Modeling Uncertainty in Diabetes Incidence by Race in the United States

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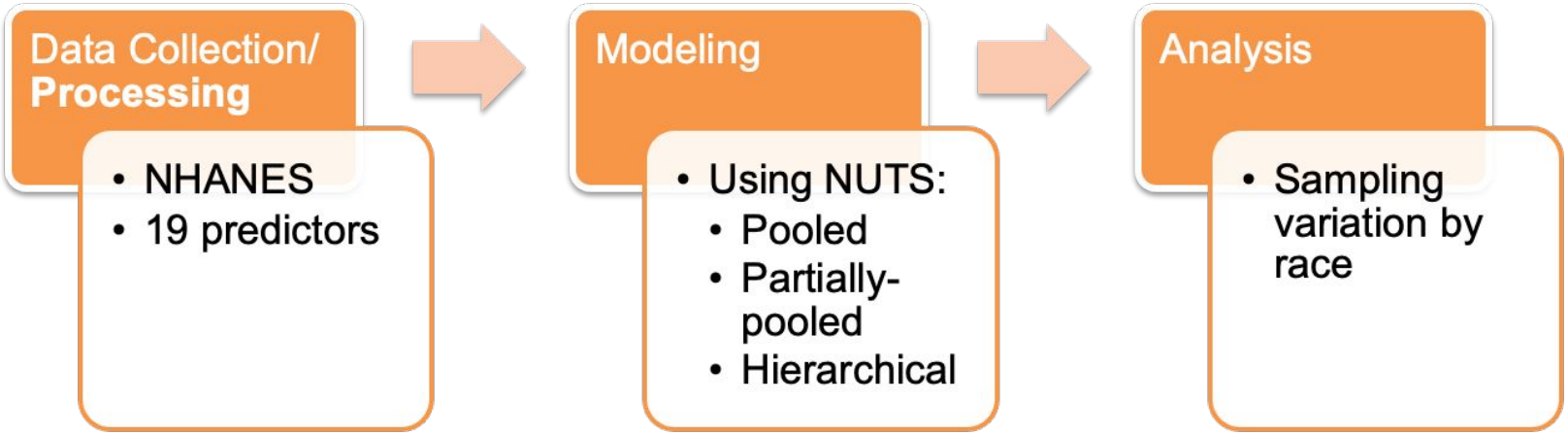
Problem Description

- **Prevalence:** 10% of the US population had diabetes (2018)
- **Undiagnosed:** 34.2 million adults with diabetes, 7.3 million were undiagnosed.
- **Prediabetes:** 88 million Americans age 18 and older had prediabetes (2015)
- **Why race/ethnicity matters?** : 77% higher for African Americans, 66% higher for Latinos/Hispanics, 18% higher for Asian Americans
- Approach: Logistic classification tool to predict the incidence of diabetes by race

Methodology



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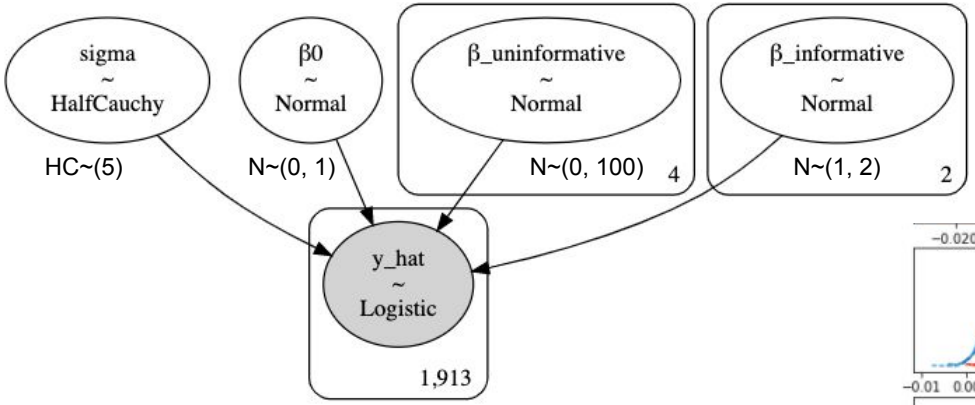
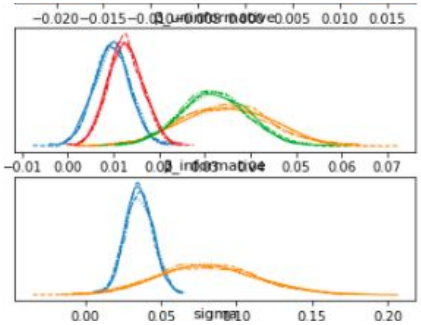
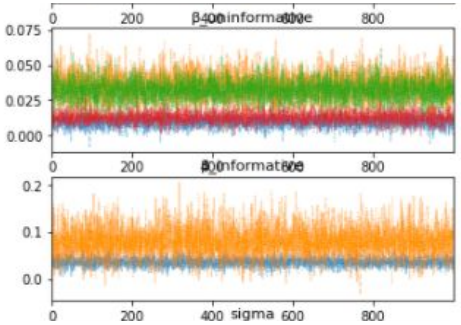
Pooled Model







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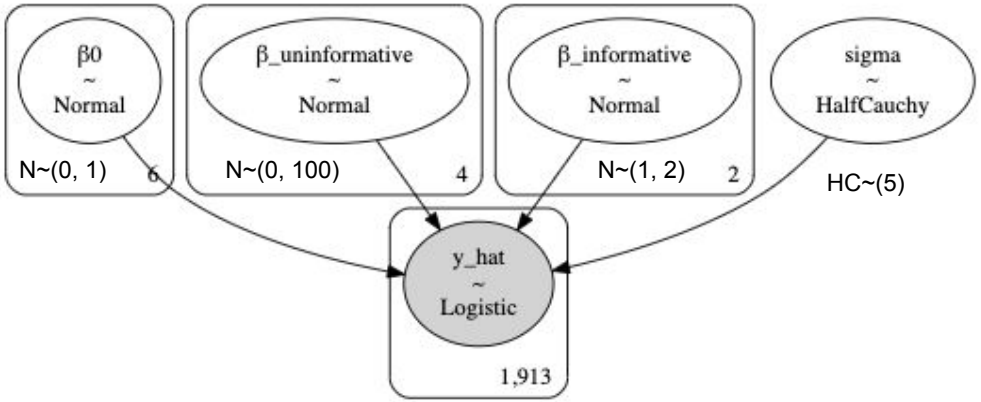
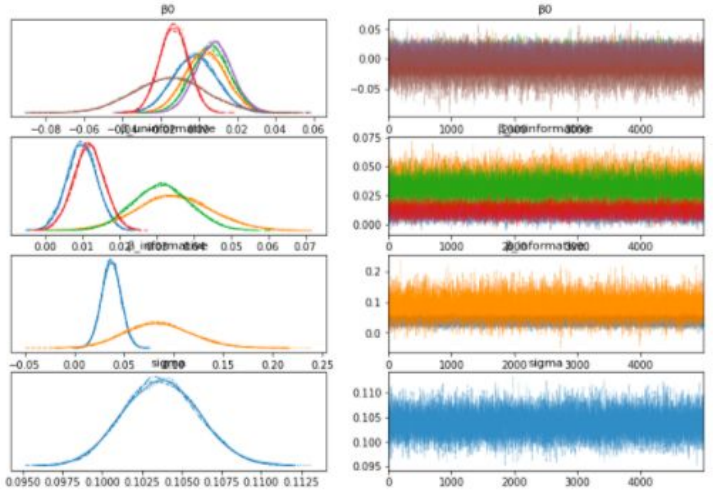
Partially-Pooled Model



Results:



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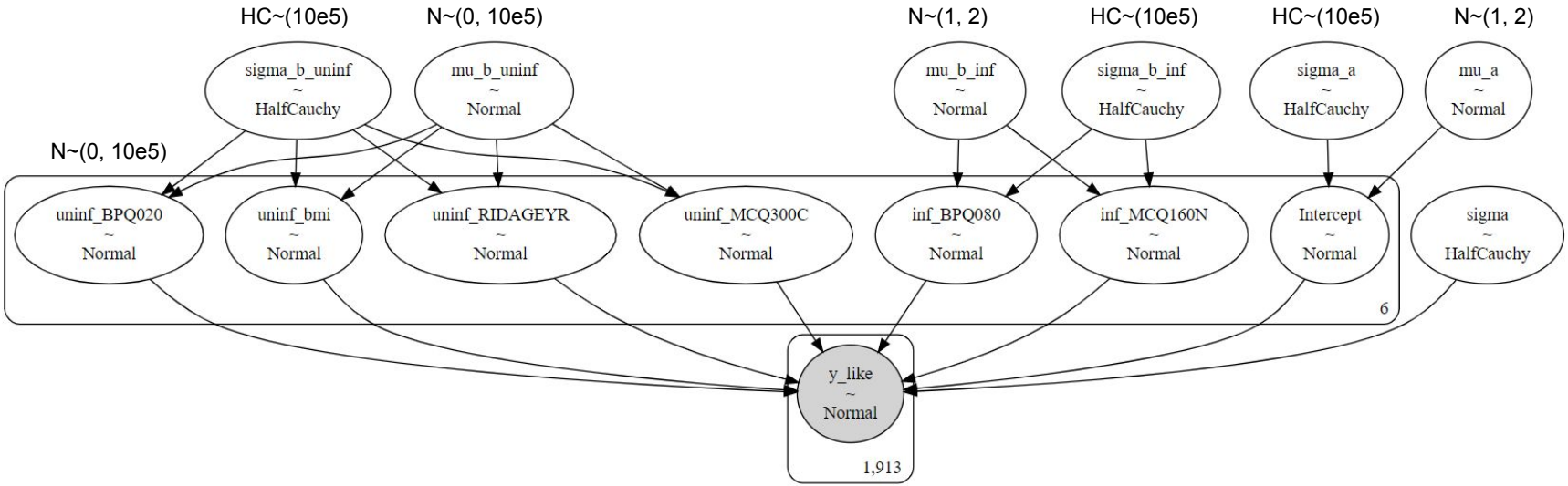
Hierarchical Model



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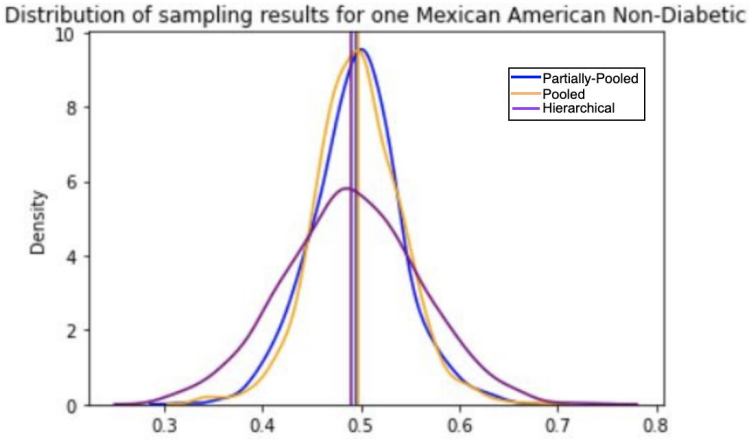
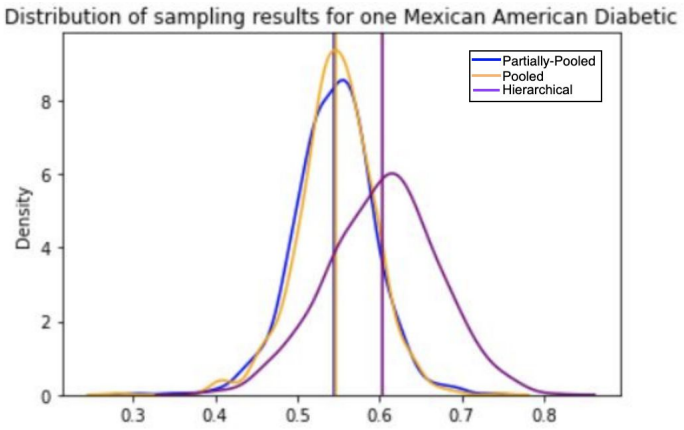
Results by Race: Mexican American



Distribution of Sampling Results for one Mexican American Non-Diabetic individual



Distribution of Sampling Results for one Mexican American Diabetic individual

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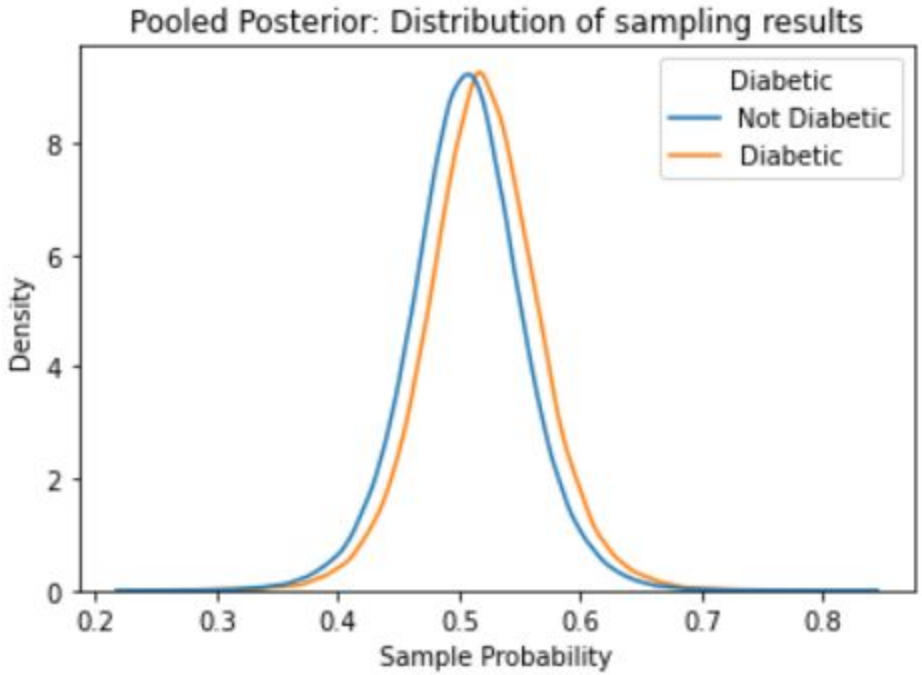
Pooled Predictions



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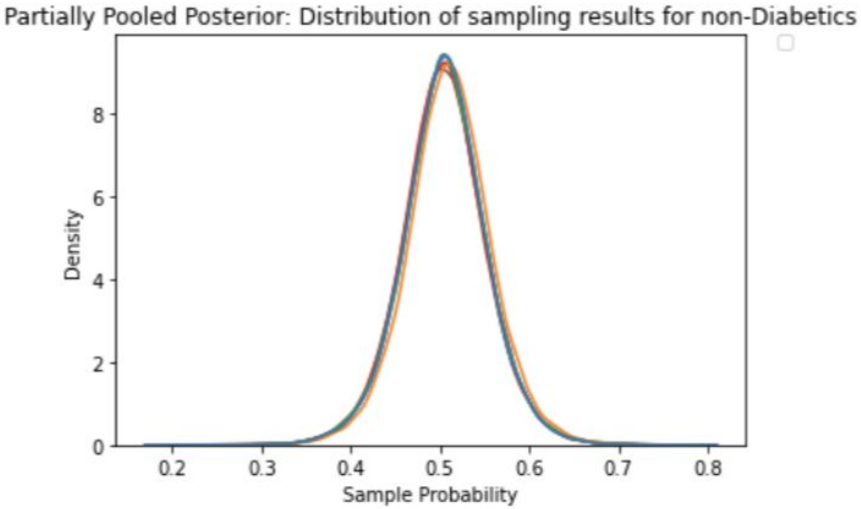
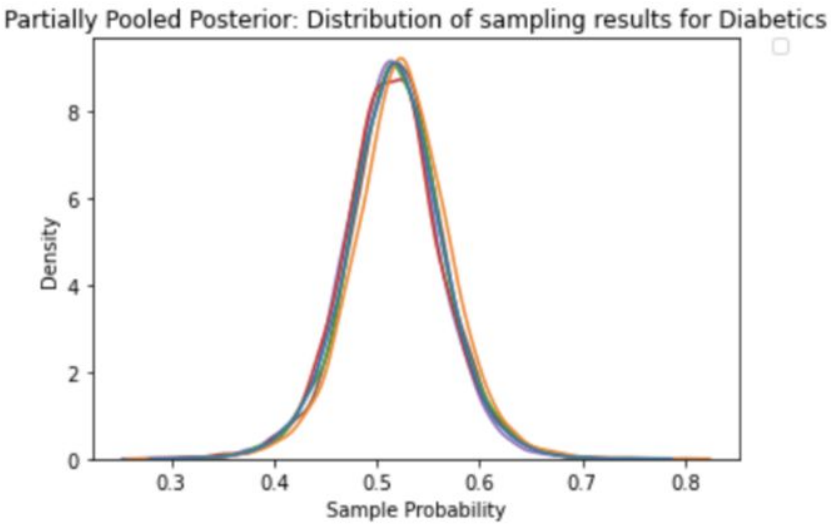
Partially-Pooled Predictions





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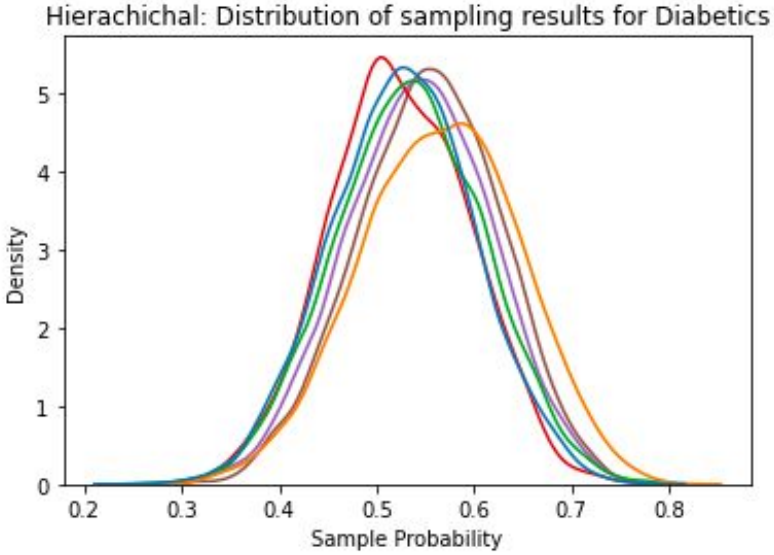
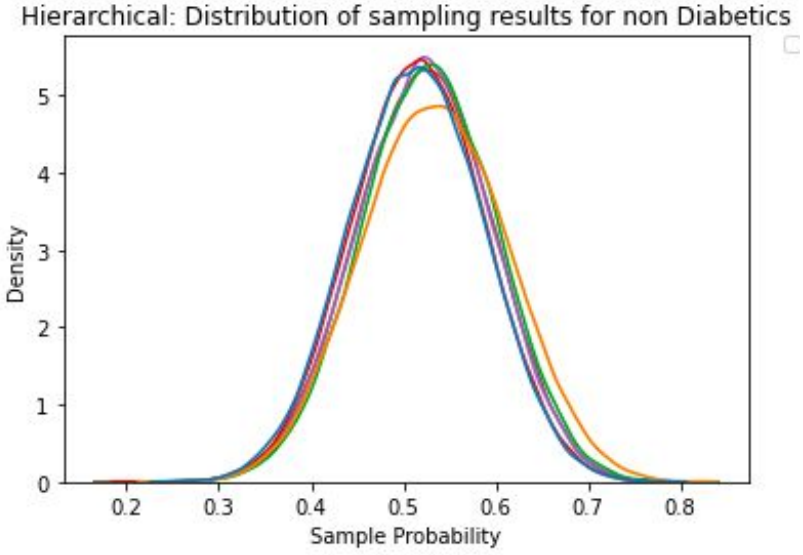
Hierarchical Predictions





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Results

- Pooled:
  - False Positive Rate: 67.92%
  - False Negative Rate: 1.92%
- Partially Pooled:
  - False Positive Rate: 66.04%;
  - False Negative Rate: 1.92%
- Hierarchical:
  - False Positive Rate: 71.53%;
  - False Negative Rate: 1.61%

Conclusions

- There is significantly more variance in the hierarchical predictions than the pooled or partially pooled models, but this does not significantly negatively impact model performance.
- The hierarchical model best captures the increased likelihood of diabetes for minorities.
- All of these models would be useful for identifying additional individuals who are at high risk for diabetes in the US.

References

- "Statistics About Diabetes | ADA."*American Diabetes Association*, https://www.diabetes.org/resources/statistics/statistics-about-diabetes. Accessed 6 December 2021.
- Meng, Ying-Ying et al. "Racial and Ethnic Disparities in Diabetes Care and Impact of Vendor-Based Disease Management Programs." *Diabetes Care*, vol. 2016;39:743–749, no. 39, 2016, pp. 743–749. *American Diabetes Association*, https://care.diabetesjournals.org/content/39/5/743.full-text.pdf.
- "NHANES 2005-2006: Diabetes Data Documentation, Codebook, and Frequencies." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, https://wwwn.cdc.gov/Nchs/Nhanes/2005-2006/DIQ_D.htm.
- "Cholesterol and Diabetes." *Www.heart.org*, https://www.heart.org/en/health-topics/diabetes/diabetes-complications-and-risks/cholesterol-abnormalities–diabetes.
- Tung, Yi-Ching, et al. "Association between Gout and Incident Type 2 Diabetes Mellitus: A Retrospective Cohort Study." *The American Journal of Medicine*, vol. 129, no. 11, 2016, https://doi.org/10.1016/j.amjmed.2016.06.041.
- Biondi, Bernadette, et al. "Thyroid Dysfunction and Diabetes Mellitus: Two Closely Associated Disorders." *Endocrine Reviews*, vol. 40, no. 3, 2019, pp. 789–824., https://doi.org/10.1210/er.2018-00163.

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