Linear Modeling Case Study for Birth Weight Dataset

Machine Learning

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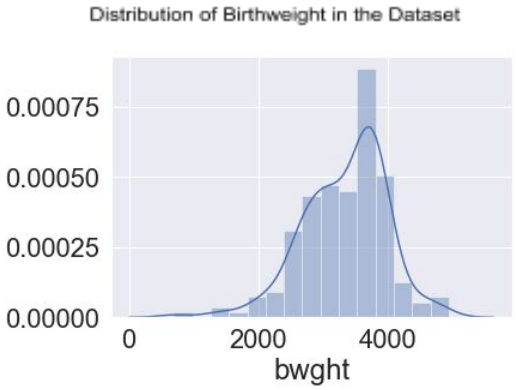
Analysis Write-Up - Team 2 (Bedetta, Dionisio, Li, Malik, Sondermann)

Problem

Birth weight is probably the single most important factor that affects mortality of newborn infants, in both developed and developing countries (Wardlaw, 2004). Therefore, birth weight has been an important subject of medical research and an object for public health intervention. Extensive consideration has been focused on the causal determinants of birth weight, and especially of low birth weight, in order to identify potentially actionable factors.

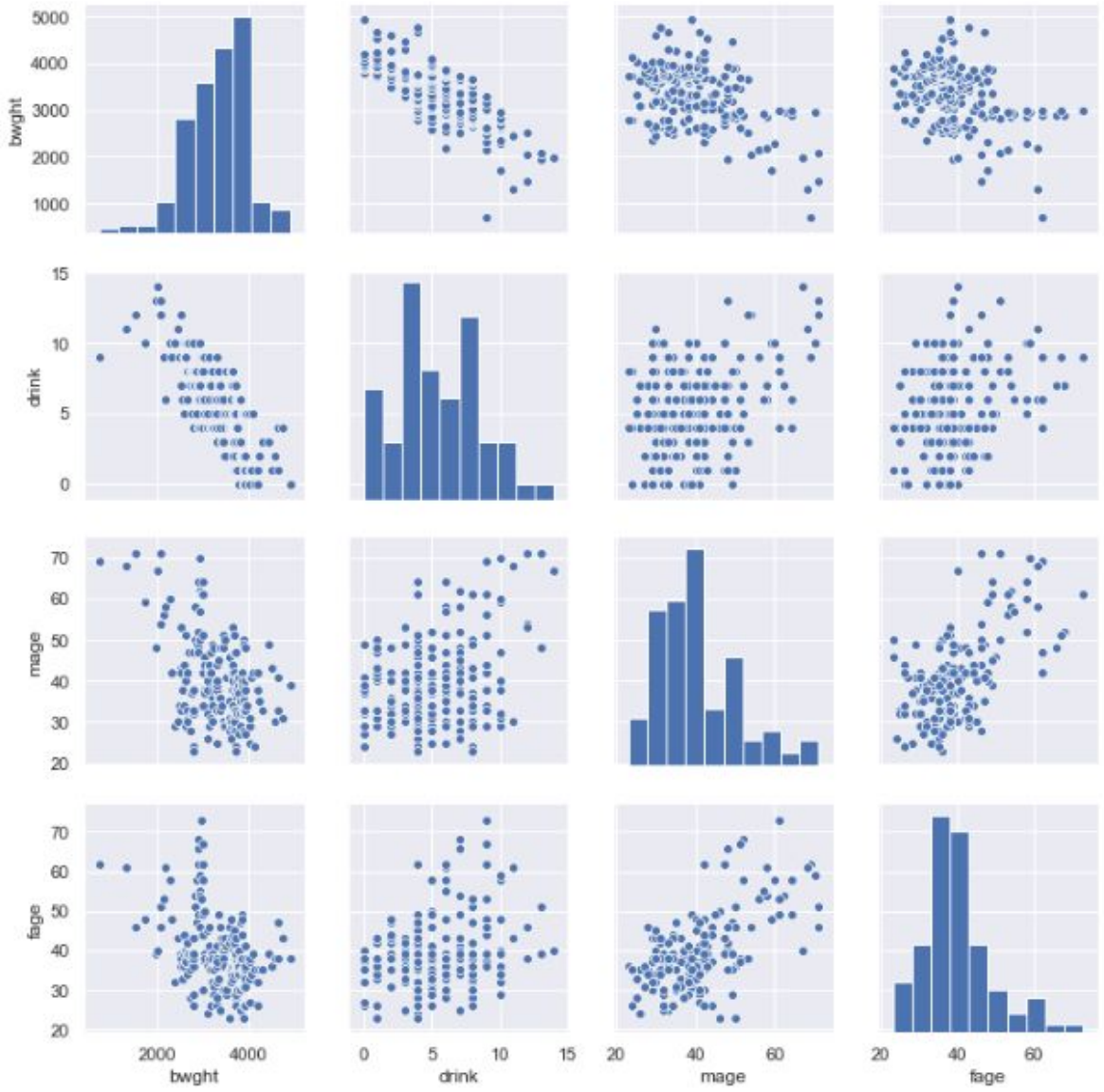


Low birthweight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams (5.5 pounds). This is based on epidemiological observations that infants weighing less than 2,500g are approximately 20 times more likely to die than heavier babies (Wardlaw, 2004). A birthweight below 2,500g contributes to a range of varying degrees of developmental and medical risk.

Factors with some preconceived and scientifically-proven causal impacts on birth weight include parental age, prenatal care, infant sex, racial origin, cigarette smoking, and alcohol consumption. This data analysis of the birth weight dataset focuses on identifying which of these factors are of potential quantitative importance to determine which factors are most influential to an infant's birth weight. Actionable factors with large effects on birth weight should be targeted for public health intervention to reduce the risk of poor health outcomes such as mortality, short-term and long-term problems in growth, cognition, attention, and neuromotor functioning.

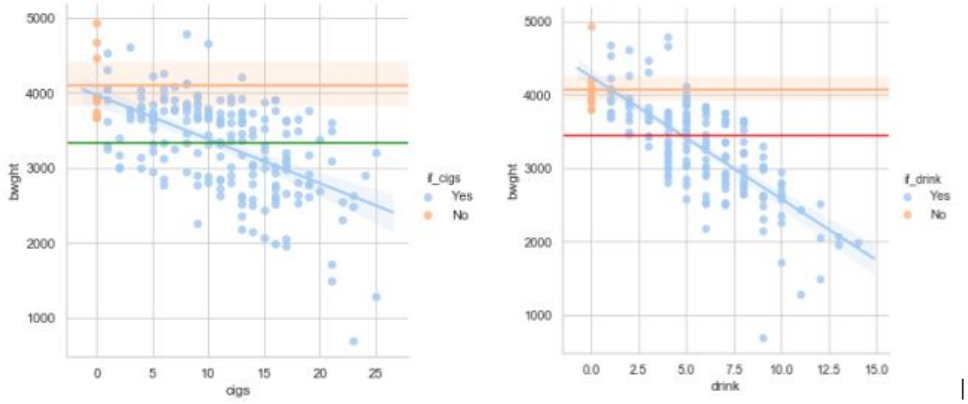
Actionable Key Insights

The team used Ordinary Least Squares Regression model which explains or predicts 74% (R-squared) of the response data around the regression line. Based on our exploratory analysis (see scatter plots below) and testing on different models, we were able to identify five factors that can significantly predict an infant's birth weight: smoking and drinking during pregnancy, mother's age, father's age, and mother's education.



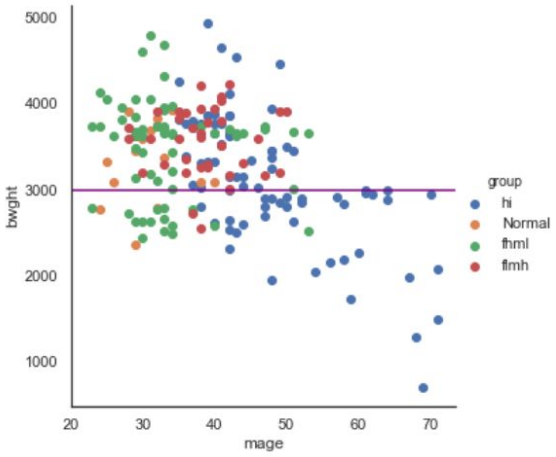
Mother's smoking and drinking habits

Smoking and drinking alcohol during pregnancy can cause premature birth or low birth weight, making it more likely for the baby to be sick, stay in the hospital longer, and be of risk for infant death. Smoking during pregnancy reduces the supply of oxygen and nutrients to the fetus, hindering growth (Kramer, 1987). Alcohol can also enter the placenta, hinder the growth and weight of the fetus, cause unique facial plaques, damage neurons and brain structures, and cause physical, mental or behavioral problems (EL & JH, 1995).



Parent's age

In the figure to the right, blue dots represent birth weights where both parents are older than 35, green dots for pairs of older fathers and younger mothers, red dots for pairs of younger fathers and older mothers, and orange for both parents having the normal age between 25 to 35. According to studies, infants born to mothers younger than age 25 or older than 35 have worse outcomes with respect to mortality, self-rated health, height, obesity, and the number of diagnosed conditions than those born to mothers aged 25–34 (Myrskylä,



2012). Our analysis suggest that infants born to young parents might be better off if the parents waited a few years due to parents' lack of parental experience or immaturity of the reproductive system. Subsequently, infants born to older parents may have a higher risk of getting complications with their newborn due to DNA damage in germ cells, chromosomal changes, and hormonal changes that increase with age (Shmueli & Cullen, 2000).

Mother's Education

Based on the results of our analysis, mothers with more years of education are less likely to give birth to babies with low birth weight. Maternal education may affect infant health through its positive effects on maternal health, prenatal behaviours such as smoking, the use of prenatal care, or family characteristics (Shmueli & Cullen, 2000).

Recommendations

Birth weight can be affected by smoking cigarettes, drinking, the parent's age and the mother's education. According to a study by University of Pennsylvania there are over 77 countries who use warning images on cigarette boxes, the United States is not one of them. In 2011 there was an attempt to put warning labels on boxes but it was overturned. In the study it states that people are 2 times more likely to quit smoking because of the image warning than the text warning. If the United States can get this overturned and have images of pregnant ladies on the cigarette boxes and how they can affect pregnancies, this can decrease the chances of birth weight being affected by smoking. In the article "Are there laws against serving alcohol to Pregnant Women" mentioned that many states have their own laws regarding serving pregnant women alcohol. In many states the person who served would not go to jail, neither would the women for purchasing, but in some case it would be considered child abuse. There should be more laws or a clear definition of serving alcohol to women while they are pregnant since it affects birth weight and other challenges for the babies. If the government issues laws against selling/serving alcohol to women it can reduce the

alcohol consumption of mother's to be. In many states of the United States, Sexual Education is offered in public school. If sexual education is improved through the schools can improve the knowledge of abstinence and therefore probably having babies in the future with healthier weight. Finally, if there is increasing support for children to finish high school and continue to college, there would be a greater chance for mothers to give birth to normal weight babies. There are some ways this can be done. One way in is to create a program for current mothers and their children to ensure that their children finish school and go to college.

Further exploration

In order to make better recommendations based on the model, some new data can be looked at. This new data should be: at what week/month did the mother give birth during her pregnancy, the mother's weight and if she is eating a healthy diet, if any of the parents have a sexually transmitted disease, and also by looking at income and regional demographics to see if there is a socioeconomic indicator at play.

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