Interactive Clinical Utility Decision Analytic (iCUDA) Dashboard – Sensitivity Analysis of Predictive Model Performance and Clinical Utility

JOHNS HOPKINS MEDICINE

Presenter: Star Liu, PhD Y3
Biomedical Informatics and Data Science

Motivation

Clinical predictive model performance and clinical utility evaluations are critical to understanding the potential success and failure modes in the context of use.

To drive decision-oriented evaluations, tradeoffs such as treatment harms and benefits need to be quantified and elicited, preferably from the clinicians.

- While decision analysis offers such a framework by incorporating harms and benefit utilities[1], there lack of a practical tool for fast and iterative sensitivity analysis of model utility.

We present the Interactive Clinical Utility Decision Analytic (iCUDA) dashboard, an interactive visualization that supports the evaluation of model deployment via multi-attribute sensitivity analyses on predictive model performance under various utility tradeoffs and outcome prevalence scenarios.

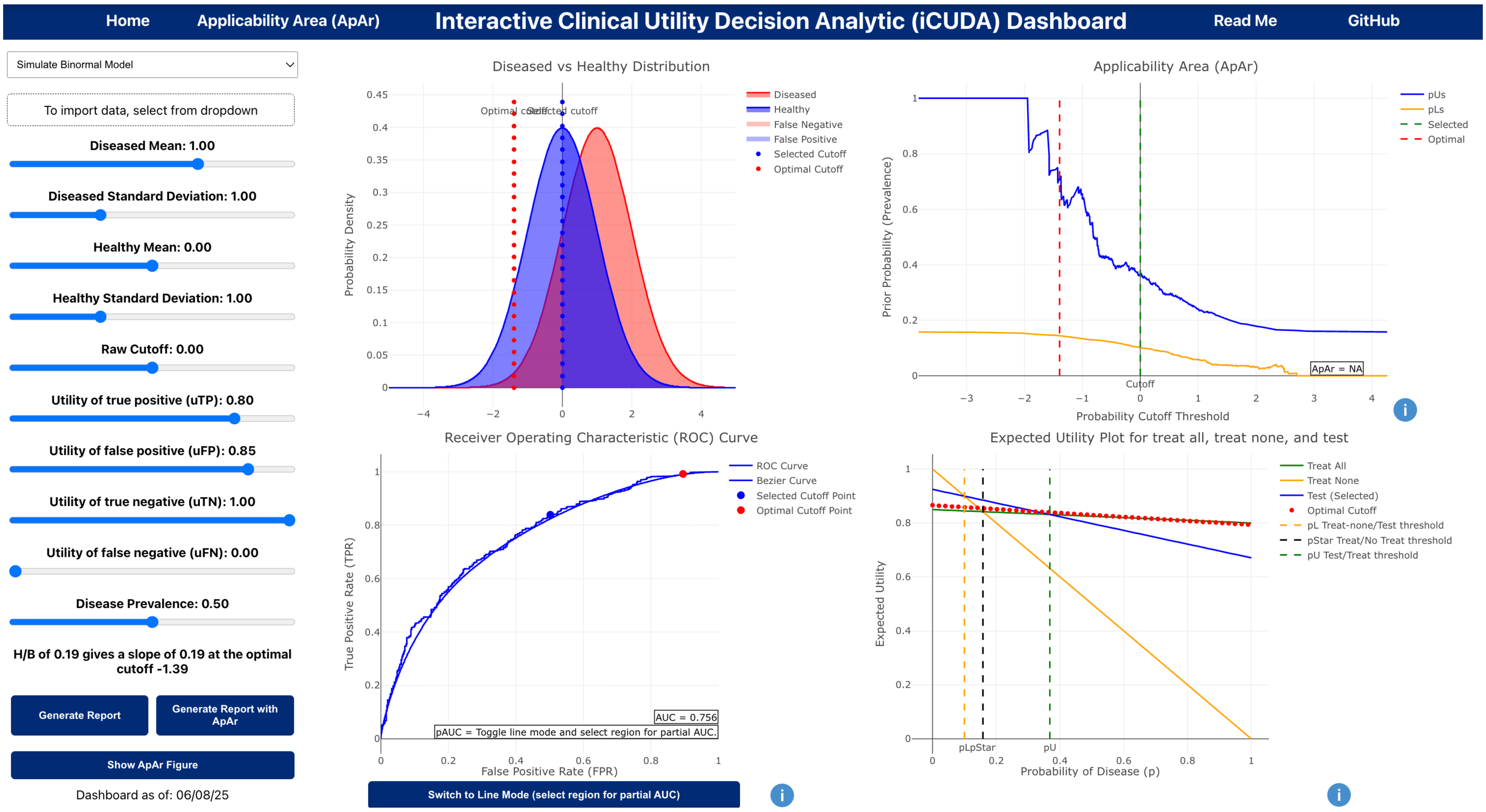
Methods and Design

Technical Stack

- JavaScript with React.js and Plotly.js for interactive visualizations
- ROC curve Bezier fitting algorithms

Our design consideration included:

1. Enabling what-if analyses & multi-attribute sensitivity analyses for iterative hypothesis generation and evaluation[3].
2. Interactive sliders enabling users to configure:
   - Statistical distributions
   - Utility tradeoffs (harms and benefits) given a clinical decision problem
   - Context of use (disease prevalence).
3. Utility tradeoffs should reflect changes in:
   - A model's ideal operating point (on the ROC curve)
   - Expected utility
4. Selection of clinically meaningful pAUC
5. Assess the range of priors within which a model remains useful (ApAr)[2].
6. Generate a PDF report summarizing the utility specifications, graphics, and key clinical decision-making implications.



Take a picture of the QR Code & Access it using your laptop!

Access through GitHub: github.com/StarLiu1/icuda

Future Work and Conclusion

- Visualize model calibration
- Quantify the uncertainty associated with the optimal point
- Add preprocessing features and enhance case-specific performance sensitivity analysis using large language models.

The dashboard provides researchers with interactive visualizations that reflect predictive models' performance, clinical utilities in configurable contexts of use, and alignment with medical decision-making.

References

1. Sox HC, Higgins MC, Owens DK. Medical Decision Making. 2nd ed. Hoboken: John Wiley & Sons, Ltd; 2013.
2. van Wijk JJ. The value of visualization. VIS 05. IEEE Visualization, 2005; 79-86.
3. Liu S, Wei S, Lehmann HP. Applicability Area: A novel utility-based approach for evaluating predictive models, beyond discrimination. AMIA Annual Symposium proceedings 2023; 2023:494-503.

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* References available upon request. Please contact: *Star Liu* (sliu197@jhmi.edu)