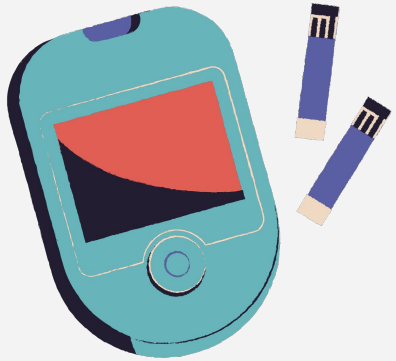
Prevalence of Diabetes in United States Counties

presented by Lindsey Hunnicutt, Data Scientist

Background

Diabetes: a disorder characterized by elevated blood glucose (> 125 mg/dL)(1)

- Complications: damage to the nerves, heart, and/or kidneys, oral health, vision & more…(2)
- Prevalence of diabetes in U.S.(3)
  - 11.3 % Diagnosed
  - 23.0% Adults - Undiagnosed
  - 38.0 % Adults - Prediabetic



1. Diabetes Tests. CDC. https://www.cdc.gov/diabetes/basics/getting-tested.html#:~:text=A%20fasting%20blood%20sugar%20level,higher%20indicates%20you%20have%20diabetes.

2. Prevent Diabetes Complications. CDC. https://www.cdc.gov/diabetes/managing/problems.html#:~:text=Common%20diabetes%20health%20complications%20include,how%20to%20improve%20overall%20health.

3. National Diabetic Statistics Report. https://www.cdc.gov/diabetes/data/statistics-report/index.html.

Background

Type II Diabetes:

- 90.9% of Diabetic Cases (2016)[4]
- 9/10 cases can be prevented[5]
- Personal Risk Factors (examples)
  - Weight
  - Poor Diet
  - Low Exercise

- Community Risk Factors
  - Vary by state, county, e.t.c.
  - “Food Environment”
    - Economics
    - Availability of foods
    - Many other factors…

- *Also related…*
  - *Chronic stress*[6]
  - *Depression & Anxiety*[7]
  - *Emotional Eating*[8]
  - *Eating Disorders*[9]

4. Prevalence of Diagnosed Diabetes in Adults by Diabetes Type. (2016) https://www.cdc.gov/mmwr/volumes/67/wr/mm6712a2.htm#:~:text=Overall%2C%20based%20on%20self%2Dreported,diabetes%2C%20representing%2021.0%20million%20adults.

5. Simple Steps to Preventing Diabetes. Harvard TH Chan School of Public Health. https://www.hsph.harvard.edu/nutritionsource/disease-prevention/diabetes-prevention/preventing-diabetes-full-story/

6. Blood Sugar & Stress. Diabetes Teaching Center at the University of California San Francisco. https://dtc.ucsf.edu/types-of-diabetes/type2/understanding-type-2-diabetes/how-the-body-processes-sugar/blood-sugar-stress/

7. The Association between Diabetes Mellitus and Depression. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4863499/#R13

8. Stress Eating and Health: findings from MIDUS, a National Study of U.S. Adults. Tsekenova et al. (2013). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3733123/

9. Binge Eating Disorder in Patients with Type 2 Diabetes: Diagnostic & Management Challenges. Chevinsky et al. (2019). https://www.dovepress.com/binge-eating-disorder-in-patients-with-type-2-diabetes-diagnostic-and--peer-reviewed-fulltext-article-DMSO

Research Question

How well can I predict prevalence of diabetes in U.S. counties based on food environmental features?

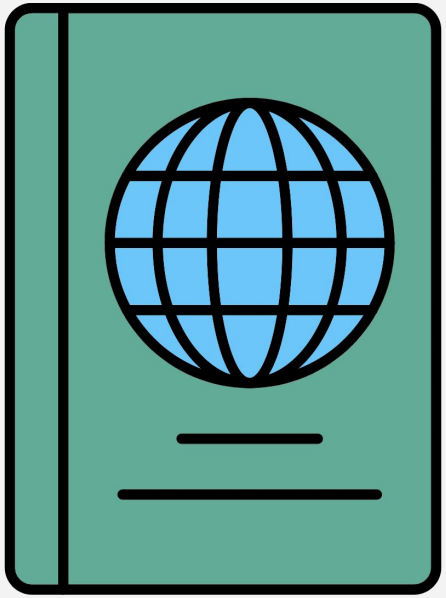
Data Description

Food Environment Atlas

3,142 U.S. counties assessed

281 Variables assessed 2007 - 2018

1. Health
2. Access
3. Assistance
4. Food Insecurity
5. Local (Farms)
6. Restaurants
7. Socioeconomics
8. Stores
9. Taxes



Diabetes Atlas (Target)

- Prevalence of Diabetes in Adults
- Collected during US Diabetes Surveillance System
- Year 2018

**Mental Health Providers (2017-2018)*

- *# of MH providers per 100k pop.*
  - *State-level*

**Adults Receiving MH Services in the Last Year (2015-2016)*

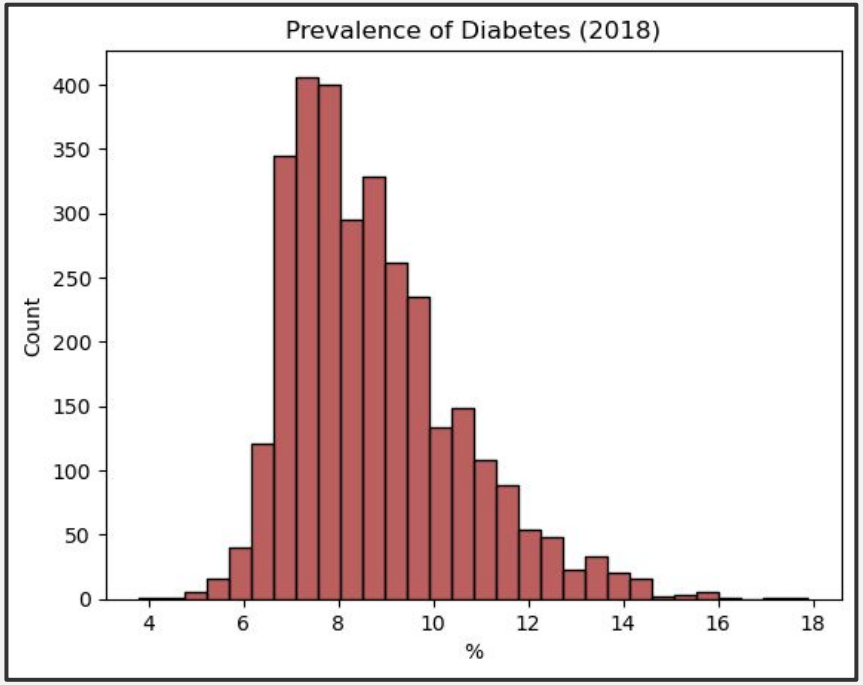
- *Percentage*
  - *State-level*

Data: Collection, Cleaning & EDA

- Data Collection
  - Websites
    - USDA, CDC, SAMHSA, UHF
  - Spreadsheets, Tables & CSV's
- Data Cleaning
  - Feature Selection
  - Null values
  - Reconciling counties

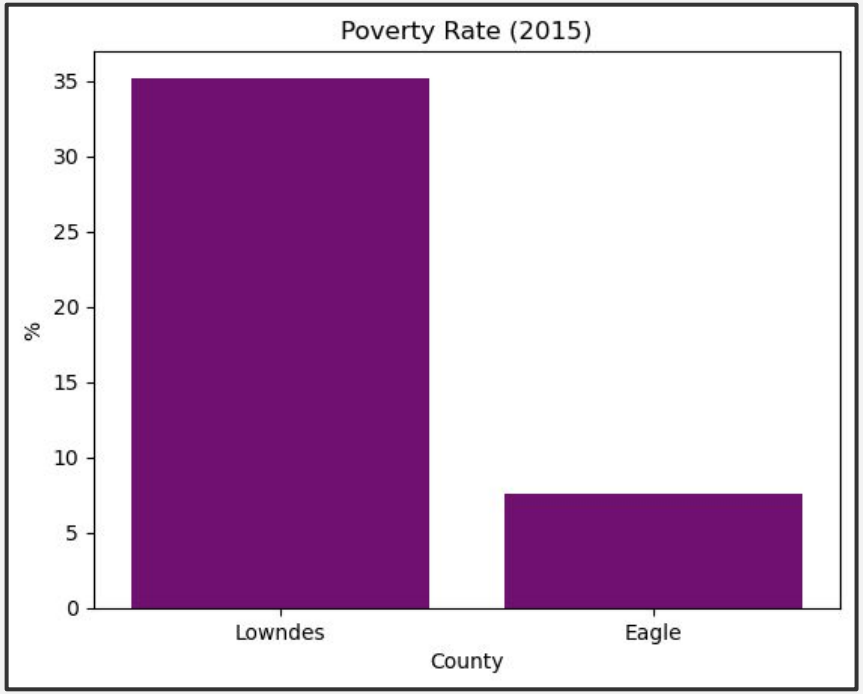
- EDA
  - Part I - SQL
    - Cross-comparisons
    - ORDER BY
    - ANTI-JOIN
  - Part II - Pandas
    - Correlations
    - Visualizations
    - Case study
      - Eagle County, CO (3.3%)
      - Lowndes County, AL (23.5%)

EDA



Median: 8.4%

Mean: 8.72%

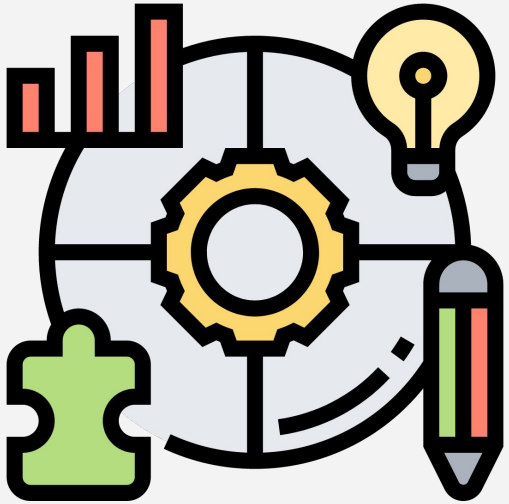


Lowndes County, AL
Eagle County, CO

MAX (Diabetes Prev. = 23.5%)
MIN (Diabetes Prev. = 3.3%)

Methods

- Feature Selection & Modification
  - MH information into Health dataframe
  - Creating Classes: High v. Low Prevalence
    - Mean as separator (8.72%)
    - Accounts for change in % year-to-year
  - Target Values into FEA datasets
- Modeling
  - Each dataset had its own model
  - Baseline = majority class (0 - Low - ~0.58)
  - KNN
  - Random Forest Classification
    - Highest scoring datasets
  - F1 Score as Metric
    - Sensitivity tended to be lower
    - Takes TP, FP, FN into account

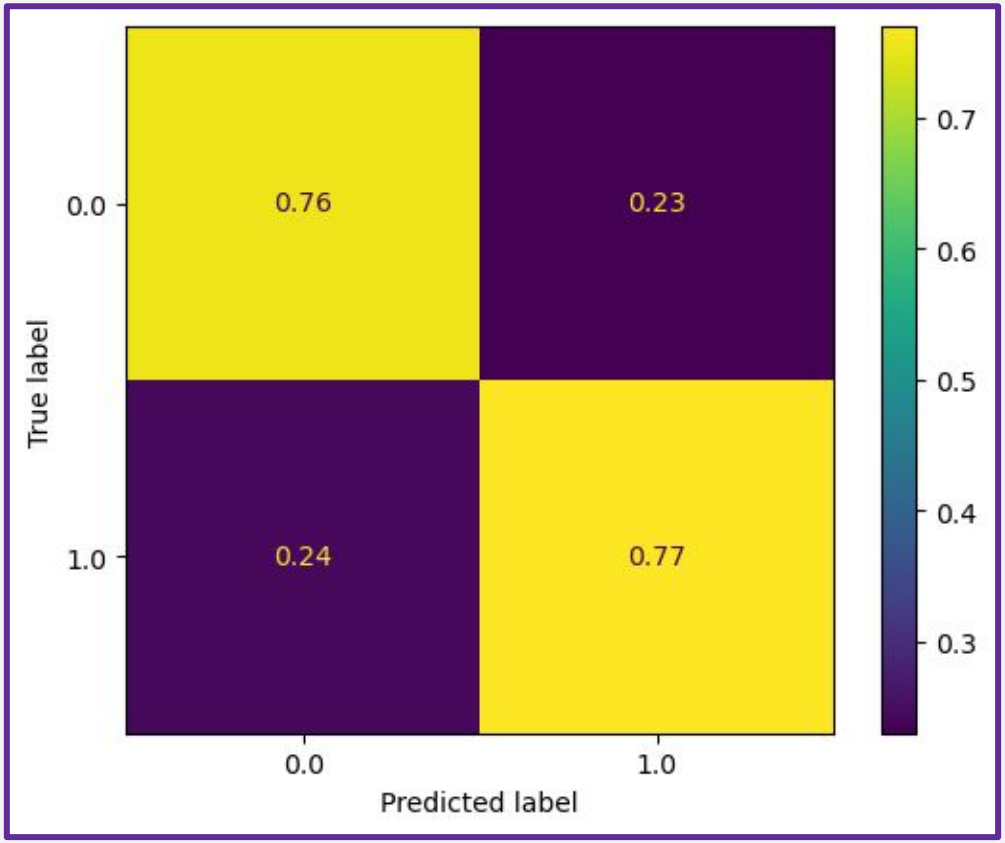


Models & Evaluation

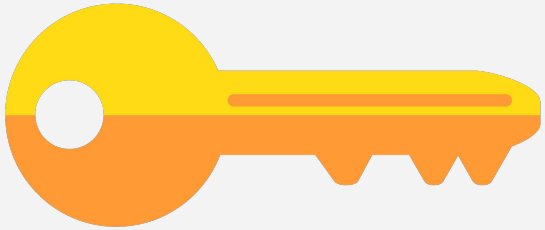
Model	Score (F1)
Health & Restaurants	0.713
Health	0.706
Food Environment Atlas	0.679
Restaurants	0.654
Food Insecurity	*0.626 (KNN)*
Assistance	*0.626 (KNN)*

Health & Restaurants (Random Forest Classifier)

Baseline: 0.583 F1: 0.713



Key Features



Health

- # of Recreational Facilities (2011, 2016)
  - Total number
  - # per 1000 population
- % Adults receiving MH services in last yr.* (‘15- ‘16)
  - Age 18+
  - Age 18-26
  - Age 26+
- # of MH providers* (2017, 2018)
  - # per 100,000 population
  - State Rank

*State-level variables

Restaurants

- Fast Food Restaurants (2011, 2016)
  - Total number
  - # per 1000 population
- Full-Service Restaurants (2011, 2016)
  - Total number
  - # per 1000 population
- Per capita Fast Food Restaurant Sales (‘07, ‘12)
- Per capita Full-Service Restaurant Sales (‘07, ‘12)

Conclusion

Answer:

- **Up to 76% of low prevalence predictions correct**
- **Up to 77% of high prevalence predictions correct**

We can predict prevalence of diabetes based on:

- **Health**
- **Restaurants**
- ***Assistance***
- ***Food Insecurity***

Demonstrates key areas of focus for community leaders

  - **Interventions targeted to specific communities**

<u>Limitations</u>

- **Datasets are older**
  - **Models more useful for inference**

Next Steps & Recommendations

Next Steps

- Research the connection between mental health & physical disease states
- Study impact of plant based diets
- Research cost of preventative versus other types of healthcare
    - Total cost of diagnosed diabetes in 2017 (US):
        - $327 billion(1)

Recommendations:

- Education: how to eat healthier on a low budget
- Address portion size & nutrient content
    - Restaurants
    - Products
- Increase minimum wage(2, 3)
- Preventative healthcare

1. Statistics about Diabetes. https://diabetes.org/about-us/statistics/about-diabetes.

2. A Calculation of the Living Wage. https://livingwage.mit.edu/articles/99-a-calculation-of-the-living-wage

3. Income Related Inequalities in Diabetes Have Widened over Past Decade, CDC Study Finds. ADA. https://diabetes.org/newsroom/press-releases/2021/income-related-inequalities-in-diabetes-have-widened-over-past-decade-cdc-study-finds

Thank you!