Infant Mortality in the United States: Socioeconomic Factors Predicting Infant Survival in Late Neo-natal and Post Neo-natal Infants from Birth Certificate Data

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INFANT MORTALITY IN THE UNITED STATES:
SOCIOECONOMIC FACTORS PREDICTING INFANT SURVIVAL IN LATE NEO-
NATAL AND POST NEO-NATAL INFANTS FROM BIRTH CERTIFICATE DATA

by

Mark Brunk-Grady

A Thesis Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Master of Science
in Biostatistics

at
The University of Wisconsin-Milwaukee

May 2020
ABSTRACT

INFANT MORTALITY IN THE UNITED STATES
SOCIO ECONOMIC FACTORS PREDICTING INFANT SURVIVAL IN LATE NEO-NATAL AND POST NEO-NATAL INFANTS FROM BIRTH CERTIFICATE DATA

by

Mark Brunk-Grady

The University of Wisconsin-Milwaukee, 2020
Under the Supervision of Professor Shengtong Han

According to the Centers for Disease Control and Prevention, the infant mortality rate in the United States in 2018 was 5.6 deaths per 1000 live births. Infant mortality is defined as a child being born alive but dying before their first birthday. This study aimed to determine if adding socioeconomic factors to traditional predictive survival models improved the predictive power in terms of survival for late and post neonatal infants. Secondly, this study looked to develop a risk score to and predict which mothers would be classified as “High” or “Low” risk for infant death.

Data were analyzed from a retrospective cohort study using 2016 Period Linked Birth/Infant Death Data Set from the Centers for Disease Control and Prevention. Kaplan-Meier curves, which model estimated survival functions, were created for the parameters of interest and compared unadjusted survival statistics using Log-rank test. A risk score was developed using Cox Proportional Hazards model from potential predictors. From the start of 2016 through the end of 2017 there were 20,334 infant deaths in the United States. Of these, 7979 (39.2%) occurred after the first week of life, 7477 without congenital abnormalities. Time dependent ROC were used to determine the AUC at each time point from a base model consisting of Apgar score at five minutes, gestation age at birth, and birthweight, and compared them to a model with
socioeconomic factors added. Goodness of fit tests were also investigated to see how each model fits the data overall. Kaplan Meier curves of the risk categories on training and validation test sets were not statistically significantly different from each other for both the “High” and “Low” risk groups (Brier score 0.096) indicating that the prediction of risk category is very good.

The model with socioeconomic factors included had better predictive power compared to the base model with very similar AUC values for months 1-5 and then higher AUC values for months 6-11. As well, goodness of fit tests showed that the socioeconomic status (SES) model fit the data much better (Base p< 0.001, SES p= 0.046). Concordance was also a bit higher for the SES model compared to the Base model, 63.76% vs 63.14%. Kaplan Meier curves indicate that there is potential to utilize baseline clinical information to predict whether an infant should be considered as high risk for mortality within the first year of life. With this information, physicians will be able to direct their attention to patients that may require more social or medical interventions.
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To

my wife,

without whom none of this would be possible
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Chapter 1 Introduction

1.1 Disparities in Infant Mortality Rate

The infant mortality rate (IMR) is a significant indicator of a nation’s overall health. Infant mortality is defined as a child with a live birth not living to their first birthday. IMR is linked to other health factors such as maternal health, quality and access to medical care, practices in public health, and socioeconomic status (SES) [1]. It is widely known that IMR varies significantly among different racial and ethnic groups in the United States, however, the mechanisms that drive these differences are not well studied. The availability of data on birth certificates indicative of SES is limited, however, according to William Nersesian at the Metropolitan Pediatric Specialists in Edina, Minnesota, SES indicators available from birth certificates that are related to infant mortality are race and ethnicity, parental education, parental age, maternal marriage status, amount of prenatal care, multiparity, health insurance status, having a previous live-birth, interval between pregnancies, substance abuse, migrant status, place of birth, and by whom the birth was attended [2]. While it has been well documented that infant mortality within the first week of life is influenced strongly by birthweight and gestational age at delivery, post-neonatal mortality, defined as greater than seven days old, is increasingly driven by parental socioeconomic status and the care provided to the infant [3,4].

Given the well-known disparities in SES between race and ethnic groups, a study by Todd Elder, John Goddeeris, and Steven Haider in 2016 attempted to examine to what extent IMR differences related to SES. It was found that while SES characteristics available on birth certificates are limited, the IMR discrepancies for non-Hispanic blacks,
Puerto Ricans, Asians, and First Nations people as compared to non-Hispanic whites are all driven by three main predictors, maternal education, maternal marital status, and maternal age; these three predictors are also closely related to income and thus poverty for new mothers \(^6\). Further findings from the study show that the IMR differences by race and ethnicity exhibit several similarities suggesting that SES plays a significant role in the IMR \(^5\). Research routinely shows that socioeconomic disadvantage is correlated with a greater risk of poor birth outcomes in the United States. Globally, the U.S. has among the highest infant mortality rates of developed nations but also has the highest proportion of gross national product spent on health care, suggesting that health care is not the only factor contributing to higher IMR and racial disparity in IMR \(^6\). In a study by Alice Chen, Emily Oster, and Heidi Williams in 2016 that compared the US to selected European countries it was found that during the post-neonatal period the US had an excess mortality ranging from 0.45 deaths per 1000 (relative to Belgium) to 1.1 deaths per 1000 (relative to Austria). During the post-neonatal period, the IMR in Austria was 0.81 per 1000 with the U.S. being predicted at 1.89 per 1000 given the same birthweight distribution, which is surprising as Austria and the U.S. are very similar in terms of birthweight distribution and neonatal mortality \(^7\). For these reasons and others, it is imperative to investigate what is causing the higher IMR so action can be taken to rectify the issue by identifying factors that need to be addressed.

Further, the actionable determinates of health disproportionately affect persons who are socioeconomically disadvantaged. Some of these downstream factors include personal behavior, social factors, such as education level, wealth, and family size, environmental factors, and access to quality health care. More and more studies show
that SES alone may not fully account for the disparities in IMR. Rabah Kamal, Julie Hudman, and Daniel McDermott note that the Black-White infant mortality gap is not fully explained when adjusting for maternal characteristics and that structural racism as a primary risk factor for non-Hispanic black mothers could be key in explaining the difference in IMR based in large on the amount of stress it places on mothers of color throughout their lives. An example of structural racism in the health care system is shown by racial minorities receiving less intensive and lower quality health services compared to non-Hispanic whites due to providers’ prejudices and acceptance of negative racial stereotypes. As SES improves, it is expected that birth outcomes also improve. Studies have shown that while birth outcomes do improve, but they do not improve at the same rate for each race and ethnic group. In fact, the IMR gap widens as SES improves and non-Hispanic blacks have lower income and wealth on average compared to non-Hispanic whites with the equivalent education level and having higher expenditures for basic needs with more dependents.

A study in South Carolina women concluded that maternal stress was associated with pre-term birth in mothers in disadvantaged neighborhoods, but not in mothers who lived in more advantaged neighborhoods, suggesting that other social and infrastructural resources help to buffer stress as well as more positive techniques being utilized to adapt to stress demonstrated in another study that showed the odds of having a pre-term birth was approximately two times greater for mothers with low social support compared to those with high social support. This disparity is related to processes of unequal income distribution and mediating influences of psychosocial factors associated with maternal race and ethnicity and it is suggested that neighborhood income
inequality relates directly to societal underinvestment in the health and social services required to improve infant and maternal care and access to material resources, socioeconomic status, and neglect of existing infrastructure, thus, it follows that there is an unequal distribution of burdens of diseases and other adverse health outcomes including low birth weight or preterm birth \(^{[10]}\). In another study it is suggested that stressful life events and neighborhood resources are important determinants of prenatal health during pregnancy and postpartum however operate in different manners to influence low birthweight or preterm birth outcomes \(^{[11]}\).

1.2 Objectives

IMR for the first week of life has been well examined with most prediction models utilizing metabolic factors for infants with very low birthweights and those born very prematurely. However, much less work has been done on causes of infant death past the first week of life, especially for those infants that were not born very prematurely or with a very low birthweight. In order to identify important risk factors, this research is an attempt to help fill that gap.

Most studies investigating infant mortality have utilized logistic regression to form predictive models and more recent studies have made use of different machine learning classifiers to try to predict survivability. This research investigates the IMR starting after the first week of life for those infants who did not have congenital defects employing survival analysis methods as it is imperative to investigate how time plays a part in infant survival.
The use of socioeconomic factors and how they relate to infant survival is largely under studied even though it is widely known that lower SES is closely related to poorer health outcomes. The use of logistic regression for modeling infant survival does not account for how the risk of infant death changes with time. This motivates the use of Cox Proportional Hazards modeling in this study. During the first week of life, infants change drastically in terms of development. This trend continues through the first year of life, and thus how the predictors model survival, must also change. It is hypothesized that as time passes, the drivers behind survival rates will shift from metabolic factors to socioeconomic factors. This shift will aid in finding the populations that may require more social interventions.

1.3 Summary of Thesis

This thesis is organized as five main chapters. Chapter 1 gives a brief background of the disparities in IMR and the objectives for this study. Chapter 2 lays out the details of the dataset used. The method of statistical analysis will be explained in Chapter 3. Chapter 4 discusses the results of the study and Chapter 5 summarizes the results and their implications. Lastly, the R code for the study and additional tables and graphs are given in the Appendices.
Chapter 2 Data Description

2.1 Data Source

The data is the 2017 Period/2016 Cohort Linked Birth/Infant Death Public Use File compiled by the Centers for Disease Control and Prevention (CDC). This is the most recent linked dataset available and consists of all births in 2016 and all infant deaths from those born in 2016.

2.2 Infant Birth and Death Dataset

The birth certificate data can be summarized into the place and month of birth, parental characteristics, pregnancy information, medical risk factors, obstetric procedures, labor and delivery complications, delivery method, infant abnormalities, maternal morbidities, and sex of the infant. The death certificate information can be summarized as infant age at death and cause of death as denoted by 10th revision of the International Classification of Diseases (ICD 10). As of 2005, no geographic information is available in the public use dataset, however, it is noted that thirty-six jurisdictions (thirty-four states, New York City, and D.C.) linked 100% of their infant deaths; sixteen states have below a 100% linkage rate. Five states have a linkage of under 99%: Alaska (98.0%), California (98.3%), Texas (98.7%), Connecticut (98.8%), and Arizona (98.9%).

The raw birth and death certificate data consisted of 259 variables with 3,946,058 live births with 22,927 linked infant death records. There were 106 (0.4%) unlinked deaths that were excluded from the study. This study is focused on those infants who survived from at least the seventh day of life up to and including the 364th day of life to
mother’s born within the United States. An equal number of observations were randomly selected from the portion of infants that lived through their first birthday. Other exclusion criteria were those observations that were not reported in both the numerator and denominator files for each variable, marked in the dataset using reporting flags, 1 for being reported in both datasets, 0 for missing from at least one dataset were excluded as they would falsely skew results. Variables were left out of modeling that recoded observations, e.g. multiple reports of race, gestation age measures, education level. Predictor values related to the quality of measurement were also removed, such as those indicating if an observation was imputed. Missing observations were grouped into a separate level for each variable during data compilation by the CDC. After the above exclusion and random selection from the sample of infants that lived through their first birthday, there are 14,954 records remaining with 82 variables. Two more variables were created from the data, a continuous risk score and categorical risk, giving 84 final potential predictors.
Chapter 3 Methodology

3.1 Research Questions

The factors relating to SES of interest are maternal race, maternal education, if the infant is being breastfed, if the mother is a recipient of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), maternal marriage status, and how the pregnancy will be paid for. Breastfeeding and marriage status are not direct measures of SES; however, they are highly correlated with it and are thus being considered as measures of SES in this study. Metabolic factors which will be used as a baseline measure are Apgar score at 5 minutes, gestation age at birth, and birthweight. The Apgar score is a measure of five components to evaluate clinical signs of neonatal depression \[12\]. This study aims to determine if the SES factors given can improve the prediction of infant survival compared to metabolic measures only and if a risk score can be used to determine potential increased risk of death in infants based on data available from birth certificates. The first hypothesis is that socioeconomic factors available on a birth certificate will have better prediction of survival compared to a model with birth certificate metabolic factors. The secondary hypothesis is that a risk score can be developed from birth certificate data to identify those mothers who are at a high risk for infant death.

3.2 Participants

Participants in this study are mothers and their infants born in the United States in 2016. The subpopulation that was studied were those infants who experienced death within the first year of life and an equal number of randomly selected observations who
did not die during the first year of life, none of which exhibited any congenital abnormalities. Specifically, this study examines those infants that experienced death after their first six days of life until the 364th day of life. The average level of each of the socioeconomic factors of interest are non-Hispanic white women (47.9%) aged 25-29 (28.0%) with a high school diploma (29.3%) not receiving WIC benefits (55.1%) that breast fed their infants (64.2%) and started prenatal care in the first trimester (69.4%) with 11-12 prenatal visits (20.0%) who were on Medicaid (51.2%) and had a Doctor of Medicine as their attending health care provider (83.8%). There were an equal percentage of married and unmarried women (48.0% and 47.9% respectively). The complete data are summarized in Appendix A Tables 3.1-3.4 which are separated by survival status. Approval from the Institutional Review Board was not required as the data is publicly available and lacks all personal identifying information.

3.3 Statistical Analysis

All statistical analyses were conducted using R statistical software version 3.6.1. Cox Proportional Hazard models, from the Survive package, were used to investigate potential relationships between a base model of metabolic factors and survival as well as a model with the base factors and socioeconomic factors available on infant birth certificates [13]. The hazard ratios were used to compare event frequency among each predictor level compared to the reference groups. The hazard ratio is a measure of the probability of an event in the treatment group compared to that in the control group at a specific time. A hazard ratio greater than 1 indicates that the probability of event is
greater for the treatment group and a value less than 1 indicates a greater probability of the control group.

Predictor selection for the base model was performed using forward selection based on the Akaike information criterion (AIC) while predictors for the socioeconomic model were added based on current research relating each factor to health outcomes. The two models were compared using time dependent Receiver Operating Curves (ROC) and comparing the area under the curve (AUC) at each time point with Z tests using the survivalROC package \cite{14}. The AUC is the percentage that a randomly selected pair of observations are correctly classified. This study focuses on the change in AUC values to determine how model prediction improves.

A risk score was created from the beta coefficients from all potential predictors on a training dataset created by randomly splitting the full dataset into two halves. The beta coefficients from the training dataset were then applied to the test dataset and validated using Kaplan Meier (KM) plots and obtaining the Brier score. Due to the skewness of the risk score the median value was used to separate the predictor into “High” and “Low” risk categories. KM plots are used to visualize time-to-event, in this study the event is death, with differences in hazard function being tested by the log-rank test. The KM estimator is used to estimate the survival function of a sample population. The Brier score is a means to verify accuracy of a prediction, measured from 0 to 1, with a lower value indicating a better prediction.

The Sensitivity, Positive Predictive Value (PPV), and Accuracy were evaluated for the created risk categories as they predict infant survival. The Sensitivity is defined as the percentage of all infant deaths that were correctly predicted. The PPV is defined
as the percentage of true positives compared to all predicted infant deaths. The accuracy of the model is the percentage of all infants who were classified correctly, either as living or dead.
Chapter 4 Results

4.1 Univariate Analysis

Univariate Cox Proportional Hazard models showed that all predictors of interest were statistically significant when predicting survival status apart from infant sex ($p = 0.525$). All univariate results are in Table 4.A1 in Appendix A. In the Cox model of maternal race regressed on survival, infants born to non-Hispanic black, First Nations or Alaskan Native (AIAN), and mothers identifying with two or more races all had significantly better survival rates at alpha 0.1 compared to non-Hispanic white mothers ($\text{HR} = 0.95$, 95% CI $= [0.90-1.00]$, $p = 0.068$; $\text{HR} = 0.69$, 95% CI $= [0.50-0.88]$, $p < 0.001$; $\text{HR} = 0.86$, 95% CI $= [0.73-0.99]$, $p = 0.023$, respectively). As this goes against traditional findings, it should be noted that this may be due to the fact that there is a much higher proportion of minority infants dying in the first week of life compared to non-Hispanic whites. Highest level of maternal and paternal education attainment were both significant overall ($p < 0.001$ and $p < 0.001$) when regressed on survival by Cox regression, but only Bachelor’s and Master’s degree attainment within paternal education were significantly different from the reference group, both of which having lower survival rates ($\text{HR} = 1.22$, 95% CI $= [1.08-1.37]$, $p = 0.007$ and $\text{HR} = 1.26$, 95% CI $= [1.08-1.45]$, $p = 0.014$). Cox regression of maternal marriage status on infant survival was observed to have significantly higher survival rates for those who were unmarried and whose marriage status is unknown compared to those mothers that were married ($\text{HR} = 0.86$, 95% CI $= [0.81-0.90]$, $p < 0.001$; $\text{HR} = 0.90$, 95% CI $= [0.81-0.99]$, $p = 0.022$).

Prenatal care predictors from the birth certificate, when prenatal care began and how many prenatal visits to healthcare providers occurred, were significant when
regressed individually on infant survival overall (p< 0.001 and p< 0.001). As the number of prenatal visits increases in the range of 9-18 visits, the hazard ratios become less than 1 and thus improved survival rates (all p< 0.1) compared to a mother having no prenatal visits. As prenatal care starts later, there were observed increases in infant survival hazards. For those mother’s starting prenatal care in the 2nd trimester, the hazard ratio was 0.93 (95% CI= [0.87-0.99], p= 0.013), and for the 3rd trimester the hazard ratio was 0.83 (95% CI= [0.73-0.93], p< 0.001). The attending health care provider, when regressed on infant survival, was significant (alpha= 0.1) in terms of infant survival for both certified nurse midwives (HR= 0.81, 95% CI= [0.70-0.91], p< 0.001) and other midwives (HR= 0.67, 95% CI= [0.27-1.07], p= 0.053) compared to doctors of medicine.

From Cox regression models for breast feeding, WIC benefits, and Payer, infants being breast fed, those receiving WIC benefits, and those having Medicaid all had lower hazards of infant death. The hazard ratio for those not being breast fed was 1.11 (95% CI= [1.05-1.16], p< 0.001) indicating a higher risk of infant death. Similarly, for those mothers and infants receiving WIC benefits the hazard ratio was 0.89 (95% CI= [0.85-0.94], p< 0.001) indicating a significantly lower risk of infant death. Those mothers and infants covered by Medicaid had 14% lower risk of death compared to those with a private insurance payer (95% CI= [1.09-1.19], p< 0.001).

The metabolic factors of interest, Apgar score at 5 minutes, gestation age, and birth weight, were all positively related to infant survival though Cox regression, meaning that as each of them increased in level, hazard ratios all decreased and were less than 1 (all p< 0.1). The risk category that was created from the beta coefficients
showed increased risk of infant death for the “High” risk group compared to the “Low” risk group (HR= 1.42, 95% CI= [1.38-1.47], p< 0.001).

Univariate analysis shows there are many potential metabolic and SES predictors of infant survival. All predictors of interest, except infant sex, will be further investigated using KM curves and multivariate analyses.

4.2 Kaplan Meier Analysis

Kaplan Meier analyses were performed to investigate infant survival between each predictor level. Figure 4.2.1, as below, shows survival curves for each level of maternal race with the median survival times indicated by the dashed lines.

![Figure 4.2.1 Maternal Race Kaplan Meier Curve](image)

In this population, infants of non-Hispanic black mothers and those with more than one race identified, had a median survival time one month greater than non-Hispanic whites.
Further, those infants born to First Nations and Alaskan Native mothers had a median survival two months longer than those of non-Hispanic white mothers (log-rank p=0.0016).

Other maternal characteristics showed similar significance levels between groups. Maternal age, shown in Appendix A Figure 4.2.1, shows median survival times for infants of mothers who were in age groups 15, 16, 18, 19, 20-24, and 25-29 all being a month longer than those infants born to mothers aged younger than 15 (log-rank p<0.001). Highest maternal education (Appendix A Figure 4.2.A2) and paternal education (Appendix A Figure 4.2.A3) attainment showed significant differences in infant survival for the groups, however, lower education was associated with higher median survival times for both factors (log-rank p<0.001 and p<0.001). For both mothers and fathers, higher degree attainment was associated with worse infant survival, with exception of maternal doctoral degree attainment. Maternal marriage status (Appendix Figure 4.2.A4) showed significant differences in infant survival between the married and unmarried groups. Infants from unmarried mothers were associated with higher survival times, 1.05 months compared to 2.04 months (log-rank p<0.001).

As in the univariate Cox Proportional Hazard models above, prenatal care showed significant differences in survival curves between each group. As indicated in Appendix Figure 4.2.A5, as the number of prenatal visits increases to at least 7, the median infant survival increases by about 1 month (log-rank p<0.001). In the below figure showing the survival curves of the trimester in which prenatal care began, Figure 4.2.2, those who started prenatal care in the second or third trimesters had higher
survival compared to those who did not have any prenatal care or those that started in the first trimester.

Figure 4.2.2 Prenatal Care Start Kaplan Meier Curve

Not only is prenatal care significant, but the attending provider is as well. As can be seen in Figure 4.2.3, both certified nurse midwives and other midwives had greater survival rates compared to doctor’s of medicine, while doctors of osteopathy had very similar survival rates compared to doctors of medicine (log-rank p= 0.001).
Figure 4.2.3 Attending Health Care Provider Kaplan Meier Curve

Consistent with the Cox regression, breast feeding, receiving WIC benefits and having Medicaid are shown to extend infant survival. The median survival for infants who were breast fed (Appendix Figure 4.2.A6) was 1.97 compared to 1.05 for those who were not (log-rank $p< 0.001$). For those mothers and infants receiving WIC benefits (Appendix A Figure 4.2.A7), the median survival time was 2.04 months compared to 1.05 for those who did not receive WIC benefits (log-rank $p< 0.001$). For those mothers and infants having private insurance, the survival curve was lower than for any other known payer with a median survival of 1.05 months, shown in Appendix A Figure 4.2.A8 (log-rank $p< 0.001$). The metabolic factors, five-minute Apgar score, gestation age, and birthweight (Appendix A Figures 4.2.A9-11), all show increased survival with increasing levels (log-rank $p< 0.001$, $p< 0.001$, and $p< 0.001$, respectively). These results follow patterns of known research.
4.3 Multivariate Analysis

4.3.1 Base Cox Model

As a base for comparison, a Cox Proportional Hazards model was fit with the metabolic predictors of interest, Apgar score at 5 minutes, gestation age at birth, and birth weight. These were chosen as they are widely known to influence infant survival. The model is summarized below in Table 4.3.1. Each level of Apgar score has a decrease hazard ratio compared to the reference group, all significant at alpha= 0.1. A similar trend is seen for each gestation age group as well. Each level of gestation age is significantly different from the reference group (p= 0.1 or less). While birthweight was significant in univariate analysis (p< 0.001), when added with the Apgar score and gestation age, the individual levels are no longer significant (p= 0.58 and p= 0.36).

Table 4.3.1 Multivariate Cox Regression Base Model

<table>
<thead>
<tr>
<th>Apgar 5 mins.</th>
<th>HR</th>
<th>95% LCL</th>
<th>95% UCL</th>
<th>p</th>
</tr>
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<td>0.83</td>
<td>1.01</td>
<td>0.06</td>
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<tr>
<td>7-8</td>
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<tr>
<td>9-10</td>
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<td>0.58</td>
<td>0.70</td>
<td>&lt; 0.001</td>
</tr>
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<td>0.79</td>
<td>0.64</td>
<td>0.98</td>
<td>0.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gestation Age (weeks)</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<td>0.15</td>
<td>0.02</td>
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<td>32-33</td>
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<td>37-38</td>
<td>0.12</td>
<td>0.02</td>
<td>0.88</td>
<td>0.04</td>
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<td>39</td>
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<td>0.02</td>
<td>0.87</td>
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<td>40</td>
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<td>0.02</td>
<td>0.88</td>
<td>0.04</td>
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<td>41</td>
<td>0.12</td>
<td>0.02</td>
<td>0.88</td>
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<td>42+</td>
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<td>0.02</td>
<td>1.32</td>
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<td>1.34</td>
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<table>
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<th>Birthweight (grams)</th>
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<td>1500-2499</td>
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<td>0.85</td>
<td>1.10</td>
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<tr>
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<td>1.08</td>
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<td>1.90</td>
<td>0.68</td>
<td>5.32</td>
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4.3.2 SES Cox Model

As the SES factors are entered into the model, the metabolic factors increase in terms of their hazard ratios across all levels. The full SES model summary is shown in Table 4.3.2 in Appendix A. Notably non-Hispanic white and Hispanic infants have higher hazard ratios compared to other races. As well, higher levels of maternal education attainment now become significant. At the master’s degree level, the hazard ratio is 0.82 (95% CI= [0.67-1.00], p= 0.05) and at the doctoral level, the hazard ratio is 0.68 (95% CI= [0.52-0.90], p= 0.01). Mothers who are unmarried have lower hazard ratio compared to married mothers (HR= 0.93, 95% CI= [0.88-0.99], p= 0.02) and those who breast fed their infants had improved survival compared to those who did not (HR= 1.12, 95% CI= [1.06-1.18], p< 0.001).

4.3.3 Model Comparison and Diagnostics

The goodness of fit test from the survMisc package in R for the base model indicated that the model does not fit the data well ($X^2= 1686.2$, df= 9, p< 0.001) while the SES model does fit the model well at alpha= 0.1 significance ($X^2= 17.235$, df= 9, p= 0.045) [15]. Further, the concordance, which is a measure of goodness of fit in survival models, was higher for the SES model compared to the base model (63.76% compared to 63.14%), indicating a slightly better model, however this may also be due to sampling. Both models were used to examine the time dependent ROC’s to see how the survival prediction changed at each time point. ROC plots are in Appendix A Figures 4.3.A1-2 and are summarized below in Table 4.3.2. The base Cox model has a higher AUC at each time point through the first year of life compared to the SES Cox model.
Table 4.3.2 AUC of time dependent ROC at each time point

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<tbody>
<tr>
<td>Base</td>
<td>0.927</td>
<td>0.765</td>
<td>0.742</td>
<td>0.725</td>
<td>0.704</td>
<td>0.686</td>
<td>0.674</td>
<td>0.667</td>
<td>0.663</td>
<td>0.657</td>
<td>0.656</td>
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<tr>
<td>SES</td>
<td>0.897</td>
<td>0.731</td>
<td>0.687</td>
<td>0.651</td>
<td>0.618</td>
<td>0.592</td>
<td>0.576</td>
<td>0.567</td>
<td>0.561</td>
<td>0.553</td>
<td>0.551</td>
</tr>
<tr>
<td>Differ</td>
<td>-0.030</td>
<td>-0.034</td>
<td>-0.055</td>
<td>-0.074</td>
<td>-0.086</td>
<td>-0.094</td>
<td>-0.098</td>
<td>-0.100</td>
<td>-0.102</td>
<td>-0.104</td>
<td>-0.105</td>
</tr>
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</table>

Multivariate analyses show that the addition of the socioeconomic factors to the base model of metabolic factors improves model fitting and but lowers survival prediction.

4.4 Risk Score Analysis

To create a risk score, a Cox Proportional Hazard model was fit on a training dataset to all potential covariates. The resulting estimates of the log-hazard for each predictor were then added together based on parental and infant demographics. The estimates from the training dataset were then used to create a risk score on a test dataset. These scores were then put into categories “Low” and “High” split by the median score from the training dataset. KM curves of risk category on survival were then plotted for both the training and test datasets, seen in Figure 4.4.1.
The curves were then evaluated using the Brier score, which gave a value of 0.096, indicating that risk category predictions between the training and test datasets are very close to each other. Evaluating the risk score’s ability to predict survival from the training dataset on the test dataset, the sensitivity, positive predictive value (PPV), and accuracy were calculated. The sensitivity was 50.39%, the PPV was 75.33% and the accuracy was 50.56%. From these values the risk score is fair at predicting survival from those infants that did survive in the test dataset. However, the sensitivity and overall accuracy are very poor.
Chapter 5 Discussion

5.1 Conclusions

The first objective of this thesis was to first determine if socioeconomic factors improved survival prediction of infants in the United States. Cox regression models and Kaplan Meier curves were used to evaluate potential predictors of survival in univariate analyses. Those that were shown to have a significant relationship with infant survival were then used in a multivariate Cox regression model with the base metabolic factors, Apgar score at 5 minutes, gestation age at birth, and infant birthweight. The SES model was compared to the Base model, consisting of metabolic factors only using time dependent ROC plots and their corresponding AUC values. The SES factors included in the final model were maternal race, age, marital status, and education level, paternal education, WIC benefit status, whether the infant was breast fed, the timing of the start of prenatal care and number of prenatal visits, as well as the type of attending health care provider. It was found that the SES model fits the data better than the Base model using goodness of fit testing, however, the Base model outperformed the SES model when predicting infant survival.

The second objective of this thesis was to develop a risk score to assign mothers based on the available birth certificate data. A multivariate Cox regression model was fit using all potential predictors on a training dataset created by randomly splitting the full dataset in half. The beta estimates for each level of the predictors were then used to assign a score to each mother in both the training and validation datasets. The risk scores were then split into “High” and “Low” risk categories using the median value from the training dataset. Kaplan Meier plots were created for both the training and validation
risk categories and overlain to examine how the risk score fit each dataset. The resulting Kaplan Meier curve showed that both levels from each dataset were very close to each other and the Brier score indicated that they were statistically similar to each other as well. The validation between training and test datasets shows promise that risk categories could be used to guide health care providers to offer potential interventions either prior to birth or to guide relevant treatment after birth.

5.2 Limitations

This research does have some limitations. The first limitation is that there is not a direct measure of socioeconomic status available from birth certificate data. This is generally a measure of economic resources (e.g. income, net worth, cost of living, assets). This is important as income is directly related to health outcomes. As MacDorman and Mathews note, in 2005 there were almost three times as many minority children (<18 years of age) living in families who had incomes below the federal poverty line [1]. A second limitation is that there are no geographic identifying factors in the public data produced by the CDC. This makes estimating income and related factors impossible. It is well known that income in the United States is not distributed equally throughout the country so making assumptions on a national level is difficult. Further, the lack of geography eliminates investigation potential confounding factors from known industry locations (e.g. mining operations vs corporate office buildings)
5.3 Further Research

Elder and Goddeeris noted in 2006 that roughly one-third of the black-white gap in IMR is attributed to characteristics available on birth certificates, but richer data could support an SES explanation for much of the gap [5]. Sociologic research looking at the experiences of women of color in the health care space should be done to investigate how discrimination, either implicit or explicit, impacts health outcomes in minority populations. Early efforts in addressing the social determinants affecting birth outcomes are underway, however, most are too new to be able to observe changes in birth outcomes. Further research is needed working with these initiatives to better understand how their efforts are working.
References


### Table 3.A1: Raw dataset by parental characteristics

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<tr>
<th></th>
<th>Level</th>
<th>Overall</th>
<th>Survived</th>
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<th>X²</th>
<th>p</th>
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<td>7477</td>
<td>7477</td>
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<td>Maternal Race (%)</td>
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<td>Hispanic</td>
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<td>1688 (22.6)</td>
<td>1394 (18.6)</td>
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<td>Non-Hisp AIAN</td>
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<td>63 (0.8)</td>
<td>109 (1.5)</td>
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<td></td>
<td></td>
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<td>1079 (14.4)</td>
<td>2091 (28.0)</td>
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<td>Non-Hisp More than one race</td>
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<td>167 (2.2)</td>
<td>245 (3.3)</td>
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<td>Maternal Age (%)</td>
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<td>&lt; 15</td>
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<td>303 (2.0)</td>
<td>128 (1.7)</td>
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<td>1967 (26.3)</td>
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<td>25-29</td>
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<td>478 (6.4)</td>
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<td>Bachelor's degree</td>
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<td>122 (1.6)</td>
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<td>Maternal Height (mean (SD))</td>
<td>64.40 (4.24)</td>
<td>64.44 (4.18)</td>
<td>64.36 (4.29)</td>
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<td>Pre-Pregnancy Weight (mean (SD))</td>
<td>189.55 (159.79)</td>
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<td>Delivery Weight (mean (SD))</td>
<td>210.45 (140.75)</td>
<td>202.75 (120.37)</td>
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<td>Weight Gained (mean (SD))</td>
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Cont.
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<td>Interstate Non-res</td>
<td>Intrastate Non-res</td>
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<td>4720 (63.1)</td>
<td>1501 (20.1)</td>
<td>150 (2.0)</td>
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<tr>
<td>Prenatal Visits (%)</td>
<td>1-2</td>
<td>3-4</td>
<td>5-6</td>
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<td>340 (2.3)</td>
<td>874 (5.8)</td>
<td>1281 (8.6)</td>
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<td>81 (1.1)</td>
<td>162 (2.2)</td>
<td>355 (4.7)</td>
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<td>259 (3.5)</td>
<td>712 (9.5)</td>
<td>926 (12.4)</td>
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<td>Payer (%)</td>
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<td>Medicaid</td>
<td>Self-pay</td>
</tr>
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<td>562 (3.8)</td>
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<td>1668 (22.3)</td>
<td>2489 (33.3)</td>
<td>3285 (43.9)</td>
</tr>
<tr>
<td>Paternal Age (%)</td>
<td>&lt; 15</td>
<td>15-19</td>
<td>20-24</td>
</tr>
<tr>
<td></td>
<td>3 (0.0)</td>
<td>337 (2.3)</td>
<td>1890 (12.6)</td>
</tr>
<tr>
<td></td>
<td>1 (0.0)</td>
<td>142 (1.9)</td>
<td>843 (11.3)</td>
</tr>
<tr>
<td></td>
<td>2 (0.0)</td>
<td>195 (2.6)</td>
<td>1047 (14.0)</td>
</tr>
<tr>
<td>Prior Termination/ Fetal Deaths (mean (SD))</td>
<td>Paternal Age (%)</td>
<td>Cont.</td>
<td></td>
</tr>
<tr>
<td>Paternal Race (%)</td>
<td>Overall</td>
<td>Survived</td>
<td><em>χ²</em> p</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2596 (17.4)</td>
<td>1460 (19.5)</td>
<td>1136 (15.2)</td>
</tr>
<tr>
<td>Non-Hisp AIAN</td>
<td>93 (0.6)</td>
<td>48 (0.6)</td>
<td>45 (0.6)</td>
</tr>
<tr>
<td>Non-Hisp Asian</td>
<td>664 (4.4)</td>
<td>415 (5.6)</td>
<td>249 (3.3)</td>
</tr>
<tr>
<td>Non-Hisp Black</td>
<td>2337 (15.6)</td>
<td>889 (11.9)</td>
<td>1448 (19.4)</td>
</tr>
<tr>
<td>Non-Hisp More than one race</td>
<td>250 (1.7)</td>
<td>121 (1.6)</td>
<td>129 (1.7)</td>
</tr>
<tr>
<td>Non-Hisp NHOPI</td>
<td>40 (0.3)</td>
<td>23 (0.3)</td>
<td>17 (0.2)</td>
</tr>
<tr>
<td>Non-Hisp White</td>
<td>5912 (39.5)</td>
<td>3488 (46.6)</td>
<td>2424 (32.4)</td>
</tr>
<tr>
<td>Non-Hisp More than one race</td>
<td>3100 (20.7)</td>
<td>1035 (13.8)</td>
<td>2065 (27.6)</td>
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</table>

<table>
<thead>
<tr>
<th>Paternal Education (%)</th>
<th>Overall</th>
<th>Survived</th>
<th><em>χ²</em> p</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 9th grade</td>
<td>480 (3.2)</td>
<td>231 (3.1)</td>
<td>249 (3.3)</td>
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<tr>
<td>9-12 grade</td>
<td>1379 (9.2)</td>
<td>588 (7.9)</td>
<td>791 (10.6)</td>
</tr>
<tr>
<td>HS Grad/GED</td>
<td>4023 (26.9)</td>
<td>1885 (25.2)</td>
<td>2138 (28.6)</td>
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<tr>
<td>Some college</td>
<td>2290 (15.3)</td>
<td>1244 (16.6)</td>
<td>1046 (14.0)</td>
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<td>Associate degree</td>
<td>808 (5.4)</td>
<td>508 (6.8)</td>
<td>300 (4.0)</td>
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<td>Bachelor's degree</td>
<td>1889 (12.6)</td>
<td>1285 (17.2)</td>
<td>604 (8.1)</td>
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<tr>
<td>Master's degree</td>
<td>696 (4.7)</td>
<td>497 (6.6)</td>
<td>199 (2.7)</td>
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<tr>
<td>Doctorate or Professional degree</td>
<td>289 (1.9)</td>
<td>204 (2.7)</td>
<td>85 (1.1)</td>
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<tr>
<td>Unknown</td>
<td>3100 (20.7)</td>
<td>1035 (13.8)</td>
<td>2065 (27.6)</td>
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Table 3.A2: Raw dataset by medical risk factors

<table>
<thead>
<tr>
<th>Pre-pregnancy Smoking (%)</th>
<th>Overall</th>
<th>Survived</th>
<th><em>χ²</em> p</th>
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</thead>
<tbody>
<tr>
<td>Nonsmoker</td>
<td>12671 (84.7)</td>
<td>6734 (90.1)</td>
<td>5937 (79.4)</td>
</tr>
<tr>
<td>1-5</td>
<td>560 (3.7)</td>
<td>188 (2.5)</td>
<td>372 (5.0)</td>
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<tr>
<td>6-10</td>
<td>724 (4.8)</td>
<td>238 (3.2)</td>
<td>486 (6.5)</td>
</tr>
<tr>
<td>11-20</td>
<td>742 (5.0)</td>
<td>247 (3.3)</td>
<td>495 (6.6)</td>
</tr>
<tr>
<td>21-40</td>
<td>122 (0.8)</td>
<td>34 (0.5)</td>
<td>88 (1.2)</td>
</tr>
<tr>
<td>41+</td>
<td>13 (0.1)</td>
<td>4 (0.1)</td>
<td>9 (0.1)</td>
</tr>
<tr>
<td>Unknown</td>
<td>122 (0.8)</td>
<td>32 (0.4)</td>
<td>90 (1.2)</td>
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<table>
<thead>
<tr>
<th>1st Trimester Smoking (%)</th>
<th>Overall</th>
<th>Survived</th>
<th><em>χ²</em> p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsmoker</td>
<td>13111 (87.7)</td>
<td>6916 (92.5)</td>
<td>6195 (82.9)</td>
</tr>
<tr>
<td>1-5</td>
<td>554 (3.7)</td>
<td>171 (2.3)</td>
<td>383 (5.1)</td>
</tr>
<tr>
<td>6-10</td>
<td>671 (4.5)</td>
<td>214 (2.9)</td>
<td>457 (6.1)</td>
</tr>
<tr>
<td>11-20</td>
<td>435 (2.9)</td>
<td>127 (1.7)</td>
<td>308 (4.1)</td>
</tr>
<tr>
<td>21-40</td>
<td>51 (0.3)</td>
<td>13 (0.2)</td>
<td>38 (0.5)</td>
</tr>
<tr>
<td>41+</td>
<td>5 (0.0)</td>
<td>1 (0.0)</td>
<td>4 (0.1)</td>
</tr>
<tr>
<td>Unknown</td>
<td>127 (0.8)</td>
<td>35 (0.5)</td>
<td>92 (1.2)</td>
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<table>
<thead>
<tr>
<th>2nd Trimester Smoking (%)</th>
<th>Overall</th>
<th>Survived</th>
<th><em>χ²</em> p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsmoker</td>
<td>13294 (88.9)</td>
<td>6999 (93.6)</td>
<td>6295 (84.2)</td>
</tr>
<tr>
<td>1-5</td>
<td>606 (4.1)</td>
<td>177 (2.4)</td>
<td>429 (5.7)</td>
</tr>
<tr>
<td>6-10</td>
<td>632 (4.2)</td>
<td>182 (2.4)</td>
<td>450 (6.0)</td>
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Cont.
<table>
<thead>
<tr>
<th>3rd Trimester Smoking (%)</th>
<th>11-20</th>
<th>21-40</th>
<th>41+</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsmoker</td>
<td>261 (1.7)</td>
<td>72 (1.0)</td>
<td>189 (2.5)</td>
<td>13400 (89.6)</td>
</tr>
<tr>
<td>1-5</td>
<td>642 (4.3)</td>
<td>182 (2.4)</td>
<td>460 (6.2)</td>
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<tr>
<td>6-10</td>
<td>544 (3.6)</td>
<td>166 (2.2)</td>
<td>378 (5.1)</td>
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</tr>
<tr>
<td>11-20</td>
<td>212 (1.4)</td>
<td>60 (0.8)</td>
<td>152 (2.0)</td>
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</tr>
<tr>
<td>21-40</td>
<td>23 (0.2)</td>
<td>6 (0.1)</td>
<td>17 (0.2)</td>
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</tr>
<tr>
<td>41+</td>
<td>5 (0.0)</td>
<td>0 (0.0)</td>
<td>5 (0.1)</td>
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<tr>
<td>Unknown</td>
<td>128 (0.9)</td>
<td>34 (0.5)</td>
<td>94 (1.3)</td>
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<table>
<thead>
<tr>
<th>Pre-pregnancy Diabetes (%)</th>
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<th>Unknown</th>
</tr>
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<tbody>
<tr>
<td>No</td>
<td>14737 (98.5)</td>
<td>7427 (99.3)</td>
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<tr>
<td>Yes</td>
<td>198 (1.3)</td>
<td>6 (0.1)</td>
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<table>
<thead>
<tr>
<th>Gestational Diabetes (%)</th>
<th>No</th>
<th>Yes</th>
<th>Unknown</th>
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</thead>
<tbody>
<tr>
<td>No</td>
<td>14107 (94.3)</td>
<td>7014 (93.8)</td>
<td>7093 (94.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>828 (5.5)</td>
<td>457 (6.1)</td>
<td>371 (5.0)</td>
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<table>
<thead>
<tr>
<th>Pre-pregnancy Hypertension (%)</th>
<th>No</th>
<th>Yes</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>13843 (92.6)</td>
<td>7044 (94.2)</td>
<td>6799 (90.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>1092 (7.3)</td>
<td>427 (5.7)</td>
<td>665 (8.9)</td>
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<table>
<thead>
<tr>
<th>Gestational Hypertension (%)</th>
<th>No</th>
<th>Yes</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>13843 (92.6)</td>
<td>7044 (94.2)</td>
<td>6799 (90.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>1092 (7.3)</td>
<td>427 (5.7)</td>
<td>665 (8.9)</td>
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</table>

<table>
<thead>
<tr>
<th>Hypertension Eclampsia (%)</th>
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<th>Yes</th>
<th>Unknown</th>
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</thead>
<tbody>
<tr>
<td>No</td>
<td>14876 (99.5)</td>
<td>7455 (99.7)</td>
<td>7421 (99.3)</td>
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<td>16 (0.2)</td>
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<table>
<thead>
<tr>
<th>Previous Pre-term Birth (%)</th>
<th>No</th>
<th>Yes</th>
<th>Unknown</th>
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</thead>
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<td>No</td>
<td>14145 (94.6)</td>
<td>7250 (97.0)</td>
<td>6895 (92.2)</td>
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<tr>
<td>Yes</td>
<td>790 (5.3)</td>
<td>221 (3.0)</td>
<td>569 (7.6)</td>
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</table>

<table>
<thead>
<tr>
<th>Infertility Treatment (%)</th>
<th>No</th>
<th>Yes</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>14671 (98.1)</td>
<td>7363 (98.5)</td>
<td>7308 (97.7)</td>
</tr>
<tr>
<td>Yes</td>
<td>264 (1.8)</td>
<td>108 (1.4)</td>
<td>156 (2.1)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Fertility Enhancing Drugs (%)</th>
<th>No</th>
<th>Yes</th>
<th>Not Applicable</th>
<th>Unknown</th>
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</thead>
<tbody>
<tr>
<td>No</td>
<td>129 (0.9)</td>
<td>49 (0.7)</td>
<td>80 (1.1)</td>
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<td>Yes</td>
<td>123 (0.8)</td>
<td>54 (0.7)</td>
<td>69 (0.9)</td>
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</table>

<table>
<thead>
<tr>
<th>Asst. Reproductive Tech (%)</th>
<th>No</th>
<th>Yes</th>
<th>Not Applicable</th>
<th>Unknown</th>
</tr>
</thead>
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<tr>
<td>No</td>
<td>100 (0.7)</td>
<td>41 (0.5)</td>
<td>59 (0.8)</td>
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</tr>
<tr>
<td>Yes</td>
<td>152 (1.0)</td>
<td>62 (0.8)</td>
<td>90 (1.2)</td>
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</table>

Cont.
<table>
<thead>
<tr>
<th>Previous Cesareans (mean (SD))</th>
<th>0.42 (4.31)</th>
<th>0.31 (3.28)</th>
<th>0.52 (5.14)</th>
<th>0.003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gonorrhea (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14827 (99.2)</td>
<td>7442 (99.5)</td>
<td>7385 (98.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>72 (0.5)</td>
<td>22 (0.3)</td>
<td>50 (0.7)</td>
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<tr>
<td>Unknown</td>
<td>55 (0.4)</td>
<td>13 (0.2)</td>
<td>42 (0.6)</td>
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</tr>
<tr>
<td>Chlamydia (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14515 (97.1)</td>
<td>7336 (98.1)</td>
<td>7179 (96.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>384 (2.6)</td>
<td>128 (1.7)</td>
<td>256 (3.4)</td>
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<td>55 (0.4)</td>
<td>13 (0.2)</td>
<td>42 (0.6)</td>
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<tr>
<td>Syphilis (%)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14874 (99.5)</td>
<td>7456 (99.7)</td>
<td>7418 (99.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>25 (0.2)</td>
<td>8 (0.1)</td>
<td>17 (0.2)</td>
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<td>Unknown</td>
<td>55 (0.4)</td>
<td>13 (0.2)</td>
<td>42 (0.6)</td>
<td></td>
</tr>
<tr>
<td>Hepatitis C (%)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14774 (98.8)</td>
<td>7437 (99.5)</td>
<td>7337 (98.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>125 (0.8)</td>
<td>27 (0.4)</td>
<td>98 (1.3)</td>
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<tr>
<td>Unknown</td>
<td>55 (0.4)</td>
<td>13 (0.2)</td>
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<tr>
<td>Hepatitis B (%)</td>
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<td></td>
<td></td>
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<tr>
<td>No</td>
<td>14871 (99.4)</td>
<td>7451 (99.7)</td>
<td>7420 (99.2)</td>
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<tr>
<td>Yes</td>
<td>28 (0.2)</td>
<td>13 (0.2)</td>
<td>15 (0.2)</td>
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<tr>
<td>Unknown</td>
<td>55 (0.4)</td>
<td>13 (0.2)</td>
<td>42 (0.6)</td>
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Table 3.A3: Raw dataset by labor and delivery information

<table>
<thead>
<tr>
<th>Level</th>
<th>Overall</th>
<th>Survived</th>
<th>X^2</th>
<th>p</th>
</tr>
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<tbody>
<tr>
<td>n</td>
<td>14954</td>
<td>7477</td>
<td>7477</td>
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<tr>
<td>Birthing Facility (%)</td>
<td>Hospital</td>
<td>14742 (98.6)</td>
<td>7362 (98.5)</td>
<td>7380 (98.7)</td>
</tr>
<tr>
<td></td>
<td>Not Hospital</td>
<td>212 (1.4)</td>
<td>115 (1.5)</td>
<td>97 (1.3)</td>
</tr>
<tr>
<td>Live Birth Order (mean (SD))</td>
<td>2.31 (1.49)</td>
<td>2.17 (1.36)</td>
<td>2.45 (1.59)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total Pregnancy Order (mean (SD))</td>
<td>2.78 (1.83)</td>
<td>2.58 (1.69)</td>
<td>2.98 (1.95)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Interval Last Live Birth (%)</td>
<td>1st live birth</td>
<td>5327 (35.6)</td>
<td>2815 (37.6)</td>
<td>2512 (33.6)</td>
</tr>
<tr>
<td></td>
<td>0-3 months</td>
<td>413 (2.8)</td>
<td>104 (1.4)</td>
<td>309 (4.1)</td>
</tr>
<tr>
<td></td>
<td>4-11 months</td>
<td>264 (1.8)</td>
<td>70 (0.9)</td>
<td>194 (2.6)</td>
</tr>
<tr>
<td></td>
<td>12-17 months</td>
<td>947 (6.3)</td>
<td>349 (4.7)</td>
<td>598 (8.0)</td>
</tr>
<tr>
<td></td>
<td>18-23 months</td>
<td>1135 (7.6)</td>
<td>552 (7.4)</td>
<td>583 (7.8)</td>
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<tr>
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<td>24-35 months</td>
<td>1869 (12.5)</td>
<td>997 (13.3)</td>
<td>872 (11.7)</td>
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<td>36-47 months</td>
<td>1223 (8.2)</td>
<td>692 (9.3)</td>
<td>531 (7.1)</td>
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<td>48-59 months</td>
<td>789 (5.3)</td>
<td>412 (5.5)</td>
<td>377 (5.0)</td>
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<td>60-71 months</td>
<td>572 (3.8)</td>
<td>295 (3.9)</td>
<td>277 (3.7)</td>
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<tr>
<td></td>
<td>72+ months</td>
<td>1792 (12.0)</td>
<td>905 (12.1)</td>
<td>887 (11.9)</td>
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<td>Unknown</td>
<td>623 (4.2)</td>
<td>286 (3.8)</td>
<td>337 (4.5)</td>
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<tr>
<td>Interval Last Other Outcome (%)</td>
<td>1st live birth</td>
<td>10543 (70.5)</td>
<td>5459 (73.0)</td>
<td>5084 (68.0)</td>
</tr>
<tr>
<td></td>
<td>0-3 months</td>
<td>9 (0.1)</td>
<td>1 (0.0)</td>
<td>8 (0.1)</td>
</tr>
<tr>
<td></td>
<td>4-11 months</td>
<td>383 (2.6)</td>
<td>167 (2.2)</td>
<td>216 (2.9)</td>
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</table>

Cont.
<table>
<thead>
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Table 3.A4: Raw dataset by infant abnormalities

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Table 4.A1 Univariate Analysis of Predictors

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| Variable                  | 4-6 | 7-8 | 9-10 | Unknown | 20-27 | 28-31 | 32-33 | 34-36 | 37-38 | 39 | 40 | 41 | 42+ | Unknown | Dr. of Osteopathy | Certified Nurse Midwife | Other Midwife | Other | Unknown | 1500-2499 | 2500-8165 | Unknown | Yes | Unknown | Private Insurance | Self-Pay | Other | Unknown | Maternal Education |
|--------------------------|-----|-----|------|--------|-------|-------|-------|-------|-------|-----|----|----|-----|---------|------------------|---------------------|-----------------|------|---------|-------------------|-----------|-------|---------|-------------------|
| **Apgar 5 Minutes**      |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
|                          | 0.92| 0.63| 0.49 | 0.75   | 0.16 | 0.12 | 0.10  | 0.09  | 0.08  | 0.08 | 0.08| 0.12| 0.16 | 1.00   | 0.81               | 0.67               | 1.11            | 0.78 | 0.64    | 0.55              | 1.73       | 1.00  | 1.14    | 1.05               |
| **Gestation Age (Weeks)**|     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
|                          |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| **Attending**            |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Dr. of Osteopathy        |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Certified Nurse Midwife  |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Other Midwife            |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Other                    |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Unknown                  |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| **Birth Weight (grams)** |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
|                          |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| **WIC**                  |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Yes                      |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Unknown                  |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| **Payer**                |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Private Insurance        |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Self-Pay                 |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Other                    |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Unknown                  |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| **Maternal Education**   |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| 9-12                     |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| HS Grad/GED              |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Some College             |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Associate Degree         |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Bachelor's Degree        |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Master's Degree          |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
| Cont.                    |     |     |      |        |       |       |       |       |       |     |    |    |     |         |                   |                    |                 |      |         |                   |           |       |         |                   |
Figure 4.2.A1 Maternal Age Kaplan Meier Curve
Figure 4.2.A2 Maternal Education Kaplan Meier Curve

Figure 4.2.A3 Paternal Education Kaplan Meier Curve
Figure 4.2.A4 Maternal Marriage Status Kaplan Meier Curve

Figure 4.2.A5 Number of Prenatal Visits Kaplan Meier Curve
Figure 4.2.A7 WIC Benefits Status Kaplan Meier Curve

Figure 4.2.A6 Breast Feeding Status Kaplan Meier Curve
Figure 4.2.A8 Payer Kaplan Meier Curve

Figure 4.2.A9 5-Minute Apgar Score Kaplan Meier Curve
Figure 4.2.A10 Gestation Age Kaplan Meier Curve

Figure 4.2.A11 Birthweight Kaplan Meier Curve
Table 4.3.A2 Multivariate Cox Regression SES Model

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Figure 4.3.A1 Model Comparison of Time Dependent ROCs
APPENDIX B: SAS and R Programming Code

FILENAME born16 '\VS16LINK.Public.USDENPUB_2019_08_29';
DATA b16;
INFILE born16 LRECL = 20000 ;
attrib dob_yy length=4 label="Birth Year";
attrib dob_mm length=3 label="Birth Month 01 January";
attrib dob_tt length=4 label="Time of Birth 0000-2359 Time of Birth";
attrib dob_wk length=3 label="Birth Day of Week 1 Sunday";
attrib bfacil length=3 label="Birth Place 1 Hospital";
attrib f_bfacil length=3 label="Reporting Flag for Birth Place 0 Non-Reporting";
attrib bfacil3 length=3 label="Facility Recode 1 In Hospital";
attrib mageimp length=3 label="Mother's Age Imputed Blank Age not imputed";
attrib magerep length=3 label="Reported Age of Mother Used Flag Blank Reported age not used";
attrib mager length=3 label="Mother's Single Years of Age 12 10 -- 12 years";
attrib mager14 length=3 label="Mother's Age Recode 14 01 Under 15 Years";
attrib mager9 length=3 label="Mother's Age Recode 9 1 Under 15 years";
attrib mbstate_rec length=3 label="Mother's Nativity 1 Born in the U.S. (50 US States)";
attrib restatus length=3 label="Residence Status";
attrib mrace31 length=3 label="Mother's Race Recode 31";
attrib mrace6 length=3 label="Mother's Race Recode 6";
attrib mrace15 length=3 label="Mother's Race Recode 15";
attrib mbrace length=3 label="Bridged Race Mother";
attrib mraceimp length=$1 label="Mother's Race Imputed Flag Blank Mother's race not imputed";
attrib mhisp_r length=3 label="Mother's Hispanic Origin Recode 0 Non-Hispanic";
attrib f_mhisp length=3 label="Reporting Flag for Mother's Origin 0 Non-Reporting";
attrib mracehisp length=3 label="Mother's Race/Hispanic Origin 1 Non-Hispanic White (only)";
attrib mar_p length=$1 label="Paternity Acknowledged Y Yes";
attrib dmar length=3 label="Marital Status";
attrib mar_imp length=3 label="Mother's Marital Status Imputed Blank Marital Status not imputed";
attrib f_mar_p length=3 label="Reporting Flag for Paternity Acknowledged 0 Non-Reporting";
attrib meduc length=3 label="Mother's Education 1 8th grade or less";
attrib f_meduc length=3 label="Reporting Flag for Education of Mother 0 Non-Reporting";
attrib fagerpt_flg length=3 label="Father's Reported Age Used Blank Father's reported age not u";
attrib fagecomb length=3 label="Father's Combined Age (Revised) 09-98 Father's combined age in ye";
attrib fage11 length=3 label="Father's Age Recode 11 01 Under 15 years";
attrib frace31 length=3 label="Father's Race Recode 31 01 White (only) [only one race]";
attrib frace6 length=3 label="Father's Race Recode 6 1 White (only)";
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attrib priordead length=3 label="Prior Births Now Dead 00-30 Number of children dead";
attrib priorterm length=3 label="Prior Other Terminations 00-30 Number other terminations";
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attrib tpo_rec length=3 label="Total Birth Order Recode 1-7 Number of total birth order";
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attrib illb_r11 length=3 label="Interval Since Last Live Birth Recode 11 00 Zero to 3 months (plural de)";
attrib iloo_r length=3 label="Interval Since Last Other Pregnancy Recode 000-003 Plural delivery";
attrib iloo_r11 length=3 label="Interval Since Last Other Pregnancy Recode 11 00 Zero to 3 months (plural de)";
attrib ilp_r length=3 label="Interval Since Last Pregnancy Recode 000-003 Plural delivery";
attrib ilp_r11 length=3 label="Interval Since Last Pregnancy Recode 11 00 Zero to 3 months (plural de)";
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attrib f_mpcb length=3 label="Reporting Flag for Month Prenatal Care Began 0 Non-Reporting";
attrib precare5 length=3 label="Month Prenatal Care Began Recode 1 1st to 3rd month";
attrib previs length=3 label="Number of Prenatal Visits (Revised only) 00-98 Number of prenatal visits";
attrib previs_rec label="Number of Prenatal Visits Recode 01 No visits";
attrib f_tpcv label="Reporting Flag for Total Prenatal Care Visits 0 Non-Reporting";
attrib wic label="WIC Y Yes";
attrib f_wic label="Reporting Flag for WIC 0 Non-Reporting";
attrib cig_0 label="Cigarettes Before Pregnancy 00-97 Number of cigarettes daily";
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attrib f_cigs_3 label="Reporting Flag for Cigarettes 3rd Trimester 0 Non-Reporting";
attrib cig_rec label="Cigarette Recode (Revised) Y Yes";
attrib f_tobacco label="Reporting Flag for Tobacco use 0 Non-Reporting";
attrib mhtr label="Mother's Height in Total Inches 30-78 Height in inches";
attrib f_m_ht label="Reporting Flag for Mother's Height 0 Non-Reporting";
attrib bmi label="Body Mass Index 13.0-69.9 Body Mass Index";
attrib bmi_r label="Body Mass Index Recode 1 Underweight <18.5";
attrib pwgt_r label="Pre-pregnancy Weight Recode 075-375 Weight in pounds";
attrib f_pwgt label="Reporting Flag for Pre-pregnancy Weight 0 Non-Reporting";
attrib dwgt_r label="Delivery Weight Recode 100-400 Weight in pounds";
attrib f_dwgt label="Reporting Flag for Delivery Weight 0 Non-Reporting";
attrib wtgain label="Weight Gain 00-97 Weight gain in pounds";
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attrib no_infec length=3 label="No Infections Reported 1 True";
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attrib ld_antb length=$1 label="Antibiotics Y Yes";
attrib ld_chor length=$1 label="Chorioamnionitis Y Yes";
attrib ld_anes length=$1 label="Anesthesia Y Yes";
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attrib f_ld_antb length=3 label="Reporting Flag for Antibiotics 0 Non-Reporting";
attrib f_ld_chor length=3 label="Reporting Flag for Chorioamnionitis 0 Non-Reporting";
attrib f_ld_anes length=3 label="Reporting Flag for Anesthesia 0 Non-Reporting";
attrib no_lbrdlv length=3 label="No Characteristics of Labor Reported 1 True";
attrib me_pres length=$1 label="Fetal Presentation at Delivery 1 Cephalic";
attrib me_rout length=$1 label="Final Route and Method of Delivery 1 Spontaneous";
attrib me_trial length=$1 label="Trial of Labor Attempted (if cesarean) Y Yes";
attrib f_me_pres length=3 label="Reporting Flag for Fetal Presentation 0 Non-Reporting";
attrib f_me_rout length=3 label="Reporting Flag for Final Route and Method of Deliver 0 Non-Reporting";
attrib f_me_trial length=3 label="Reporting Flag for Trial of Labor Attempted 0 Non-Reporting";
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attrib dmeth_rec length=3 label="Delivery Method Recode Combined 1 Vaginal";
attrib f_dmeth_rec length=3 label="Reporting Flag for Method of Delivery Recode 0 Non-Reporting";
attrib mm_mtr length=$1 label="Maternal Transfusion Y Yes";
attrib mm_plac length=$1 label="Perineal Laceration Y Yes";
attrib gestrec10 length=3 label="Combined Gestation Recode 10 01 Under 20 weeks";
attrib gestrec3 length=3 label="Combined Gestation Recode 3 1 Under 37 weeks";
attrib Impused length=3 label="Combined Gestation Used Flag Blank Combined gestation not used";
attrib oegest_comb length=3 label="Obstetric Estimate Edited 17-47 Weeks of gestation";
attrib oegest_r10 length=3 label="Obstetric Estimate Recode10 01 Under 20 weeks";
attrib oegest_r3 length=3 label="Obstetric Estimate Recode 3 1 Under 37 weeks";
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attrib bwtr4 length=3 label="Birth Weight Recode 4 1 0227 - 1499 grams";
attrib brthwgt length=4 label="Imputed Birth Weight";
attrib bwtimp length=3 label="Birth Weight Imputed Flag";
attrib ab_aven1 length=$1 label="Assisted Ventilation (immediately) Y Yes";
attrib ab_aven6 length=$1 label="Assisted Ventilation > 6 hrs Y Yes";
attrib ab_nicu length=$1 label="Admission to NICU Y Yes";
attrib ab_surf length=$1 label="Surfactant Y Yes";
attrib ab_anti length=$1 label="Antibiotics for Newborn Y Yes";
attrib ab_seiz length=$1 label="Seizures Y Yes";
attrib f_ab_aven1 length=3 label="Reporting Flag for Assisted Ventilation (immediately) 0 Non-Reporting";
attrib f_ab_aven6 length=3 label="Reporting Flag for Assisted Ventilation >6 hrs 0 Non-Reporting";
attrib f_ab_nicu length=3 label="Reporting Flag for Admission to NICU 0 Non-Reporting";
attrib f_ab_surf length=3 label="Reporting Flag for Surfactant 0 Non-Reporting";
attrib f_ab_anti length=3 label="Reporting Flag for Antibiotics 0 Non-Reporting";
attrib f_ab_seiz length=3 label="Reporting Flag for Seizures 0 Non-Reporting";
attrib no_abnorm length=3 label="No Abnormal Conditions Checked 1 True";
attrib ca_anen length=$1 label="Anencephaly Y Yes";
attrib ca_mnsb length=$1 label="Meningomyelocele / Spina Bifida Y Yes";
attrib ca_cchd length=$1 label="Cyanotic Congenital Heart Disease Y Yes";
attrib ca_cdh length=$1 label="Congenital Diaphragmatic Hernia Y Yes";
attrib ca_omph length=$1 label="Omphalocele Y Yes";
attrib ca_gast length=$1 label="Gastroschisis Y Yes";
attrib f_ca_anen length=3 label="Reporting Flag for Anencephaly 0 Non-Reporting";
attrib f_ca_mnsb length=3 label="Reporting Flag for Meningomyelocele/Spina Bifida 0 Non-Reporting";
attrib f_ca_cchd length=3 label="Reporting Flag for Cyanotic Congenital Heart Disease 0 Non-Reporting";
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attrib f_ca_omph length=3 label="Reporting Flag for Omphalocele 0 Non-Reporting";
attrib f_ca_gast length=3 label="Reporting Flag for Gastroschisis 0 Non-Reporting";
attrib ca_limb length=$1 label="Limb Reduction Defect Y Yes";
attrib ca_cleft length=$1 label="Cleft Lip w/ or w/o Cleft Palate Y Yes";
attrib ca_clpal length=$1 label="Cleft Palate alone Y Yes";
attrib ca_down length=$1 label="Down Syndrome C Confirmed";
attrib ca_disor length=$1 label="Suspected Chromosomal Disorder C Confirmed";
attrib ca_hypo length=$1 label="Hypospadias Y Yes";
attrib f_ca_limb length=3 label="Reporting Flag for Limb Reduction Defect 0 Non-Reporting";
attrib f_ca_cleft length=3 label="Reporting Flag for Cleft Lip with or without Cleft Palate0 Non-Reporting";
attrib f_ca_clpal length=3 label="Reporting Flag for Cleft Palate Alone 0 Non-Reporting";
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attrib f_ca_disor length=3 label="Reporting Flag for Suspected Chromosomal Disorder 0 Non-Reporting";
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attrib no_congen length=3 label="No Congenital Anomalies Checked 1 True";
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attrib ilive length=$1 label="Infant Living at Time of Report Y Yes";
attrib bfed length=$1 label="Infant Breastfed at Discharge Y Yes";
attrib f_bfed length=3 label="Reporting Flag for Breastfed at Discharge 0 Non-Reporting";
attrib ubfacil length=3 label="Birth Place 1 Hospital";
attrib urf_diab length=3 label="Diabetes 1 Yes";
attrib urf_chype length=3 label="Chronic Hypertension 1 Yes";
attrib urf_phype length=3 label="Pregnancy Associated Hypertension 1 Yes";
attrib urf_ehype length=3 label="Eclampsia 1 Yes";
attrib ume_forc length=3 label="Forceps 1 Yes";
attrib ume_vacu length=3 label="Vacuum 1 Yes";
attrib uop_indu length=3 label="Induction of Labor 1 Yes";
attrib ufd_bree length=3 label="Breech 1 Yes";
attrib uca_anen length=3 label="Anencephalus 1 Anomaly reported";
attrib uca_spina length=3 label="Spina Bifida / Meningocele 1 Anomaly reported";
attrib uca_omph length=3 label="Omphalocele / Gastroschisis 1 Anomaly reported";
attrib uca_clip length=3 label="Cleft Lip / Palate 1 Anomaly reported";
attrib uca_hern length=3 label="Diaphragmatic Hernia 1 Anomaly reported";
attrib uca_down length=3 label="Down Syndrome 1 Anomaly reported";
attrib flgnd length=3 label="Match Status 1 Both";

INPUT

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@13 dob_mm  2.
@19 dob_tt  4.
@23 dob_wk  1.
@32 bfacil  1.
@33 f_bfacil 1.
@50 bfacil3  1.
@73 mageimp 1.
@74 magerep 1.
@75 mager  2.
@77 mager14 2.
@79 mager9  1.
@84 mbstate_rec 1.
@104 restatus 1.
@105 mrace31 2.
@107 mrace6  1.
@108 mrace15 2.
@110 mbrace  1.
@111 mraceimp $1.
@115 mhispr  1.
@116 f_mhispr 1.
@117 mracehisp 1.
@119 mar_p $1.
@120 dmar  1.
@121 mar_imp 1.
@123 f_mar_p 1.
@124 meduc  1.
@126 f_meduc 1.
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@147 fagecomb 2.
@149 fage11  2.
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@153 frace6  1.
@154 frace15 2.
@156 fbrace  1.
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@165 f_feduc 1.
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@173 priordead 2.
@175 priorterm 2.
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@182 tpo_rec 1.
@198 illb_r 3.
@201 illb_r11 2.
@206 iloo_r 3.
@209 iloo_r11 2.
@214 ilp_r 3.
@217 ilp_r11 2.
@224 precare 2.
@226 f_mpcb 1.
@227 precare5 1.
@238 previs 2.
@242 previs_rec 2.
@244 f_tpcv 1.
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@252 f_wic 1.
@253 cig_0 2.
@255 cig_1 2.
@257 cig_2 2.
@259 cig_3 2.
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@262 cig1_r 1.
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@264 cig3_r 1.
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@268 f_cigs_3 1.
@269 cig_rec $1.
@270 f_tobaco 1.
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@283 bmi 4.1
@287 bmi_r 1.
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@299  dwgt_r  3.
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@324  f_rf_ppb  1.
@325  rf_inft  $1.
@326  rf_drg  $1.
@327  rf_art  $1.
@329  f_rf_drg  1.
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@335  f_rf_cesar  1.
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@337  no_risks  1.
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@345  ip_chlam  $1.
@346  ip_hepb  $1.
@347  ip_hepc  $1.
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@364  f_ob_fail  1.
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@385  ld_ster  $1.
@386  ld_antb  $1.
@387  ld_chor  $1.
@388  ld_anes  $1.
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@390  f_ld_augm  1.
@391  f_ld_ster  1.
@392  f_ld_antb  1.
@393  f_ld_chor  1.
@394  f_ld_anes  1.
@395  no_lbrdlv  1.
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@405  f_me_rout  1.
@406  f_me_trial  1.
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@408  dmeth_rec  1.
@409  f_dmeth_rec  1.
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@416  mm_plac  $1.
@417  mm_rupt  $1.
@418  mm_uhyst  $1.
@419  mm_aicu  $1.
@421  f_mm_mtr  1.
@422  f_mm_plac  1.
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@424  f_mm_uhyst  1.
@425  f_mm_aicu  1.
@427  no_mmorb  1.
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@446  apgar5r  1.
@447  f_apgar5  1.
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DATA d16;
INFILE died16 LRECL = 20000;
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attrib dob_mm length=3 label="Birth Month 01 January";
attrib dob_tt length=4 label="Time of Birth 0000-2359 Time of Birth";
attrib dob_wk length=3 label="Birth Day of Week 1 Sunday";
attrib bfacil length=3 label="Birth Place 1 Hospital";
attrib f_bfacil length=3 label="Reporting Flag for Birth Place 0 Non-Reporting";
attrib bfacil3 length=3 label="Facility Recode 1 In Hospital";
attrib mageimp length=3 label="Mother's Age Imputed Blank Age not imputed";
attrib magerep length=3 label="Reported Age of Mother Used Flag Blank Reported age not used";
attrib mager length=3 label="Mother's Single Years of Age 12 10 -- 12 years";
attrib mager14 length=3 label="Mother's Age Recode 14 01 Under 15 Years";
attrib mager9 length=3 label="Mother's Age Recode 9 1 Under 15 years";
attrib mbstate_rec length=3 label="Mother's Nativity 1 Born in the U.S. (50 US States)";
attrib restatus length=3 label="Residence Status";
attrib mrace31 length=3 label="Mother's Race Recode 31";
attrib mrace6 length=3 label="Mother's Race Recode 6";
attrib mrace15 length=3 label="Mother's Race Recode 15";
attrib mbrace length=3 label="Bridged Race Mother";
attrib mraceimp length=$1 label="Mother's Race Imputed Flag Blank Mother's race not imputed";
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attrib f_mhisp length=3 label="Reporting Flag for Mother's Origin 0 Non-Reporting";
attrib mracehisp length=3 label="Mother's Race/Hispanic Origin 1 Non-Hispanic White (only)";
attrib mar_p length=$1 label="Paternity Acknowledged Y Yes";
attrib dmar length=3 label="Marital Status";
attrib mar_imp length=3 label="Mother's Marital Status Imputed Blank Marital Status not imputed";
attrib f_mar_p length=3 label="Reporting Flag for Paternity Acknowledged 0 Non-Reporting";
attrib meduc length=3 label="Mother's Education 1 8th grade or less";
attrib f_meduc length=3 label="Reporting Flag for Education of Mother 0 Non-Reporting";
attrib fagerpt_flg length=3 label="Father's Reported Age Used Blank Father's reported age not u";
attrib fagecomb length=3 label="Father's Combined Age (Revised) 09-98 Father's combined age in ye";
attrib fage11 length=3 label="Father's Age Recode 11 01 Under 15 years";
attrib frace31 length=3 label="Father's Race Recode 31 01 White (only) [only one race]";
attrib frace6 length=3 label="Father's Race Recode 6 1 White (only)";
attrib frace15 length=3 label="Father's Race Recode 15 01 White (only)";
attrib fbrace length=3 label="Bridged Race Father 1 White";
attrib fhisp_r length=3 label="Father's Hispanic Origin Recode 0 Non-Hispanic";
attrib f_fhisp length=3 label="Reporting Flag for Father's Origin 0 Non-Reporting";
attrib fracehisp length=3 label="Father's Race/Hispanic Origin 1 Non-Hispanic White (only)";
attrib feduc length=3 label="Father's Education 1 8th grade or less";
attrib f_feduc length=3 label="Reporting Flag for Father's Education";
attrib priorlive length=3 label="Prior Births Now Living 00-30 Number of children still li";
attrib priordead length=3 label="Prior Births Now Dead 00-30 Number of children dead";
attrib priorterm length=3 label="Prior Other Terminations 00-30 Number other terminations";
attrib lbo_rec length=3 label="Live Birth Order Recode 1-7 Number of live birth order.";
attrib tpo_rec length=3 label="Total Birth Order Recode 1-7 Number of total birth order";
attrib illb_r length=3 label="Interval Since Last Live Birth Recode 000-003 Plural delivery";
attrib illb_r11 length=3 label="Interval Since Last Live Birth Recode 11 00 Zero to 3 months (plural de)";
attrib iloo_r length=3 label="Interval Since Last Other Pregnancy Recode 000-003 Plural delivery";
attrib iloo_r11 length=3 label="Interval Since Last Other Pregnancy Recode 11 00 Zero to 3 months (plural de)";
attrib ilp_r length=3 label="Interval Since Last Pregnancy Recode 000-003 Plural delivery";
attrib ilp_r11 length=3 label="Interval Since Last Pregnancy Recode 11 00 Zero to 3 months (plural de)";
attrib precare length=3 label="Month Prenatal Care Began 00 No prenatal care";
attrib f_mpcb length=3 label="Reporting Flag for Month Prenatal Care Began 0 Non-Reporting";
attrib precare5 length=3 label="Month Prenatal Care Began Recode 1 1st to 3rd month";
attrib previs length=3 label="Number of Prenatal Visits (Revised only) 00-98 Number of prenatal visits";
attrib previs_rec length=3 label="Number of Prenatal Visits Recode 01 No visits";
attrib f_tpcv length=3 label="Reporting Flag for Total Prenatal Care Visits 0 Non-Reporting";
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attrib f_wic length=3 label="Reporting Flag for WIC 0 Non-Reporting";
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attrib cig_2 length=3 label="Cigarettes 2nd Trimester 00-97 Number of cigarettes daily";
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attrib cig3_r length=3 label="Cigarettes 3rd Trimester Recode 0 Nonsmoker";
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attrib f_cigs_1 length=3 label="Reporting Flag for Cigarettes 1st Trimester Non-Reporting";
attrib f_cigs_2 length=3 label="Reporting Flag for Cigarettes 2nd Trimester Non-Reporting";
attrib f_cigs_3 length=3 label="Reporting Flag for Cigarettes 3rd Trimester Non-Reporting";
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attrib f_tobaco length=3 label="Reporting Flag for Tobacco use 0 Non-Reporting";
attrib mhtr length=3 label="Mother's Height in Total Inches 30-78 Height in inches";
attrib f_m_ht length=3 label="Reporting Flag for Mother's Height 0 Non-Reporting";
attrib bmi length=8 label="Body Mass Index 13.0-69.9 Body Mass Index";
attrib bmi_r length=3 label="Body Mass Index Recode 1 Underweight <18.5";
attrib pwgt_r length=3 label="Pre-pregnancy Weight Recode 075-375 Weight in pounds";
attrib f_pwgt length=3 label="Reporting Flag for Pre-pregnancy Weight 0 Non-Reporting";
attrib dwgt_r length=3 label="Delivery Weight Recode 100-400 Weight in pounds";
attrib f_dwgt length=3 label="Reporting Flag for Delivery Weight 0 Non-Reporting";
attrib wtgain length=3 label="Weight Gain 00-97 Weight gain in pounds";
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attrib magerep    length=3   label="Reported Age of Mother Used Flag Blank Reported age not used";
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attrib mager9     length=3   label="Mother's Age Recode 9 1 Under 15 years";
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attrib f_m_ht length=3 label="Reporting Flag for Mother's Height 0 Non-Reporting";
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attrib mm_rupt length=$1 label="Ruptured Uterus Y Yes";
attrib mm_uhyst length=$1 label="Unplanned Hysterectomy Y Yes";
attrib mm_aicu length=$1 label="Admit to Intensive Care Y Yes";
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attrib ab_surf length=$1 label="Surfactant Y Yes";
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attrib dispo length=$1 label="Method of Disposition B Burial";
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attrib recwt length=8 label="Record Weight for Period File";
attrib hospd length=3 label="Place of Death and Decendent's Status 1 Hospital, Clinic, Med Center- Inpatient";
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DATA B16D16;
MERGE b16 d16; BY co_seqnum;
run;

DATA thesis;
MERGE B16D16 d17; BY co_seqnum;
RUN;
#
## Missing as 0 or 9
#
thesis$mar_p<- thesis$mar_p %>% fctCollapse(X = c("","X"), group_other = FALSE)
thesis$dmar[is.na(thesis$dmar)]<-9
thesis$mageimp[is.na(thesis$mageimp)]<-0
thesis$magerep[is.na(thesis$magerep)]<-0
thesis$mraceimp[is.na(thesis$mraceimp)]<-0
thesis$mar_imp[is.na(thesis$mar_imp)]<-0
thesis$imp_plur[is.na(thesis$imp_plur)]<-0
thesis$imp_sex[is.na(thesis$imp_sex)]<-0
thesis$combgst_imp[is.na(thesis$combgst_imp)]<-0
thesis$obgest_flg[is.na(thesis$obgest_flg)]<-0
thesis$Impused[is.na(thesis$Impused)]<-0
thesis$bwtimp[is.na(thesis$bwtimp)]<-0
thesis$flgnd[is.na(thesis$flgnd)]<-0
thesis$ager22[is.na(thesis$ager22)]<-99
thesis$manner[is.na(thesis$manner)]<-9
thesis$place[is.na(thesis$place)]<-99

#  ## Factor variables
#
thesis1$bfacil3 <- factor(thesis1$bfacil3, levels = c("1","2","9"),
   levels = c("Hospital","Not Hospital","Unknown"))
thesis1$mager14 <- factor(thesis1$mager14, # levels =
c("1","3","4","5","6","7","8","9","10","11","12","13","14"),
levels = c("< 15","15","16","17","18","19","20-24","25-29","30-34","35-39","40-44","45-49","50-54"))
thesis1$mbstate_rec <- factor(thesis1$mbstate_rec, #levels = c("1","2","3"),
                            levels = c("Born in US","Not born in US","Unknown"))
thesis1$restatus <- factor(thesis1$restatus, #levels = c("1","2","3"),
                           levels = c("Resident","Intraplate Non-res","Interstate Non-res"))
thesis1$mracehisp <- factor(thesis1$mracehisp, #levels = c("1","2","3","4","5","6","7","8"),
                           levels = c("Non-Hisp White","Non-Hisp Black","Non-Hisp AIAN","Non-Hisp Asian","Non-Hisp NHPOPI","Non-Hisp More than one race","Hispanic","Unknown"))
thesis1$mar_p <- factor(thesis1$mar_p, #levels = c("Y","N","U","X"),
                        levels = c("Yes","No","Unknown","Not_Applicable"))
thesis1$dmar <- factor(thesis1$dmar, #levels = c("1","2","9"),
                      levels = c("Married","Unmarried","Unknown"))
thesis1$meduc <- factor(thesis1$meduc, #levels = c("1","2","3","4","5","6","7","8"),
                       levels = c("< 9th grade","9-12 grade","HS Grad/GED","Some college","Associate degree","Bachelor's degree","Master's degree","Doctorate or Professional degree","Unknown"))
thesis1$fage11 <- factor(thesis1$fage11, #levels = c("1","2","3","4","5","6","7","8","9"),
                        levels = c("< 15","15-19","20-24","25-29","30-34","35-39","40-44","45-49","50-54","55+","Unknown"))
thesis1$fracehisp <- factor(thesis1$fracehisp, #levels = c("1","2","3","4","5","6","7","8"),
                           levels = c("Non-Hisp White","Non-Hisp Black","Non-Hisp AIAN","Non-Hisp Asian","Non-Hisp NHPOPI","Non-Hisp More than one race","Hispanic","Unknown"))
thesis1$feduc <- factor(thesis1$feduc, #levels = c("1","2","3","4","5","6","7","8"),
                       levels = c("< 9th grade","9-12 grade","HS Grad/GED","Some college","Associate degree","Bachelor's degree","Master's degree","Doctorate or Professional degree","Unknown"))
thesis1$illb_r11 <- factor(thesis1$illb_r11, #levels = c("0","1","2","3","4","5","6","7","8","9"),
                          levels = c("0-3 months","4-11 months","12-17 months","18-23 months","24-35 months","36-47 months","48-59 months","60-71 months","72+ months","1st live birth","Unknown"))
thesis1$iloo_r11 <- factor(thesis1$iloo_r11, #levels = c("0","1","2","3","4","5","6","7","8","88","99"),
                         levels = c("0-3 months","4-11 months","12-17 months","18-23 months","24-35 months","36-47 months","48-59 months","60-71 months","72+ months","1st live birth","Unknown"))
thesis1$ilp_r11 <- factor(thesis1$ilp_r11, #levels = c("0","1","2","3","4","5","6","7","8","88","99"),
                         levels = c("0-3 months","4-11 months","12-17 months","18-23 months","24-35 months","36-47 months","48-59 months","60-71 months","72+ months","1st live birth","Unknown"))
levels = c("0-3 months","4-11 months","12-17 months","18-23 months","24-35 months","36-47 months","48-59 months","60-71 months","72+ months","1st live birth","Unknown"))
thesis1$precare5 <- factor(thesis1$precare5,# levels = c("1","2","3","4","5"),
levels = c("1st Trimester","2nd Trimester","3rd Trimester","No prenatal care","Unknown"))
thesis1$previ_rec <- factor(thesis1$previ_rec,# levels = c("1","2","3","4","5","6","7","8","9","10","11","12"),
levels = c("None","1-2","3-4","5-6","7-8","9-10","11-12","13-14","15-16","17-18","19+","Unknown"))
thesis1$wic <- factor(thesis1$wic, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$cig0_r <- factor(thesis1$cig0_r,# levels = c("0","1","2","3","4","5","6"),
levels = c("Nonsmoker","1-5","6-10","11-20","21-40","41+","Unknown"))
thesis1$cig1_r <- factor(thesis1$cig1_r, #levels = c("0","1","2","3","4","5","6"),
levels = c("Nonsmoker","1-5","6-10","11-20","21-40","41+","Unknown"))
thesis1$cig2_r <- factor(thesis1$cig2_r, #levels = c("0","1","2","3","4","5","6"),
levels = c("Nonsmoker","1-5","6-10","11-20","21-40","41+","Unknown"))
thesis1$cig3_r <- factor(thesis1$cig3_r, #levels = c("0","1","2","3","4","5","6"),
levels = c("Nonsmoker","1-5","6-10","11-20","21-40","41+","Unknown"))
thesis1$rf_pdiab <- factor(thesis1$rf_pdiab,# levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$rf_gdiab <- factor(thesis1$rf_gdiab, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$rf_ghype <- factor(thesis1$rf_ghype, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$rf_ehype <- factor(thesis1$rf_ehype, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$rf_ppb <- factor(thesis1$rf_ppb, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$rf_inft <- factor(thesis1$rf_inft, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$rf_drg <- factor(thesis1$rf_drg, #levels = c("Y","N","X","U"),
levels = c("No","Yes","Not Applicable","Unknown"))
thesis1$rf_art <- factor(thesis1$rf_art, #levels = c("Y","N","X","U"),
levels = c("No","Yes","Not Applicable","Unknown"))
thesis1$ip_gon <- factor(thesis1$ip_gon, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$ip_syph <- factor(thesis1$ip_syph, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$ip_chlam <- factor(thesis1$ip_chlam, #levels = c("Y","N","U"),
levels = c("No","Yes","Unknown"))
thesis1$ip_hepb <- factor(thesis1$ip_hepb, #levels = c("Y","N","U"),
levels = c("No", "Yes", "Unknown"))
thesis1$ip_hepc <- factor(thesis1$ip_hepc, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$ob_succ <- factor(thesis1$ob_succ, #levels = c("Y", "N", "U"),
  levels = c("Yes", "No", "Unknown"))
thesis1$ob_fail <- factor(thesis1$ob_fail, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$id_indl <- factor(thesis1$id_indl, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$id_augm <- factor(thesis1$id_augm, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$id_ster <- factor(thesis1$id_ster, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$id_antb <- factor(thesis1$id_antb, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$id_chor <- factor(thesis1$id_chor, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$id_anes <- factor(thesis1$id_anes, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$me_pres <- factor(thesis1$me_pres, #levels = c("1", "2", "3", "9"),
  levels = c("Cephalic", "Breech", "Other", "Unknown"))
thesis1$me_rout <- factor(thesis1$me_rout, #levels = c("1", "2", "3", "4", "9"),
  levels = c("Spontaneous", "Cesarean", "Forceps", "Vacuum", "Unknown"))
thesis1$me_trial <- factor(thesis1$me_trial, #levels = c("Y", "N", "X", "U"),
  levels = c("Yes", "No", "Not applicable", "Unknown"))
thesis1$dmeth_rec <- factor(thesis1$dmeth_rec, #levels = c("1", "2", "9"),
  levels = c("Vaginal", "C-Sect", "Unknown"))
thesis1$mm_mtr <- factor(thesis1$mm_mtr, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$mm_plac <- factor(thesis1$mm_plac, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$mm_rupt <- factor(thesis1$mm_rupt, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$mm_uhyst <- factor(thesis1$mm_uhyst, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$mm_aicu <- factor(thesis1$mm_aicu, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$attend <- factor(thesis1$attend, #levels = c("1", "2", "3", "4", "5", "9"),
  levels = c("Dr of Med", "Dr of Osteo", "Cert Nurse Midwife", "Other Midwife", "Other", "Unknown"))
thesis1$mtran <- factor(thesis1$mtran, #levels = c("Y", "N", "U"),
  levels = c("No", "Yes", "Unknown"))
thesis1$pay_rec <- factor(thesis1$pay_rec, #levels = c("1", "2", "3", "4", "9"),
  levels = c("No", "Yes", "Unknown"))
levels = c("Medicaid","Private Ins","Self-pay","Other","Unknown"))
thesis1$apgar5r <- factor(thesis1$apgar5r, #levels = c("1","2","3","4","5"),
  levels = c("0-3","4-6","7-8","9-10","Unknown"))
thesis1$dplural <- factor(thesis1$dplural, #levels = c("1","2","3","4","5"),
  levels = c("Single","Twin","Triplet","Quadruplet","Quintuplet+"))
thesis1$setorder_r <- factor(thesis1$setorder_r, #levels = c("1","2","3","4","5","9"),
  levels = c("1st","2nd","3rd","4th","5th+","Unknown"))
thesis1$sex <- factor(thesis1$sex, #levels = c("M","F"),
  levels = c("Male","Female"))
thesis1$oegest_r10 <- factor(thesis1$oegest_r10, #levels = c("1","2","3","4","5","6","7","8","9","10","99"),
  levels = c("< 20 weeks","20-27 weeks","28-31 weeks","32-33 weeks","34-36 weeks","37-38 weeks","39 weeks","40 weeks","41 weeks","42+ weeks","Unknown"))
thesis1$bwtr4 <- factor(thesis1$bwtr4, #levels = c("1","2","3","4"),
  levels = c("227-1499 grams","1500-2499 grams","2500-8165 grams","Unknown"))
thesis1$ab_aven1 <- factor(thesis1$ab_aven1, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ab_aven6 <- factor(thesis1$ab_aven6, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ab_nicu <- factor(thesis1$ab_nicu, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ab_surf <- factor(thesis1$ab_surf, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ab_anti <- factor(thesis1$ab_anti, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ab_seiz <- factor(thesis1$ab_seiz, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_anen <- factor(thesis1$ca_anen, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_mnsb <- factor(thesis1$ca_mnsb, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_cchd <- factor(thesis1$ca_cchd, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_cdh <- factor(thesis1$ca_cdh, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_omph <- factor(thesis1$ca_omph, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_gast <- factor(thesis1$ca_gast, #levels = c("Y","N","U"),
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thesis1$ca_limb <- factor(thesis1$ca_limb, #levels = c("Y","N","U"),
  levels = c("No","Yes","Unknown"))
thesis1$ca_hypo <- factor(thesis1$ca_hypo, # levels = c("Y","N","U"),
    levels = c("No","Yes","Unknown"))
thesis1$itran <- factor(thesis1$itran, # levels = c("Y","N","U"),
    levels = c("No","Yes","Unknown"))
thesis1$bfed <- factor(thesis1$bfed, # levels = c("Y","N","U"),
    levels = c("No","Yes","Unknown"))
thesis1$urf_phype <- factor(thesis1$urf_phype, # levels = c("1","2","9"),
    levels = c("No","Yes","Unknown"))
thesis1$urf_ehype <- factor(thesis1$urf_ehype, # levels = c("1","2","9"),
    levels = c("No","Yes","Unknown"))
thesis1$uca_clip <- factor(thesis1$uca_clip, # levels = c("1","2","9"),
    levels = c("No","Yes","Unknown"))
thesis1$uca_down <- factor(thesis1$uca_down, # levels = c("1","2","9"),
    levels = c("No","Yes","Unknown"))

# Create time variable
# Right
# thesis$dod_mm + thesis$dod_yy

thesis$DOB <- paste(thesis$dob_mm, "01", thesis$dob_yy)
thesis$DOD <- paste(thesis$dod_mm, "02", thesis$dod_yy)

thesis$DOB <- as.Date(thesis$DOB, "%b %d %Y")
thesis$DOD <- as.Date(thesis$DOD, "%b %d %Y")

thesis<-%>
    mutate(os_mon = as.numeric(difftime(DOD, DOB, units = "days"))/ 30.44)

thesis<-%>
    with(thesis, order(os_mon)),]

# event indicator
# thesis$flgnd

thesis$flgnd<- as.numeric(thesis$flgnd)

# Subset data to exclude recoded and flags
#
thesis2 <- subset(thesis1, select = c(bfacil3, mager14, mracehisp, meduc, dmar, mar_p,
mbstate_rec, restatus, fage11, fracehisp, feduc, priorlive, priordead, priorterm, lbo_rec, tpo_rec, wic, bfed, bmi, mhtr, precare5, previs_rec, pwgt_r, dwgt_r, wtgain, pay_rec, cig0_r, cig1_r, cig2_r, cig3_r, rf_pdiab, rf_gdiab, urf_phype, rf_ghype, urf_ehype, rf_ppb, rf_inft, rf_drg, rf_art, rf_cesarn, ip_gon, ip_chlam, ip_syph, ip_hepb, ip_hepc, illb_r11, iloo_r11, ilp_r11, ld_indl, ld_augm, ld_ster, ld_antb, ld_chor, ld_anes, me_pres, me_rout, me_trial, ob_succ, ob_fail, dmeth_rec, mm_mtr, mm_plac, mm_rupt, mm_uhyst, mm_aicu, attend, mtran, itran, apgar5r, dplural, setorder_r, sex, oegest_r10, bwtr4, ab_aven1, ab_aven6, ab_nicu, ab_surf, ab_anti, ab_seiz, os_mon, flgnd))

#  # Frequency tables (TableOne)
#


rf_vars <- c("cig0_r", "cig1_r", "cig2_r", "cig3_r", "rf_pdiab", "rf_gdiab", "urf_phype", "rf_ghype", "urf_ehype", "rf_ppb", "rf_inft", "rf_drg", "rf_art", "rf_cesarn", "ip_gon", "ip_chlam", "ip_syph", "ip_hepc", "ip_hepb", "flgnd")

ld_vars <- c("bfacil3", "lbo_rec", "tpo_rec", "illb_r11", "iloo_r11", "ilp_r11", "ld_indl", "ld_augm", "ld_ster", "ld_antb", "ld_chor", "ld_anes", "me_pres", "me_rout", "me_trial", "ob_succ", "ob_fail", "dmeth_rec", "mm_mtr", "mm_plac", "mm_rupt", "mm_uhyst", "mm_aicu", "attend", "mtran", "itran", "apgar5r", "dplural", "setorder_r", "sex", "oegest_r10", "bwtr4", "flgnd")

ab_vars <- c("ab_aven1", "ab_aven6", "ab_nicu", "ab_surf", "ab_anti", "ab_seiz", "flgnd")

ses_vars <-
c("mracehisp", "mager14", "meduc", "dmarr", "wic", "bfed", "feduc", "previs_rec", "precare5", "pay_rec", "attend", "flgnd")
ses <- CreateTableOne(vars = ses_vars, strata = "flgnd", data = thesis2, includeNA = T, 
argsApprox = list(correct = T), addOverall = T)

ses_table <- print(ses, showAllLevels = F, printToggle = F, quote = F, noSpaces = T)

parental_char <- CreateTableOne(vars = parental_vars, strata = "flgnd", 
data = thesis2, includeNA = T, test = T, 
argsApprox = list(correct = T), addOverall = T)

parental_table <- print(parental_char, showAllLevels = F, printToggle = F, quote = F, 
noSpaces = T)

rf_table <- CreateTableOne(vars = rf_vars, strata = "flgnd", data = thesis2, includeNA = T, test = T, 
argsApprox = list(correct = T), addOverall = T)

risk_factor_tab <- print(rf_table, showAllLevels = F, printToggle = F, quote = F, 
noSpaces = T)

ld_table <- CreateTableOne(vars = ld_vars, strata = "flgnd", data = thesis2, includeNA = T, test = T, 
argsApprox = list(correct = T), addOverall = T)

labor_tab <- print(ld_table, showAllLevels = F, printToggle = F, quote = F, noSpaces = T)

ab_table <- CreateTableOne(vars = ab_vars, strata = "flgnd", data = thesis2, includeNA = T, test = T, 
argsApprox = list(correct = T), addOverall = T)

abnorm_tab <- print(ab_table, showAllLevels = F, printToggle = F, quote = F, noSpaces = T)

# # Create training and test data 
#

set.seed(12345)

trainingRows <- sample(1:nrow(thesis2), 0.5 * nrow(thesis2))

train <- thesis2[trainingRows, ]

test <- thesis2[-trainingRows, ]

# # Create risk scores 
#
train$riskscore <- 0

for (i in 1:nrow(train)){
  if (train$bfacil3[i] == "Not Hospital")
  {
    train$riskscore[i] = train$riskscore[i] + (-0.109)
  }
  if (train$mager14[i] == "15")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.492)
  }
  else if (train$mager14[i] == "16")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.411)
  }
  else if (train$mager14[i] == "17")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.364)
  }
  else if (train$mager14[i] == "18")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.232)
  }
  else if (train$mager14[i] == "19")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.420)
  }
  else if (train$mager14[i] == "20-24")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.404)
  }
  else if (train$mager14[i] == "25-29")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.433)
  }
  else if (train$mager14[i] == "30-34")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.390)
  }
  else if (train$mager14[i] == "35-39")
  {
    train$riskscore[i] = train$riskscore[i] + (-2.237)
  }
else if (train$mager14[i] == "40-44")
{
    train$riskscore[i] = train$riskscore[i] + (-2.357)
}
else if (train$mager14[i] == "45-49")
{
    train$riskscore[i] = train$riskscore[i] + (-2.109)
}
else if (train$mager14[i] == "50-54")
{
    train$riskscore[i] = train$riskscore[i] + (-1.587)
}
if (train$restatus[i] == "Intrastate Non-res")
{
    train$riskscore[i] = train$riskscore[i] + (0.035)
}
else if (train$mbstate_rec[i] == "Interstate Non-res")
{
    train$riskscore[i] = train$riskscore[i] + (0.010)
}
if (train$mracehisp[i] == "Non-Hisp Black")
{
    train$riskscore[i] = train$riskscore[i] + (-0.101)
}
else if (train$mracehisp[i] == "Non-Hisp AIAN")
{
    train$riskscore[i] = train$riskscore[i] + (-0.602)
}
else if (train$mracehisp[i] == "Non-Hisp Asian")
{
    train$riskscore[i] = train$riskscore[i] + (-0.235)
}
else if (train$mracehisp[i] == "Non-Hisp NHOP")
{
    train$riskscore[i] = train$riskscore[i] + (-0.661)
}
else if (train$mracehisp[i] == "Non-Hisp More than one race")
{
    train$riskscore[i] = train$riskscore[i] + (-0.199)
}
else if (train$mracehisp[i] == "Hispanic")
{
train$riskscore[i] = train$riskscore[i] + (-0.006)
}
else if (train$mracehisp[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.148)
}
if (train$mar_p[i] == "No")
{
    train$riskscore[i] = train$riskscore[i] + (0.022)
}
else if (train$mar_p[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.328)
}
else if (train$mar_p[i] == "Not Applicable")
{
    train$riskscore[i] = train$riskscore[i] + (0.063)
}
if (train$dmar[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.464)
}
if (train$meduc[i] == "9-12")
{
    train$riskscore[i] = train$riskscore[i] + (-0.031)
}
else if (train$meduc[i] == "HS Grad/GED")
{
    train$riskscore[i] = train$riskscore[i] + (-0.030)
}
else if (train$meduc[i] == "Some college")
{
    train$riskscore[i] = train$riskscore[i] + (-0.021)
}
else if (train$meduc[i] == "Associate degree")
{
    train$riskscore[i] = train$riskscore[i] + (-0.017)
}
else if (train$meduc[i] == "Bachelor's degree")
{
    train$riskscore[i] = train$riskscore[i] + (-0.036)
}
else if (train$meduc[i] == "Master's degree")
{  
    train$riskscore[i] = train$riskscore[i] + (-0.092)  
}  
else if (train$meduc[i] == "Doctorate or Professional degree")  
{  
    train$riskscore[i] = train$riskscore[i] + (-0.370)  
}  
else if (train$meduc[i] == "Unknown")  
{  
    train$riskscore[i] = train$riskscore[i] + (-0.121)  
}  
if (train$fage11[i] == "15-19")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.453)  
}  
else if (train$fage11[i] == "20-24")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.434)  
}  
else if (train$fage11[i] == "25-29")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.358)  
}  
else if (train$fage11[i] == "30-34")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.455)  
}  
else if (train$fage11[i] == "35-39")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.352)  
}  
else if (train$fage11[i] == "40-44")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.392)  
}  
else if (train$fage11[i] == "45-49")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.501)  
}  
else if (train$fage11[i] == "50-54")  
{  
    train$riskscore[i] = train$riskscore[i] + (0.811)  
}
else if (train$fage11[i] == "55+")
{
    train$riskscore[i] = train$riskscore[i] + (0.481)
}
else if (train$fage11[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.780)
}
if (!is.na(train$fracehisp[i]) == "Non-Hisp Black")
{
    train$riskscore[i] = train$riskscore[i] + (-0.060)
}
else if (!is.na(train$fracehisp[i]) == "Non-Hisp AIAN")
{
    train$riskscore[i] = train$riskscore[i] + (-0.095)
}
else if (!is.na(train$fracehisp[i]) == "Non-Hisp Asian")
{
    train$riskscore[i] = train$riskscore[i] + (0.183)
}
else if (!is.na(train$fracehisp[i]) == "Non-Hisp NHOPI")
{
    train$riskscore[i] = train$riskscore[i] + (0.156)
}
else if (!is.na(train$fracehisp[i]) == "Non-Hisp More than one race")
{
    train$riskscore[i] = train$riskscore[i] + (-0.034)
}
else if (!is.na(train$fracehisp[i]) == "Hispanic")
{
    train$riskscore[i] = train$riskscore[i] + (-0.082)
}
else if (!is.na(train$fracehisp[i]) == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.186)
}
if (train$feduc[i] == "9-12")
{
    train$riskscore[i] = train$riskscore[i] + (-0.281)
}
else if (train$feduc[i] == "HS Grad/GED")
{
    train$riskscore[i] = train$riskscore[i] + (-0.343)
else if (train$feduc[i] == "Some college")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.264)
    }
else if (train$feduc[i] == "Associate degree")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.105)
    }
else if (train$feduc[i] == "Bachelor's degree")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.167)
    }
else if (train$feduc[i] == "Master's degree")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.107)
    }
else if (train$feduc[i] == "Doctorate or Professional degree")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.282)
    }
else if (train$feduc[i] == "Unknown")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.464)
    }
if (train$priorlive[i] != "99")
    {
        train$riskscore[i] = train$riskscore[i] + train$priorlive[i]*(-0.003)
    }
if (train$priordead[i] != "99")
    {
        train$riskscore[i] = train$riskscore[i] + train$priordead[i]*(0.001)
    }
if (train$priorterm[i] != "99")
    {
        train$riskscore[i] = train$riskscore[i] + train$priorterm[i]*(-0.001)
    }
if (train$lbo_rec[i] != "9")
    {
        train$riskscore[i] = train$riskscore[i] + train$lbo_rec[i]*(-0.003)
    }
if (train$tpo_rec[i] != "9")
    {

\[
\text{train$\text{riskscore}[i] = train$\text{riskscore}[i] + train$\text{tpo_rec}[i]*0.008)}
\]

if (train$\text{illb_r11}[i] == "4-11 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.151)
}
else if (train$\text{illb_r11}[i] == "12-17 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.474)
}
else if (train$\text{illb_r11}[i] == "18-23 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.415)
}
else if (train$\text{illb_r11}[i] == "24-35 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.410)
}
else if (train$\text{illb_r11}[i] == "36-47 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.380)
}
else if (train$\text{illb_r11}[i] == "48-59 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.358)
}
else if (train$\text{illb_r11}[i] == "60-71 months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.362)
}
else if (train$\text{illb_r11}[i] == "72+ months")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.319)
}
else if (train$\text{illb_r11}[i] == "1st live birth")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.473)
}
else if (train$\text{illb_r11}[i] == "Unknown")
{
  train$\text{riskscore}[i] = train$\text{riskscore}[i] + (-0.361)
}
if (train$\text{iloo_r11}[i] == "4-11 months")
train$riskscore[i] = train$riskscore[i] + (-1.053) 
}
else if (train$iloo_r11[i] == "12-17 months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.483)
}
else if (train$iloo_r11[i] == "18-23 months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.241)
}
else if (train$iloo_r11[i] == "24-35 months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.318)
}
else if (train$iloo_r11[i] == "36-47 months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.432)
}
else if (train$iloo_r11[i] == "48-59 months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.582)
}
else if (train$iloo_r11[i] == "60-71 months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.333)
}
else if (train$iloo_r11[i] == "72+ months")
{
    train$riskscore[i] = train$riskscore[i] + (-1.432)
}
else if (train$iloo_r11[i] == "1st live birth")
{
    train$riskscore[i] = train$riskscore[i] + (-1.371)
}
else if (train$iloo_r11[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-1.163)
}
if (train$ilp_r11[i] == "4-11 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.548)
else if (train$ilp_r11[i] == "12-17 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.049)
}
else if (train$ilp_r11[i] == "18-23 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.139)
}
else if (train$ilp_r11[i] == "24-35 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.037)
}
else if (train$ilp_r11[i] == "36-47 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.126)
}
else if (train$ilp_r11[i] == "48-59 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.188)
}
else if (train$ilp_r11[i] == "60-71 months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.083)
}
else if (train$ilp_r11[i] == "72+ months")
{
    train$riskscore[i] = train$riskscore[i] + (-0.171)
}
else if (train$ilp_r11[i] == "1st live birth")
{
    train$riskscore[i] = train$riskscore[i] + (0.027)
}
else if (train$ilp_r11[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.230)
}
if (train$precare5[i] == "2nd Trimester")
{
    train$riskscore[i] = train$riskscore[i] + (-0.006)
}
else if (train$precare5[i] == "3rd Trimester")
{
    train$riskscore[i] = train$riskscore[i] + (-0.120)
"No prenatal care"

else if (train$previs_rec[i] == "1-2")
{
  train$riskscore[i] = train$riskscore[i] + (0.056)
}
else if (train$previs_rec[i] == "3-4")
{
  train$riskscore[i] = train$riskscore[i] + (-0.174)
}
else if (train$previs_rec[i] == "5-6")
{
  train$riskscore[i] = train$riskscore[i] + (-0.012)
}
else if (train$previs_rec[i] == "7-8")
{
  train$riskscore[i] = train$riskscore[i] + (0.033)
}
else if (train$previs_rec[i] == "9-10")
{
  train$riskscore[i] = train$riskscore[i] + (-0.013)
}
else if (train$previs_rec[i] == "11-12")
{
  train$riskscore[i] = train$riskscore[i] + (-0.065)
}
else if (train$previs_rec[i] == "13-14")
{
  train$riskscore[i] = train$riskscore[i] + (0.032)
}
else if (train$previs_rec[i] == "15-16")
{
  train$riskscore[i] = train$riskscore[i] + (0.106)
}
else if (train$previs_rec[i] == "17-18")
{
train$riskscore[i] = train$riskscore[i] + (0.107)
}
else if (train$previs_rec[i] == "19+")
{
    train$riskscore[i] = train$riskscore[i] + (-0.023)
}

if (train$wic[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.039)
}
else if (train$wic[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.074)
}

if (train$cig0_r[i] == "1-5")
{
    train$riskscore[i] = train$riskscore[i] + (0.089)
}
else if (train$cig0_r[i] == "6-10")
{
    train$riskscore[i] = train$riskscore[i] + (0.115)
}
else if (train$cig0_r[i] == "11-20")
{
    train$riskscore[i] = train$riskscore[i] + (-0.030)
}
else if (train$cig0_r[i] == "21-40")
{
    train$riskscore[i] = train$riskscore[i] + (0.342)
}
else if (train$cig0_r[i] == "41+")
{
    train$riskscore[i] = train$riskscore[i] + (0.932)
}
else if (train$cig0_r[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.477)
}

if (train$cig1_r[i] == "1-5")
{
    train$riskscore[i] = train$riskscore[i] + (-0.419)
}
else if (train$cig1_r[i] == "6-10")
{
    train$riskscore[i] = train$riskscore[i] + (-0.280)
}
else if (train$cig1_r[i] == "11-20")
{
    train$riskscore[i] = train$riskscore[i] + (-0.432)
}
else if (train$cig1_r[i] == "21-40")
{
    train$riskscore[i] = train$riskscore[i] + (-0.856)
}
else if (train$cig1_r[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.315)
}
if (train$cig2_r[i] == "1-5")
{
    train$riskscore[i] = train$riskscore[i] + (0.575)
}
else if (train$cig2_r[i] == "6-10")
{
    train$riskscore[i] = train$riskscore[i] + (0.372)
}
else if (train$cig2_r[i] == "11-20")
{
    train$riskscore[i] = train$riskscore[i] + (0.287)
}
else if (train$cig2_r[i] == "21-40")
{
    train$riskscore[i] = train$riskscore[i] + (1.067)
}
else if (train$cig2_r[i] == "41+")
{
    train$riskscore[i] = train$riskscore[i] + (0)
}
else if (train$cig2_r[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.573)
}
if (train$cig3_r[i] == "1-5")
{
    train$riskscore[i] = train$riskscore[i] + (-0.205)
}
else if (train$cig3_r[i] == "6-10")
{
    train$riskscore[i] = train$riskscore[i] + (-0.194)
}
else if (train$cig3_r[i] == "11-20")
{
    train$riskscore[i] = train$riskscore[i] + (0.184)
}
else if (train$cig3_r[i] == "21-40")
{
    train$riskscore[i] = train$riskscore[i] + (0.208)
}
else if (train$cig3_r[i] == "41+")
{
    train$riskscore[i] = train$riskscore[i] + (-1.497)
}
else if (train$cig3_r[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.500)
}
if (train$mhtr[i] != "99")
{
    train$riskscore[i] = train$riskscore[i] + train$mhtr[i]*(0.001)
}
if (train$bmi[i] != "99.9")
{
    train$riskscore[i] = train$riskscore[i] + train$bmi[i]*(-0.005)
}
if (train$pwgt_r[i] != "999")
{
    train$riskscore[i] = train$riskscore[i] + train$pwgt_r[i]*(0.0005)
}
if (train$dwgt_r[i] != "999")
{
    train$riskscore[i] = train$riskscore[i] + train$dwgt_r[i]*(0.00005)
}
if (train$wtgain[i] != "99")
{
    train$riskscore[i] = train$riskscore[i] + train$wtgain[i]*(0.00006)
}
if (train$rf_pdiab[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + train$rf_pdiab[i]*(0.000005)
}
train$riskscore[i] = train$riskscore[i] + (0.096)
}
else if (train$rf_pdiab[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.546)
}
if (train$rf_gdiab[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.091)
}
if (train$urf_phype[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.029)
}
if (train$urf_ehype[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.046)
}
if (train$rf_ppb[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.136)
}
if (train$rf_inft[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.847)
}
if (train$rf_drg[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.779)
}
else if (train$rf_drg[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.639)
}
if (train$rf_art[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.811)
}
if (train$rf_cesarn[i] != "99")
{
    train$riskscore[i] = train$riskscore[i] + (train$rf_cesarn*(-0.010))
}
if (train$ip_gon[i] == "Yes")
```r
train$riskscore[i] = train$riskscore[i] + (0.098)
}
else if (train$ip_gon[i] == "Unknown")
{
  train$riskscore[i] = train$riskscore[i] + (0.452)
}
if (train$ip_syph[i] == "Yes")
{
  train$riskscore[i] = train$riskscore[i] + (0.369)
}
if (train$ip_chlam[i] == "Yes")
{
  train$riskscore[i] = train$riskscore[i] + (-0.110)
}
if (train$ip_hepb[i] == "Yes")
{
  train$riskscore[i] = train$riskscore[i] + (0.777)
}
if (train$ip_hepc[i] == "Yes")
{
  train$riskscore[i] = train$riskscore[i] + (0.178)
}
if (train$ob_succ[i] == "No")
{
  train$riskscore[i] = train$riskscore[i] + (0.481)
}
else if (train$ob_succ[i] == "Unknown")
{
  train$riskscore[i] = train$riskscore[i] + (0.725)
}
if (train$ob_fail[i] == "Yes")
{
  train$riskscore[i] = train$riskscore[i] + (-0.107)
}
if (train$ld_indl[i] == "Yes")
{
  train$riskscore[i] = train$riskscore[i] + (0.0004)
}
else if (train$ld_indl[i] == "Unknown")
{
  train$riskscore[i] = train$riskscore[i] + (0.267)
}
```
if (train$ld_augm[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.048)
}
if (train$ld_ster[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.076)
}
if (train$ld_antb[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.077)
}
if (train$ld_chor[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.072)
}
if (train$ld_anes[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.0003)
}
if (train$me_pres[i] == "Breech")
{
    train$riskscore[i] = train$riskscore[i] + (0.007)
}
else if (train$me_pres[i] == "Other")
{
    train$riskscore[i] = train$riskscore[i] + (-0.079)
}
else if (train$me_pres[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.073)
}
if (train$me_rout[i] == "Forceps")
{
    train$riskscore[i] = train$riskscore[i] + (0.201)
}
else if (train$me_rout[i] == "Vacuum")
{
    train$riskscore[i] = train$riskscore[i] + (-0.050)
}
else if (train$me_rout[i] == "Cesarean")
{
    train$riskscore[i] = train$riskscore[i] + (-0.055)
else if (train$me_rout[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.431)
}

if (train$me_trial[i] == "No")
{
    train$riskscore[i] = train$riskscore[i] + (-0.050)
}
else if (train$me_trial[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.342)
}

if (train$mm_mtr[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.089)
}
else if (train$mm_mtr[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.623)
}

if (train$mm_plac[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.582)
}

if (train$mm_rupt[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.097)
}

if (train$mm_uhyst[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.206)
}

if (train$mm_aicu[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.276)
}

if (train$attend[i] == "Dr of Osteo")
{
    train$riskscore[i] = train$riskscore[i] + (0.036)
}
else if (train$attend[i] == "Cert Nurse Midwife")
{
train$riskscore[i] = train$riskscore[i] + (0.008)
}
else if (train$attend[i] == "Other Midwife")
{
    train$riskscore[i] = train$riskscore[i] + (-0.529)
}
else if (train$attend[i] == "Other")
{
    train$riskscore[i] = train$riskscore[i] + (0.052)
}
else if (train$attend[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0.421)
}
if (train$mtran[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.080)
}
else if (train$mtran[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.759)
}
if (train$pay_rec[i] == "Private Ins")
{
    train$riskscore[i] = train$riskscore[i] + (0.066)
}
else if (train$pay_rec[i] == "Self-pay")
{
    train$riskscore[i] = train$riskscore[i] + (-0.013)
}
else if (train$pay_rec[i] == "Other")
{
    train$riskscore[i] = train$riskscore[i] + (-0.073)
}
else if (train$pay_rec[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.137)
}
if (train$apgar5r[i] == "4-6")
{
    train$riskscore[i] = train$riskscore[i] + (-0.104)
}
else if (train$apgar5r[i] == "7-8")
{ train$riskscore[i] = train$riskscore[i] + (-0.318) }
else if (train$apgar5r[i] == "9-10")
{ train$riskscore[i] = train$riskscore[i] + (-0.403) }
else if (train$apgar5r[i] == "Unknown")
{ train$riskscore[i] = train$riskscore[i] + (0.018) }
if (train$dplural[i] == "Twin")
{ train$riskscore[i] = train$riskscore[i] + (-0.614) }
else if (train$dplural[i] == "Triplet")
{ train$riskscore[i] = train$riskscore[i] + (-0.419) }
else if (train$dplural[i] == "Quadruplet")
{ train$riskscore[i] = train$riskscore[i] + (0.451) }
else if (train$dplural[i] == "Quintuplet+")
{ train$riskscore[i] = train$riskscore[i] + (0) }
if (train$setorder_r[i] == "2nd")
{ train$riskscore[i] = train$riskscore[i] + (-0.225) }
else if (train$setorder_r[i] == "3rd")
{ train$riskscore[i] = train$riskscore[i] + (-1.154) }
else if (train$setorder_r[i] == "4th")
{ train$riskscore[i] = train$riskscore[i] + (0) }
else if (train$setorder_r[i] == "5th+")
{ train$riskscore[i] = train$riskscore[i] + (0) }
else if (train$etorder_r[i] == "Unknown")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.616)
    }
if (train$sex[i] == "Female")
    {
        train$riskscore[i] = train$riskscore[i] + (0.051)
    }
if (train$oegest_r10[i] == "20-27 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.149)
    } else if (train$oegest_r10[i] == "28-31 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.474)
    } else if (train$oegest_r10[i] == "32-33 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.550)
    } else if (train$oegest_r10[i] == "34-36 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.563)
    } else if (train$oegest_r10[i] == "37-38 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.617)
    } else if (train$oegest_r10[i] == "39 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.618)
    } else if (train$oegest_r10[i] == "40 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.595)
    } else if (train$oegest_r10[i] == "41 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.654)
    } else if (train$oegest_r10[i] == "42 weeks")
    {
        train$riskscore[i] = train$riskscore[i] + (-0.626)
if (train$oegest_r10[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (0)
}
if (train$bwtr4[i] == "1500-2499 grams")
{
    train$riskscore[i] = train$riskscore[i] + (-0.019)
} else if (train$bwtr4[i] == "2500-8165 grams")
{
    train$riskscore[i] = train$riskscore[i] + (0.048)
} else if (train$bwtr4[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (1.939)
}
if (train$ab_aven1[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.071)
} else if (train$ab_aven1[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-1.230)
}
if (train$ab_aven6[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.005)
}
if (train$ab_nicu[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.025)
}
if (train$ab_surf[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.026)
}
if (train$ab_anti[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.00003)
}
if (train$ab_seiz[i] == "Yes")
{

train$riskscore[i] = train$riskscore[i] + (0.180)
}
if (train$itran[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (0.017)
}
else if (train$itran[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (2.321)
}
if (train$bfed[i] == "Yes")
{
    train$riskscore[i] = train$riskscore[i] + (-0.091)
}
else if (train$bfed[i] == "Unknown")
{
    train$riskscore[i] = train$riskscore[i] + (-0.345)
}

for (i in 1:nrow(test)) {
    if (test$bfacil3[i] == "Not Hospital")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.109)
    }
    if (test$mager14[i] == "15")
    {
        test$riskscore[i] = test$riskscore[i] + (-2.492)
    }
    else if (test$mager14[i] == "16")
    {
        test$riskscore[i] = test$riskscore[i] + (-2.411)
    }
    else if (test$mager14[i] == "17")
    {
        test$riskscore[i] = test$riskscore[i] + (-2.364)
    }
    else if (test$mager14[i] == "18")
    {
        test$riskscore[i] = test$riskscore[i] + (-2.232)
    }
}
else if (test$mager14[i] == "19")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.420)
  }
else if (test$mager14[i] == "20-24")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.404)
  }
else if (test$mager14[i] == "25-29")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.433)
  }
else if (test$mager14[i] == "30-34")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.390)
  }
else if (test$mager14[i] == "35-39")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.237)
  }
else if (test$mager14[i] == "40-44")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.357)
  }
else if (test$mager14[i] == "45-49")
  {
    test$riskscore[i] = test$riskscore[i] + (-2.109)
  }
else if (test$mager14[i] == "50-54")
  {
    test$riskscore[i] = test$riskscore[i] + (-1.587)
  }
if (test$restatus[i] == "Intrastate Non-res")
  {
    test$riskscore[i] = test$riskscore[i] + (0.035)
  }
else if (test$mbstate_rec[i] == "Interstate Non-res")
  {
    test$riskscore[i] = test$riskscore[i] + (0.010)
  }
if (test$mracehisp[i] == "Non-Hisp Black")
  {
    test$riskscore[i] = test$riskscore[i] + (-0.101)
  }
else if (test$mracehisp[i] == "Non-Hisp AIAN")
{
    test$riskscore[i] = test$riskscore[i] + (-0.602)
}
else if (test$mracehisp[i] == "Non-Hisp Asian")
{
    test$riskscore[i] = test$riskscore[i] + (-0.235)
}
else if (test$mracehisp[i] == "Non-Hisp NHOPi")
{
    test$riskscore[i] = test$riskscore[i] + (-0.661)
}
else if (test$mracehisp[i] == "Non-Hisp More than one race")
{
    test$riskscore[i] = test$riskscore[i] + (-0.199)
}
else if (test$mracehisp[i] == "Hispanic")
{
    test$riskscore[i] = test$riskscore[i] + (-0.006)
}
else if (test$mracehisp[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.148)
}
if (test$mar_p[i] == "No")
{
    test$riskscore[i] = test$riskscore[i] + (0.022)
}
else if (test$mar_p[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.328)
}
else if (test$mar_p[i] == "Not Applicable")
{
    test$riskscore[i] = test$riskscore[i] + (0.063)
}
if (test$dmar[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.464)
}
if (test$meduc[i] == "9-12")
{
test$riskscore[i] = test$riskscore[i] + (-0.031)
} else if (test$meduc[i] == "HS Grad/GED")
{
  test$riskscore[i] = test$riskscore[i] + (-0.030)
} else if (test$meduc[i] == "Some college")
{
  test$riskscore[i] = test$riskscore[i] + (-0.021)
} else if (test$meduc[i] == "Associate degree")
{
  test$riskscore[i] = test$riskscore[i] + (-0.017)
} else if (test$meduc[i] == "Bachelor's degree")
{
  test$riskscore[i] = test$riskscore[i] + (-0.036)
} else if (test$meduc[i] == "Master's degree")
{
  test$riskscore[i] = test$riskscore[i] + (-0.092)
} else if (test$meduc[i] == "Doctorate or Professional degree")
{
  test$riskscore[i] = test$riskscore[i] + (-0.370)
} else if (test$meduc[i] == "Unknown")
{
  test$riskscore[i] = test$riskscore[i] + (-0.121)
} if (test$fage11[i] == "15-19")
{
  test$riskscore[i] = test$riskscore[i] + (0.453)
} else if (test$fage11[i] == "20-24")
{
  test$riskscore[i] = test$riskscore[i] + (0.434)
} else if (test$fage11[i] == "25-29")
{
  test$riskscore[i] = test$riskscore[i] + (0.358)
} else if (test$fage11[i] == "30-34")
{  
  test$riskscore[i] = test$riskscore[i] + (0.455)
}
else if (test$fage11[i] == "35-39")
{
  test$riskscore[i] = test$riskscore[i] + (0.352)
}
else if (test$fage11[i] == "40-44")
{
  test$riskscore[i] = test$riskscore[i] + (0.392)
}
else if (test$fage11[i] == "45-49")
{
  test$riskscore[i] = test$riskscore[i] + (0.501)
}
else if (test$fage11[i] == "50-54")
{
  test$riskscore[i] = test$riskscore[i] + (0.811)
}
else if (test$fage11[i] == "55+")
{
  test$riskscore[i] = test$riskscore[i] + (0.481)
}
else if (test$fage11[i] == "Unknown")
{
  test$riskscore[i] = test$riskscore[i] + (0.780)
}
if (!is.na(test$fracehisp[i]) == "Non-Hisp Black")
{
  test$riskscore[i] = test$riskscore[i] + (-0.060)
}
else if (!is.na(test$fracehisp[i]) == "Non-Hisp AIAN")
{
  test$riskscore[i] = test$riskscore[i] + (-0.095)
}
else if (!is.na(test$fracehisp[i]) == "Non-Hisp Asian")
{
  test$riskscore[i] = test$riskscore[i] + (0.183)
}
else if (lis.na(test$fracehisp[i]) == "Non-Hisp NHOPI")
{
  test$riskscore[i] = test$riskscore[i] + (0.156)
}
else if (!is.na(test$fracehisp[[i]]) == "Non-Hisp More than one race")
{
    test$riskscore[i] = test$riskscore[i] + (-0.034)
}
else if (!is.na(test$fracehisp[[i]]) == "Hispanic")
{
    test$riskscore[i] = test$riskscore[i] + (-0.082)
}
else if (!is.na(test$fracehisp[[i]]) == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.186)
}
if (test$feduc[[i]] == "9-12")
{
    test$riskscore[i] = test$riskscore[i] + (-0.281)
}
else if (test$feduc[[i]] == "HS Grad/GED")
{
    test$riskscore[i] = test$riskscore[i] + (-0.343)
}
else if (test$feduc[[i]] == "Some college")
{
    test$riskscore[i] = test$riskscore[i] + (-0.264)
}
else if (test$feduc[[i]] == "Associate degree")
{
    test$riskscore[i] = test$riskscore[i] + (-0.105)
}
else if (test$feduc[[i]] == "Bachelor's degree")
{
    test$riskscore[i] = test$riskscore[i] + (-0.167)
}
else if (test$feduc[[i]] == "Master's degree")
{
    test$riskscore[i] = test$riskscore[i] + (-0.107)
}
else if (test$feduc[[i]] == "Doctorate or Professional degree")
{
    test$riskscore[i] = test$riskscore[i] + (-0.282)
}
else if (test$feduc[[i]] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.464)
}
if (test$priorlive[i] != "99")
{
  test$riskscore[i] = test$riskscore[i] + test$priorlive[i]*(-0.003)
}
if (test$priordead[i] != "99")
{
  test$riskscore[i] = test$riskscore[i] + test$priordead[i]*(0.001)
}
if (test$priorterm[i] != "99")
{
  test$riskscore[i] = test$riskscore[i] + test$priorterm[i]*(-0.001)
}
if (test$lbo_rec[i] != "9")
{
  test$riskscore[i] = test$riskscore[i] + test$lbo_rec[i]*(-0.003)
}
if (test$tpo_rec[i] != "9")
{
  test$riskscore[i] = test$riskscore[i] + test$tpo_rec[i]*(0.008)
}
if (test$illb_r11[i] == "4-11 months")
{
  test$riskscore[i] = test$riskscore[i] + (-0.151)
}
else if (test$illb_r11[i] == "12-17 months")
{
  test$riskscore[i] = test$riskscore[i] + (-0.474)
}
else if (test$illb_r11[i] == "18-23 months")
{
  test$riskscore[i] = test$riskscore[i] + (-0.415)
}
else if (test$illb_r11[i] == "24-35 months")
{
  test$riskscore[i] = test$riskscore[i] + (-0.410)
}
else if (test$illb_r11[i] == "36-47 months")
{
  test$riskscore[i] = test$riskscore[i] + (-0.380)
}
else if (test$illb_r11[i] == "48-59 months")
{
test$riskscore[i] = test$riskscore[i] + (-0.358)
}
else if (test$illb_r11[i] == "60-71 months")
{
    test$riskscore[i] = test$riskscore[i] + (-0.362)
}
else if (test$illb_r11[i] == "72+ months")
{
    test$riskscore[i] = test$riskscore[i] + (-0.319)
}
else if (test$illb_r11[i] == "1st live birth")
{
    test$riskscore[i] = test$riskscore[i] + (-0.473)
}
else if (test$illb_r11[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.361)
}
if (test$iloo_r11[i] == "4-11 months")
{
    test$riskscore[i] = test$riskscore[i] + (-1.053)
}
else if (test$iloo_r11[i] == "12-17 months")
{
    test$riskscore[i] = test$riskscore[i] + (-1.483)
}
else if (test$iloo_r11[i] == "18-23 months")
{
    test$riskscore[i] = test$riskscore[i] + (-1.241)
}
else if (test$iloo_r11[i] == "24-35 months")
{
    test$riskscore[i] = test$riskscore[i] + (-1.318)
}
else if (test$iloo_r11[i] == "36-47 months")
{
    test$riskscore[i] = test$riskscore[i] + (-1.432)
}
else if (test$iloo_r11[i] == "48-59 months")
{
    test$riskscore[i] = test$riskscore[i] + (-1.582)
}
else if (test$iloo_r11[i] == "60-71 months")
{  
  test$risk_{score}[i] = test$risk_{score}[i] + (-1.333)  
}
else if (test$iloo_r11[i] == "72+ months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-1.432)  
}
else if (test$iloo_r11[i] == "1st live birth")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-1.371)  
}
else if (test$iloo_r11[i] == "Unknown")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-1.163)  
}
if (test$ilp_r11[i] == "4-11 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.548)  
}
else if (test$ilp_r11[i] == "12-17 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.049)  
}
else if (test$ilp_r11[i] == "18-23 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.139)  
}
else if (test$ilp_r11[i] == "24-35 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.037)  
}
else if (test$ilp_r11[i] == "36-47 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.126)  
}
else if (test$ilp_r11[i] == "48-59 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.188)  
}
else if (test$ilp_r11[i] == "60-71 months")
{
  test$risk_{score}[i] = test$risk_{score}[i] + (-0.083)  
}
else if (test$ilp_r11[i] == "72+ months")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.171)
    }
else if (test$ilp_r11[i] == "1st live birth")
    {
        test$riskscore[i] = test$riskscore[i] + (0.027)
    }
else if (test$ilp_r11[i] == "Unknown")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.230)
    }
if (test$precare5[i] == "2nd Trimester")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.006)
    }
else if (test$precare5[i] == "3rd Trimester")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.120)
    }
else if (test$precare5[i] == "No prenatal care")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.092)
    }
else if (test$precare5[i] == "Unknown")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.009)
    }
if (test$previs_rec[i] == "1-2")
    {
        test$riskscore[i] = test$riskscore[i] + (0.056)
    }
else if (test$previs_rec[i] == "3-4")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.174)
    }
else if (test$previs_rec[i] == "5-6")
    {
        test$riskscore[i] = test$riskscore[i] + (-0.012)
    }
else if (test$previs_rec[i] == "7-8")
    {
        test$riskscore[i] = test$riskscore[i] + (0.033)
    }
```r
else if (test$previs_rec[i] == "9-10")
{
  test$riskscore[i] = test$riskscore[i] + (-0.013)
}
else if (test$previs_rec[i] == "11-12")
{
  test$riskscore[i] = test$riskscore[i] + (-0.065)
}
else if (test$previs_rec[i] == "13-14")
{
  test$riskscore[i] = test$riskscore[i] + (0.032)
}
else if (test$previs_rec[i] == "15-16")
{
  test$riskscore[i] = test$riskscore[i] + (0.106)
}
else if (test$previs_rec[i] == "17-18")
{
  test$riskscore[i] = test$riskscore[i] + (0.107)
}
else if (test$previs_rec[i] == "19+")
{
  test$riskscore[i] = test$riskscore[i] + (-0.023)
}

if (test$wic[i] == "Yes")
{
  test$riskscore[i] = test$riskscore[i] + (0.039)
}
else if (test$wic[i] == "Unknown")
{
  test$riskscore[i] = test$riskscore[i] + (-0.074)
}
if (test$cig0_r[i] == "1-5")
{
  test$riskscore[i] = test$riskscore[i] + (0.089)
}
else if (test$cig0_r[i] == "6-10")
{
  test$riskscore[i] = test$riskscore[i] + (0.115)
}
else if (test$cig0_r[i] == "11-20")
```

```r
test$riskscore[i] = test$riskscore[i] + (-0.030)
if (test$cig0_r[i] == "21-40") {
  test$riskscore[i] = test$riskscore[i] + (0.342)
}
else if (test$cig0_r[i] == "41+") {
  test$riskscore[i] = test$riskscore[i] + (0.932)
}
else if (test$cig0_r[i] == "Unknown") {
  test$riskscore[i] = test$riskscore[i] + (0.477)
}
if (test$cig1_r[i] == "1-5") {
  test$riskscore[i] = test$riskscore[i] + (-0.419)
}
else if (test$cig1_r[i] == "6-10") {
  test$riskscore[i] = test$riskscore[i] + (-0.280)
}
else if (test$cig1_r[i] == "11-20") {
  test$riskscore[i] = test$riskscore[i] + (-0.432)
}
else if (test$cig1_r[i] == "21-40") {
  test$riskscore[i] = test$riskscore[i] + (-0.856)
}
else if (test$cig1_r[i] == "Unknown") {
  test$riskscore[i] = test$riskscore[i] + (-0.315)
}
if (test$cig2_r[i] == "1-5") {
  test$riskscore[i] = test$riskscore[i] + (0.575)
}
else if (test$cig2_r[i] == "6-10") {
  test$riskscore[i] = test$riskscore[i] + (0.372)
}
```
else if (test$cig2_r[i] == "11-20")
{
    test$riskscore[i] = test$riskscore[i] + (0.287)
}
else if (test$cig2_r[i] == "21-40")
{
    test$riskscore[i] = test$riskscore[i] + (1.067)
}
else if (test$cig2_r[i] == "41+")
{
    test$riskscore[i] = test$riskscore[i] + (0)
}
else if (test$cig2_r[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.573)
}
if (test$cig3_r[i] == "1-5")
{
    test$riskscore[i] = test$riskscore[i] + (-0.205)
}
else if (test$cig3_r[i] == "6-10")
{
    test$riskscore[i] = test$riskscore[i] + (-0.194)
}
else if (test$cig3_r[i] == "11-20")
{
    test$riskscore[i] = test$riskscore[i] + (0.184)
}
else if (test$cig3_r[i] == "21-40")
{
    test$riskscore[i] = test$riskscore[i] + (0.208)
}
else if (test$cig3_r[i] == "41+")
{
    test$riskscore[i] = test$riskscore[i] + (-1.497)
}
else if (test$cig3_r[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.500)
}
if (test$mhtr[i] != "99")
{
    test$riskscore[i] = test$riskscore[i] + test$mhtr[i]*(0.001)
if (test$bmi[i] != "99.9")
{
    test$riskscore[i] = test$riskscore[i] + test$bmi[i]*(-0.005)
}
if (test$pwgt_r[i] != "999")
{
    test$riskscore[i] = test$riskscore[i] + test$pwgt_r[i]*(0.0005)
}
if (test$dwgt_r[i] != "999")
{
    test$riskscore[i] = test$riskscore[i] + test$dwgt_r[i]*(0.00005)
}
if (test$wtgain[i] != "99")
{
    test$riskscore[i] = test$riskscore[i] + test$wtgain[i]*(0.00006)
}
if (test$rf_pdiab[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.096)
}
else if (test$rf_pdiab[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.546)
}
if (test$rf_gdiab[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.091)
}
if (test$urf_phype[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.029)
}
if (test$urf_ehype[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.046)
}
if (test$rf_ppb[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.136)
}
if (test$rf_inft[i] == "Yes")
{
# Risk Score Calculation

The risk score is calculated as follows:

\[ \text{test_riskscore}[i] = \text{test_riskscore}[i] + (-0.847) \]

if (test_rf_drg[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (-0.779)
}
else if (test_rf_drg[i] == "Unknown")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.639)
}
if (test_rf_art[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.811)
}
if (test_rf_cesarn[i] != "99")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.010*\text{test_riskscore}[i] + \text{test_rf_cesarn}*(-0.010))
}
if (test_ip_gon[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.098)
}
else if (test_ip_gon[i] == "Unknown")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.452)
}
if (test_ip_syph[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.369)
}
if (test_ip_chlam[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (-0.110)
}
if (test_ip_hepb[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (0.777)
}
if (test_ip_hepc[i] == "Yes")
{
    \text{test_riskscore}[i] = \text{test_riskscore}[i] + (-0.178)
}
if (test_ob_succ[i] == "Yes")
test$riskscore[i] = test$riskscore[i] + (0.481)
}
else if (test$ob_succ[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.725)
}
if (test$ob_fail[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.107)
}
if (test$ld_indl[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.0004)
}
else if (test$ld_indl[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.267)
}
if (test$ld_augm[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.048)
}
if (test$ld_ster[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.076)
}
if (test$ld_antb[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.077)
}
if (test$ld_chor[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.072)
}
if (test$ld_anes[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.0003)
}
if (test$me_pres[i] == "Breech")
{
    test$riskscore[i] = test$riskscore[i] + (0.007)
}
else if (test$me_pres[i] == "Other")
{
    test$riskscore[i] = test$riskscore[i] + (-0.079)
}
else if (test$me_pres[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.073)
}
if (test$me_rout[i] == "Forceps")
{
    test$riskscore[i] = test$riskscore[i] + (0.201)
}
else if (test$me_rout[i] == "Vacuum")
{
    test$riskscore[i] = test$riskscore[i] + (-0.050)
}
else if (test$me_rout[i] == "Cesarean")
{
    test$riskscore[i] = test$riskscore[i] + (-0.055)
}
else if (test$me_rout[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.431)
}
if (test$me_trial[i] == "No")
{
    test$riskscore[i] = test$riskscore[i] + (-0.050)
}
else if (test$me_trial[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.342)
}
if (test$mm_mtr[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.089)
}
else if (test$mm_mtr[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.623)
}
if (test$mm_plac[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.582)
}
if (test$mm_rupt[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.097)
}
if (test$mm_uhyst[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.206)
}
if (test$mm_aicu[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.276)
}
if (test$attend[i] == "Dr of Osteo")
{
    test$riskscore[i] = test$riskscore[i] + (0.036)
}
else if (test$attend[i] == "Cert Nurse Midwife")
{
    test$riskscore[i] = test$riskscore[i] + (0.008)
}
else if (test$attend[i] == "Other Midwife")
{
    test$riskscore[i] = test$riskscore[i] + (-0.529)
}
else if (test$attend[i] == "Other")
{
    test$riskscore[i] = test$riskscore[i] + (0.052)
}
else if (test$attend[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.421)
}
if (test$mtran[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.080)
}
else if (test$mtran[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.759)
}
if (test$pay_rec[i] == "Private Ins")
{
test$riskscore[i] = test$riskscore[i] + (0.066)
}
else if (test$pay_rec[i] == "Self-pay")
{
    test$riskscore[i] = test$riskscore[i] + (-0.013)
}
else if (test$pay_rec[i] == "Other")
{
    test$riskscore[i] = test$riskscore[i] + (-0.073)
}
else if (test$pay_rec[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.137)
}
if (test$apgar5r[i] == "4-6")
{
    test$riskscore[i] = test$riskscore[i] + (-0.104)
}
else if (test$apgar5r[i] == "7-8")
{
    test$riskscore[i] = test$riskscore[i] + (-0.318)
}
else if (test$apgar5r[i] == "9-10")
{
    test$riskscore[i] = test$riskscore[i] + (-0.403)
}
else if (test$apgar5r[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0.018)
}
if (test$dplural[i] == "Twin")
{
    test$riskscore[i] = test$riskscore[i] + (-0.614)
}
else if (test$dplural[i] == "Triplet")
{
    test$riskscore[i] = test$riskscore[i] + (-0.419)
}
else if (test$dplural[i] == "Quadruplet")
{
    test$riskscore[i] = test$riskscore[i] + (0.451)
}
else if (test$dplural[i] == "Quintuplet+")
{  test$riskscore[i] = test$riskscore[i] + (0)
}
if (test$setorder_r[i] == "2nd")
{
  test$riskscore[i] = test$riskscore[i] + (-0.225)
}
else if (test$setorder_r[i] == "3rd")
{
  test$riskscore[i] = test$riskscore[i] + (-1.154)
}
else if (test$setorder_r[i] == "4th")
{
  test$riskscore[i] = test$riskscore[i] + (0)
}
else if (test$setorder_r[i] == "5th+")
{
  test$riskscore[i] = test$riskscore[i] + (0)
}
else if (test$setorder_r[i] == "Unknown")
{
  test$riskscore[i] = test$riskscore[i] + (-0.616)
}
if (test$sex[i] == "Female")
{
  test$riskscore[i] = test$riskscore[i] + (0.051)
}
if (test$oegestr10[i] == "20-27 weeks")
{
  test$riskscore[i] = test$riskscore[i] + (-0.149)
}
else if (test$oegestr10[i] == "28-31 weeks")
{
  test$riskscore[i] = test$riskscore[i] + (-0.474)
}
else if (test$oegestr10[i] == "32-33 weeks")
{
  test$riskscore[i] = test$riskscore[i] + (-0.550)
}
else if (test$oegestr10[i] == "34-36 weeks")
{
  test$riskscore[i] = test$riskscore[i] + (-0.563)
}
else if (test$oegest_r10[i] == "37-38 weeks")
{
    test$riskscore[i] = test$riskscore[i] + (-0.617)
}
else if (test$oegest_r10[i] == "39 weeks")
{
    test$riskscore[i] = test$riskscore[i] + (-0.618)
}
else if (test$oegest_r10[i] == "40 weeks")
{
    test$riskscore[i] = test$riskscore[i] + (-0.595)
}
else if (test$oegest_r10[i] == "41 weeks")
{
    test$riskscore[i] = test$riskscore[i] + (-0.654)
}
else if (test$oegest_r10[i] == "42 weeks")
{
    test$riskscore[i] = test$riskscore[i] + (-0.626)
}
else if (test$oegest_r10[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (0)
}
if (test$bwtr4[i] == "1500-2499 grams")
{
    test$riskscore[i] = test$riskscore[i] + (-0.019)
}
else if (test$bwtr4[i] == "2500-8165 grams")
{
    test$riskscore[i] = test$riskscore[i] + (0.048)
}
else if (test$bwtr4[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (1.939)
}
if (test$ab_aven1[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.071)
}
else if (test$ab_aven1[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-1.230)
}
if (test$ab_aven6[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.005)
}
if (test$ab_nicu[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.025)
}
if (test$ab_surf[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.026)
}
if (test$ab_anti[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.00003)
}
if (test$ab_seiz[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.180)
}
if (test$itran[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (0.017)
}
else if (test$itran[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (2.321)
}
if (test$bfed[i] == "Yes")
{
    test$riskscore[i] = test$riskscore[i] + (-0.091)
}
else if (test$bfed[i] == "Unknown")
{
    test$riskscore[i] = test$riskscore[i] + (-0.345)
}

thesis2$riskscore <- 0

for (i in 1:nrow(thesis2))
{
    if (thesis2$bfacil3[i] == "Not Hospital")
        thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.192)
}
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.109) 
} 
if (thesis2$mager14[i] == "15") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.492) 
} 
else if (thesis2$mager14[i] == "16") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.411) 
} 
else if (thesis2$mager14[i] == "17") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.364) 
} 
else if (thesis2$mager14[i] == "18") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.232) 
} 
else if (thesis2$mager14[i] == "19") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.420) 
} 
else if (thesis2$mager14[i] == "20-24") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.404) 
} 
else if (thesis2$mager14[i] == "25-29") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.433) 
} 
else if (thesis2$mager14[i] == "30-34") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.390) 
} 
else if (thesis2$mager14[i] == "35-39") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.237) 
} 
else if (thesis2$mager14[i] == "40-44") 
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.357) 
}
else if (thesis2$mager14[i] == "45-49")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-2.109)
}
else if (thesis2$mager14[i] == "50-54")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-1.587)
}
if (thesis2$restatus[i] == "Intrastate Non-res")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.035)
}
else if (thesis2$mbstate_rec[i] == "Interstate Non-res")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.010)
}
if (thesis2$mracehisp[i] == "Non-Hisp Black")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.101)
}
else if (thesis2$mracehisp[i] == "Non-Hisp AIAN")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.602)
}
else if (thesis2$mracehisp[i] == "Non-Hisp Asian")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.235)
}
else if (thesis2$mracehisp[i] == "Non-Hisp NHOPI")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.661)
}
else if (thesis2$mracehisp[i] == "Non-Hisp More than one race")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.199)
}
else if (thesis2$mracehisp[i] == "Hispanic")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.006)
}
else if (thesis2$mracehisp[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.148)
if (thesis2$mar_p[i] == "No")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.022)
}
else if (thesis2$mar_p[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.328)
}
else if (thesis2$mar_p[i] == "Not Applicable")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.063)
}
if (thesis2$dmar[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.464)
}
if (thesis2$meduc[i] == "9-12")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.031)
}
else if (thesis2$meduc[i] == "HS Grad/GED")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.030)
}
else if (thesis2$meduc[i] == "Some college")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.021)
}
else if (thesis2$meduc[i] == "Associate degree")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.017)
}
else if (thesis2$meduc[i] == "Bachelor's degree")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.036)
}
else if (thesis2$meduc[i] == "Master's degree")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.092)
}
else if (thesis2$meduc[i] == "Doctorate or Professional degree")
{
thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.370)
} 
else if (thesis2$meduc[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.121)
}
if (thesis2$fage11[i] == "15-19")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.453)
}
else if (thesis2$fage11[i] == "20-24")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.434)
}
else if (thesis2$fage11[i] == "25-29")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.358)
}
else if (thesis2$fage11[i] == "30-34")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.455)
}
else if (thesis2$fage11[i] == "35-39")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.352)
}
else if (thesis2$fage11[i] == "40-44")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.392)
}
else if (thesis2$fage11[i] == "45-49")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.501)
}
else if (thesis2$fage11[i] == "50-54")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.811)
}
else if (thesis2$fage11[i] == "55+")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.481)
}
else if (thesis2$fage11[i] == "Unknown")
```r
thesis2$riskscore[i] = thesis2$riskscore[i] + (0.780)
}
if (!is.na(thesis2$fracehisp[i]) == "Non-Hisp Black")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.060)
}
else if (!is.na(thesis2$fracehisp[i]) == "Non-Hisp AIAN")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.095)
}
else if (!is.na(thesis2$fracehisp[i]) == "Non-Hisp Asian")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (0.183)
}
else if (!is.na(thesis2$fracehisp[i]) == "Non-Hisp NHOPI")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (0.156)
}
else if (!is.na(thesis2$fracehisp[i]) == "Non-Hisp More than one race")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.034)
}
else if (!is.na(thesis2$fracehisp[i]) == "Hispanic")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.082)
}
else if (!is.na(thesis2$fracehisp[i]) == "Unknown")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.186)
}
if (thesis2$feduc[i] == "9-12")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.281)
}
else if (thesis2$feduc[i] == "HS Grad/GED")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.343)
}
else if (thesis2$feduc[i] == "Some college")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.264)
}
```
else if (thesis2$feduc[i] == "Associate degree")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.105)
}
else if (thesis2$feduc[i] == "Bachelor’s degree")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.167)
}
else if (thesis2$feduc[i] == "Master’s degree")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.107)
}
else if (thesis2$feduc[i] == "Doctorate or Professional degree")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.282)
}
else if (thesis2$feduc[i] == "Unknown")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.464)
}
if (thesis2$priorlive[i] != "99")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$priorlive[i]*(-0.003)
}
if (thesis2$priordead[i] != "99")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$priordead[i]*(0.001)
}
if (thesis2$priorterm[i] != "99")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$priorterm[i]*(-0.001)
}
if (thesis2$lbo_rec[i] != "9")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$lbo_rec[i]*(-0.003)
}
if (thesis2$tpo_rec[i] != "9")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$tpo_rec[i]*(0.008)
}
if (thesis2$illb_r11[i] == "4-11 months")
{
  thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.151)
}
else if (thesis2$illb_r11[i] == "12-17 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.474)
}
else if (thesis2$illb_r11[i] == "18-23 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.415)
}
else if (thesis2$illb_r11[i] == "24-35 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.410)
}
else if (thesis2$illb_r11[i] == "36-47 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.380)
}
else if (thesis2$illb_r11[i] == "48-59 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.358)
}
else if (thesis2$illb_r11[i] == "60-71 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.362)
}
else if (thesis2$illb_r11[i] == "72+ months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.319)
}
else if (thesis2$illb_r11[i] == "1st live birth")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.473)
}
else if (thesis2$illb_r11[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.361)
}
if (thesis2$iloo_r11[i] == "4-11 months")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-1.053)
}
else if (thesis2$iloo_r11[i] == "12-17 months")
{
\[
\text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.483)
\]
else if (thesis2\_iloo\_r11[i] == "18-23 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.241)
}
else if (thesis2\_iloo\_r11[i] == "24-35 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.318)
}
else if (thesis2\_iloo\_r11[i] == "36-47 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.432)
}
else if (thesis2\_iloo\_r11[i] == "48-59 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.582)
}
else if (thesis2\_iloo\_r11[i] == "60-71 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.333)
}
else if (thesis2\_iloo\_r11[i] == "72+ months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.432)
}
else if (thesis2\_iloo\_r11[i] == "1st live birth")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.371)
}
else if (thesis2\_iloo\_r11[i] == "Unknown")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-1.163)
}
if (thesis2\_ilp\_r11[i] == "4-11 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-0.548)
}
else if (thesis2\_ilp\_r11[i] == "12-17 months")
{
    \text{thesis2}\_\text{riskscore}[i] = \text{thesis2}\_\text{riskscore}[i] + (-0.049)
}
else if (thesis2\_ilp\_r11[i] == "18-23 months")

{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.139)
} 
else if (thesis2$ilp_r11[i] == "24-35 months")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.037)
} 
else if (thesis2$ilp_r11[i] == "36-47 months")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.126)
} 
else if (thesis2$ilp_r11[i] == "48-59 months")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.188)
} 
else if (thesis2$ilp_r11[i] == "60-71 months")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.083)
} 
else if (thesis2$ilp_r11[i] == "72+ months")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.171)
} 
else if (thesis2$ilp_r11[i] == "1st live birth")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.027)
} 
else if (thesis2$ilp_r11[i] == "Unknown")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.230)
} 
if (thesis2$precare5[i] == "2nd Trimester")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.006)
} 
else if (thesis2$precare5[i] == "3rd Trimester")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.120)
} 
else if (thesis2$precare5[i] == "No prenatal care")
{ 
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.092)
} 
}
else if (thesis2$precare5[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.009)
}
if (thesis2$previs_rec[i] == "1-2")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.056)
}
else if (thesis2$previs_rec[i] == "3-4")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.174)
}
else if (thesis2$previs_rec[i] == "5-6")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.012)
}
else if (thesis2$previs_rec[i] == "7-8")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.033)
}
else if (thesis2$previs_rec[i] == "9-10")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.013)
}
else if (thesis2$previs_rec[i] == "11-12")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.065)
}
else if (thesis2$previs_rec[i] == "13-14")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.032)
}
else if (thesis2$previs_rec[i] == "15-16")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.106)
}
else if (thesis2$previs_rec[i] == "17-18")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.107)
}
else if (thesis2$previs_rec[i] == "19+")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.023)
if (thesis2$wic[i] == "Yes")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (0.039) }
else if (thesis2$wic[i] == "Unknown")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.074) }
if (thesis2$cig0_r[i] == "1-5")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (0.089) }
else if (thesis2$cig0_r[i] == "6-10")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (0.115) }
else if (thesis2$cig0_r[i] == "11-20")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.030) }
else if (thesis2$cig0_r[i] == "21-40")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (0.342) }
else if (thesis2$cig0_r[i] == "41+")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (0.932) }
else if (thesis2$cig0_r[i] == "Unknown")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (0.477) }
if (thesis2$cig1_r[i] == "1-5")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.419) }
else if (thesis2$cig1_r[i] == "6-10")
    { thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.280) }
else if (thesis2$cig1_r[i] == "11-20")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.432)}
else if (thesis2$cig1_r[i] == "21-40")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.856)}
else if (thesis2$cig1_r[i] == "Unknown")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.315)}
if (thesis2$cig2_r[i] == "1-5")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.575)}
else if (thesis2$cig2_r[i] == "6-10")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.372)}
else if (thesis2$cig2_r[i] == "11-20")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.287)}
else if (thesis2$cig2_r[i] == "21-40")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (1.067)}
else if (thesis2$cig2_r[i] == "41+")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0)}
else if (thesis2$cig2_r[i] == "Unknown")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.573)}
if (thesis2$cig3_r[i] == "1-5")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.205)}
else if (thesis2$cig3_r[i] == "6-10")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.194)}
else if (thesis2$cig3_r[i] == "11-20")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.184)
}
else if (thesis2$cig3_r[i] == "21-40")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.208)
}
else if (thesis2$cig3_r[i] == "41+")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-1.497)
}
else if (thesis2$cig3_r[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.500)
}
if (thesis2$mhtr[i] != "99")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$mhtr[i]*(0.001)
}
if (thesis2$bmi[i] != "99.9")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$bmi[i]*(-0.005)
}
if (thesis2$pwgt_r[i] != "999")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$pwgt_r[i]*(0.0005)
}
if (thesis2$dwgt_r[i] != "999")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$dwgt_r[i]*(0.00005)
}
if (thesis2$wtgain[i] != "99")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$wtgain[i]*(0.00006)
}
if (thesis2$rf_pdiab[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.096)
}
else if (thesis2$rf_pdiab[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.546)
if (thesis2$rf_gdiab[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.091)
}
if (thesis2$urf_phype[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.029)
}
if (thesis2$urf_ehype[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.046)
}
if (thesis2$rf_ppb[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.136)
}
if (thesis2$rf_inft[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.847)
}
if (thesis2$rf_drg[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.779)
}
else if (thesis2$rf_drg[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.639)
}
if (thesis2$rf_art[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.811)
}
if (thesis2$rf_cesarn[i] != "99")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + thesis2$rf_cesarn*(-0.010)
}
if (thesis2$ip_gon[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.098)
}
else if (thesis2$ip_gon[i] == "Unknown")
{

thesis2$riskscore[i] = thesis2$riskscore[i] + (0.452)
}
if (thesis2$ip_syph[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.369)
}
if (thesis2$ip_chlam[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.110)
}
if (thesis2$ip_hepb[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.777)
}
if (thesis2$ip_hepc[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.178)
}
if (thesis2$ob_succ[i] == "No")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.481)
}
else if (thesis2$ob_succ[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.725)
}
if (thesis2$ob_fail[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.107)
}
if (thesis2$ld_indl[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.0004)
}
else if (thesis2$ld_indl[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.267)
}
if (thesis2$ld_augm[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.048)
}
if (thesis2$ld_ster[i] == "Yes")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.076)}
if (thesis2$ld_antb[i] == "Yes")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.077)}
if (thesis2$ld_chor[i] == "Yes")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.072)}
if (thesis2$ld_anes[i] == "Yes")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.0003)}
if (thesis2$me_pres[i] == "Breech")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.007)}
else if (thesis2$me_pres[i] == "Other")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.079)}
else if (thesis2$me_pres[i] == "Unknown")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.073)}
if (thesis2$me_rout[i] == "Forceps")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.201)}
else if (thesis2$me_rout[i] == "Vacuum")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.050)}
else if (thesis2$me_rout[i] == "Cesarean")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.055)}
else if (thesis2$me_rout[i] == "Unknown")
{thesis2$riskscore[i] = thesis2$riskscore[i] + (0.431)}
if (thesis2$me_trial[i] == "No")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.050)
}
else if (thesis2$me_trial[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.342)
}
if (thesis2$mm_mtr[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.089)
}
else if (thesis2$mm_mtr[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.623)
}
if (thesis2$mm_plac[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.582)
}
if (thesis2$mm_rupt[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.097)
}
if (thesis2$mm_uhyst[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.206)
}
if (thesis2$mm_aicu[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.276)
}
if (thesis2$attend[i] == "Dr of Osteo")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.036)
}
else if (thesis2$attend[i] == "Cert Nurse Midwife")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.008)
}
else if (thesis2$attend[i] == "Other Midwife")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.529)
}
```c
// Add code for the remaining if-else conditions...
```
thesis2\$riskscore[i] = thesis2\$riskscore[i] + (-0.403)
}
else if (thesis2\$apgar5r[i] == "Unknown")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (0.018)
}
if (thesis2\$dplural[i] == "Twin")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (-0.614)
}
else if (thesis2\$dplural[i] == "Triplet")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (-0.419)
}
else if (thesis2\$dplural[i] == "Quadruplet")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (0.451)
}
else if (thesis2\$dplural[i] == "Quintuplet+")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (0)
}
if (thesis2\$setorder_r[i] == "2nd")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (-0.225)
}
else if (thesis2\$setorder_r[i] == "3rd")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (-1.154)
}
else if (thesis2\$setorder_r[i] == "4th")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (0)
}
else if (thesis2\$setorder_r[i] == "5th+")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (0)
}
else if (thesis2\$setorder_r[i] == "Unknown")
{
    thesis2\$riskscore[i] = thesis2\$riskscore[i] + (-0.616)
}
if (thesis2\$sex[i] == "Female")
\begin{verbatim}
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0.051)
}
if (thesis2$oegest_r10[i] == "20-27 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.149)
}
else if (thesis2$oegest_r10[i] == "28-31 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.474)
}
else if (thesis2$oegest_r10[i] == "32-33 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.550)
}
else if (thesis2$oegest_r10[i] == "34-36 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.563)
}
else if (thesis2$oegest_r10[i] == "37-38 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.617)
}
else if (thesis2$oegest_r10[i] == "39 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.618)
}
else if (thesis2$oegest_r10[i] == "40 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.595)
}
else if (thesis2$oegest_r10[i] == "41 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.654)
}
else if (thesis2$oegest_r10[i] == "42 weeks")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.626)
}
else if (thesis2$oegest_r10[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (0)
}
\end{verbatim}
if (thesis2$bwtr4[i] == "1500-2499 grams")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.019)}
else if (thesis2$bwtr4[i] == "2500-8165 grams")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (0.048)}
else if (thesis2$bwtr4[i] == "Unknown")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (1.939)}
if (thesis2$ab_aven1[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (0.071)}
else if (thesis2$ab_aven1[i] == "Unknown")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (-1.230)}
if (thesis2$ab_aven6[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.005)}
if (thesis2$ab_nicu[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (0.025)}
if (thesis2$ab_surf[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (0.026)}
if (thesis2$ab_anti[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.00003)}
if (thesis2$ab_seiz[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (0.180)}
if (thesis2$itran[i] == "Yes")
  {thesis2$riskscore[i] = thesis2$riskscore[i] + (0.017)
```r
} else if (thesis2$itran[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (2.321)
}
if (thesis2$bfed[i] == "Yes")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.091)
} else if (thesis2$bfed[i] == "Unknown")
{
    thesis2$riskscore[i] = thesis2$riskscore[i] + (-0.345)
}

# # Create categories for risk score #

train$riskscore <- exp(train$riskscore)
test$riskscore <- exp(test$riskscore)
thesis2$riskscore <- exp(thesis2$riskscore)

attach(thesis2)
thesis2$riskcat[riskscore < 0.005466591] <- "Low"
thesis2$riskcat[riskscore >= 0.005466591] <- "High"
detach(thesis2)

thesis2$riskcat <- factor(thesis2$riskcat, levels = c("Low","High"))

attach(train)
train$riskcat[riskscore < 0.005466591] <- "Low"
train$riskcat[riskscore >= 0.005466591] <- "High"
detach(train)

train$riskcat <- factor(train$riskcat, levels = c("Low","High"))

attach(test)
test$riskcat[riskscore < 0.005466591] <- "Low"
test$riskcat[riskscore >= 0.005466591] <- "High"
detach(test)
```
test$riskcat <- factor(test$riskcat, levels = c("Low","High"))

# # Kaplan Meier plots # mracehisp, mar_p, meduc+feduc, oegest_r10, bwt4, attend, apgar5r, sex, bfed

KM_risk_train <- survfit(Surv(os_mon, flgnd)~ riskcat, data= train, conf.type= 'log-log')

KM_risk_test <- survfit(Surv(os_mon, flgnd)~ riskcat, data= test, conf.type= 'log-log')

KM_risk_fit1 <- list(KM_risk_train, KM_risk_test)
ggsurvplot_combine(KM_risk_fit1, data= thesis2, break.time.by= 1, palette = rainbow(4), conf.int= T, pval = TRUE, ggtheme = theme_survminer(), legend.labs = c("Training Low Risk", "Training High Risk", "Test Low Risk", "Test High Risk"), xlab = "Time (Months)")

tr<- data.frame("time"=train$os_mon, "event"= train$flgnd, "score"= train$riskcat)
ts<- data.frame("time"=test$os_mon, "event"= test$flgnd, "score"= test$riskcat)
sbrier.score2proba(data.tr = tr, data.ts = ts, method = "cox") # 0.096 (lower better 0-1)

risk_cox_train <- coxph(Surv(os_mon, flgnd)~ riskscore, data = train, ties = "efron")
risk_pred <- predict(risk_cox_train, newdata = test, type = "risk")
pred_prob<-risk_pred
pred_prob <- ifelse(pred_prob > 1,1, 0)
table(pred_prob, train$flgnd)
TP<- 2818
FN<- 2774
FP<- 923
TN<- 962
risk_sensitivity <- TP/(TP+FN)
risk_specificity<- TN/(TN+FP)
risk_precision <- TP/(TP+FP)
risk_npv <- TN/(TN+FN)
risk_accuracy <- (TP+TN)/(TP+TN+FP+FN)

KM_risk <- survfit(Surv(os_mon, flgnd) ~ riskcat, data= thesis2, conf.type= 'log-log')
ggsurvplot(KM_risk, data= thesis2, 
   pval = T, # <0.0001 
   break.time.by = 1, 
   fontsize = 20, 
   risk.table = F, 
   risk.table.fontsize = 5, 
   surv.median.line = "hv", 
   palette = c("red","blue"), 
   legend.labs = c("Low", "High"), 
   xlab = "Time (Months)"
)

KM_mracehisp <- survfit(Surv(time = os_mon, event = flgnd)~ mracehisp, data= thesis2, 
   conf.type= 'log-log')
surv_summary(KM_risk, thesis2)

ggsurvplot(KM_mracehisp, data= thesis2, 
   pval = T, # 0.0016 
   break.time.by = 1, 
   palette = rainbow(8), 
   surv.median.line = "hv", 
   fontsize = 20, 
   risk.table = F, 
   risk.table.fontsize = 3, 
   legend.labs = c("Non-Hisp White","Non-Hisp Black","Non-Hisp AIAN", 
   "Non-Hisp Asian","Non-Hisp NHOP","Non-Hisp More than one race", 
   "Hispanic","Unknown"), 
   xlab = "Time (Months)"
)

KM_marriage <- survfit(Surv(time = os_mon, event = flgnd)~ dmar, data= thesis2, 
   conf.type= 'log-log')

ggsurvplot(KM_marriage, data= thesis2, 
   pval = T, # <0.0001 
   break.time.by = 1, 
   palette = rainbow(3), 
   fontsize = 20, 
   surv.median.line = "hv", 
   risk.table = F, 
   risk.table.fontsize = 3,
legend.labs = c("Married", "Unmarried", "Unknown"), 
  xlab = "Time (Months)"

KM_gestation <- survfit(Surv(time = os_mon, event = flgnd) ~ oegest_r10, data = thesis2, 
                     conf.type = 'log-log')

ggsurvplot(KM_gestation, data = thesis2,
           pval = T, # < 0.0001 
           break.time.by = 1, 
           palette = rainbow(11), 
           legend.labs = c("< 20 weeks", "20-27 weeks", "28-31 weeks", 
                           "32-33 weeks", "34-36 weeks", "37-38 weeks", 
                           "39 weeks", "40 weeks", "41 weeks", "42+ weeks", "Unknown"), 
           xlab = "Time (Months)"
)

KM_birth_weight <- survfit(Surv(time = os_mon, event = flgnd) ~ bwtr4, data = thesis2, 
                         conf.type = 'log-log')

ggsurvplot(KM_birth_weight, data = thesis2,
           pval = T, # < 0.0001 
           break.time.by = 1, 
           palette = rainbow(4), 
           fontsize = 20, 
           surv.median.line = "hv", 
           risk.table = F, 
           risk.table.fontsize = 3, 
           legend.labs = c("227-1499 grams", "1500-2499 grams", 
                           "2500-8165 grams", "Unknown"), 
           xlab = "Time (Months)"
)

KM_attend <- survfit(Surv(time = os_mon, event = flgnd) ~ attend, data = thesis2)

ggsurvplot(KM_attend, data = thesis2,
           pval = T, # 0.00054 
           break.time.by = 1, 
           palette = c("red", "blue", "green3", "purple", "dodgerblue", "orange"), 
           fontsize = 20, 
           surv.median.line = "hv", 
           risk.table = F, 
           risk.table.fontsize = 3,
legend.labs = c("Dr of Med","Dr of Osteo","Cert Nurse Midwife","Other Midwife", "Other","Unknown"),
  xlab = "Time (Months)"

KM_apgar5 <- survfit(Surv(time = os_mon, event = flgnd) ~ apgar5r, data= thesis2,  
  conf.type= 'log-log')

ggsurvplot(KM_apgar5, data= thesis2,  
  pval = T, # < 0.0001  
  break.time.by = 1,  
  palette = rainbow(5),  
  fontsize = 20,  
  surv.median.line = "hv",  
  risk.table = F,  
  risk.table.fontsize = 3,  
  legend.labs = c("0-3","4-6","7-8","9-10","Unknown"),  
  xlab = "Time (Months)"

KM_sex <- survfit(Surv(time = os_mon, event = flgnd) ~ sex, data= thesis2,  
  conf.type= 'log-log')

ggsurvplot(KM_sex, data= thesis2,  
  pval = T, # 0.52  
  break.time.by = 1,  
  palette = c("red","blue"),  
  fontsize = 20,  
  surv.median.line = "hv",  
  risk.table = F,  
  risk.table.fontsize = 3,  
  legend.labs = c("Male","Female"),  
  xlab = "Time (Months)"

KM_bfed <- survfit(Surv(time = os_mon, event = flgnd) ~ bfed, data= thesis2,  
  conf.type= 'log-log')

ggsurvplot(KM_bfed, data= thesis2,  
  pval = T, # < 0.0001  
  break.time.by = 1,  
  palette = c("red","purple","blue4"),  
  fontsize = 20,
surv.median.line = "hv",
risk.table = F,
risk.table.fontsize = 3,
legend.labs = c("Yes", "No", "Unknown"),
xlab = "Time (Months)"

KM_Meducation <- survfit(Surv(os_mon, flgnd) ~ meduc, data= thesis2,
conf.type= 'log-log')

ggsurvplot(KM_Meducation, data= thesis2,
pval = T, # < 0.0001
break.time.by = 1,
palette = c("red","orange","goldenrod","green1","green3","dodgerblue","blue4",
"purple","gray"),
fontsize = 20,
surv.median.line = "hv",
risk.table = F,
risk.table.fontsize = 3,
legend.labs = c("< 9th grade","9-12 grade","HS Grad/GED","Some College",
"Associate Degree", "Bachelor's Degree", "Master's Degree",
"PhD or Professional degree", "Unknown"),
xlab = "Time (Months)"

KM_Feducation <- survfit(Surv(os_mon, flgnd) ~ feduc, data = thesis2,
conf.type= 'log-log')

ggsurvplot(KM_Feducation, data= thesis2,
pval = T, # < 0.0001
break.time.by = 1,
palette = c("red","orange","goldenrod","green1","green3","dodgerblue","blue4",
"purple","gray"),
fontsize = 20,
surv.median.line = "hv",
risk.table = F,
risk.table.fontsize = 3,
legend.labs = c("< 9th grade","9-12 grade","HS Grad/GED","Some College",
"Associate Degree", "Bachelor's Degree", "Master's Degree",
"PhD or Professional degree", "Unknown"),
xlab = "Time (Months)"

KM_wic <- survfit(Surv(os_mon, flgnd) ~ wic, data = thesis2,
conf.type = 'log-log')
ggsurvplot(KM_wic, data = thesis2,
    pval = T, # < 0.0001
    break.time.by = 1,
    palette = rainbow(3),
    fontsize = 20,
    surv.median.line = "hv",
    risk.table = F,
    risk.table.fontsize = 3,
    legend.labs = c("No","Yes","Unknown"),
    xlab = "Time (Months)")

KM_mager14 <- survfit(Surv(os_mon, flgnd) ~ mager14, data = thesis2,
    conf.type = 'log-log')
surv_median(KM_mager14)

ggsurvplot(KM_mager14, data = thesis2,
    pval = T, # < 0.0001
    break.time.by = 1,
    palette = rainbow(13),
    fontsize = 20,
    surv.median.line = "hv",
    risk.table = F,
    risk.table.fontsize = 3,
    legend.labs = c("< 15","15","16","17","18","19","20-24",
        "25-29","30-34","35-39","40-44","45-49",
        "50-54"),
    xlab = "Time (Months)")

KM_previs_rec <- survfit(Surv(os_mon, flgnd) ~ previs_rec, data = thesis2,
    conf.type = 'log-log')

ggsurvplot(KM_previs_rec, data = thesis2,
    pval = T, # < 0.0001
    break.time.by = 1,
    palette = rainbow(12),
    fontsize = 20,
    surv.median.line = "hv",
    risk.table = F,
    risk.table.fontsize = 3,
    legend.labs = c("None","1-2","3-4","5-6","7-8","9-10",
        "11-12","13-14","15-16","17-18","19+","Unknown"),
    xlab = "Time (Months)"
KM_precare5 <- survfit(Surv(os_mon, flgnd) ~ precare5, data = thesis2, conf.type = 'log-log')

ggsurvplot(KM_precare5, data = thesis2,
          pval = T, # < 0.0001
          break.time.by = 1,
          palette = rainbow(5),
          fontsize = 20,
          surv.median.line = "hv",
          risk.table = F,
          risk.table.fontsize = 3,
          legend.labs = c("1st Trimester","2nd Trimester","3rd Trimester",
                          "No Prenatal Care","Unknown"),
          xlab = "Time (Months")
)

KM_pay_rec <- survfit(Surv(os_mon, flgnd) ~ pay_rec, data = thesis2, conf.type = 'log-log')

ggsurvplot(KM_pay_rec, data = thesis2,
          pval = T, # < 0.0001
          break.time.by = 1,
          palette = rainbow(5),
          fontsize = 20,
          surv.median.line = "hv",
          risk.table = F,
          risk.table.fontsize = 3,
          legend.labs = c("Medicaid", "Private Ins", "Self-pay", "Other", "Unknown"),
          xlab = "Time (Months")
)

# # Univariate Coxph Models #

covariates <- c("meduc", "sex", "mager14", "wic", "mracehis", "pay_rec", "precare5", "previs_rec", "feduc", "bfed", "apgar5r", "oegest_r10", "attend", "dmar", "bwtr4", "riskcat")
univ_formulas <- sapply(covariates,
                         function(x) as.formula(paste('Surv(os_mon, flgnd)~', x))
)
univ_models <- lapply( univ_formulas, function(x) {coxph(x, data = thesis2)})
univ_results <- lapply(univ_models,
                        function(x){
                          x <- summary(x)
                        })
beta <- signif(x$coef[1], digits=4); # coefficient beta
HR <- signif(x$coef[2], digits=4); # exp(beta)
HR.confint.lower <- signif(x$conf.int[,"lower .95"], 2)
HR.confint.upper <- signif(x$conf.int[,"upper .95"], 2)
HR <- paste0(HR, " (", HR.confint.lower, ", HR.confint.upper, ")")
res <- c(beta, HR)
names(res) <- c("beta", "HR (95% CI for HR")
return(res))

# Multivariate Coxph Models
#
Model <- coxph(Surv(os_mon, flgnd) ~ bfacil3 + mager14 + restatus + mracehisp + mar_p + dmar + meduc + fage11 + framehisp + feduc + priorlive + priordead + priorterm + lbo_rec + tpo_rec + illb_r11 + iloo_r11 + ilp_r11 + precare5 + previs_rec + wic + cig0_r + cig1_r + cig2_r + cig3_r + mhtw + bmi + pwgt_r + dwgt_r + wtgain + rf_pdiab + rf_gdiab + urf_phype + rf_ghtpe + urf_ghype + rf_inft + rf_drg + rf_art + rf_cesarn + rf_gon + ip_syph + ip_chlam + ip_hepb + ip_hepc + ob_succ + ob_fail + ld_indl + ld_augm + ld_ster + ld_antb + ld_chor + ld_anes + me_pres + me_rout + me_trial + dmeth_rec + mm_mtr + mm_plac + mm_rupt + mm_uchst + mm_ahct + attend + mtran + pay_rec + apgar5r + dplural + setorder_r + sex + oegest_r10 + bwtr4 + ab_aven1 + ab_aven6 + ab_nicu + ab_surf + ab_anti + ab_seiz + itran + bfed, data=train, x=T, ties = "efron")

selectCox(Surv(os_mon, flgnd) ~ bfacil3 + mager14 + mbstate_rec + restatus + mracehisp + mar_p + meduc + fage11 + framehisp + feduc + priorlive + priordead + priorterm + lbo_rec + tpo_rec + illb_r11 + iloo_r11 + ilp_r11 + precare5 + wic + cig0_r + cig1_r + cig2_r + cig3_r + mhtw + bmi + pwgt_r + dwgt_r + wtgain + ob_succ + dmeth_rec + attend + mtran + pay_rec + apgar5r + dplural + setorder_r + sex + oegest_r10 + bwtr4 + itran + bfed, data=thesis2, rule = "aic")
# apgar5r oegest_r10 bwtr4

cox_base <- coxph(Surv(os_mon, flgnd) ~ apgar5r + oegest_r10 + bwtr4, data = thesis2, ties = "efron")


coxmod <- coxph(Surv(os_mon, flgnd) ~ mracehisp + meduc + wic + bfed + oegest_r10 + apgar5r + dmar + pay_rec + feduc + precare5 + previs_rec + mager14 + attend + bwtr4, data=thesis2, ties = "efron", na.action = na.omit)
survMisc::gof(cox_base)
survMisc::gof(coxmod)

concord_base <- concordance(cox_base, timewt = "n", influence = 3)
concord_ses <- concordance(coxmod, timewt = "n", influence = 3)

baseROC <- timeROC(T=thesis2$os_mon, delta = thesis2$flgnd, marker = thesis2$lp2,
cause = 1, weighting = "cox", times = c(1,2,3,4,5,6,7,8,9,10,11),
ROC = T, iid = F)

sesROC <- timeROC(T=thesis2$os_mon, delta = thesis2$flgnd, marker = thesis2$lp,
cause = 1, weighting = "cox", times = c(1,2,3,4,5,6,7,8,9,10,11),
ROC = T, iid = F)

#

## Plot ROC curves
#

plot(sesROC,time=1)
plot(baseROC, time=1, add=T, col="blue")
plot(sesROC,time=2)
plot(baseROC, time=2, add=T, col="blue")
plot(sesROC,time=3)
plot(baseROC, time=3, add=T, col="blue")
plot(sesROC,time=4)
plot(baseROC, time=4, add=T, col="blue")
plot(sesROC,time=5)
plot(baseROC, time=5, add=T, col="blue")
plot(sesROC,time=6)
plot(baseROC, time=6, add=T, col="blue")
plot(sesROC,time=7)
plot(baseROC, time=7, add=T, col="blue")
plot(sesROC,time=8)
plot(baseROC, time=8, add=T, col="blue")
plot(sesROC,time=9)
plot(baseROC, time=9, add=T, col="blue")
plot(sesROC,time=10)
plot(baseROC, time=10, add=T, col="blue")
plot(sesROC,time=11,lty = 1, col="red")
plot(baseROC, time=11, add=T, col="blue")