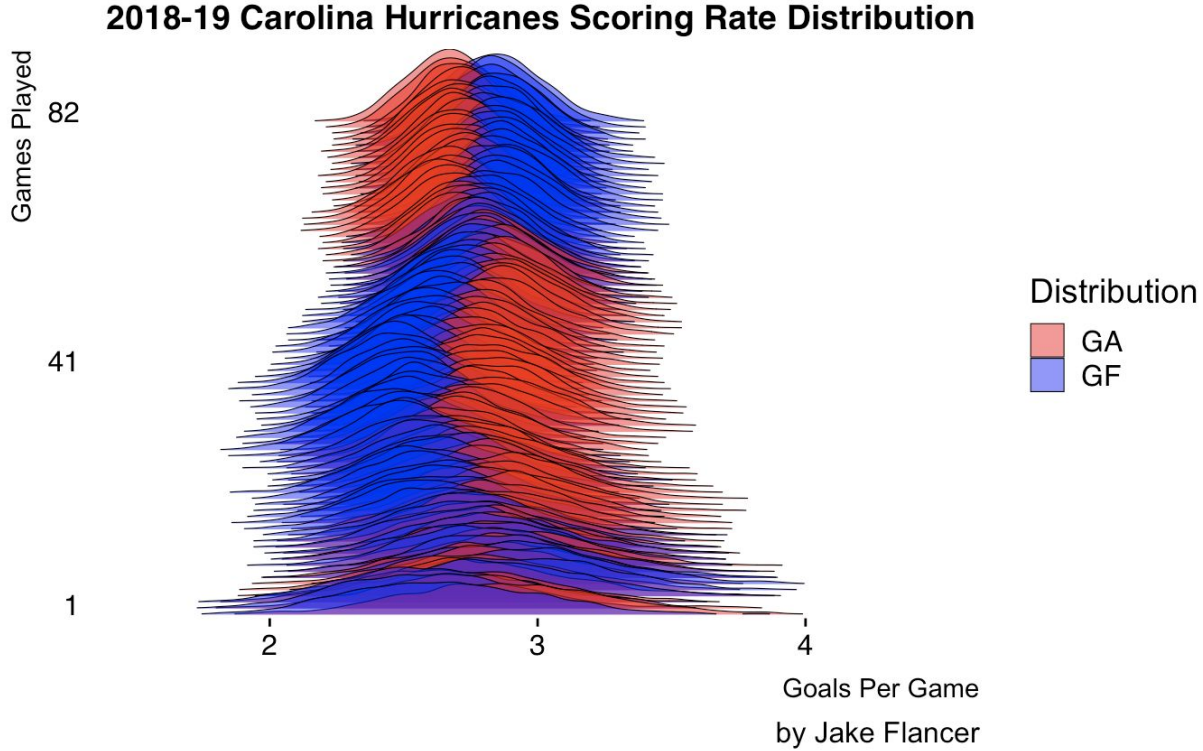
Posterior Distribution



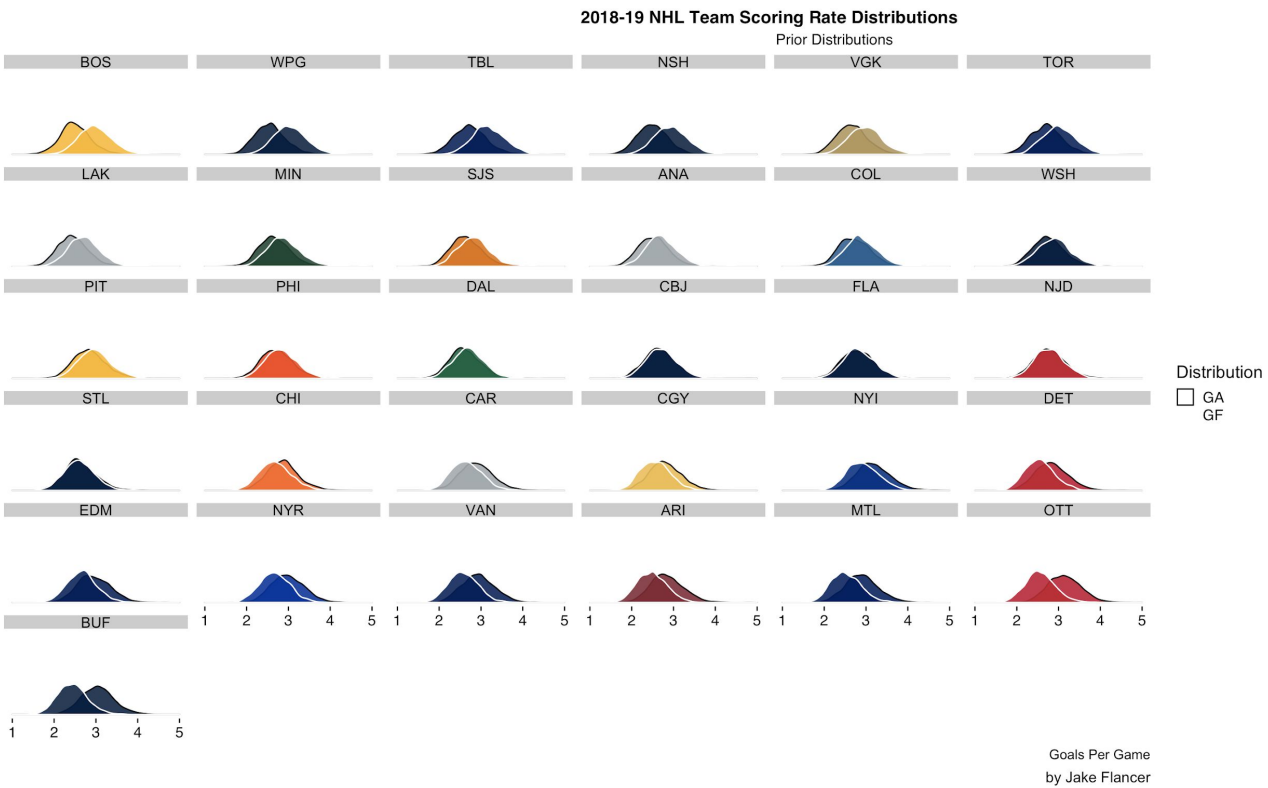
Posterior Distribution



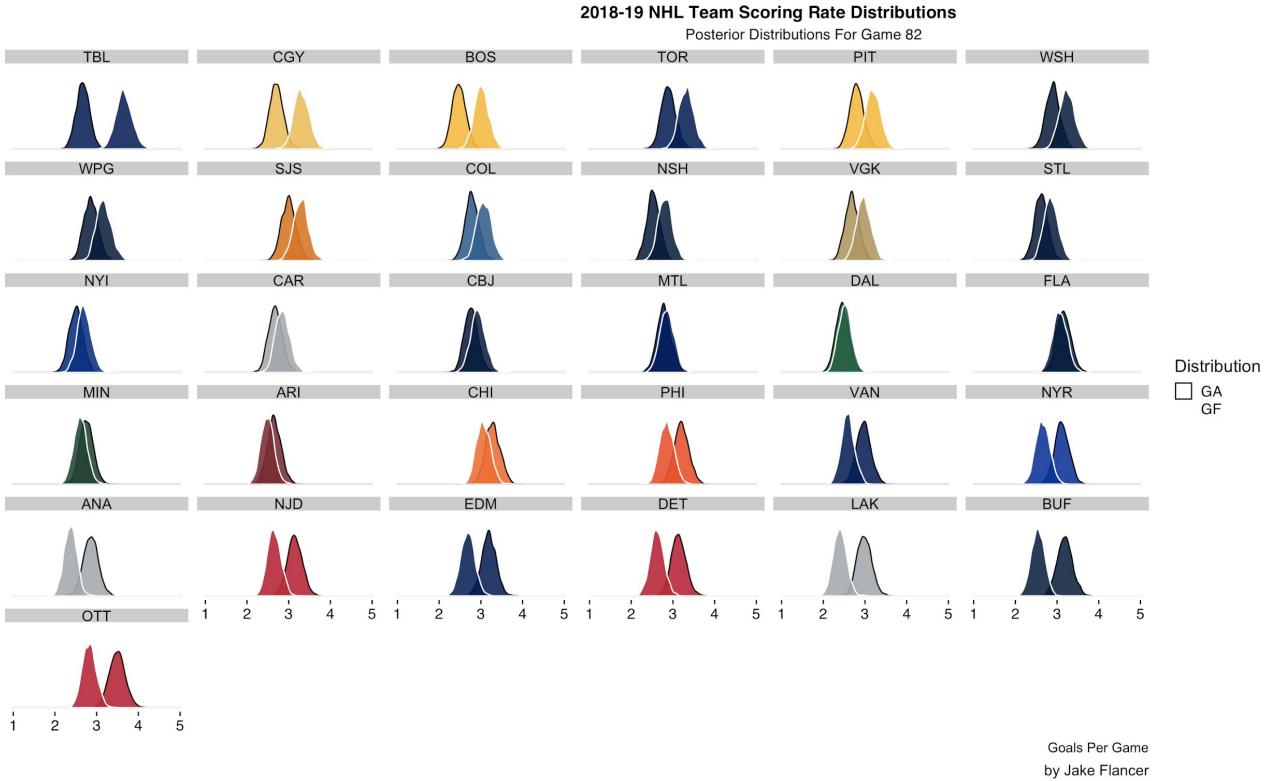
Posterior Distribution



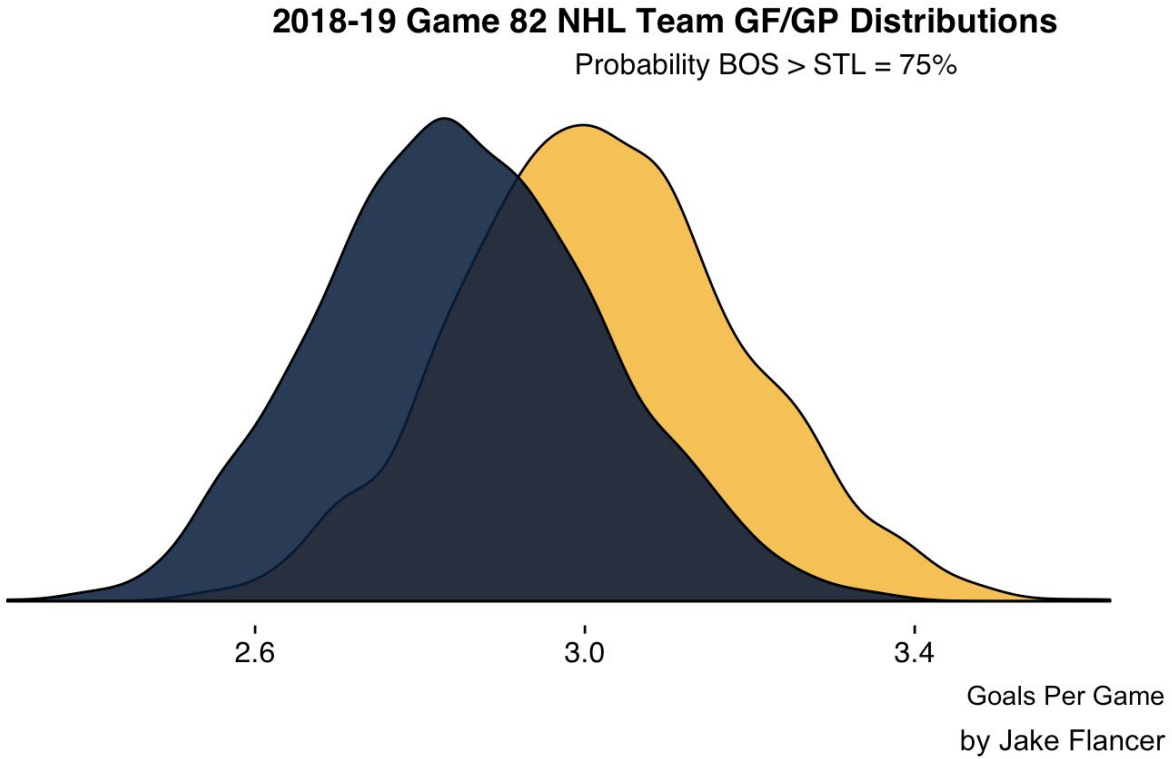
Prior Distribution



Posterior Distribution



Interpreting the Posterior



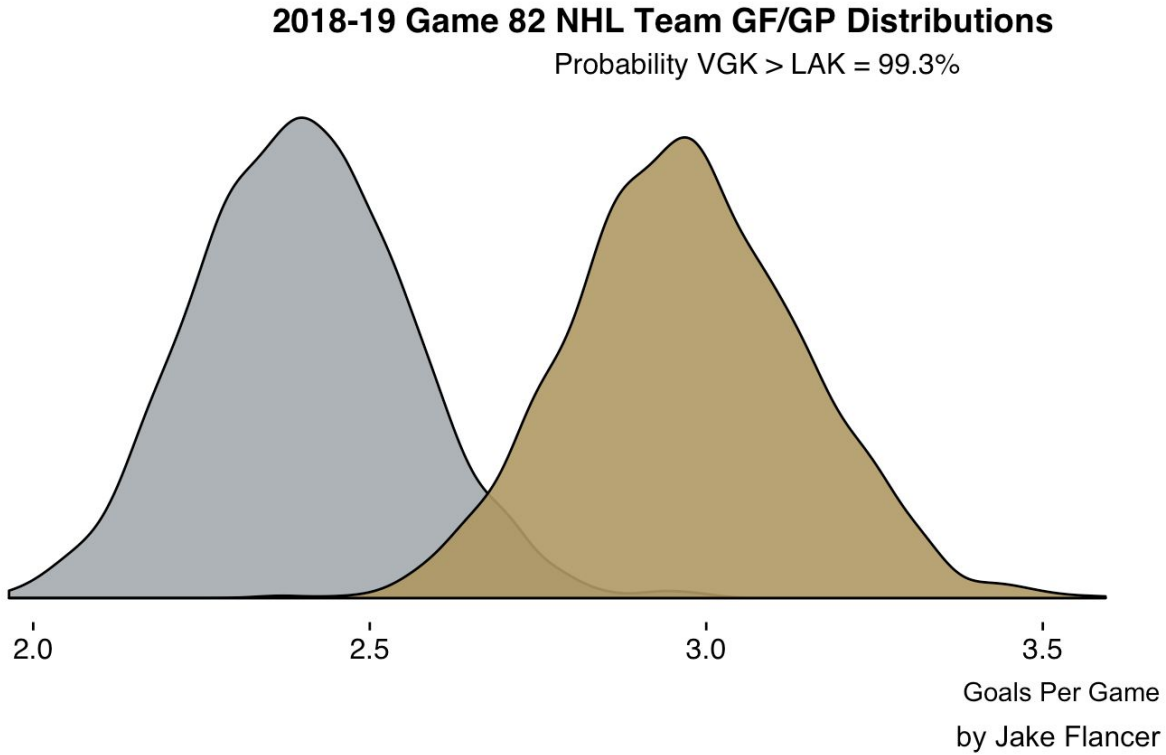
Current

- Posterior only yields P(Team A > Team B)
- Make probability statements about team parameters
- “The distribution of the expectation”

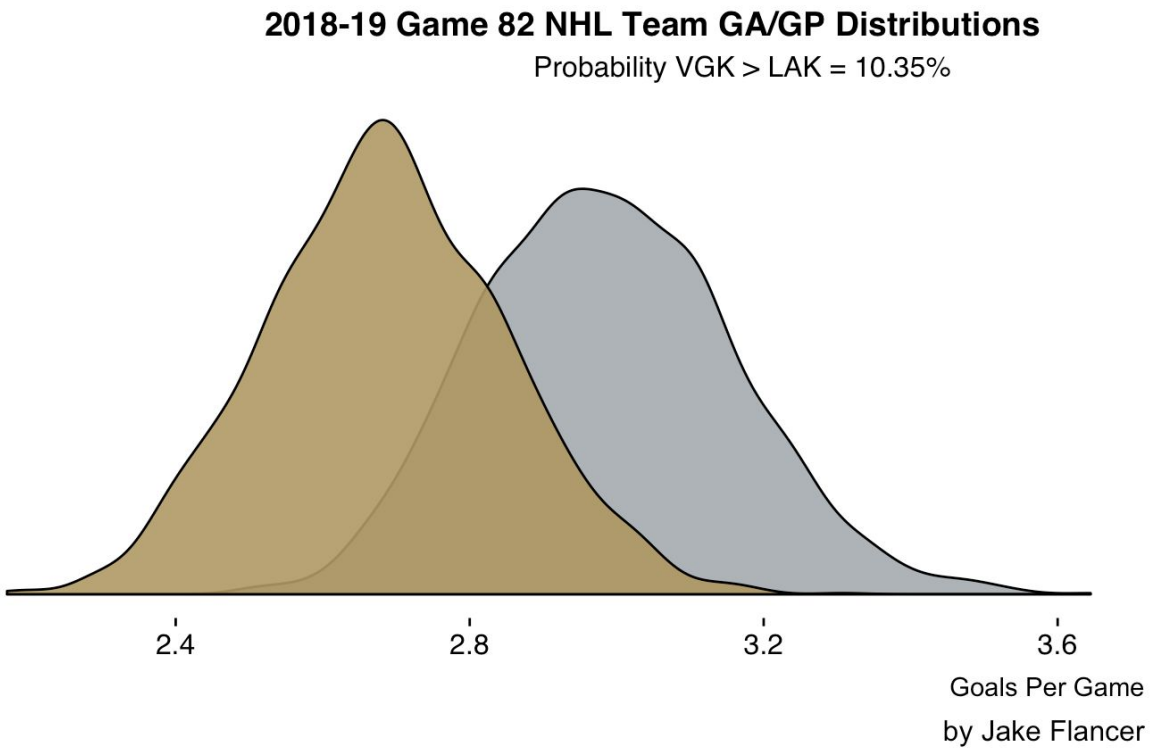
Goal

- Estimate Game Outcomes
- “The distribution of the outcomes”

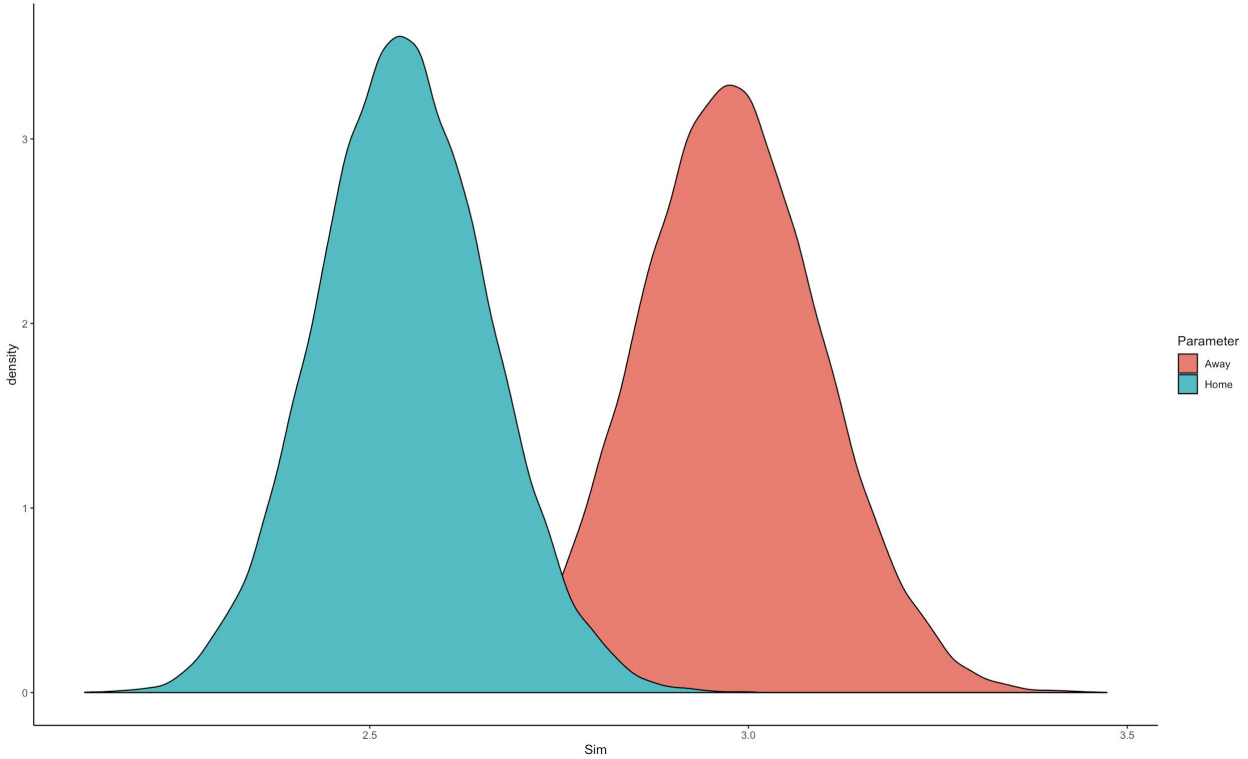
Game Prediction



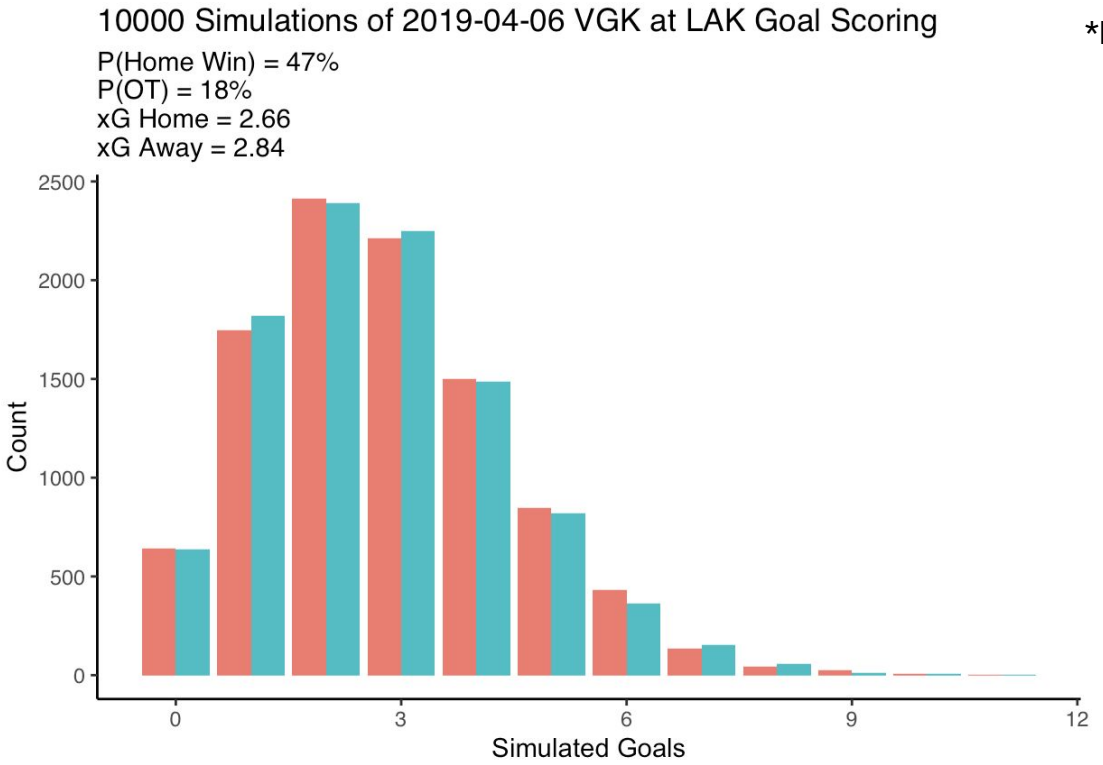
Game Prediction



Game Prediction

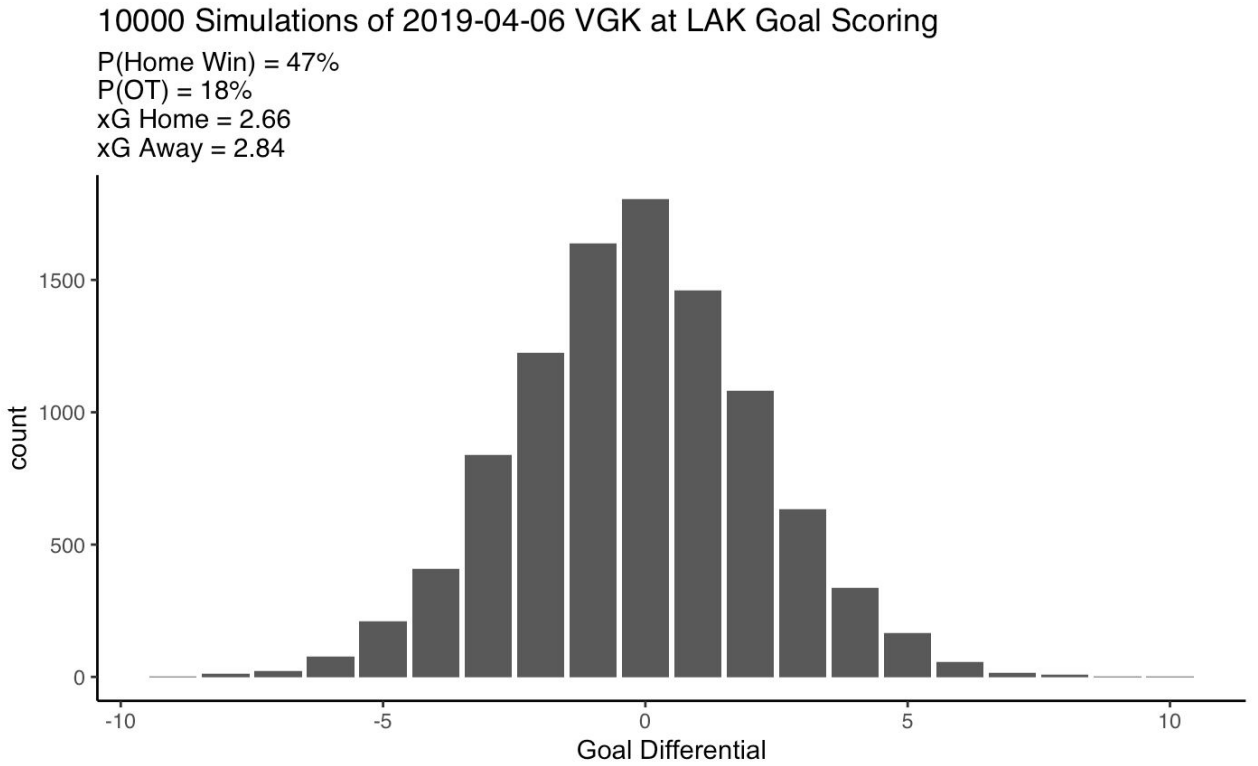


Game Prediction



*Home Advantage Added

Game Prediction



Key Assumptions and Issues

- Goal scoring is not truly poisson (score effects)
    - 16% in OT, reality is 21%
- Parameters equally weighted
- Team strength stays the same (game 1 and game 82 equally weighted)

In Summary

- Team level uncertainty estimates
- Make straightforward probabilistic team comparisons
- Game outcome distributions
- Works with limited data
- Cool plots!

Thank You!

Feel Free To Reach Out

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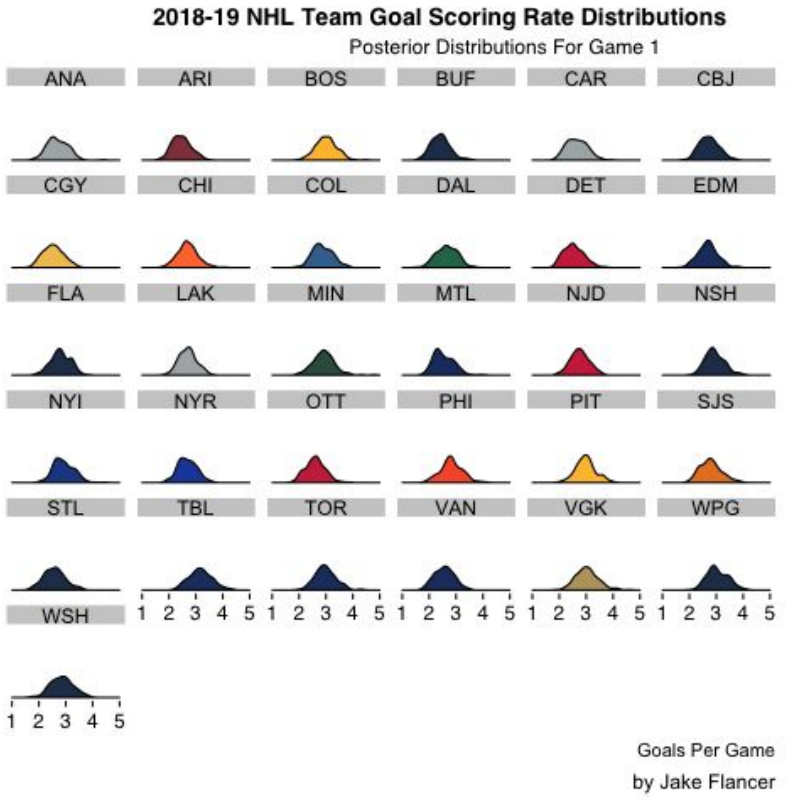
github.com/jflancer/gameModel

Use even-strength.com!!!



Appendix

- Data via nhl.com
- “Full” Presentation (w/ math): **https://tinyurl.com/RITgamemodel**