IMPACT OF MATERNAL SMOKING ON NEWBORN BIRTHWEIGHT: A STATISTICAL ANALYSIS

(Sreenivas Annagiri, Surekha Peethambharam Muralidhar, Mani Chandana Alle)

1. INTRODUCTION:

Birth weight is a critical indicator of newborn health, with low birth weight often, linked to increased risks of infant mortality and developmental issues. Various maternal factors, such as smoking, age, and overall health during pregnancy, can influence birth weight and gestation outcomes. Understanding these factors is essential for developing effective maternal health strategies and interventions.

This study was conducted to examine the birth weight outcomes of newborns based on maternal smoking status and age. Our focus lies in assessing whether babies born to mothers who smoke tend to have lower birth weights compared to those born to non-smokers, while also considering the effect of the mother's age. The findings of this study have important implications for maternal health policies and prenatal care guidelines, helping to reduce the risks associated with low birth weight and improve overall newborn health outcomes.

2. DATA DESCRIPTION:

The **Child Health and Development Studies** investigate various maternal and child health topics. One particular study focused on all pregnancies between 1960 and 1967 among women enrolled in the Kaiser Foundation Health Plan in the San Francisco East Bay area. Although the exact provenance of our dataset is not fully documented, it provides key insights into maternal factors such as smoking habits, age, and their relationship to birth weight.

2.1 Dataset Attributes:

1- case: id number

2 - bwt: birthweight (in ounces)

3 - gestation: length of gestation (in days)

4 - parity: a binary indicator for a first pregnancy (0 = first pregnancy)

5 - age: mother’s age in years

6 - height: mother’s height in inches

7 - weight: mother’s weight in pounds

8 - smoke: binary indicator of whether the mother smokes

3. SUMMARY STATISTICS:

The summary statistics provide a quick overview of the key variables in the dataset.

Mean Weight	128.4787053
Standard deviation of Weight	20.7342822
Mean Age	27.2282794
Standard deviation of Age	5.8178387
Mean Gestation	279.1013629
Standard deviation of Gestation	16.0103051
Mean Parity	0.2623509
Standard deviation of Parity	0.4400999
Mean Height	64.0494037
Standard deviation of Height	2.5261015
Mean birthweight of Babies	119.4625213
Standard deviation of birthweight of Babies	18.3286714

4. METHODS USED:

In our Statistical model, we use the Birth weight of the children as the Response Variable and the Smoking Status as the Predictor Variable. A **Multiple Linear Regression** model was fitted with birth weight as the dependent variable and maternal age and smoking status as the independent variables. This approach allows us to assess the simultaneous impact of both predictors on birth weight, providing a more comprehensive analysis. Additionally, a **Logistic Regression** model was employed to further understand the dataset by examining the probability of low birth weight outcomes based on maternal smoking status and age. The logistic model helps to identify the likelihood of a binary outcome—whether a newborn falls into the low birth weight category—relative to the independent variables.

5. DATA VISUALIZATION:

The statistical analysis conducted on the birth weights of newborns from smoking and non-smoking mothers presents a compelling visual representation through box plots and Density curves. The Box-plot visualization indicates a discernible disparity, with non-smokers' offspring exhibiting marginally higher birth weights compared to those of smokers. Notably, outliers suggest variability, yet the trend of higher birth weights in non-smokers persists. The Density curves further elucidate this difference, clearly depicting the weight distribution shift between the two groups, where the infant weights of the non-smokers are raised above when we compare the weight of babies of the smokers.

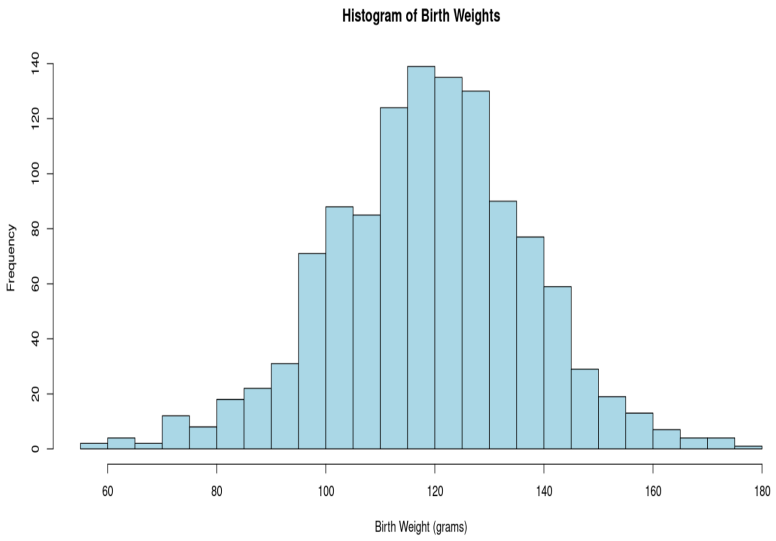


Fig.1. Histogram

Fig. 1 illustrates the distribution of birth weights. The histogram indicates that the majority of birth weights fall between 100 and 140 grams, with the average weight being approximately 120 grams. This distribution suggests a central tendency around the 120-gram mark, with most newborns' weights clustering within this range.

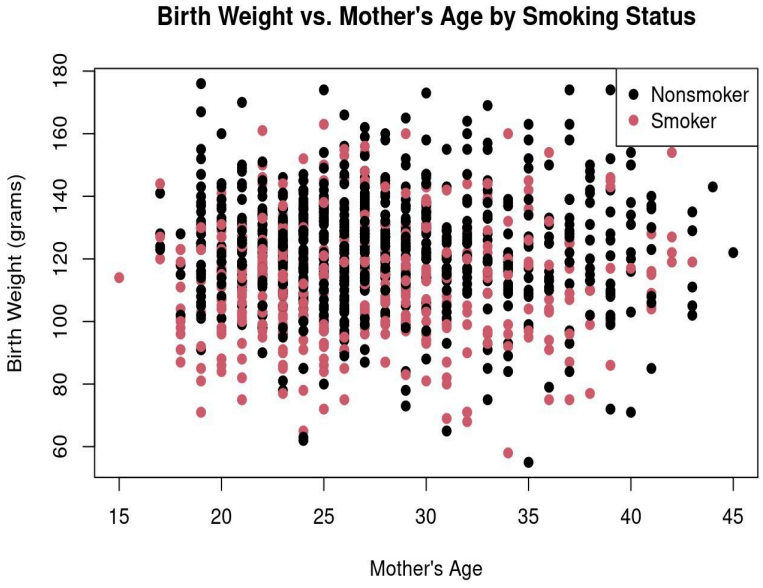


Fig.2. Scatterplot

Fig. 2 The scatterplot shows that more non-smoker mothers have babies with heavier weights when compared with smoker mothers, As the amount of black points are towards the upper limit of the weight of babies and vice-versa.

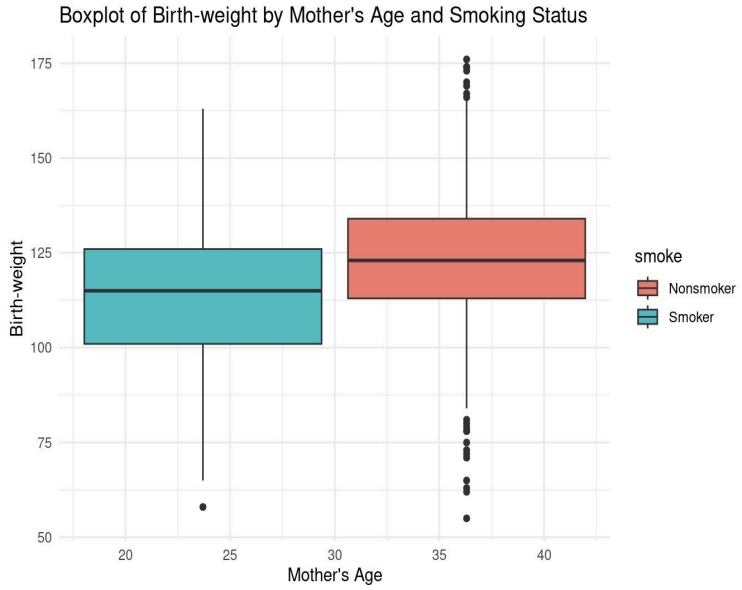


Fig.3. Boxplot

Fig. 3 shows the boxplot of the mother's age concerning their smoking status. It shows that babies with a mother who doesn't smoke have higher birthweight compared to those who smoke

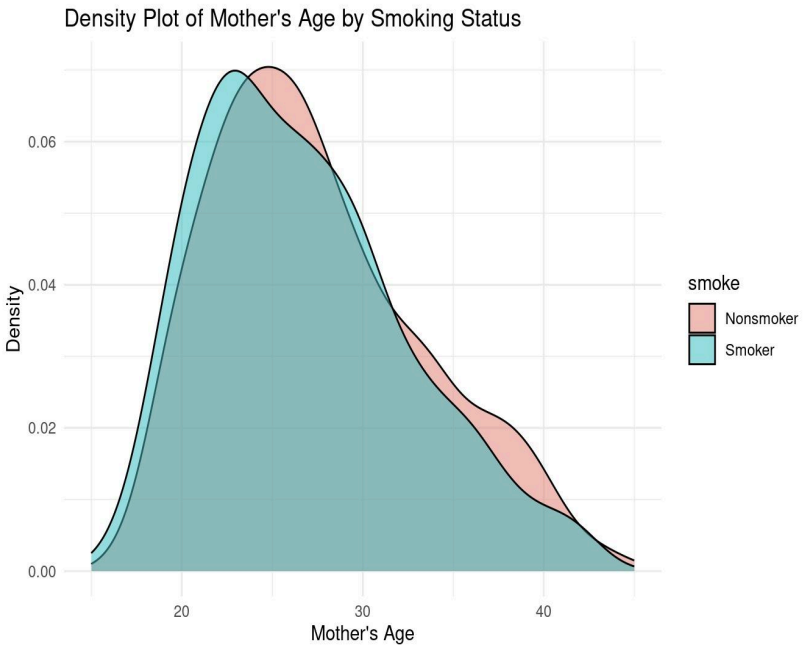


Fig. 4 Density plot of Age vs Smoke

Fig. 4 shows the density plot of age of the mother and their smoking status. It shows that non-smoking mothers tend to be younger, with their age distribution more concentrated around the mid-20s, while smokers have a broader age spread.

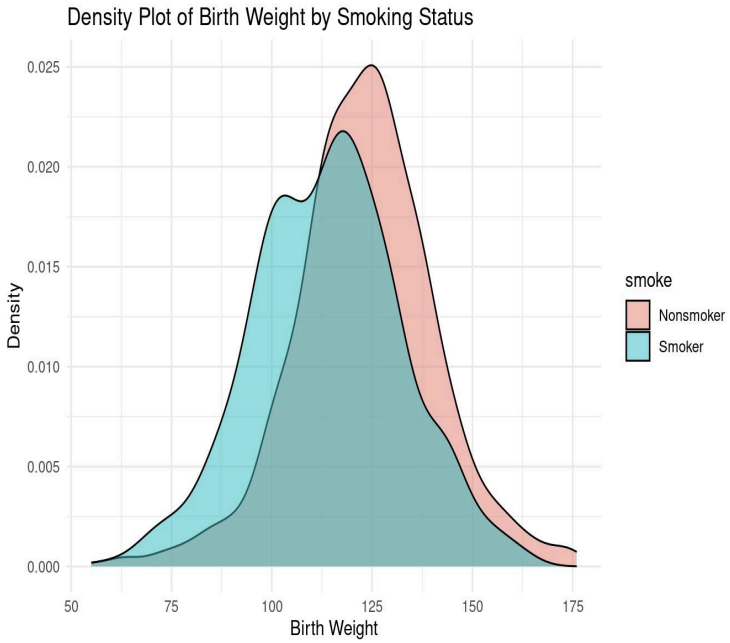
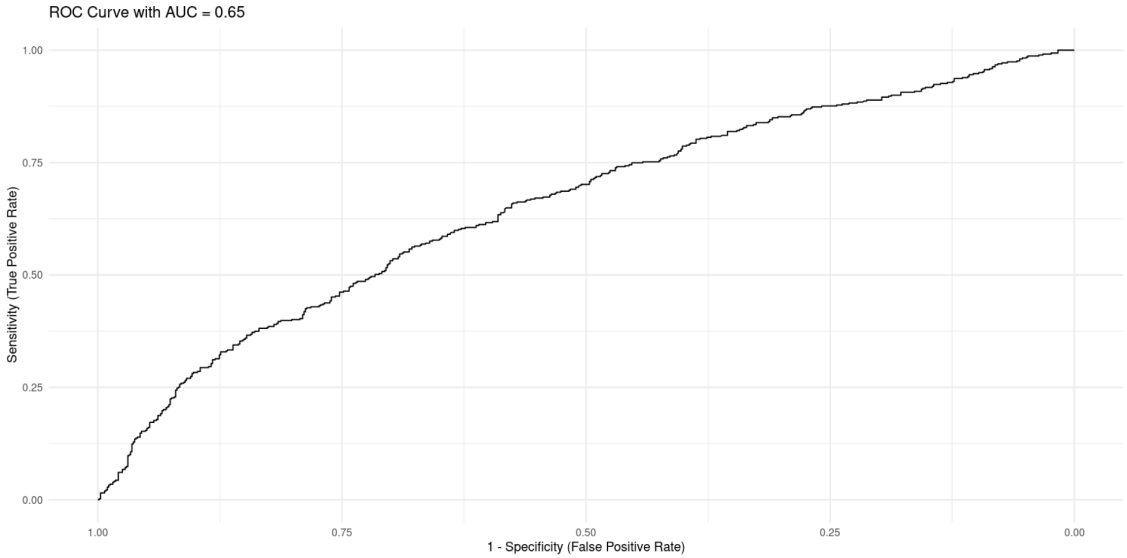


Fig. 5 Density Plot Birth Weight vs Smoke

Fig. 5 shows the density plot Birth weight of babies and the smoking status of the their mothers. It reveals that babies born to non-smoking mothers generally have higher birth weights, with a sharper peak around 120-130 grams, while babies of smoking mothers show lower and more variable birth weights.

6. Conclusion:

This study highlights the negative association between maternal smoking and birth weight. Babies born to non-smoking mothers consistently have higher and less variable birth weights compared to those born to smokers. The multiple regression model confirmed that smoking status is a significant predictor of lower birth weight, even after accounting for maternal age. Visualizations, including box plots and density curves, further supported these findings, showing a clear difference between the birth weights of smokers and non-smokers. The plots suggest that smoking status has a stronger influence on birth weight than maternal age, with smoking associated with lower birth weights. These results emphasize the importance of reducing smoking during pregnancy to improve newborn health outcomes.



7. Source: These data come from Child Health and Development Studies under 'openintro' package in R Studio.