Modeling Diabetes Risk Using Lifestyle and Demographic Predictors

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Abstract

TEXT HERE

1. Data:

The purpose of this project is to estimate the likelihood that an adult develops diabetes in the United States based on their basic demographic characteristics, as well as behavioral characteristics. The data used in this project are from the 2024 National Health Interview Survey (NHIS). This survey is conducted annually of US households and is used to monitor national health trends as well as inform public health policy. This survey collects data on a broad range of health-related information and uses a large representative sample of the U.S. population. Basic demographic characteristics include height, weight, age group, and BMI. Smoking, drinking, exercise habits are a few of the behavioral characteristics that will be explored later on in this project. Using survey data does come with limitations, there may be response or sampling bias. The National Health Interview Survey, since 1957, has conducted confidential face-to-face interviews throughout the year, which may help reduce response bias. Dividing the country into different geographic regions ensures a broad geographic coverage, and randomization also aids in procuring data from a representative sample.

The first step with any dataset, especially one this large, is to identify the key variables relating to the initial question. As diabetes is the primary focus of this project, variables related to factors that increase diabetes risk were highlighted. There are three main categories of diabetes found in the dataset: gestational, pre-diabetes, and type I and II. In the original dataset, these three variables are separate [GESDIB_A, PREDIB_A, DIBEV_A]. To increase readability and facilitate drawing conclusions, the three variables will be combined into a single variable. This new variable will take numeric observations, with 1 indicating 'yes', 2 indicating 'no', 7 indicating 'refused', 8 indicating 'not ascertained', and 9 indicating 'don't know'. Distinguishing between type I and type II diabetes will be included in another variable (DIBTYPE_A) in the answer to the previous variable is 1. In addition, the age of the surveyor when they were first diagnosed with diabetes will have its own variable DIBAGETC_A.

The outlined variables above gather information about the surveyor's diagnosis of diabetes. Since the goal is also to examine contributing factors to mitigate diabetes risk, the predictor variables also need to be included. One broad category is food insecurity, which contains the variables: [FDSRUNOUT_A worry food would run out, FDSLAST_A food didn't last, FDSHUNGRY_ A hungry because not enough money for food]. Further analysis may reveal which of the variables among the three should be prioritized, or if all are relevant. Additionally, demographic characteristics will be analyzed. These include sex (SEX_A), home location (REGION), race/ethnicity (RACEALLP_A), income level (RATCAT_A), education level of sample adults (EDUCP_A). Lastly, physical lifestyle habits will also be factored through physical activity (MONDNR_A), and weekly walking (WLKEISDAY_A).

The data used were obtained from a survey; therefore, not all surveyors answered every question. In addition, those surveyed may not have been entirely truthful or provided accurate information. This leaves us with NA values that will need to be wrangled before we begin data analysis. Therefore, conclusions can be drawn but cannot be claimed with absolute certainty. This data set has hundreds of variables, so we will remove many variables that we believe to be insignificant. We need to do testing to ensure that we remove the correct ones.

1.1. Pre-Analysis Plan

As outlined in our Data Description, the goal of this project is to develop a model that is able to predict the likelihood of a person developing diabetes in the United States, based

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on demographic and behavioral information. The dataset includes information on numerous aspects of the surveyors, including whether they have diabetes. Through training the model and establishing patterns of correlation, the goal is to create a model that can estimate whether or not one is likely to develop diabetes depending on the information entered. The demographic variables being explored include food insecurity, sex, region, race/ethnicity, income level, and education level. In regard to a patient's lifestyle, the variables included in the data examine physical activity and weekly walking habits.

After cleaning, organizing, and wrangling the data, we plan to use a decision tree. Due to the complexity of our data and the multitude of factors influencing the diabetic outcome of the patient, we felt this was the most appropriate model to use. A decision tree will be more compatible with the lack of quantitative or numeric data in our dataset. Trees are also non-reliant on linear relationships, which we are not likely to see in our data. The tree itself will also provide a useful visualization of the decision-making pathway. However, since decision trees output a categorical variable, we will have to encode or determine some threshold with diabetes being yes or no.

In order to accomplish this, we first have to encode categorical variables using one-hot encoding or pd.get$_dummies().Thedatawillbesplit80/20intotrainandtestsets,respectively,tothentrainthemodel.Fromthere,theaccuracy,R2$

1.2. Submitting Final Camera-Ready Copy

The final versions of papers accepted for publication should follow the same format and naming convention as initial submissions, except that author information (names and affiliations) should be given. See Section 2.3.2 for formatting instructions.

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You may want to include figures in the paper to illustrate your approach and results. Such artwork should be centered, legible, and separated from the text. Lines should be dark and at least 0.5 points thick for purposes of reproduction, and text should not appear on a gray background.

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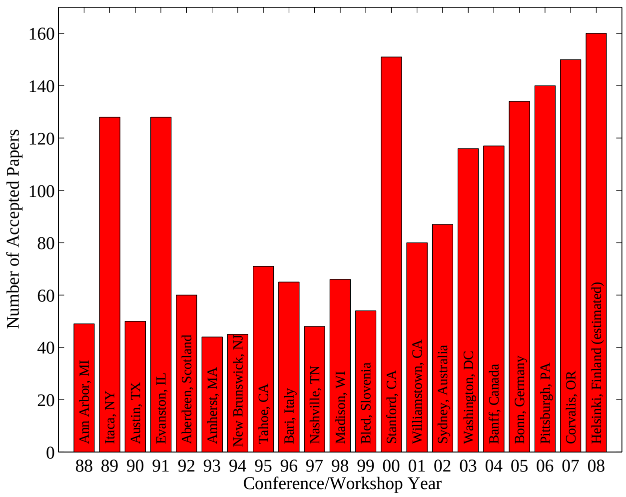

Figure 1. Historical locations and number of accepted papers for International Machine Learning Conferences (ICML 1993 – ICML 2008) and International Workshops on Machine Learning (ML 1988 – ML 1992). At the time this figure was produced, the number of accepted papers for ICML 2008 was unknown and instead estimated.

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2.7. Algorithms

If you are using LaTeX, please use the "algorithm" and "algorithmic" environments to format pseudocode. These require the corresponding stylefiles, algorithm.sty and algorithmic.sty, which are supplied with this package. Algorithm 1 shows an example.

2.8. Tables

You may also want to include tables that summarize material. Like figures, these should be centered, legible, and numbered consecutively. However, place the title *above* the table with at least 0.1 inches of space before the title and the same after it, as in Table 1. The table title should be set in 9 point type and centered unless it runs two or more lines, in which case it should be flush left.

Algorithm 1 Bubble Sort

Input: data x_i, size m
repeat
  Initialize $noChange = true$.
  for $i = 1$ **to** $m - 1$ **do**
    if $x_i > x_{i+1}$ **then**
      Swap x_i and x_{i+1}
      $noChange = false$
    end if
  end for
until $noChange$ is $true$

Table 1. Classification accuracies for naive Bayes and flexible Bayes on various data sets.

DATA SET	NAIVE	FLEXIBLE	BETTER?
BREAST	95.9$\pm$ 0.2	96.7$\pm$ 0.2	$\surd$
CLEVELAND	83.3$\pm$ 0.6	80.0$\pm$ 0.6	$\times$
GLASS2	61.9$\pm$ 1.4	83.8$\pm$ 0.7	$\surd$
CREDIT	74.8$\pm$ 0.5	78.3$\pm$ 0.6	
HORSE	73.3$\pm$ 0.9	69.7$\pm$ 1.0	$\times$
META	67.1$\pm$ 0.6	76.5$\pm$ 0.5	$\surd$
PIMA	75.1$\pm$ 0.6	73.9$\pm$ 0.5	
VEHICLE	44.9$\pm$ 0.6	61.5$\pm$ 0.4	$\surd$

Tables contain textual material, whereas figures contain graphical material. Specify the contents of each row and column in the table's topmost row. Again, you may float tables to a column's top or bottom, and set wide tables across both columns. Place two-column tables at the top or bottom of the page.

2.9. Theorems and such

The preferred way is to number definitions, propositions, lemmas, etc. consecutively, within sections, as shown below.

Definition 2.1. A function $f : X \to Y$ is injective if for any $x, y \in X$ different, $f(x) \neq f(y)$.

Using Definition 2.1 we immediate get the following result:

Proposition 2.2. *If f is injective mapping a set X to another set Y, the cardinality of Y is at least as large as that of X*

Proof. Left as an exercise to the reader. $\square$

Lemma 2.3 stated next will prove to be useful.

Lemma 2.3. *For any $f : X \to Y$ and $g : Y \to Z$ injective functions, $f \circ g$ is injective.*

Theorem 2.4. *If $f : X \to Y$ is bijective, the cardinality of X and Y are the same.*

An easy corollary of Theorem 2.4 is the following:

Corollary 2.5. *If $f : X \to Y$ is bijective, the cardinality of X is at least as large as that of Y.*

Assumption 2.6. The set X is finite.

Remark 2.7. According to some, it is only the finite case (cf. Assumption 2.6) that is interesting.

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"This paper presents work whose goal is to advance the field of Machine Learning. There are many potential societal consequences of our work, none which we feel must be specifically highlighted here."

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