



DOES LASIX MAKE HORSES RUN FASTER?

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BACKGROUND

- Lasix (furosemide) is a loop diuretic
 - Intended to treat exercise-induced pulmonary hemorrhage
 - Speculation about performance-enhancing effects
- Horseracing Integrity and Safety Authority (HISA) restricts Lasix
 - No race day Lasix for two-year-old and stakes races
 - Question: Does Lasix actually *cause* horses to run faster?
- We aim to quantify the population-level effect of Lasix on race-day performance.

DATA

- Response:** Finishing “in the money” (first, second, or third)
- Treatment:** Lasix indicator
- Curated sub-dataset:**
 - ~100,000 race results
 - ~28,000 horses
 - 1991 - 2024
 - Two-year-old horses that have raced both with and without Lasix at least once (**perfect matching**).

Figure 1: Each horse has raced roughly two times with and without Lasix on average.

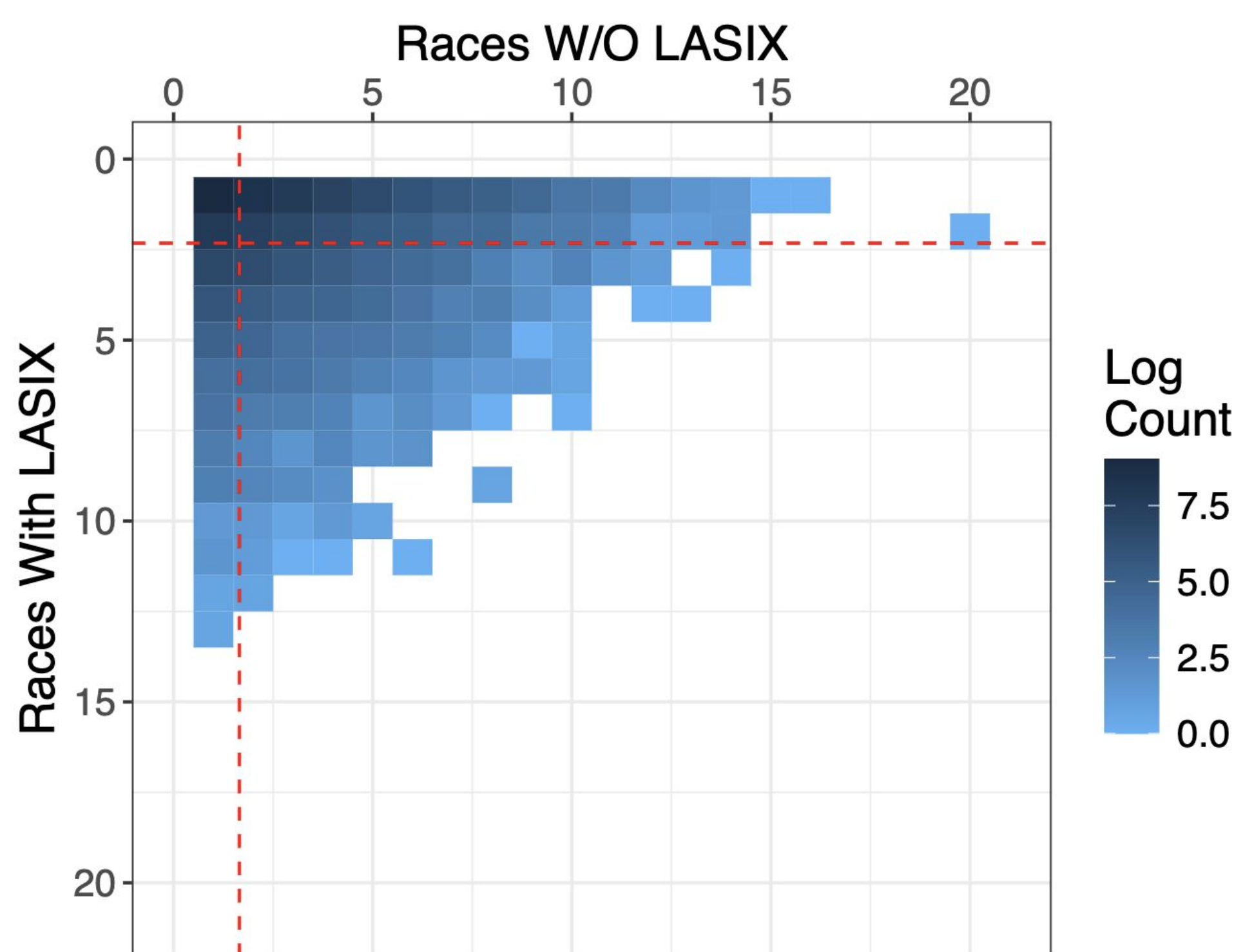


Figure 2: Relationship between finishing in the money and odds is linear and negative.

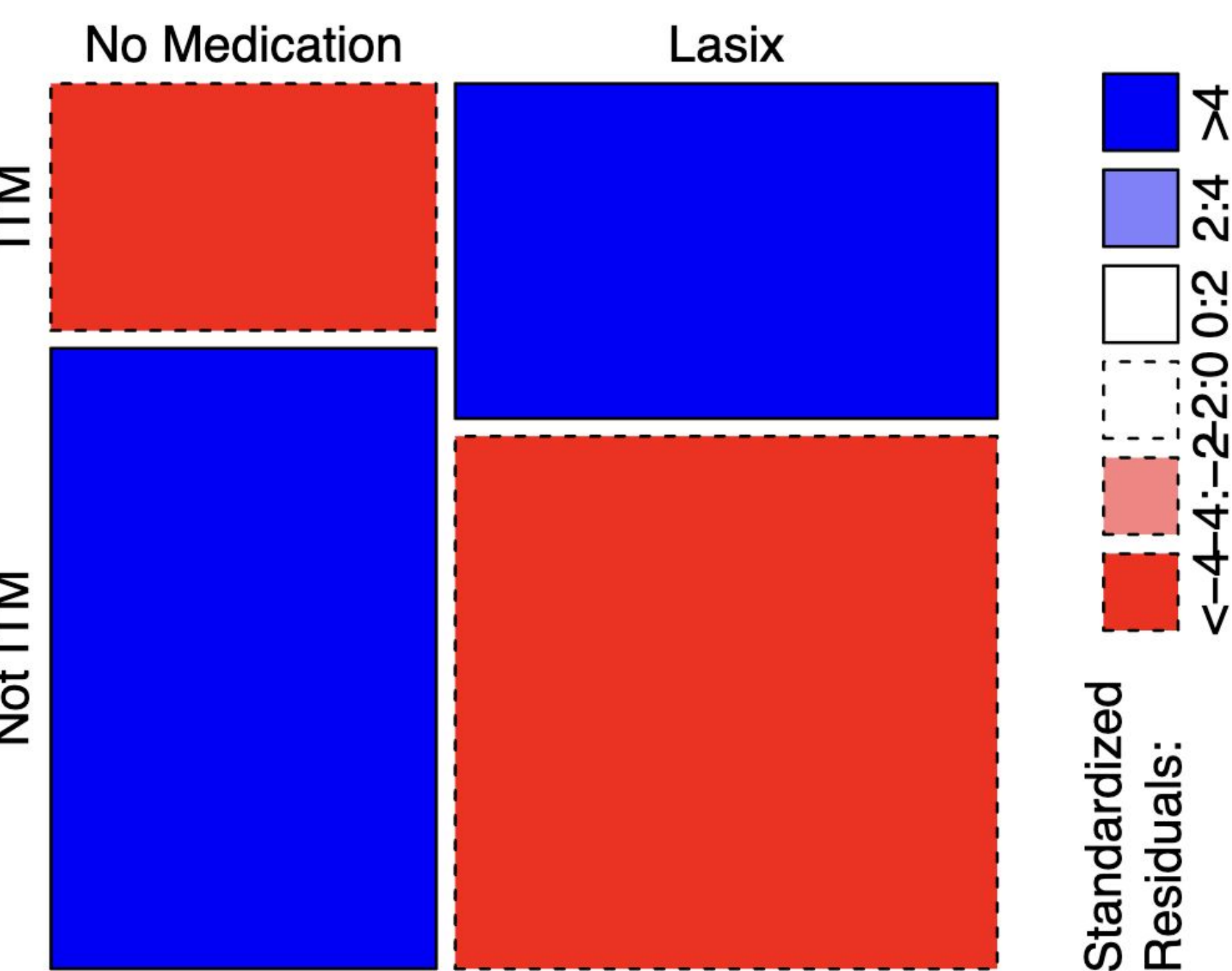
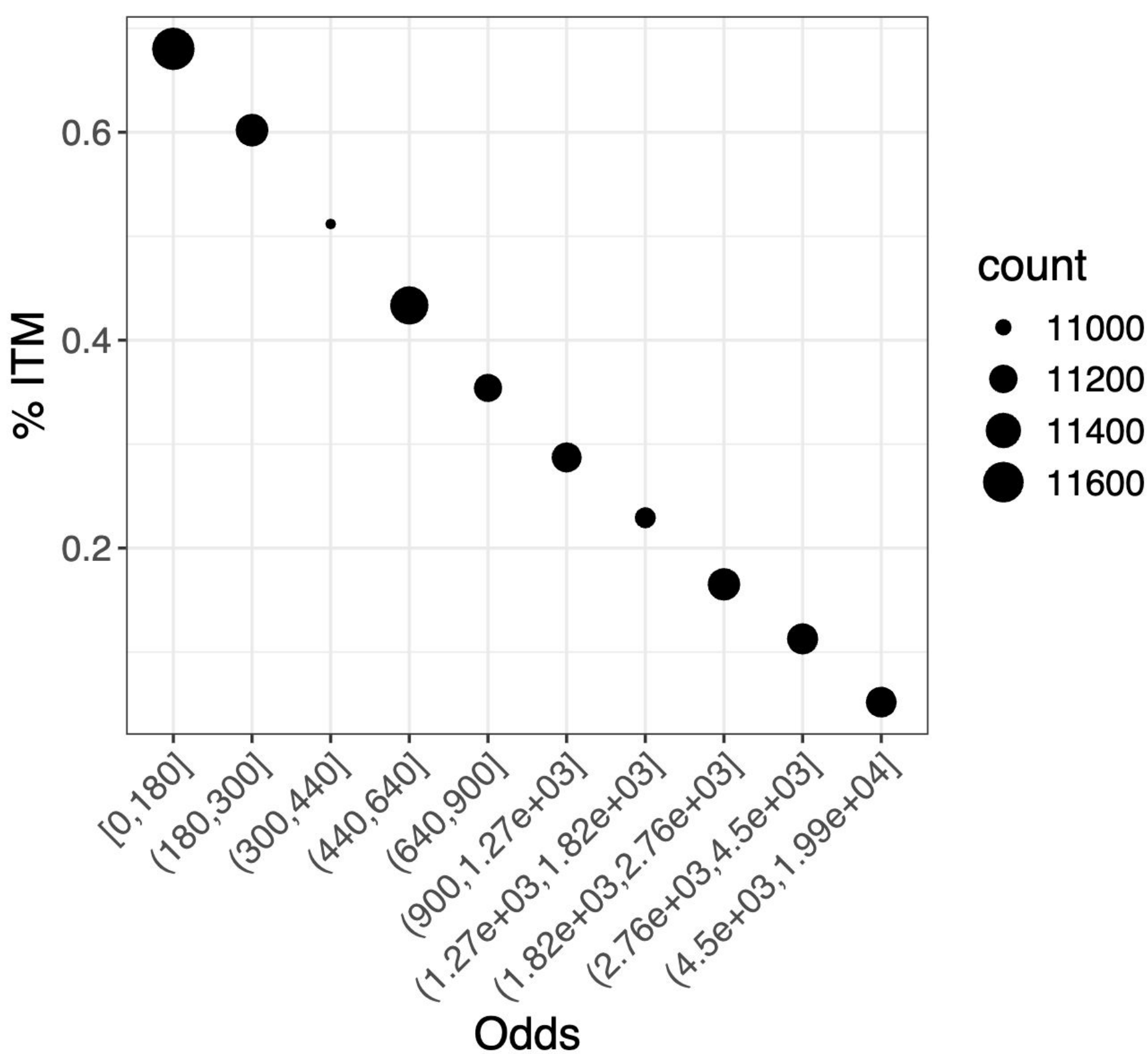


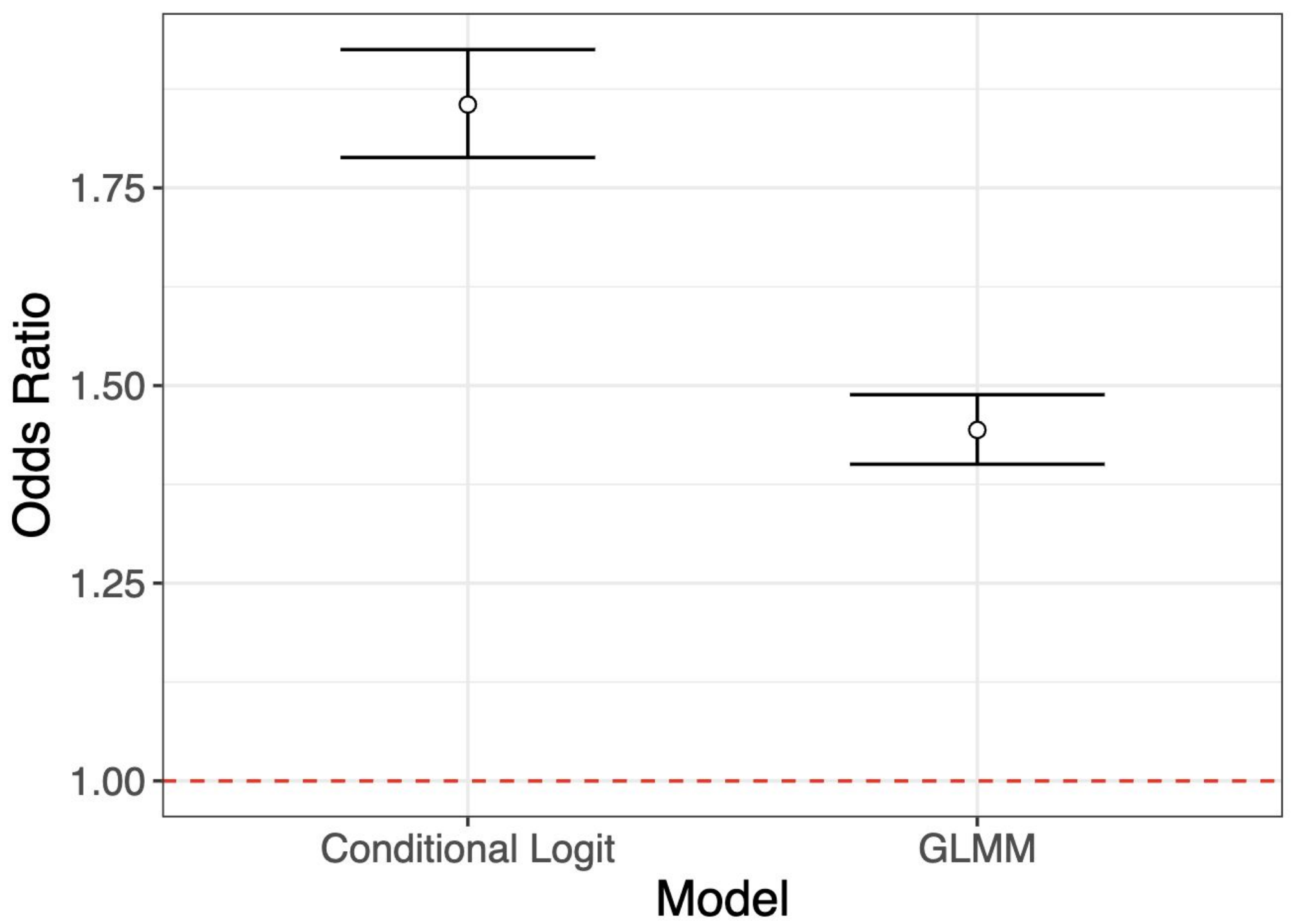
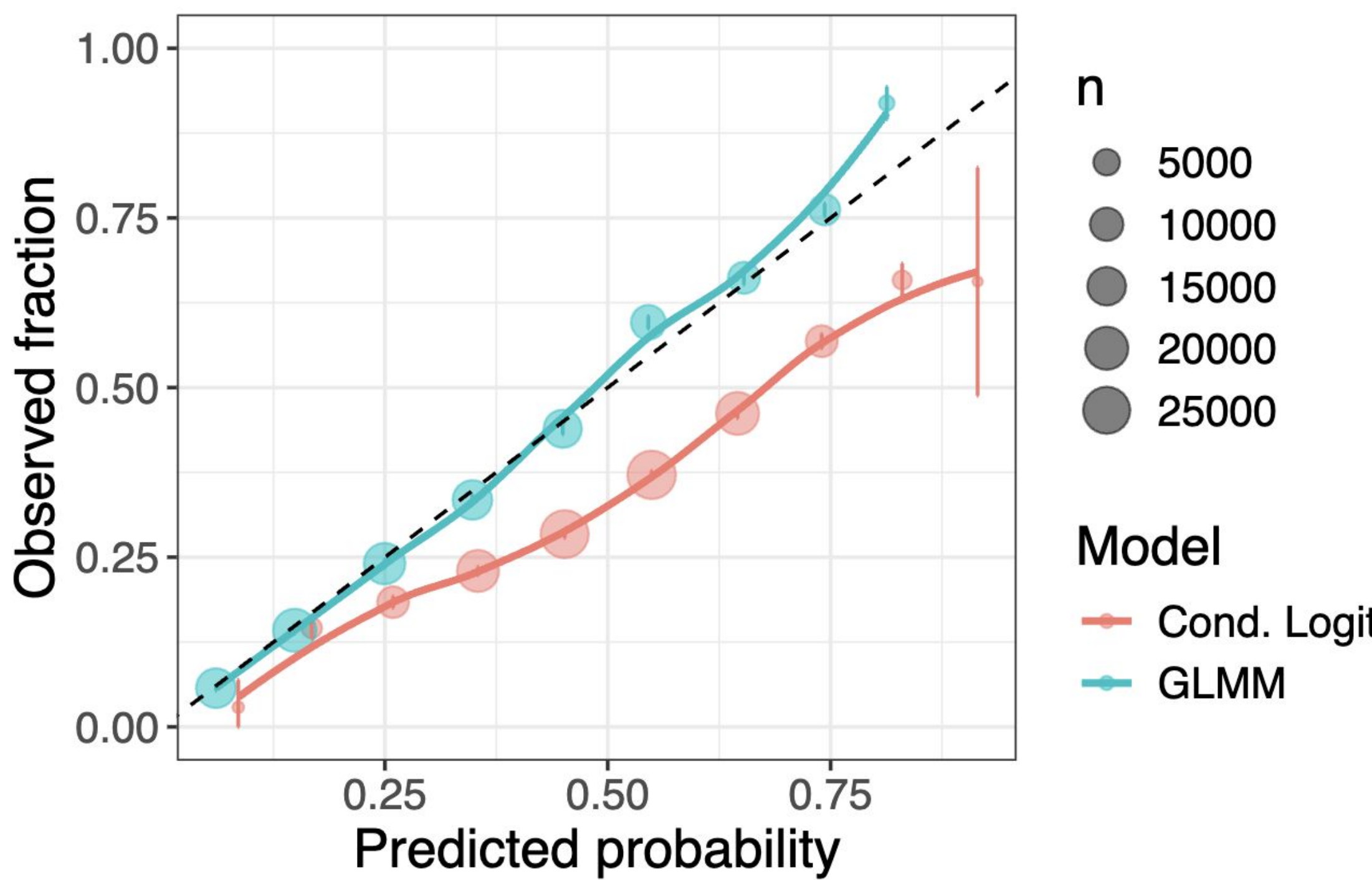
Figure 3: More horses finishing in the money (ITM) than expected when using Lasix.

METHODS

- Conditional logistic regression** treats each horse as a **strata** with their own intercept:
For the j^{th} observation from the i^{th} horse, $P(ITM_{ij} | Lasix_{ij}, X_{ij}) = \frac{1}{1 + \exp[-(\alpha_i + \tau Lasix_{ij} + \beta X_{ij})]}$
 X_{ij} is a vector with
 - Horse sex $_{ij}$
 - Post position $_{ij}$
 - Public betting odds $_{ij}$
 - Fraction of other horses on Lasix $_{ij}$
 - Field size $_{ij}$
- Mixed effects logistic regression** treats horse intercepts as random:
 $P(ITM_{ij} | Lasix_{ij}, X_{ij}) = \frac{1}{1 + \exp[-(\alpha_i + \tau Lasix_{ij} + \beta X_{ij})]}$, where $\alpha_i \sim N(0, \sigma^2)$

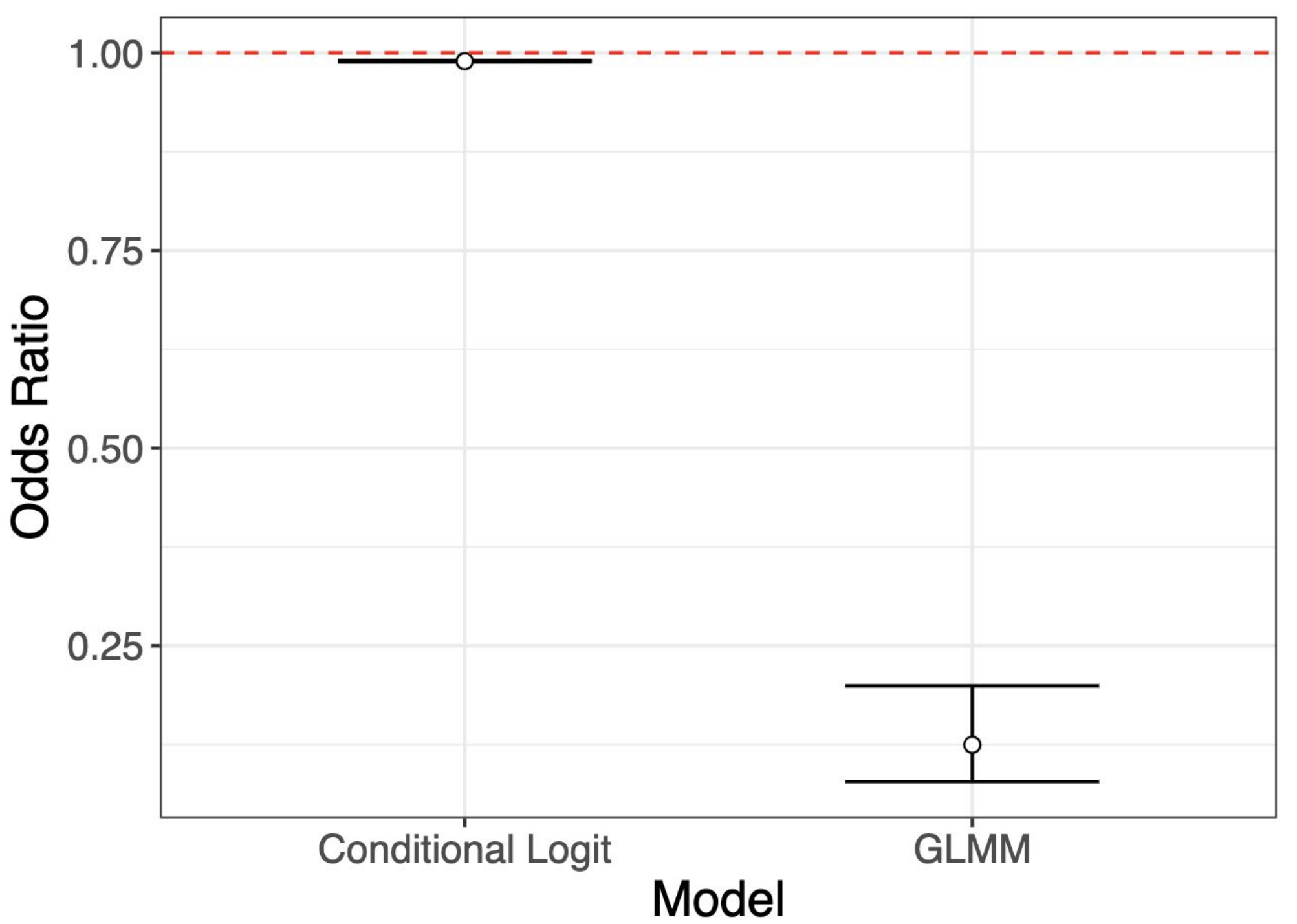
RESULTS

GLMM improves calibration by explicitly modeling between-horse variation.



Both models suggest a positive effect for Lasix on finishing in the money.

Both models suggest a negative effect for race-level fraction of Lasix.



DISCUSSION

- Among two-year-old American thoroughbred race horses, **using Lasix corresponds to a marginal effect of a 1.44-fold increase in odds of finishing in the money (GLMM)** (95% CI [1.40, 1.49]), controlling for relevant confounders.
- Among two-year-old American thoroughbred race horses, **each percentage increase in the race-level fraction of horses using Lasix corresponds to a marginal effect of a 0.12-factor change in odds of finishing in the money (GLMM)** (95% CI [0.08, 0.20]), controlling for relevant confounders.
- Model diagnostics suggest misspecification in the conditional logistic model, but correct specification of the GLMM, indicating estimation of between-horse variability is important when estimating probability of finishing in the money.

FUTURE WORK

- Fit more flexible hierarchical models, use doubly robust estimators to extend to non-matched settings, and model other performance measures like finishing times and finishing order.
- Analyze GLMM with random slopes for Lasix use and directly model distributional shape/skew parameters as functions of Lasix use to understand its impact on horse performance variability.