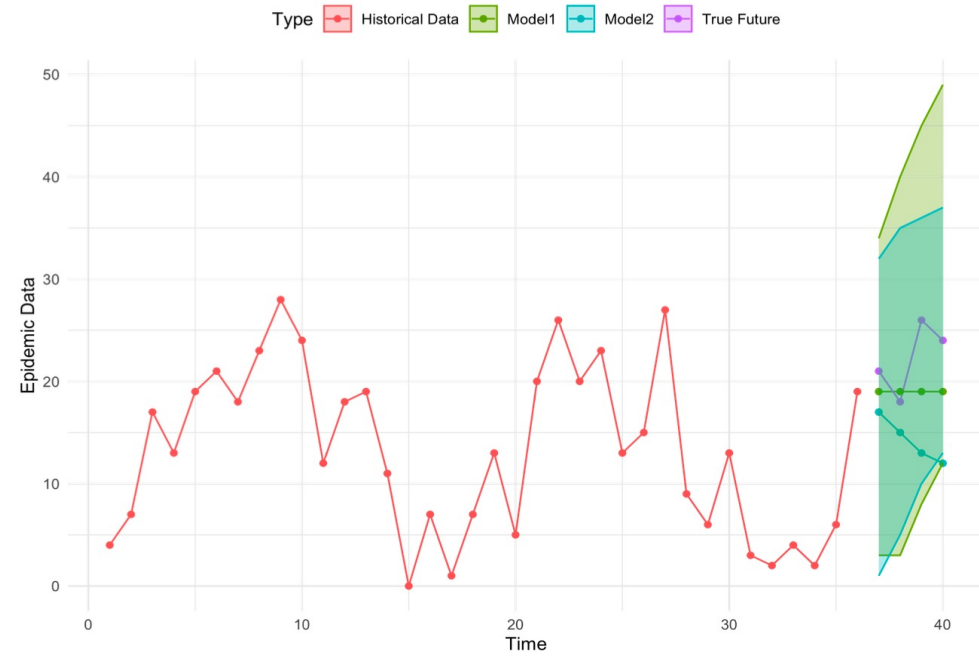


Optim-WISE: An Ensemble Approach for Probabilistic Forecasts Optimized via Weighted Interval Score

Nibir Chandra Mandal, Kaur Gursharn, Aniruddha Adiga, Srinivasan Venkatramanan, Bryan Lewis, Madhav Marathe

Epidemic Diseases Forecasting

Epidemic Forecasting is the process of predicting the future spread of infectious diseases based on current data.



Ensemble forecast combines probabilistic forecasts from multiple models.

Research problem

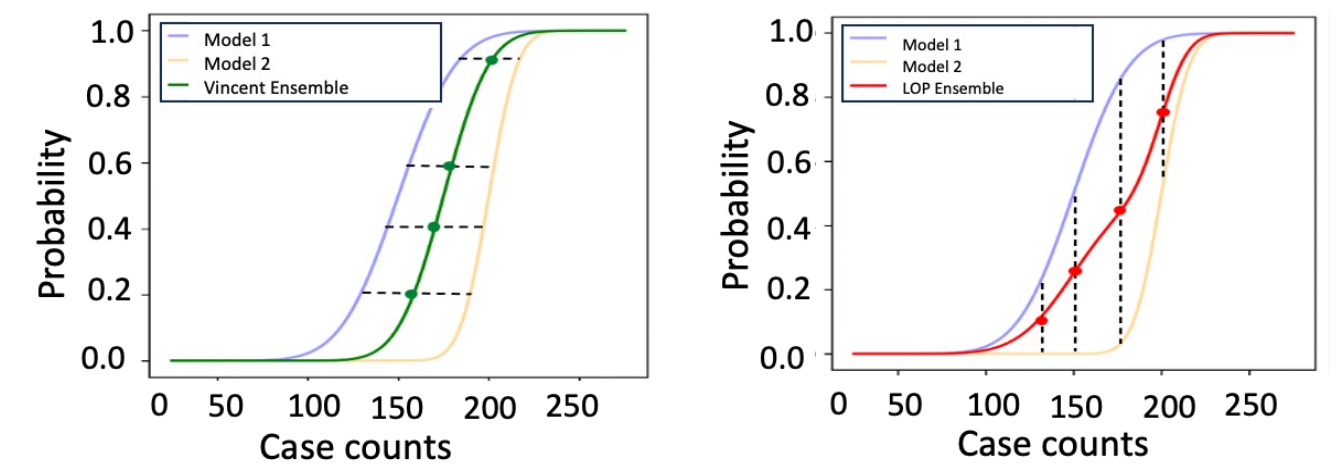
Existing ensemble model focus on **minimizing the absolute error** of forecasts; leads to **inaccurate and unreliable** estimation of uncertainty.

Objective: Design a trained ensemble model that optimizes weighted interval score (WIS) of ensemble forecast. WIS measures the accuracy of a forecast considering underlying uncertainty in prediction. For a given forecast quantiles q_i at level i for all $i \in \tau$, WIS is:

$$WIS = \frac{1}{|\tau|} \sum_{i \in \tau} 2 * (q_i - y) * (1_{q_i \leq y} - i)$$

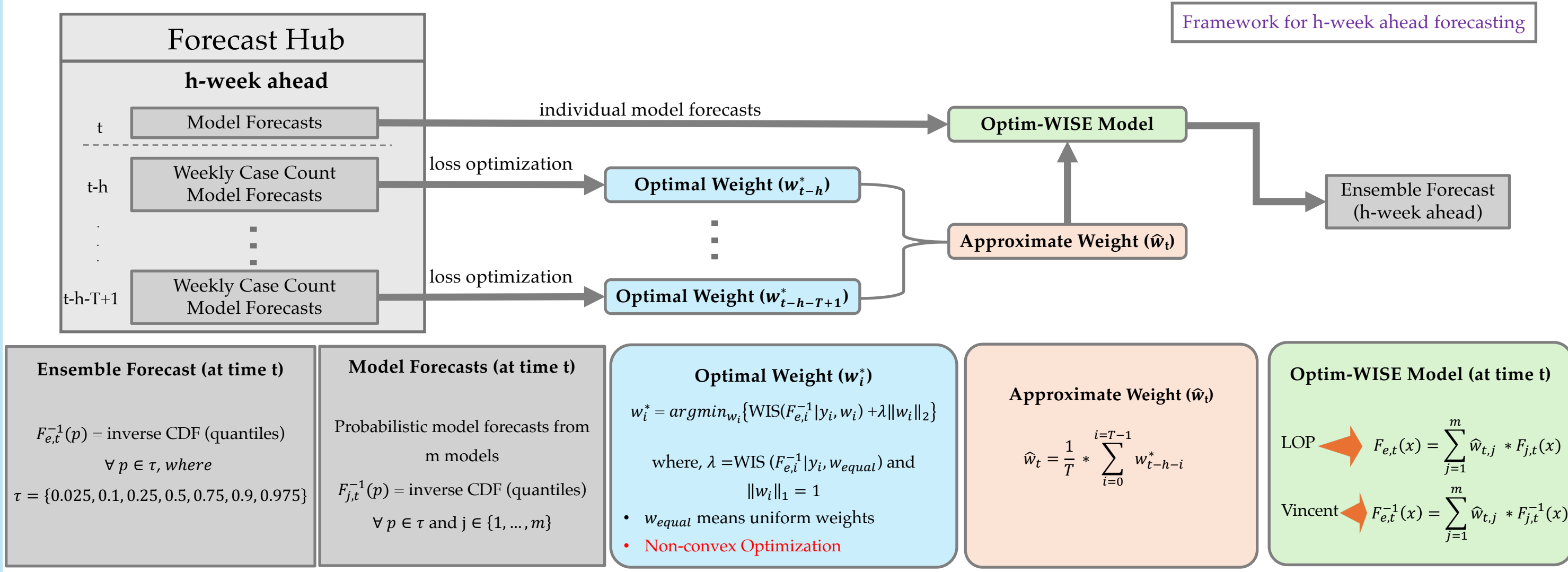
Background

Linear opinion pool (LOP) takes weighted average of cumulative probabilities across alternative prediction for a fixed forecast value.



Vincent ensemble takes weighted average of forecast value across alternative predictions for a fixed quantile.

Proposed Ensemble Model

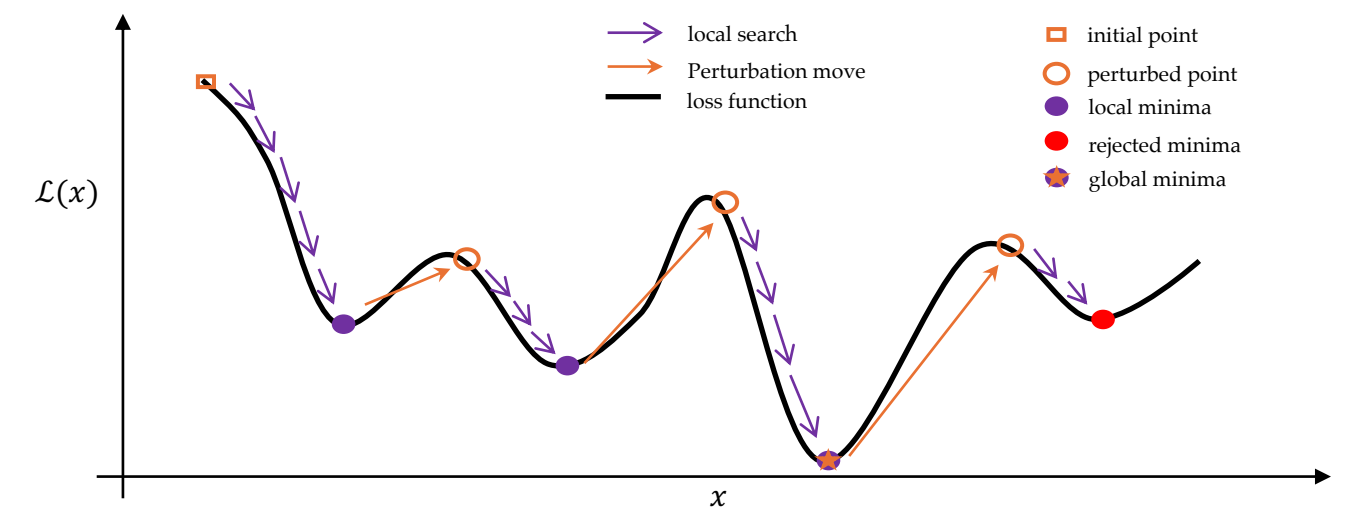


Solution for Optimal Weights

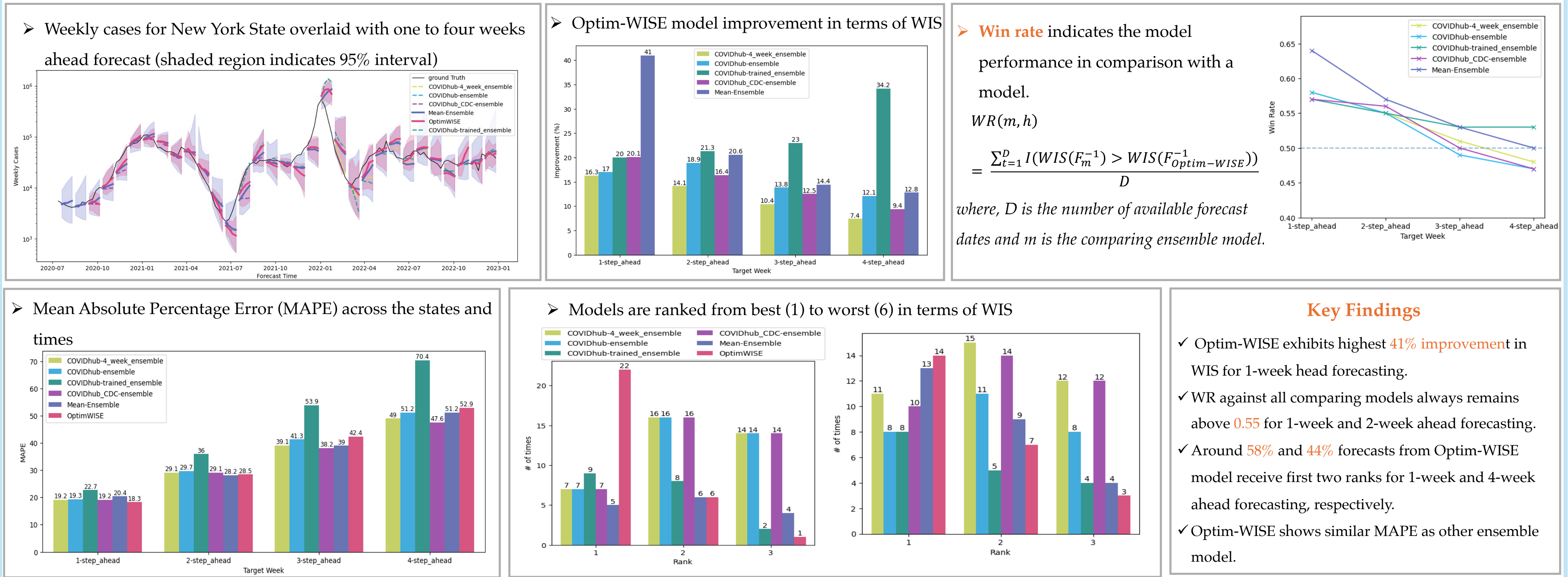
Challenge: Weights can be stuck at local minima, which leads to suboptimal ensemble forecasts.

Our approach: Basin-hopping optimization algorithm.

- ✓ Find global solution.
- ✓ Iteratively combines location optimization with random perturbation.



Model Performance for COVID-19 weekly case forecasting



Model Performance for Flu-Forecasting for season 2023-2024

