**Asthma Admissions Prediction Algorithm Project**

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* **Data:** Daily number of patients admitted with asthma.
  + **Timespan:** 1/1/2016 – 6/30/2023.
  + Covers all admissions & admissions from Avondale, City of Cincinnati, Hamilton Co.,

8 catchment area – overlap is present between these areas.

* + Aggregated weekly admissions for higher resolution of cases (per week vs. per month).
* We created an algorithm that forecasts weekly asthma admissions from historical data.
  + Algorithm takes training (historical) data, finds a time series model, and then makes forecasts for future weeks based on the model.
  + The algorithm returns point estimate averages for future weeks, with option to return confidence intervals at a specified level(s).
  + Options to predict on a test set of specified weeks.
* Tested the algorithm using historical data.
  + **Training set:** 1/1/2016 – 12/31/2021. **Test set:** 1/1/2022 – 3/31/2022.
  + Fit a time series model to the training set (2016 – 2021) and use that model to forecast admissions during the first 13 weeks of 2022.
  + Compare model predictions to observed admissions in test set to evaluate performance.
  + Predictions are balanced between most recent observations and average admissions.
  + The model is only useful to predict one or two weeks at most – no long-range forecasts.
* We illustrated how the algorithm could be used in practice by updating the model each week before making a forecast – rolling predictions.
  1. Build training data using historical weekly asthma admissions data.
  2. Fit the time series model to the training data.
  3. Predict next week’s asthma admissions from this model.
  4. Observe the actual weekly asthma admissions number.
  5. Include this newest weekly asthma admissions number to the training data.
  6. Repeat steps 2-5 each week, updating the model with latest admissions data each week.
* We deployed the algorithm so that the time series model is updated each week. We simulated how this algorithm could be used in practice.
  + **Training set:** 1/1/2016 – 3/31/2021. **Test set:** 4/1/2022 – 9/30/2022.
  + Forecast HIGH/LOW, compared to previous week’s data – score 1 point if actual admissions were correctly forecasted to be higher/lower than previous week (0 otherwise).
  + Out of 23 weeks, the algorithm correctly predicted HIGH/LOW for 16 weeks (61.5%).
* **Conclusion:** We have a “proof-of-concept” of developing a prediction algorithm that forecasts weekly asthma admissions and how to evaluate model accuracy.
* Apply for a pilot grant (Pilot Transitional and Clinical Studies) through the [Center for Clinical & Translational Science & Teaching (CCTST)](https://www.cctst.org/programs/pilot-translational-and-clinical-studies).
* Future project ideas to explore and expand upon, contingent on pilot grant status:
  + Exploration of various other time series models (e.g., ARIMA, ETS, BATS, NN).
  + Incorporate variables (e.g., AQI, PM2.5) to improve forecast accuracy (i.e., dynamic model).
  + Develop criteria to evaluate model prediction performance.
  + Expand scope of admissions (e.g., Avondale, Clifton, City of Cincinnati).
  + Develop/maintain R Shiny application for clinical use.
  + Publish weekly asthma prediction algorithm and its associated work.