

Modelling SMI Reduction

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Load packages

```
library(tidyverse)
library(broom)
library(knitr)
library(rstan)
library(rstanarm)
library(BMS)
library(mice)
library(olsrr)
library(BAS)
library(GGally)
library(skimr)
library(cowplot)
library(usmap)
library(ggExtra)
```

Read and Clean Data

```
cases <- data.frame(read.csv(file = 'Apr13USTot-2.csv'))
statetime<- suppressMessages(read_csv("us-states-NYT.csv"))
skim(cases)
```

Table 1: Data summary

Name	cases
Number of rows	50
Number of columns	46
Column type frequency:	
factor	11
numeric	35
Group variables	None

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
STATE	0	1.00	FALSE	50	Ala: 1, Ala: 1, Ari: 1, Ark: 1
GOVERNOR.PARTY	0	1.00	FALSE	2	Rep: 26, Dem: 24
GOVTERM.LIMIT	0	1.00	FALSE	2	No: 39, Yes: 11
Date.of.First.Case	0	1.00	FALSE	24	3/6: 7, 3/1: 6, 3/5: 4, 3/7: 4
Stay.At.Home.Date	8	0.84	FALSE	17	3/2: 7, 3/2: 5, 3/3: 4, 3/2: 3
Stay.At.Home.Order	0	1.00	FALSE	4	Sta: 41, Not: 6, Hig: 2, Oth: 1
Mandatory.Quarantine.for.Travelers	0	1.00	FALSE	4	No : 27, All: 14, Fro: 8, All: 1
Non.Essential.Business.Closures	7	0.86	FALSE	3	All: 35, All: 4, Not: 4
Large.Gatherings.Ban	3	0.94	FALSE	4	>10: 25, All: 18, >5 : 3, Oth: 1
School.Closures	0	1.00	FALSE	2	Yes: 49, Eff: 1
Bar.Restaurant.Limits	1	0.98	FALSE	3	Clo: 46, Lim: 2, Oth: 1

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50
X	0	1.00	25.50	14.58	1.00	13.25	25.50
cases	0	1.00	11544.84	28790.53	275.00	1400.50	3232.00
deaths	0	1.00	470.02	1452.33	1.00	30.25	101.00
REGION	0	1.00	2.66	1.06	1.00	2.00	3.00
DIVISION	0	1.00	5.12	2.56	1.00	3.00	5.00
POPULATION	0	1.00	6414931.84	7228712.62	586107.00	1857143.50	4547908.00
LAND.AREA	0	1.00	70747.60	85986.93	1045.00	36798.75	54118.50
DENSITY	0	1.00	199.66	264.22	1.30	45.48	105.60
PropAGE1	0	1.00	0.27	0.02	0.23	0.26	0.27
PropAGE2	0	1.00	0.26	0.01	0.23	0.26	0.26
PropAGE3	0	1.00	0.28	0.02	0.21	0.27	0.28
PropAGE4	0	1.00	0.19	0.02	0.13	0.18	0.19
PerCap.Income.2019	0	1.00	54499.42	8801.66	39368.00	48248.00	52786.50
CrudeMortRate	0	1.00	887.35	130.99	587.10	807.75	894.15
Percent.Uninsured	0	1.00	8.19	3.04	2.80	5.70	8.00
HospCount	0	1.00	141.00	128.28	15.00	67.25	125.50
BedsPer1000	0	1.00	2.60	0.71	1.60	2.10	2.45
GOVSTART	0	1.00	2017.04	2.36	2009.00	2015.00	2017.50
GOVEND	0	1.00	2022.48	0.93	2020.00	2022.00	2023.00
Days.Between	8	0.84	26.69	14.47	7.00	17.00	23.00
SAH7DY	0	1.00	0.02	0.14	0.00	0.00	0.00
SAH14DY	0	1.00	0.14	0.35	0.00	0.00	0.00
SAH21DY	0	1.00	0.38	0.49	0.00	0.00	0.00
SAH28DY	0	1.00	0.62	0.49	0.00	0.00	1.00
SAH35DY	0	1.00	0.70	0.46	0.00	0.00	1.00
SAH42DY	0	1.00	0.70	0.46	0.00	0.00	1.00
SAH49DY	0	1.00	0.72	0.45	0.00	0.00	1.00
SAH56DY	0	1.00	0.78	0.42	0.00	1.00	1.00
SAH63DY	0	1.00	0.82	0.39	0.00	1.00	1.00
SAH70DY	0	1.00	0.84	0.37	0.00	1.00	1.00
SMI_before	0	1.00	46.68	13.53	33.38	38.47	42.78
SMI_after	0	1.00	24.56	8.69	14.69	20.20	22.91
SMI_reduction	0	1.00	0.47	0.08	0.22	0.42	0.48
num_users	0	1.00	68798.76	96431.23	3086.00	16002.75	41408.50
num_records	0	1.00	7665182.38	10993880.28	292221.00	1488966.00	4198086.00

```

clean_cases <- cases %>%
  mutate(isRepublican = case_when(
    GOVERNOR.PARTY == "Republican" ~ 1,
    GOVERNOR.PARTY == "Democrat" ~ 0
  )) %>%
  mutate(isGovLimit = case_when(
    GOVTERM.LIMIT == "No" ~ 0,
    GOVTERM.LIMIT == "Yes" ~ 1
  )) %>%
  mutate(stayAtHomeLevel = case_when(
    Stay.At.Home.Order == "Not Statewide" ~ 0,
    Stay.At.Home.Order == "Other" | Stay.At.Home.Order == "High-risk Groups" ~ 1,
    Stay.At.Home.Order == "Statewide" ~ 2
  )) %>%
  mutate(travelerQuarantineLevel = case_when(
    Mandatory.Quarantine.for.Travelers == "No Requirement" ~ 0,
    Mandatory.Quarantine.for.Travelers == "From Certain States" | Mandatory.Quarantine.for.Travelers ==
    Mandatory.Quarantine.for.Travelers == "All Travelers" ~ 2
  )) %>%
  mutate(Percent.Uninsured = Percent.Uninsured/100) %>%
  mutate(nonEssentialClosed = case_when(
    Non.Essential.Business.Closures == "All Non-Essential Businesses" | Non.Essential.Business.Closures
    Non.Essential.Business.Closures == "Not All Non-Essential Businesses" ~ 0
  )) %>%
  mutate(banLargeGatherings = case_when(
    Large.Gatherings.Ban == "All Gatherings Prohibited" ~ 3,
    Large.Gatherings.Ban == ">10 People Prohibited" ~ 2,
    Large.Gatherings.Ban == ">5 People Prohibited" ~ 1,
    Large.Gatherings.Ban == "Other" ~ 0
  )) %>%
  mutate(barsRestaurantsClosed = case_when(
    Bar.Restaurant.Limits == "Closed except for takeout/delivery" ~ 1,
    Bar.Restaurant.Limits != "Closed except for takeout/delivery" ~ 0
  )) %>%
  select(-GOVTERM.LIMIT, -Mandatory.Quarantine.for.Travelers, -Stay.At.Home.Order, -num_users, -num_rec

clean_cases$REGION <- as.factor(clean_cases$REGION)
clean_cases$DIVISION <- as.factor(clean_cases$DIVISION)
clean_cases$GOVSTART <- as.factor(clean_cases$GOVSTART)
clean_cases$GOVEND <- as.factor(clean_cases$GOVEND)
clean_cases$isGovLimit <- as.factor(clean_cases$isGovLimit)
clean_cases$stayAtHomeLevel <- as.factor(clean_cases$stayAtHomeLevel)
clean_cases$travelerQuarantineLevel <- as.factor(clean_cases$travelerQuarantineLevel)
clean_cases$nonEssentialClosed <- as.factor(clean_cases$nonEssentialClosed)
clean_cases$banLargeGatherings <- as.factor(clean_cases$banLargeGatherings)
clean_cases$barsRestaurantsClosed <- as.factor(clean_cases$barsRestaurantsClosed)

clean_cases$Days.Between <- as.numeric(clean_cases$Days.Between)
clean_cases$Days.Between[is.na(clean_cases$Days.Between)] <- 70
clean_cases$nonEssentialClosed[is.na(clean_cases$nonEssentialClosed)] <- 0
clean_cases$banLargeGatherings[is.na(clean_cases$banLargeGatherings)] <- 0
clean_cases$barsRestaurantsClosed[is.na(clean_cases$barsRestaurantsClosed)] <- 0

```

```

modelPrep <- clean_cases %>%
  select(-X, -STATE) %>%
  select(SMI_reduction, everything())

modelPrep$PropAGE1 <- as.numeric(clean_cases$PropAGE1)
modelPrep$PropAGE2 <- as.numeric(clean_cases$PropAGE2)
modelPrep$PropAGE3 <- as.numeric(clean_cases$PropAGE3)
modelPrep$PropAGE4 <- as.numeric(clean_cases$PropAGE4)
modelPrep$REGION <- as.numeric(clean_cases$REGION)
modelPrep$DIVISION <- as.numeric(clean_cases$DIVISION)
modelPrep$GOVSTART <- as.numeric(clean_cases$GOVSTART)
modelPrep$GOVEND <- as.numeric(clean_cases$GOVEND)
modelPrep$isGovLimit <- as.numeric(clean_cases$isGovLimit)-1
modelPrep$stayAtHomeLevel <- as.numeric(clean_cases$stayAtHomeLevel)
modelPrep$travelerQuarantineLevel <- as.numeric(clean_cases$travelerQuarantineLevel)
modelPrep$nonEssentialClosed <- as.numeric(clean_cases$nonEssentialClosed)
modelPrep$banLargeGatherings <- as.numeric(clean_cases$banLargeGatherings)
modelPrep$barsRestaurantsClosed <- as.numeric(clean_cases$barsRestaurantsClosed)

```

EDA

US Cases and Deaths from state data

```

colnames(cases)[2] <- "state"

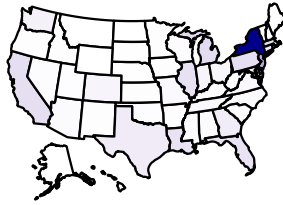
p1<-plot_usmap(data = cases, values = "cases", color = "black") +
  scale_fill_continuous(name = "Cases (until April 13)", low= "white", high="darkblue",label = scales:::
  theme(legend.position = "bottom",plot.title = element_text(hjust = 0.5,size=10, face="bold"),legend.t

p2<- plot_usmap(data = cases, values = "deaths", color = "black") +
  scale_fill_continuous(name = "Deaths (until April 13)", low= "white", high="darkred",label = scales:::
  theme(legend.position = "bottom",plot.title = element_text(hjust = 0.5,size=10, face="bold"),legend.t

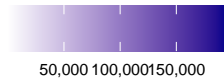
plot_grid(p1,p2,nrow=2)

```

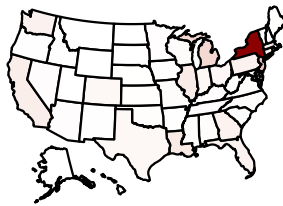
Case Distribution by state in the US



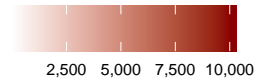
Cases (until April 13)



Death Distribution by state in the US



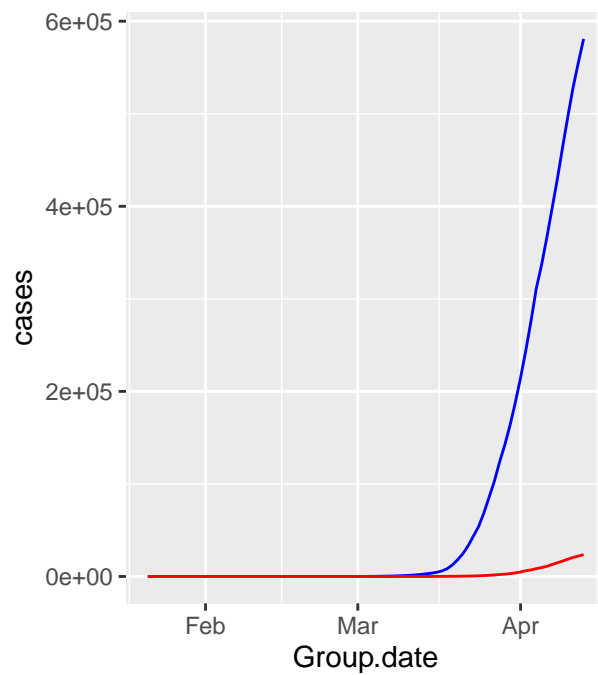
Deaths (until April 13)



```
statetime$date<- as.Date(statetime$date, format='%m/%d/%y')
dta.sum <- aggregate(x = statetime[c("cases","deaths")],
                     FUN = sum,
                     by = list(Group.date = statetime$date))
dta.sum$Group.date<- as.Date(dta.sum$Group.date, format='%m/%d/%y')

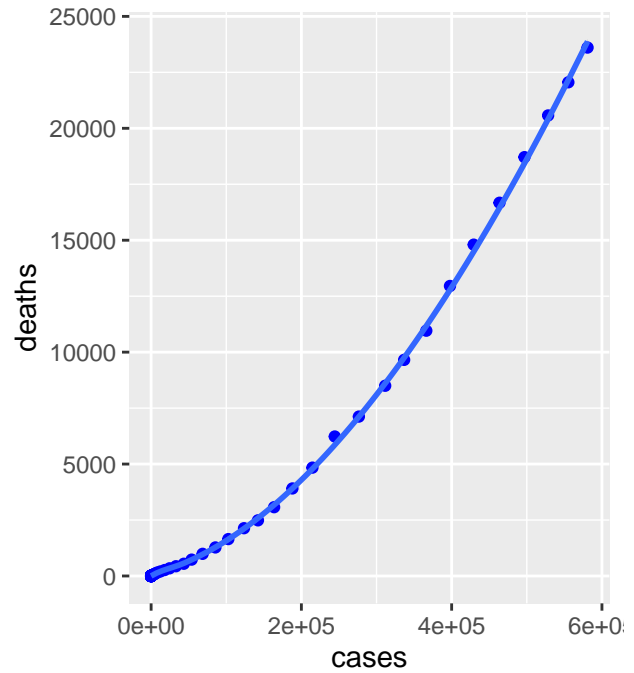
p<- ggplot(dta.sum,aes(x=Group.date))+geom_line(aes(y=cases, color="b"))+geom_line(aes(y=deaths,color="r"))
p2<- ggplot(dta.sum,aes(x=cases))+geom_point(aes(y=deaths),color="blue")+geom_smooth(aes(y=deaths), method="loess")
print(plot_grid(p,p2, align="h",axis = 'b'))
```

**Death and Case Trajectory in the US
until April 13**



Key — Cases — Deaths

**Cases vs. Deaths in the US
until April 13**

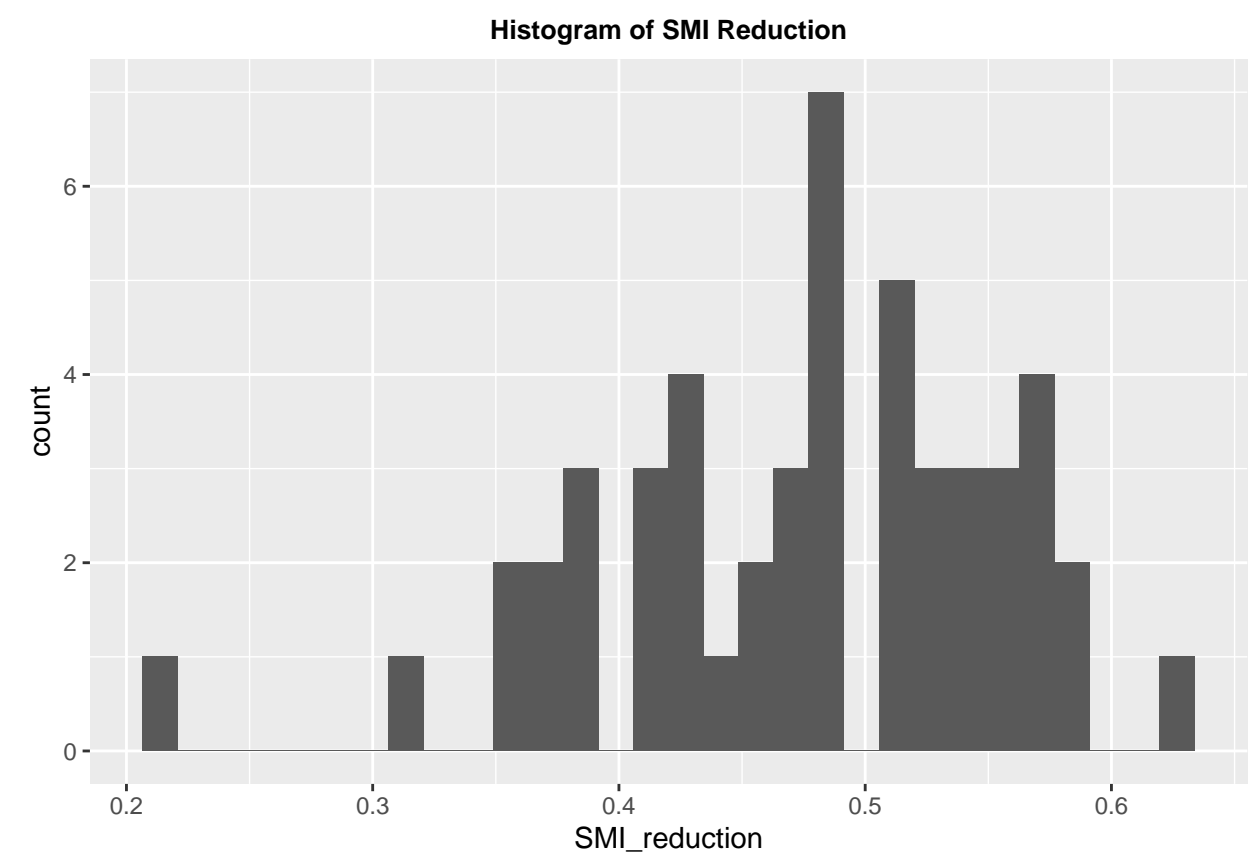


Predictor Assessment

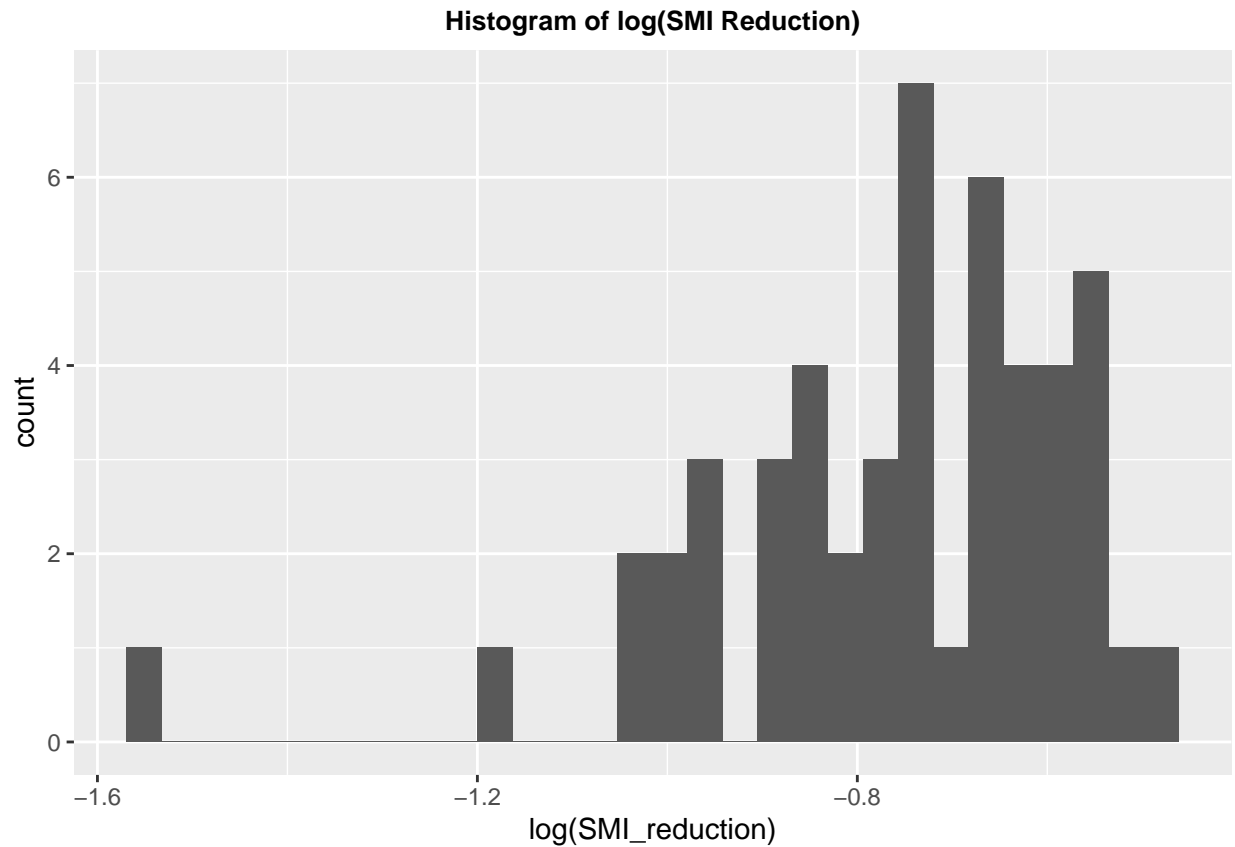
#Linearity, Constant Variance, Normality, and Independence Assumptions

#EDA Response: SMI_reduction

`ggplot(data=modelPrep, aes(SMI_reduction))+geom_histogram()+ggtitle(paste("Histogram of SMI Reduction"))`



```
ggplot(data=modelPrep, aes(log(SMI_reduction)))+geom_histogram()+ggtitle(paste("Histogram of log(SMI Red
```



```

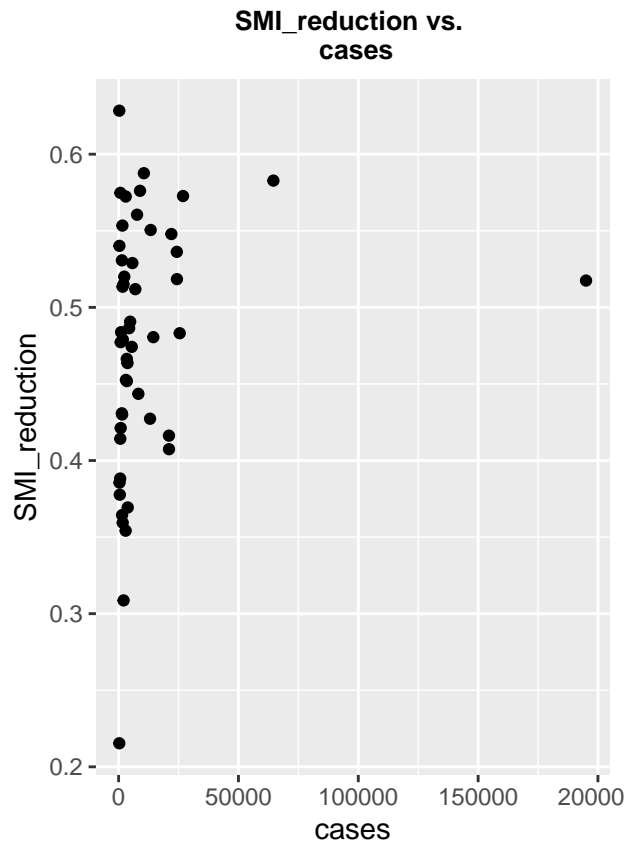
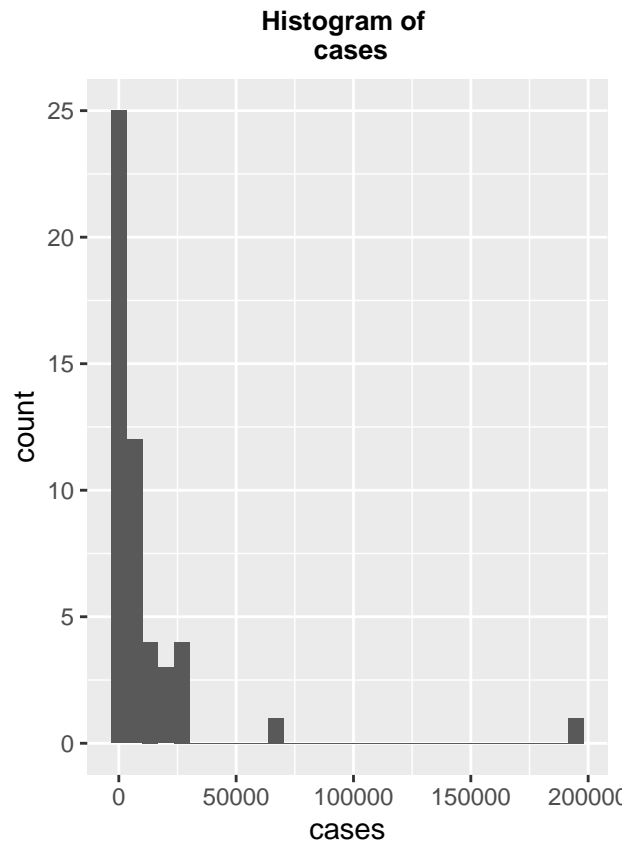
#EDA Predictors
for (i in 2:ncol(modelPrep)) { # Loop over loop.vector

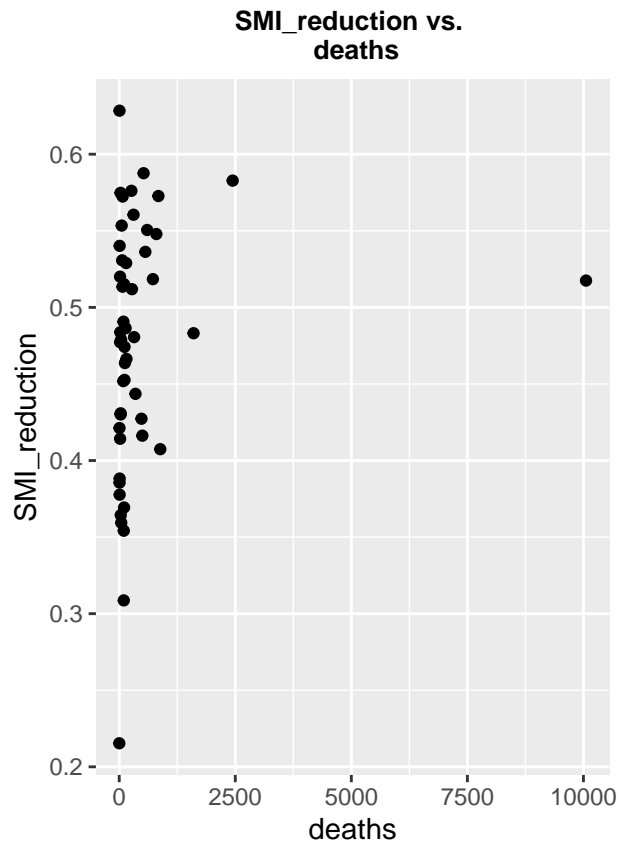
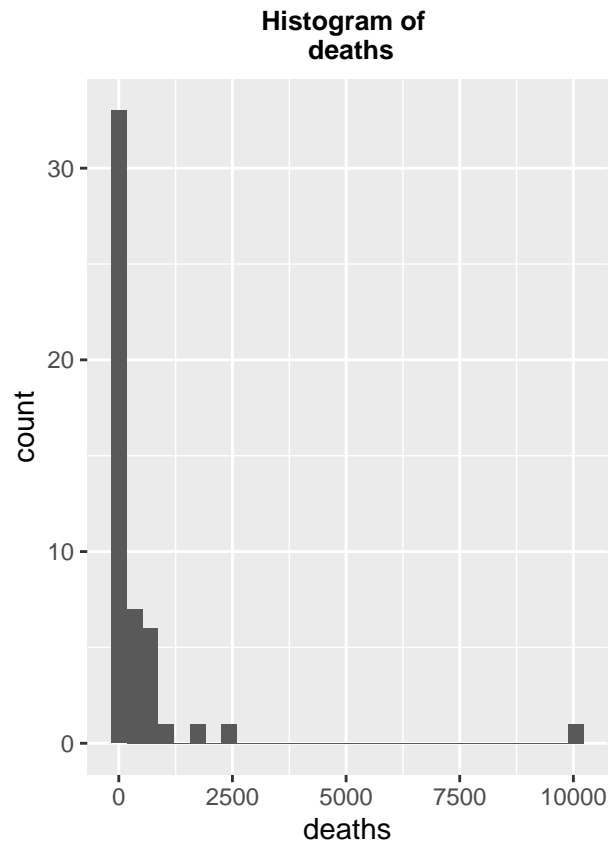
  # store data in column.i as x
  x <- modelPrep[,i]
  # Plot histogram of x
  p1<- ggplot(data=modelPrep, aes(x))+geom_histogram()+ggtitle(paste("Histogram of \n",names(modelPrep)

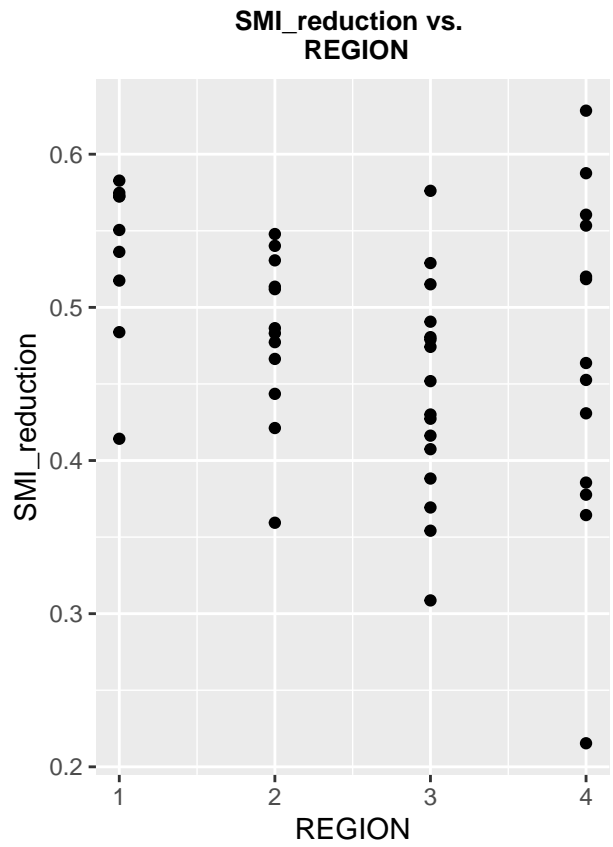
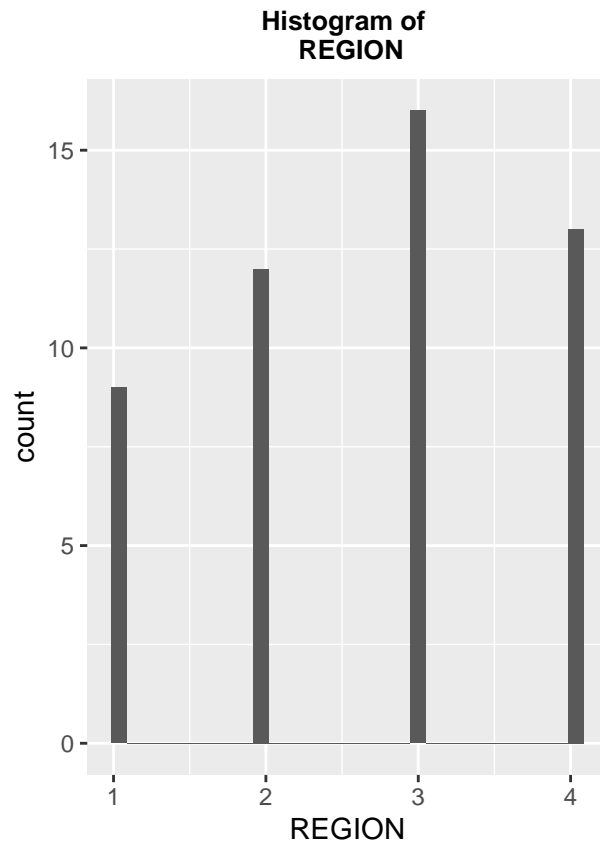
  #Plot Scatterplot
  p2<- ggplot(data=modelPrep, aes(x,SMI_reduction))+geom_point()+ggtitle(paste("SMI_reduction vs. \n",n

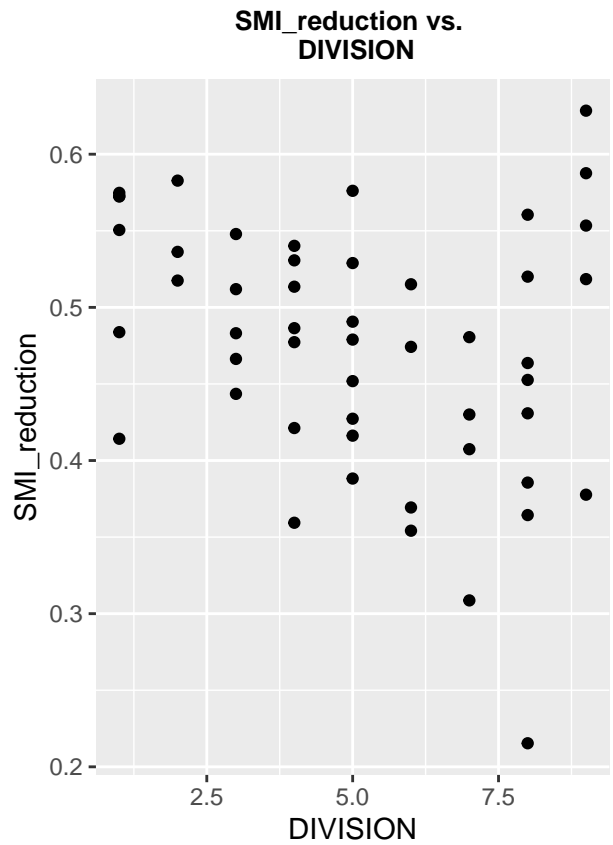
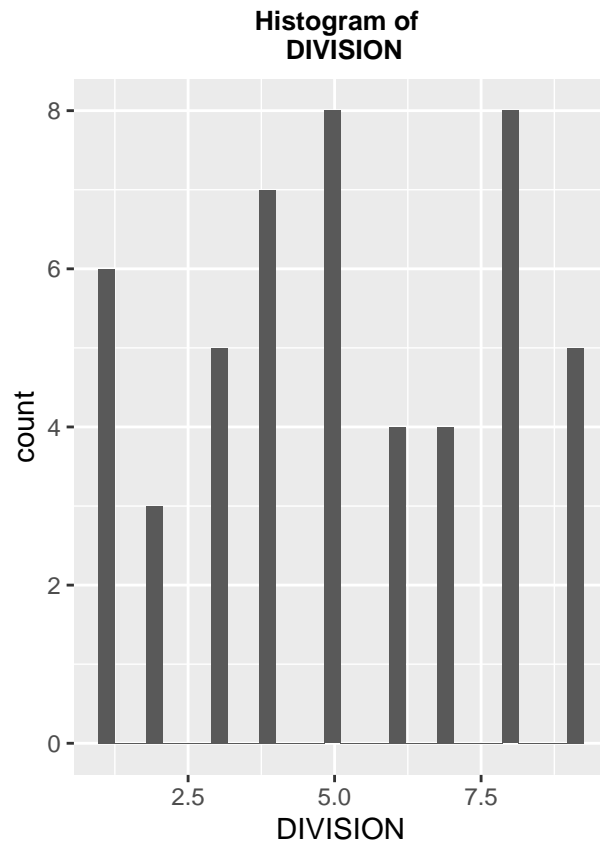
  print(plot_grid(p1,p2))
}

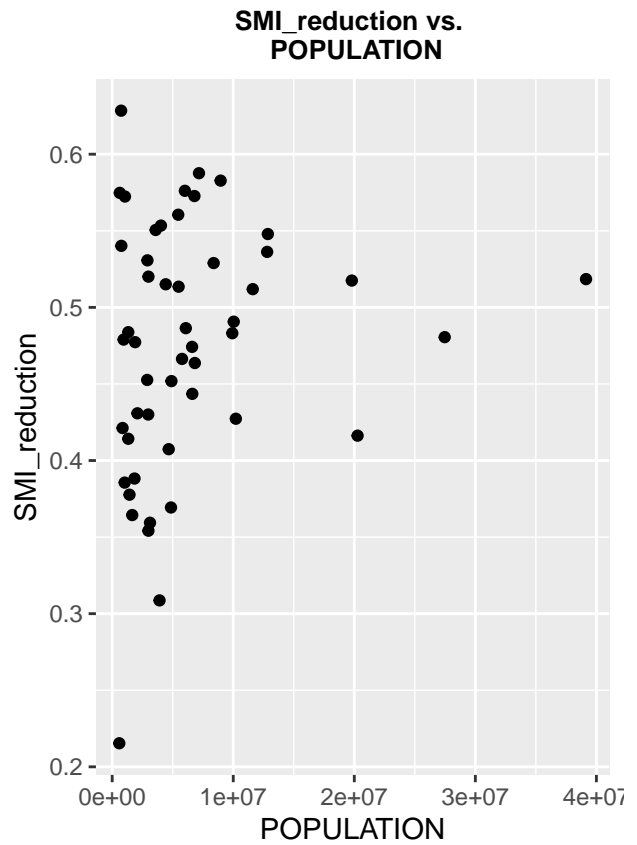
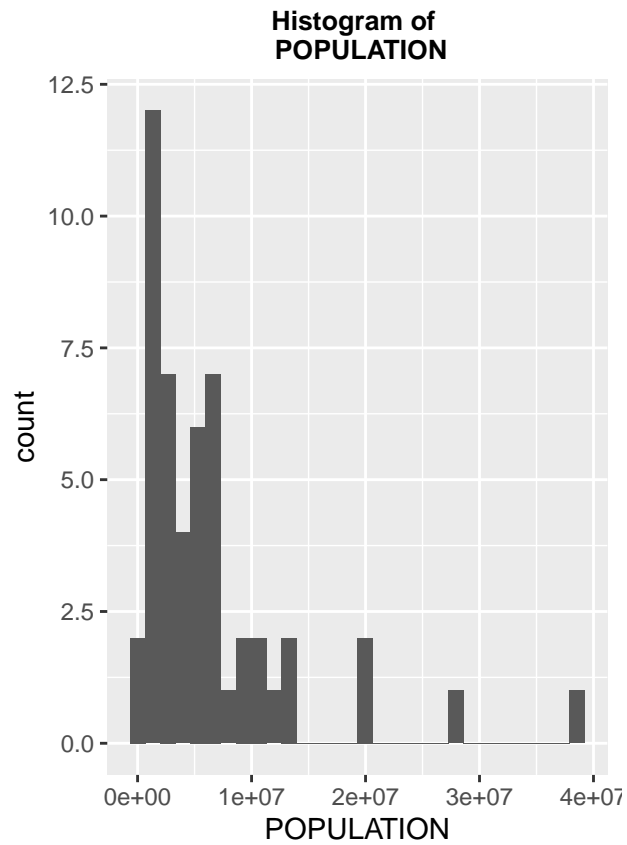
```

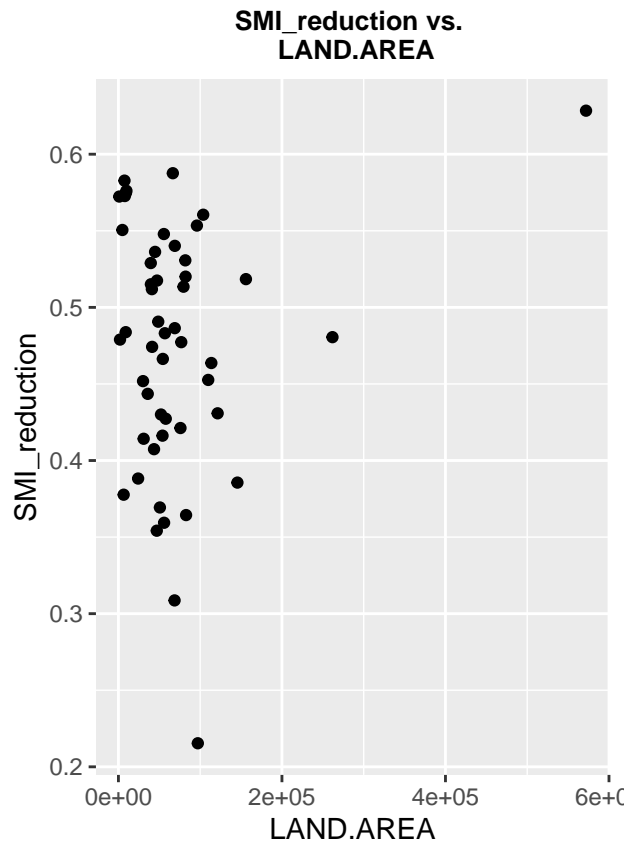
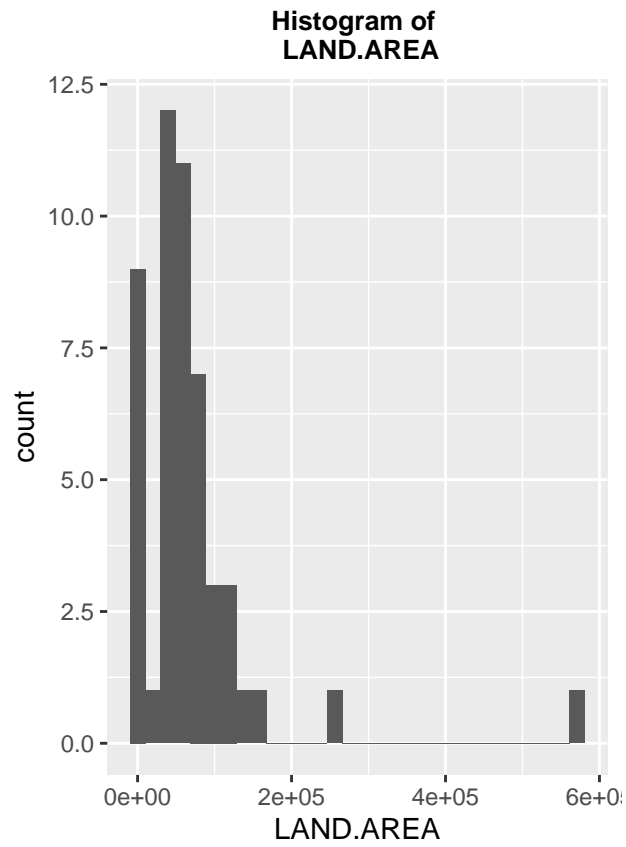



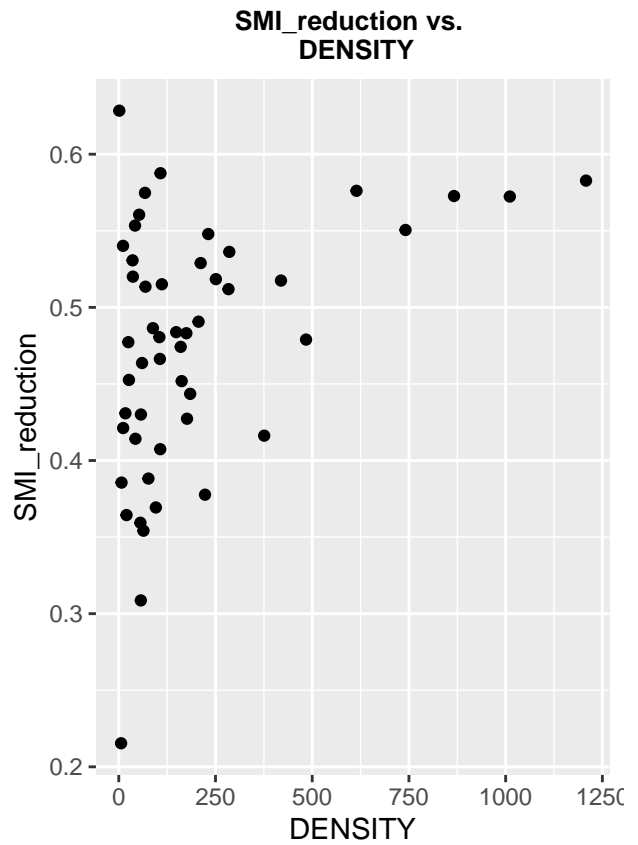
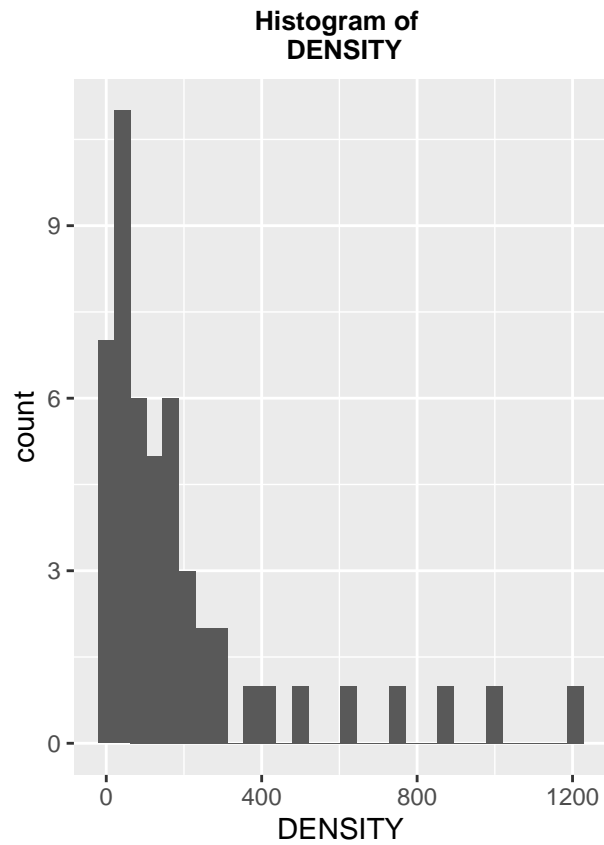


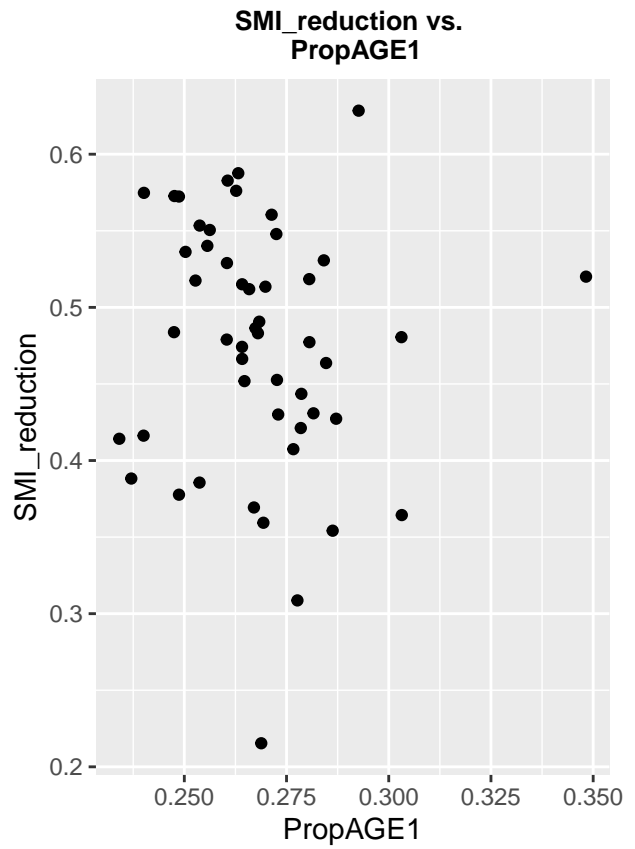
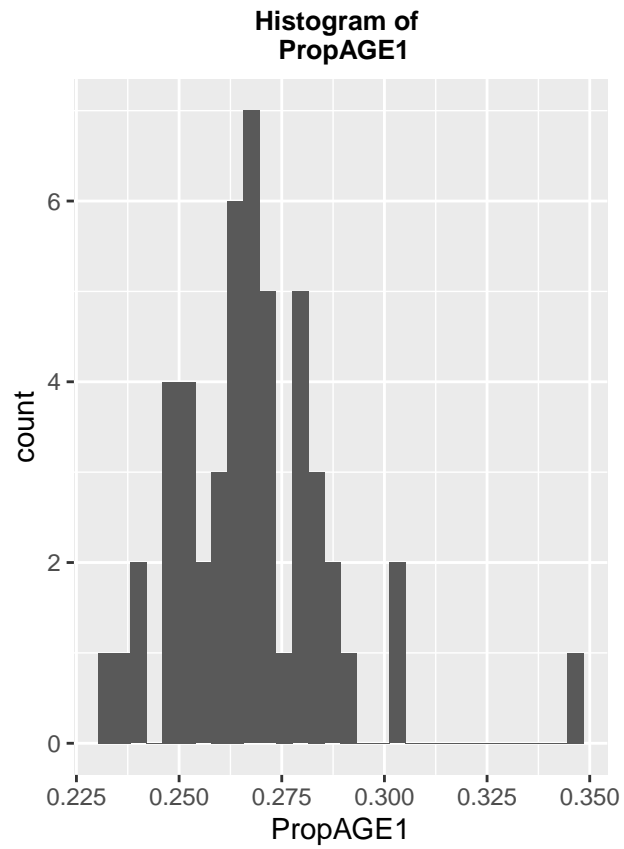


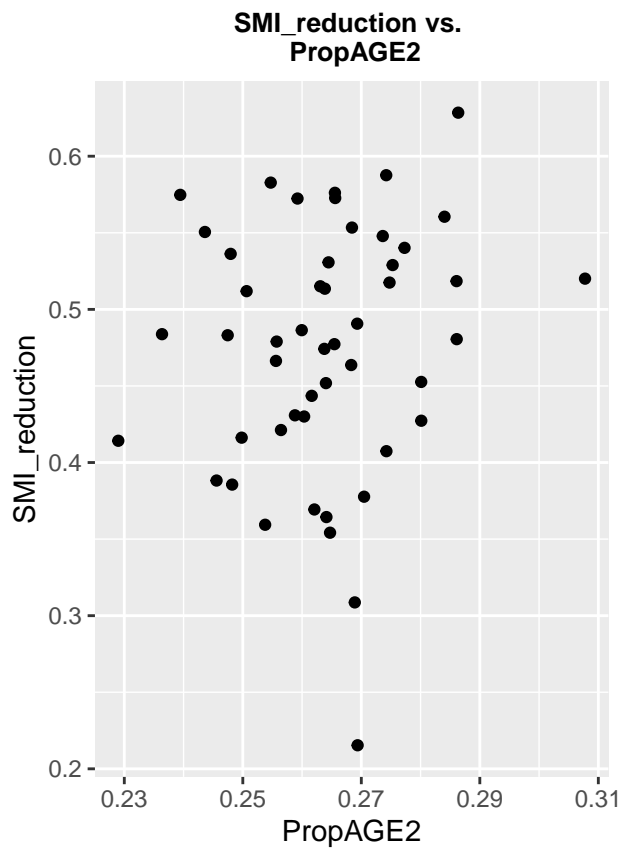
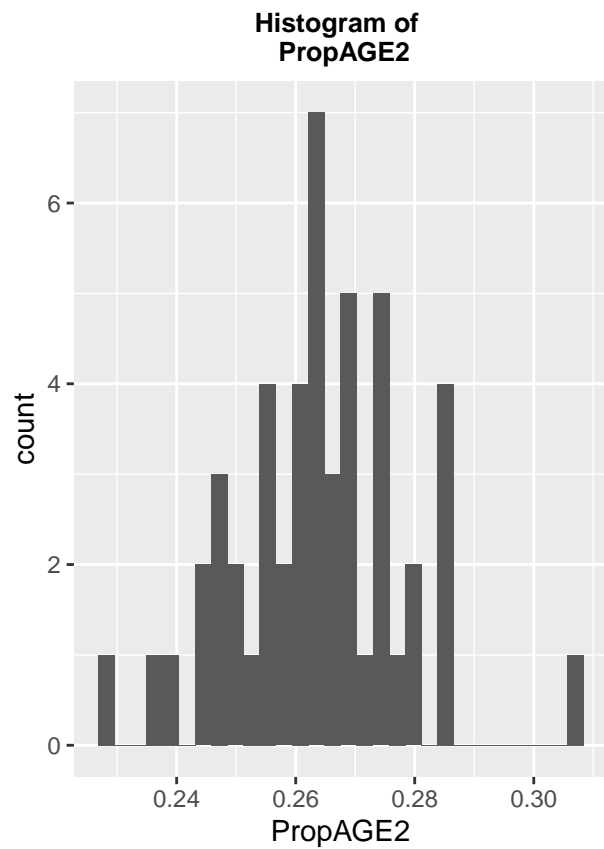


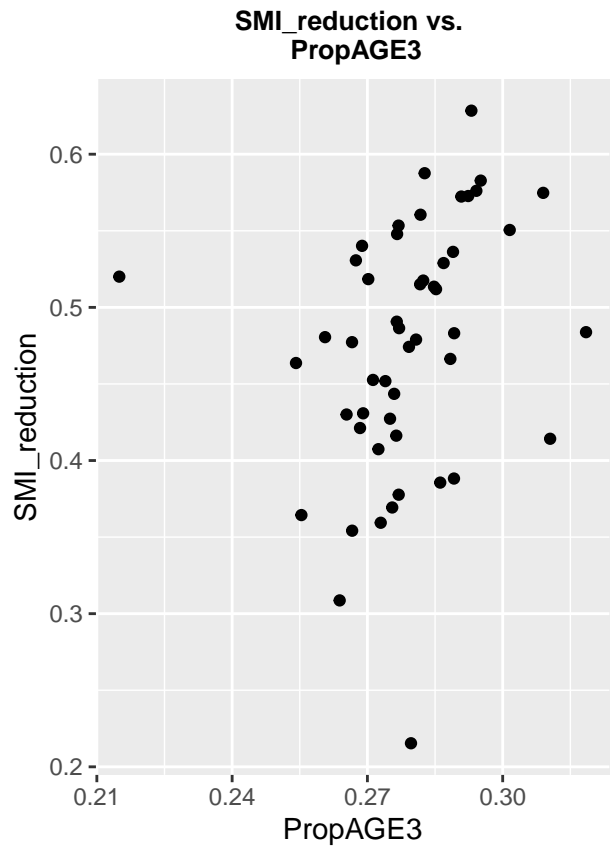
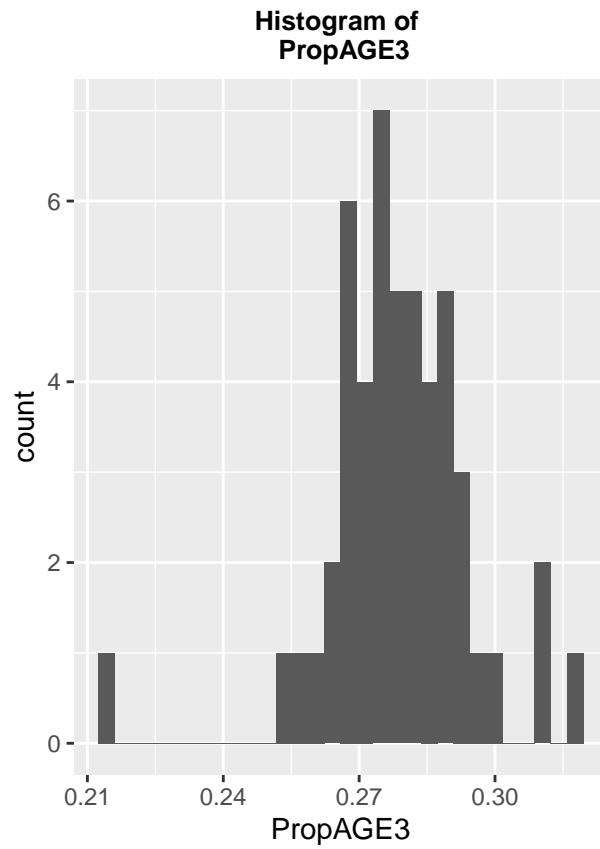


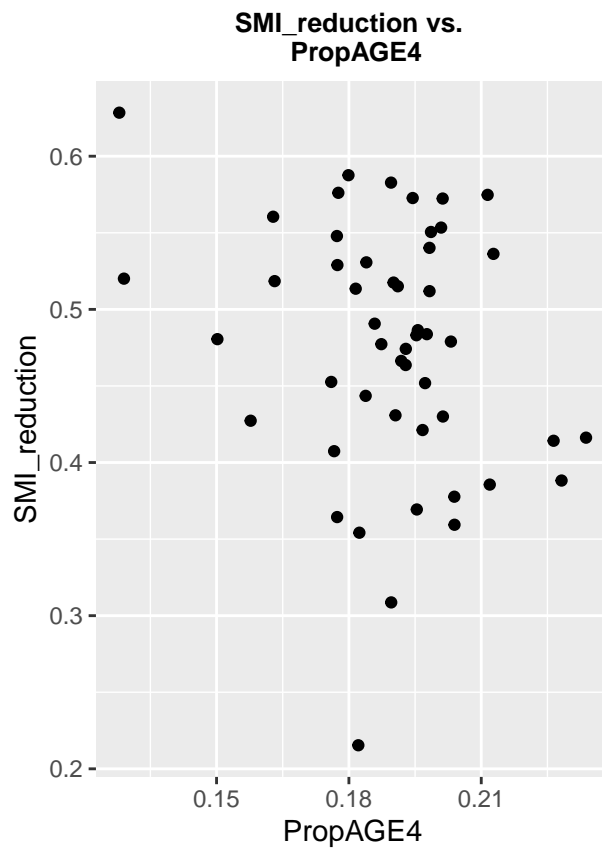
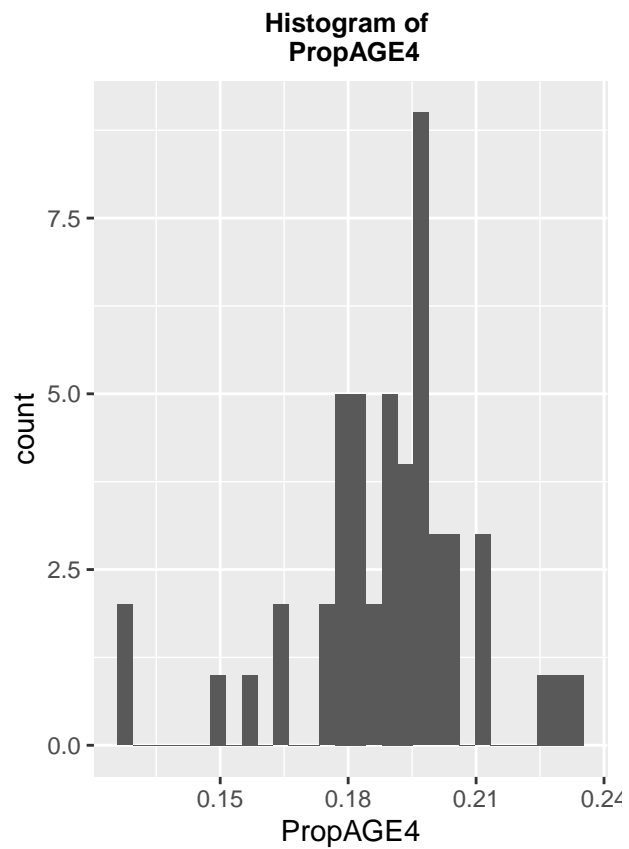


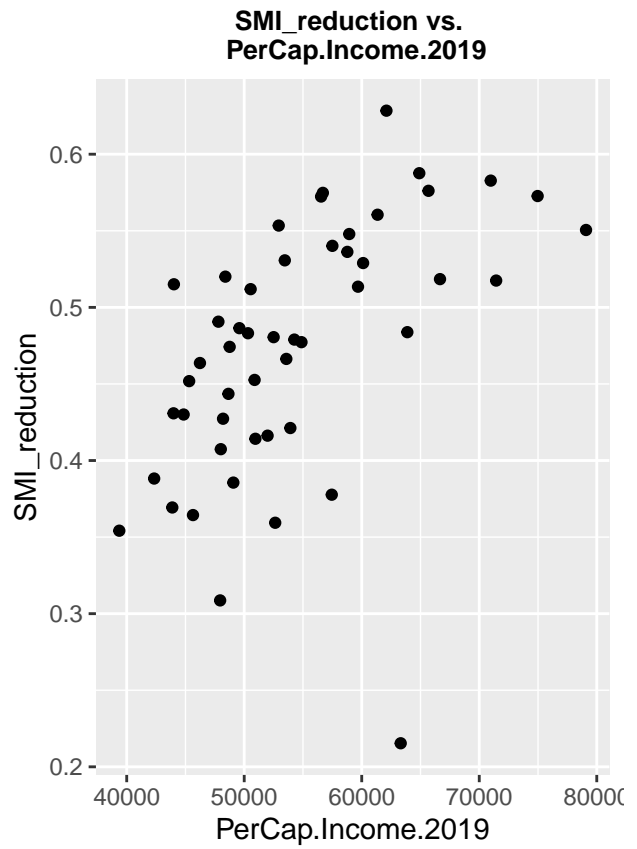
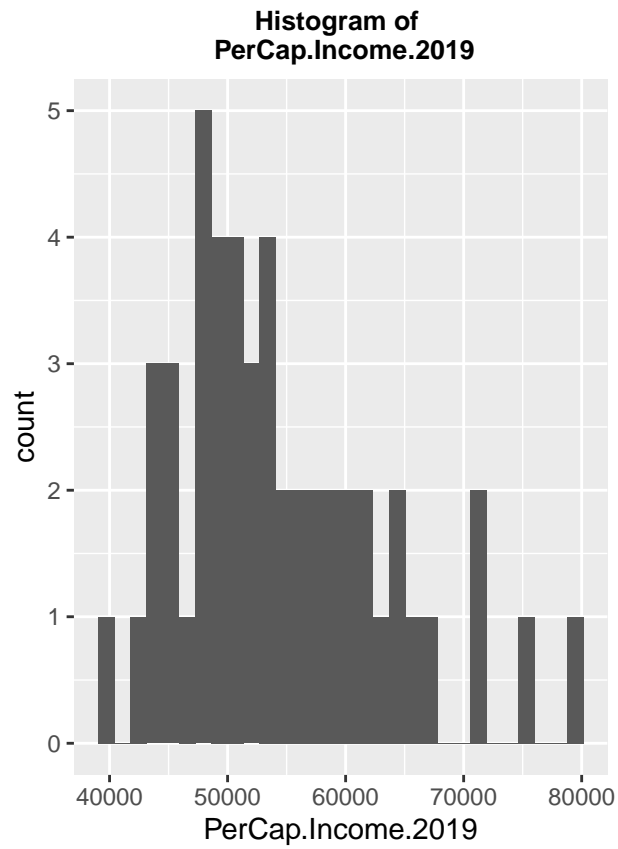


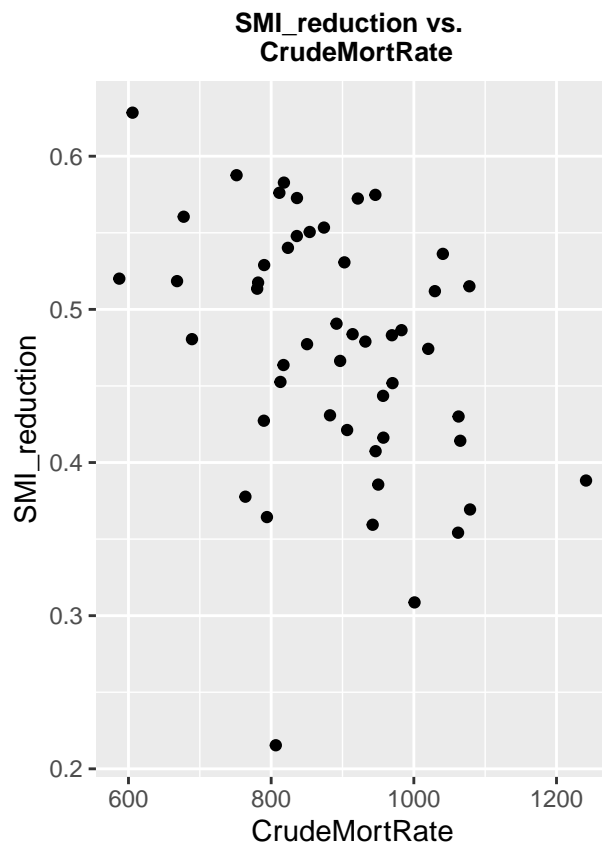
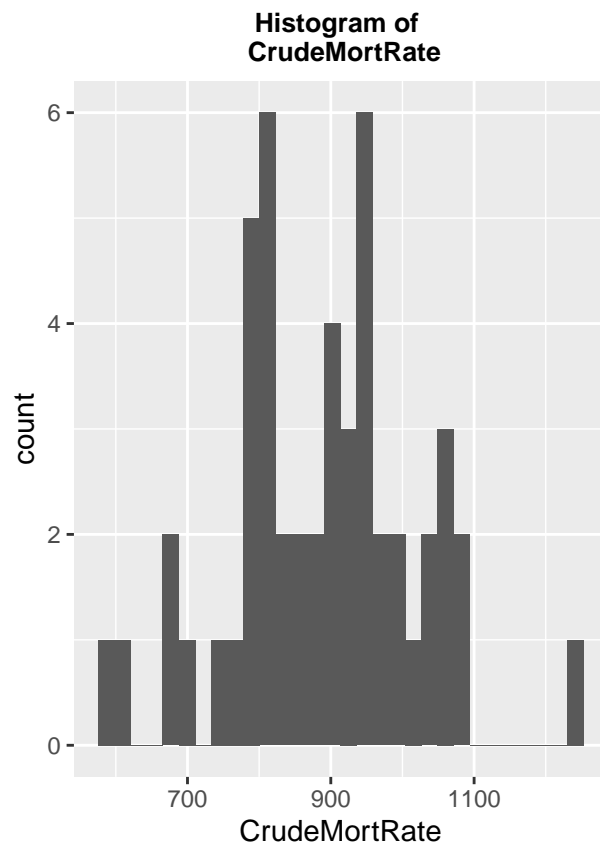


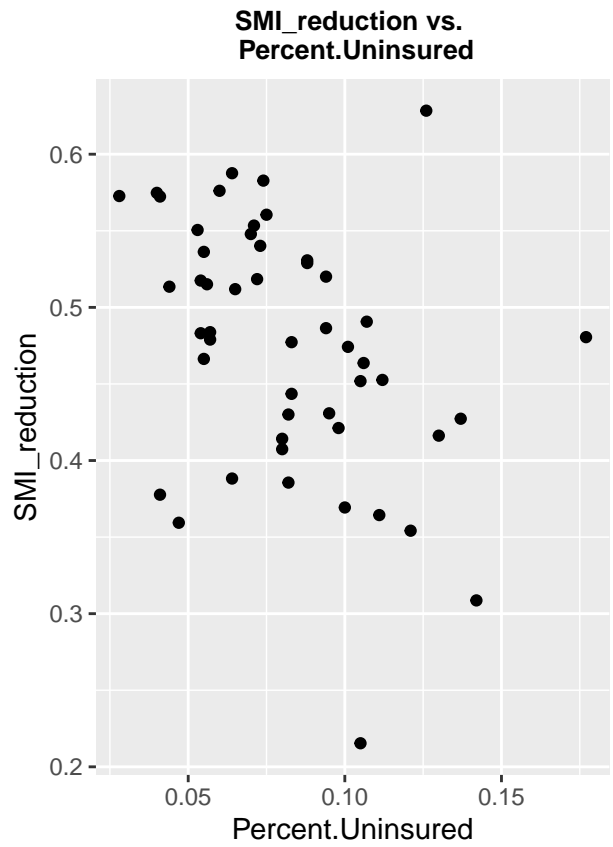
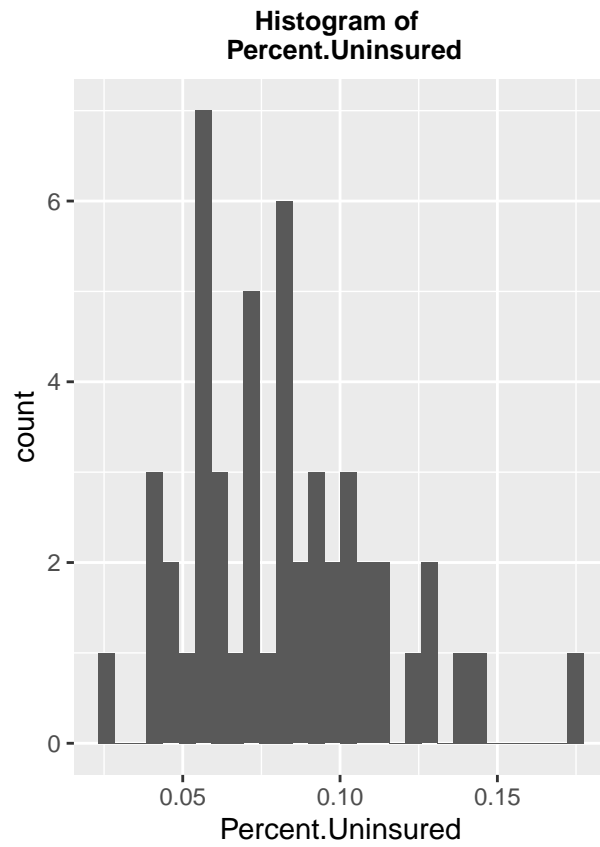


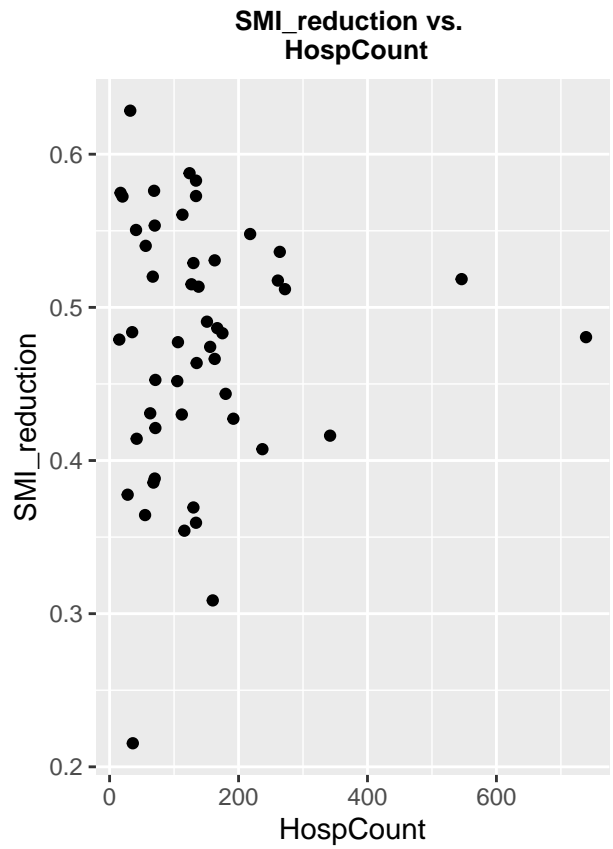
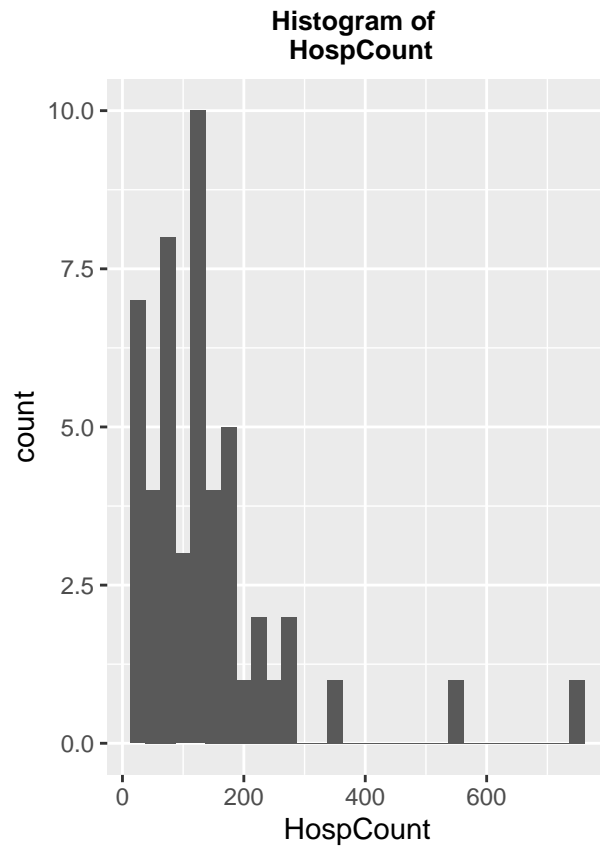


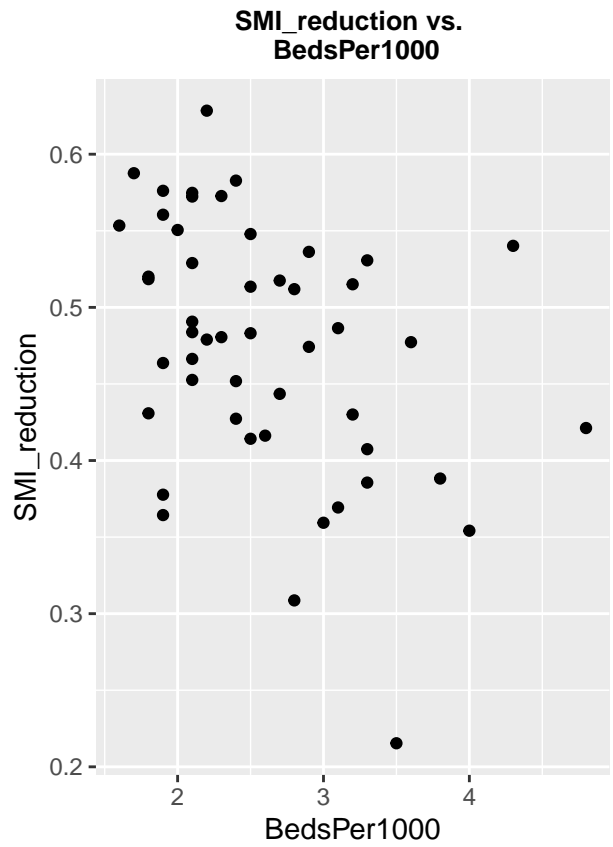
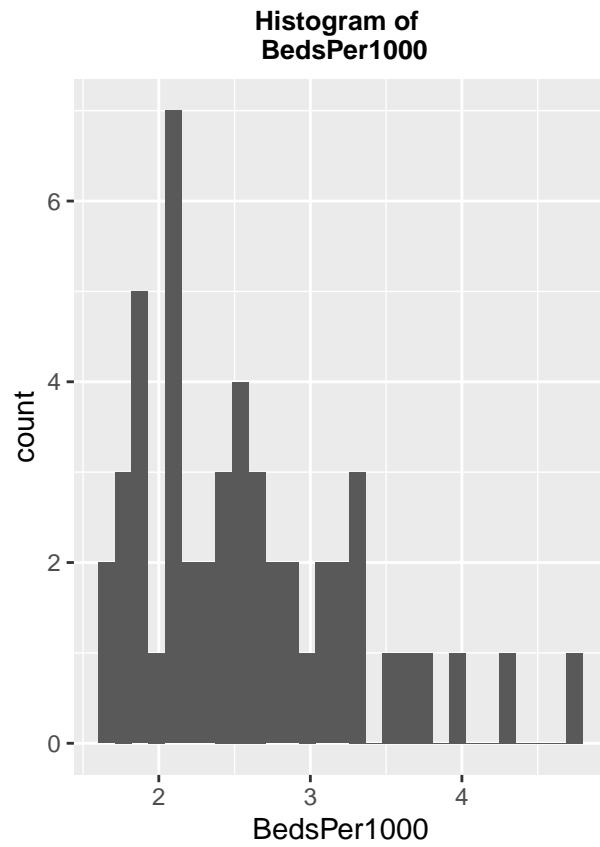


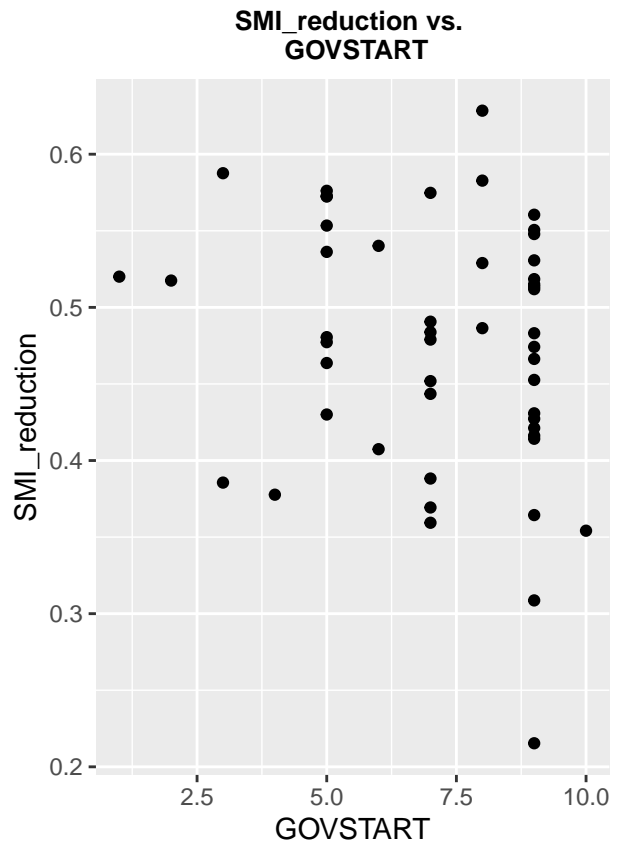
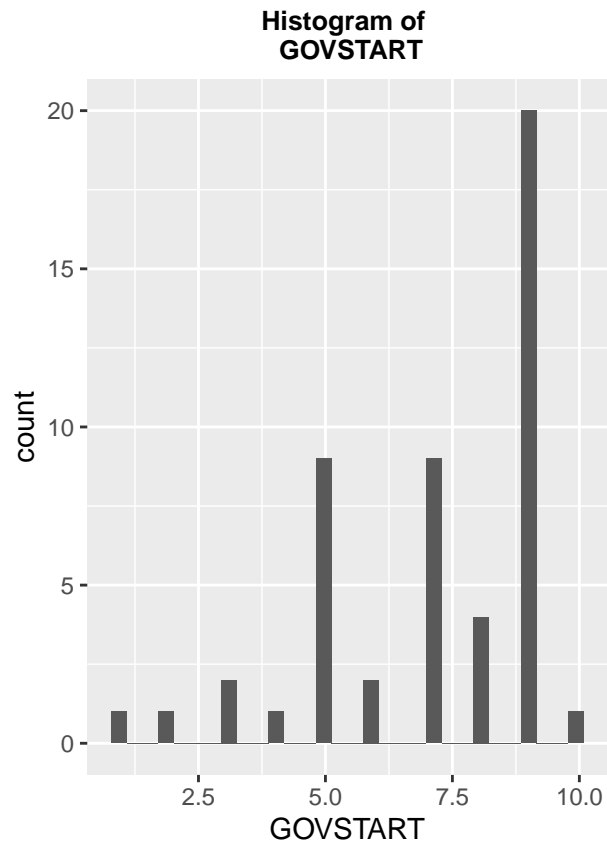


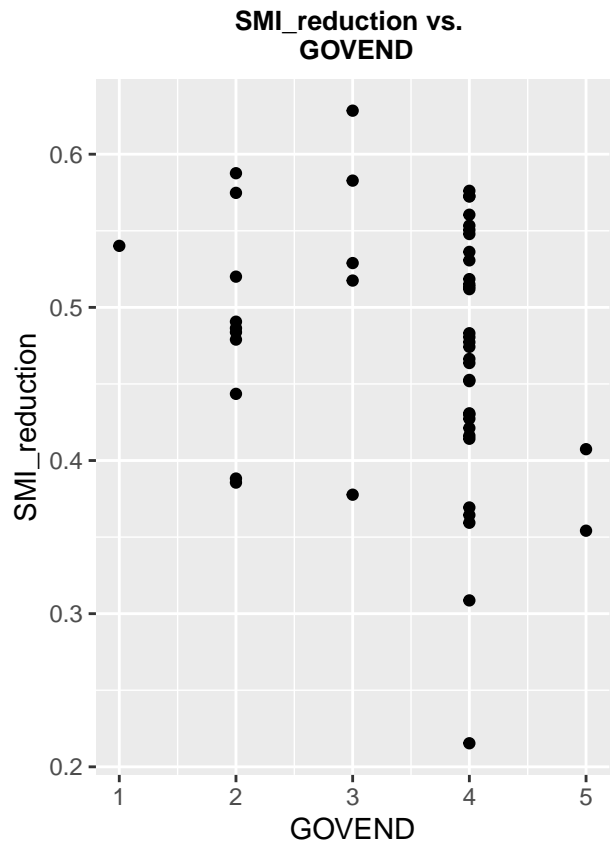
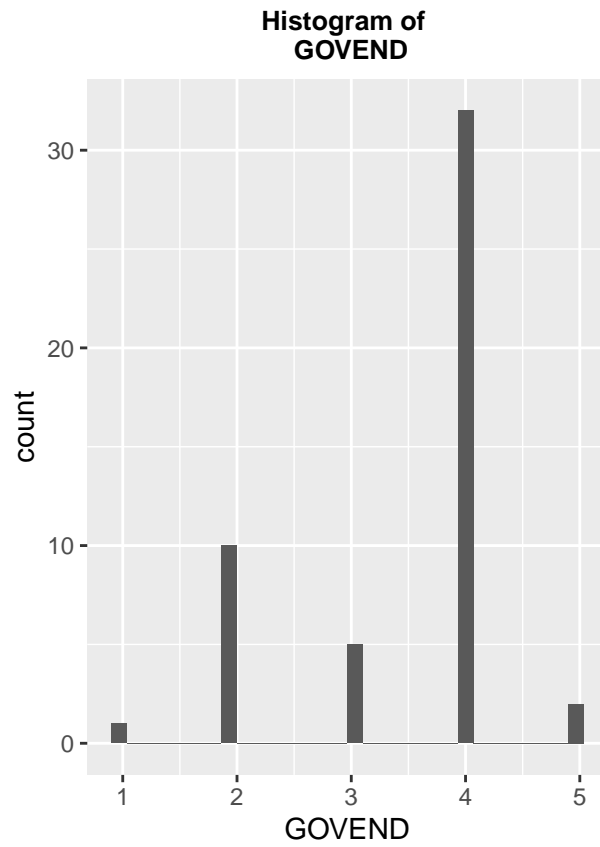


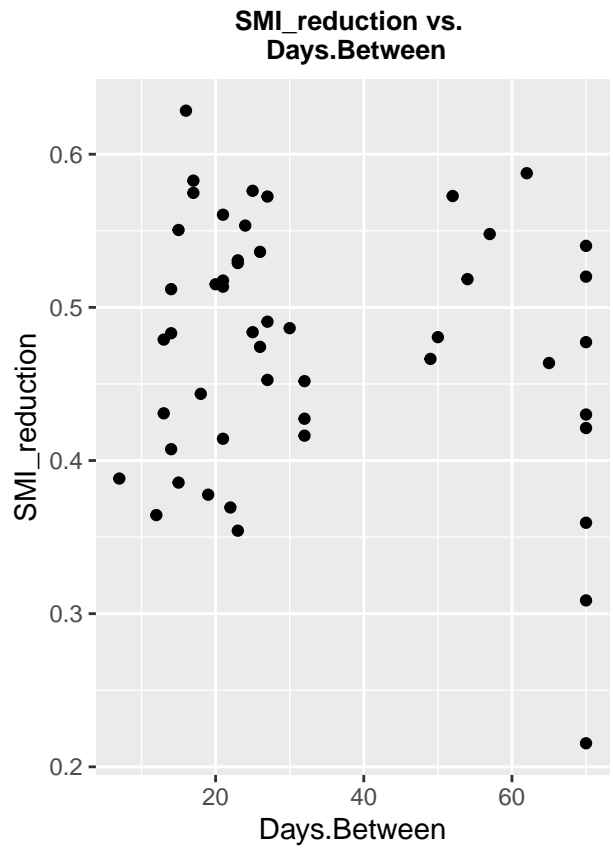
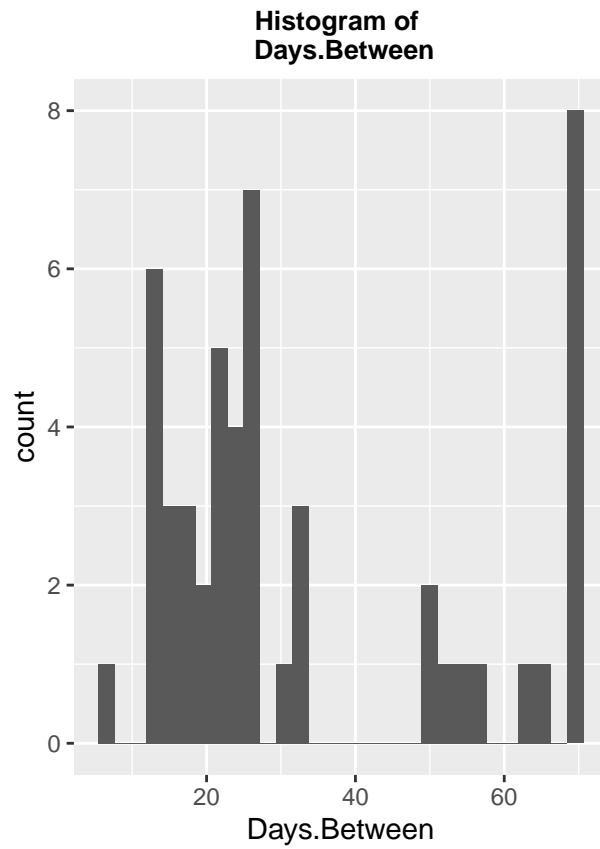


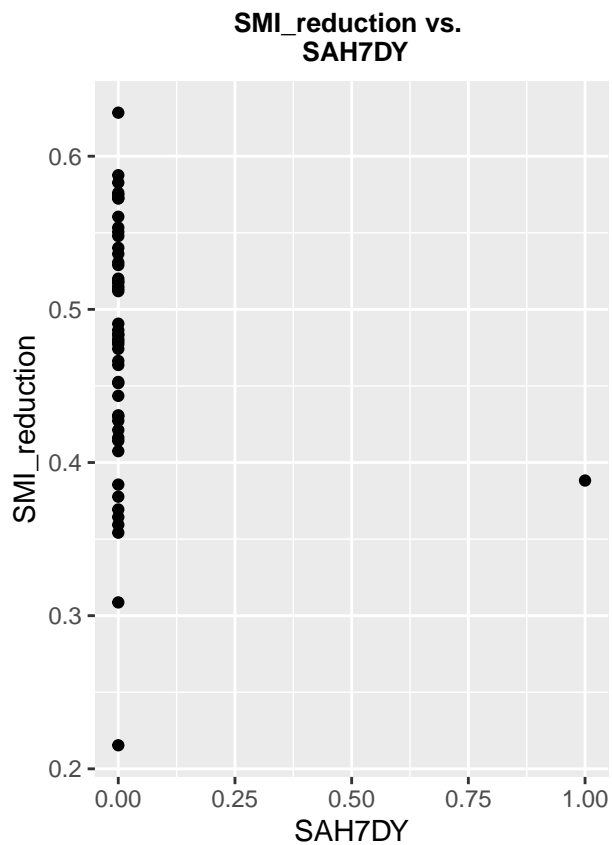
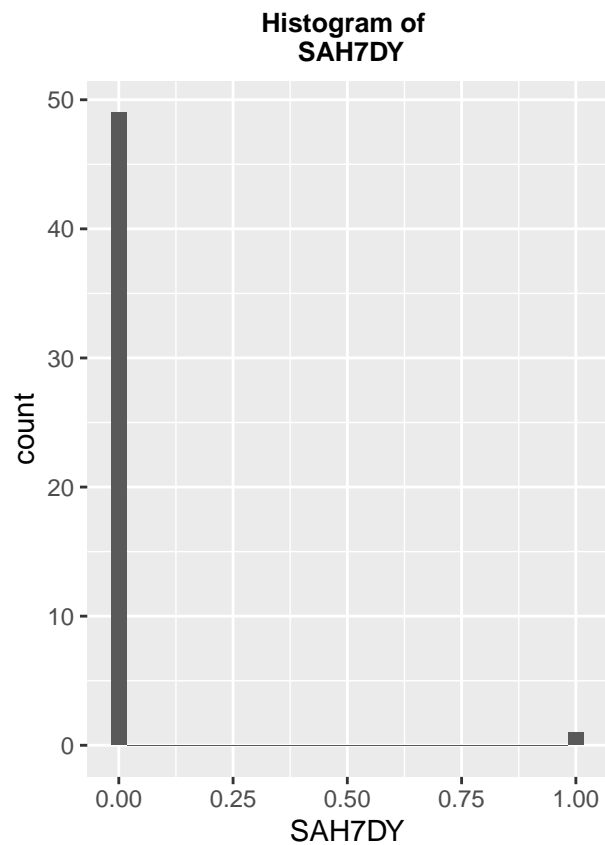


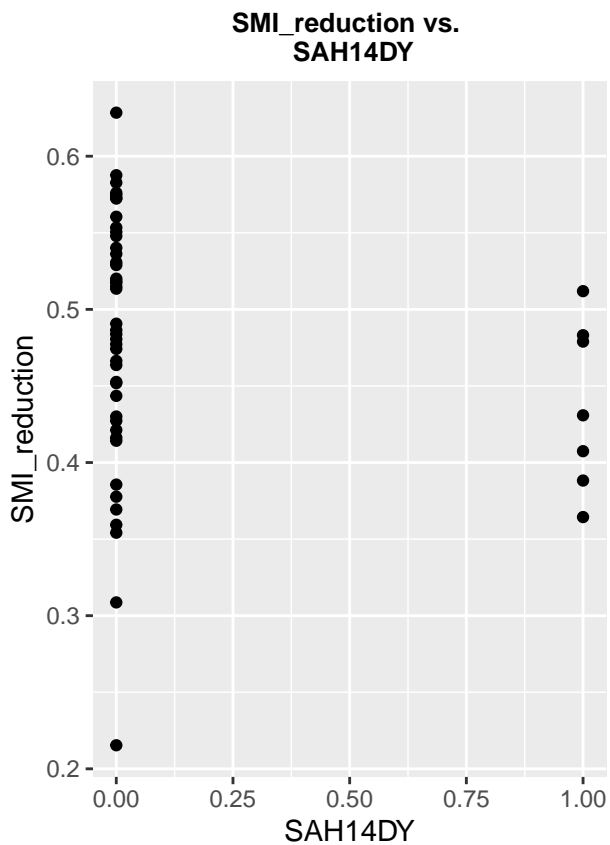
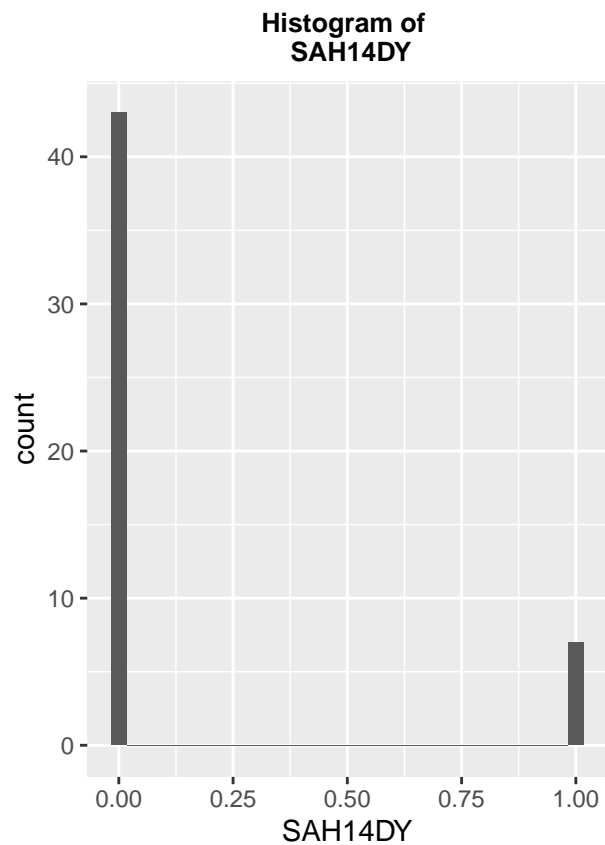


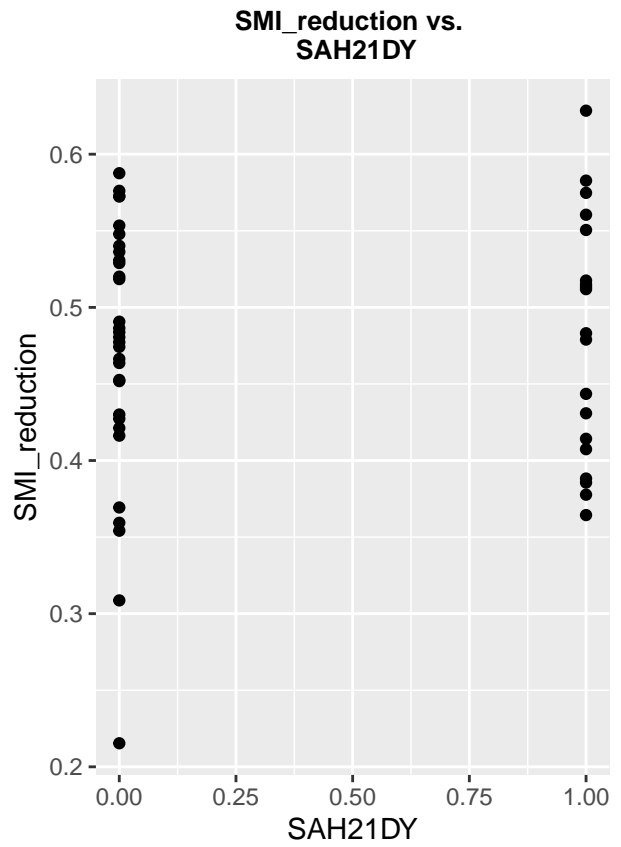
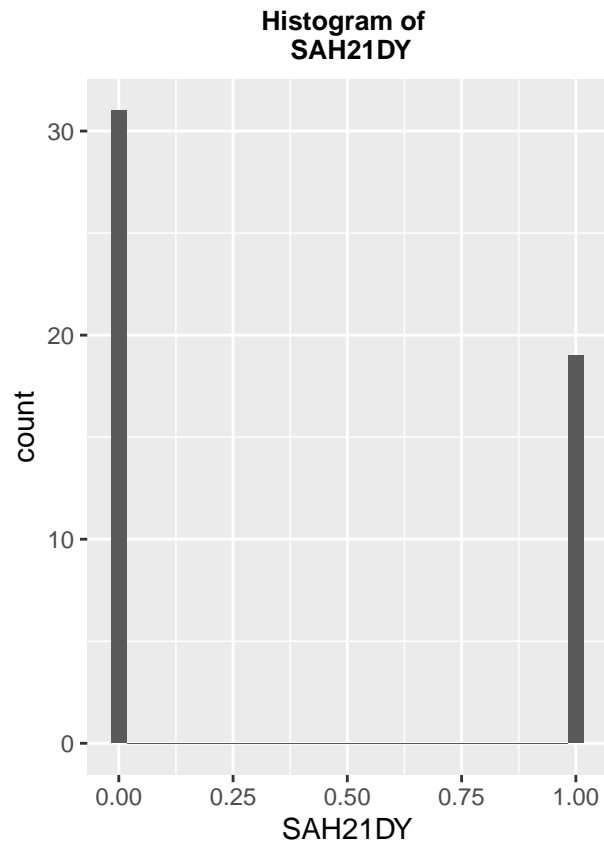


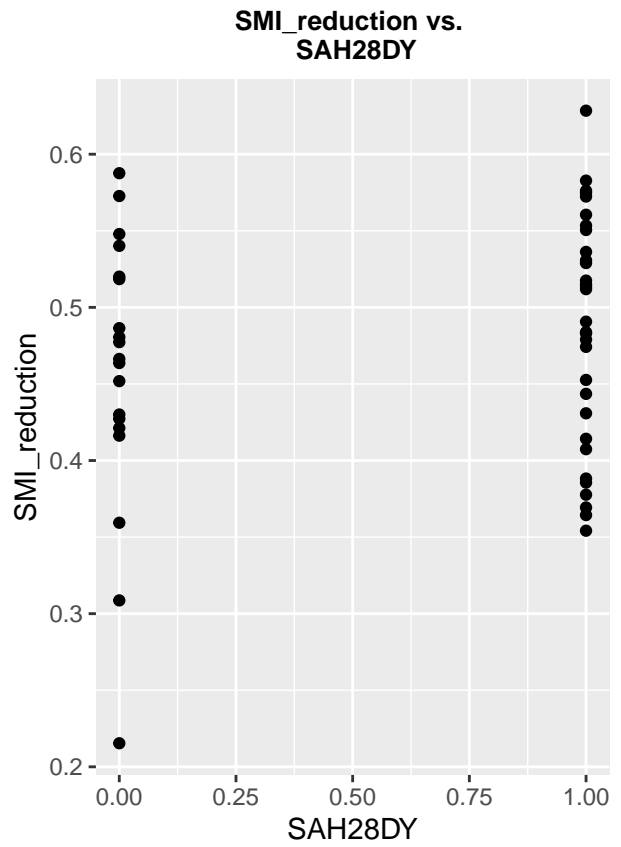
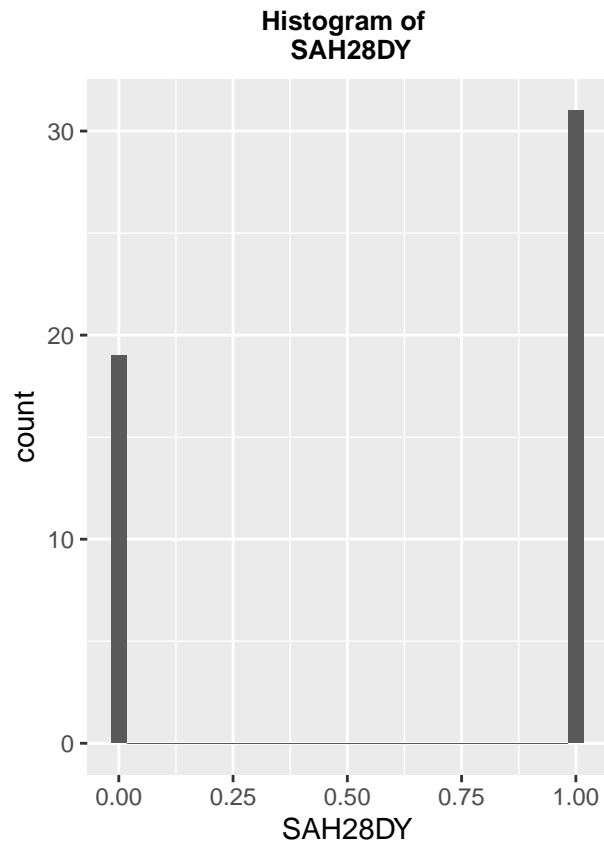


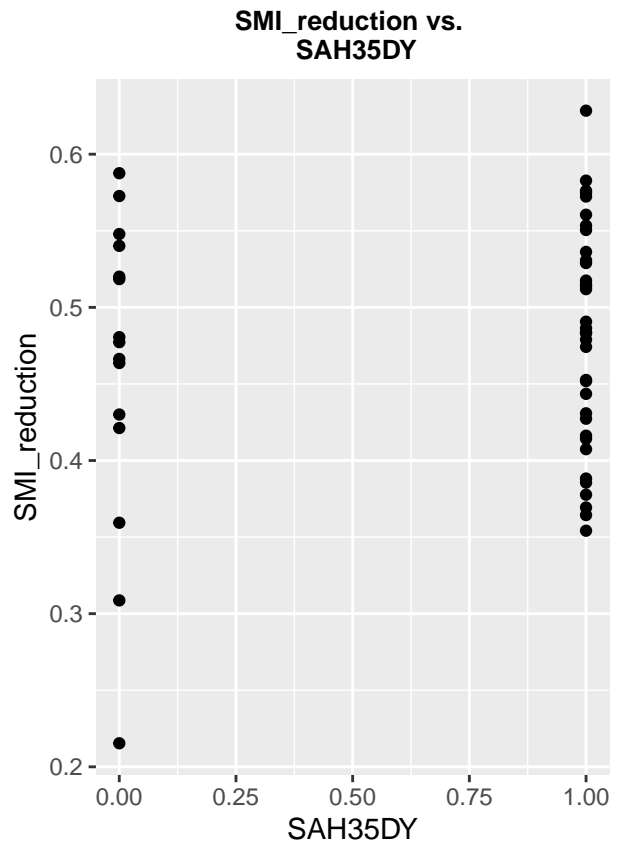
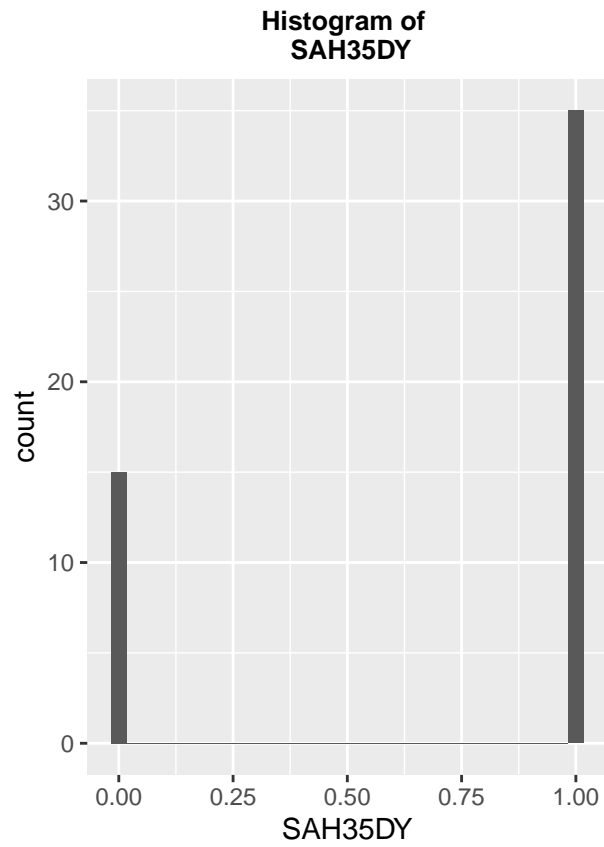


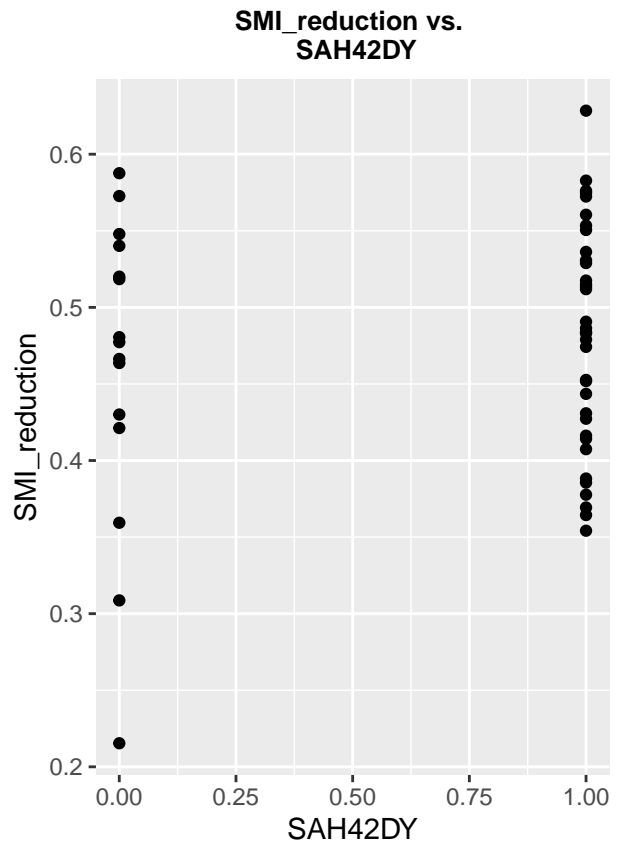
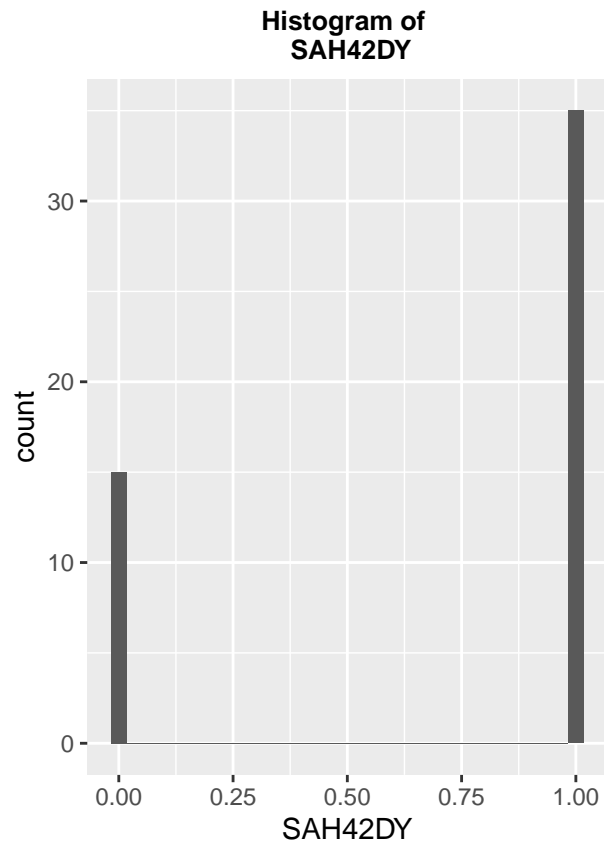


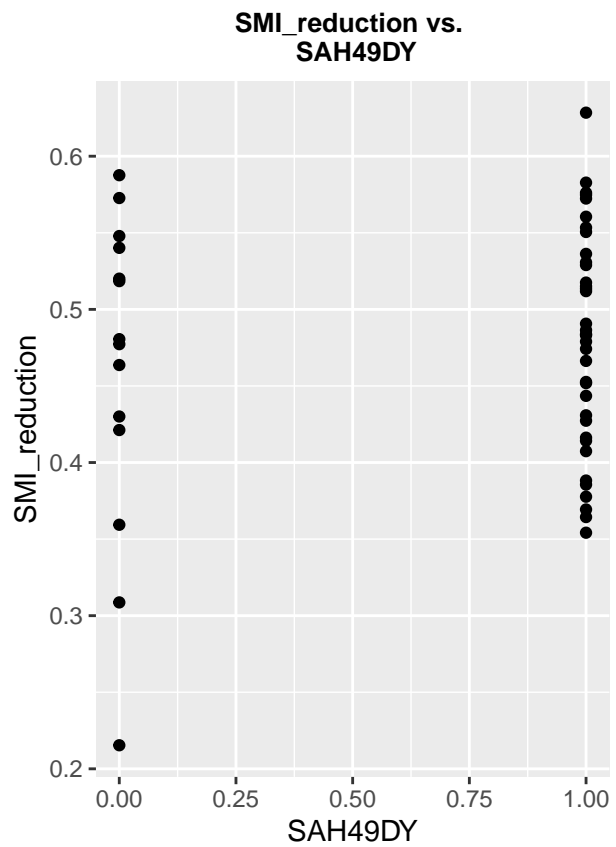
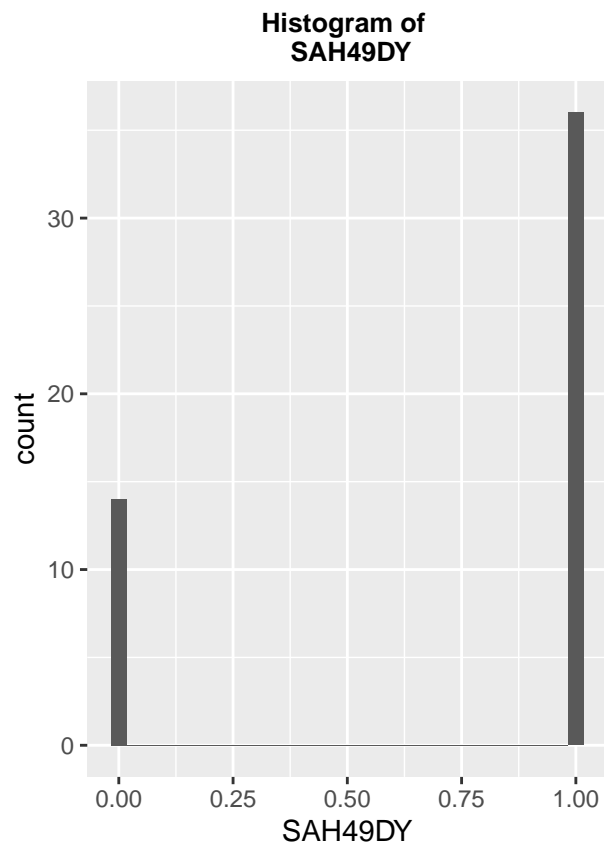


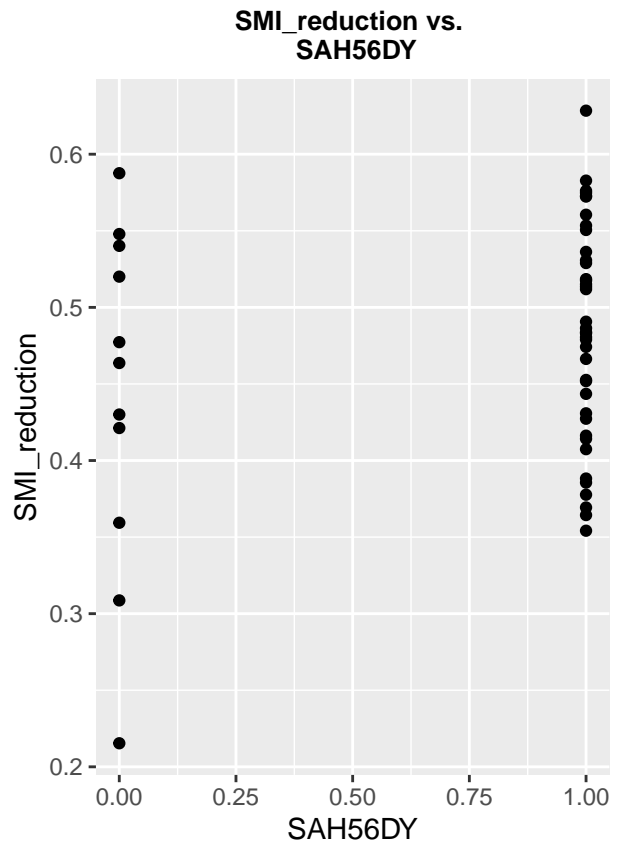
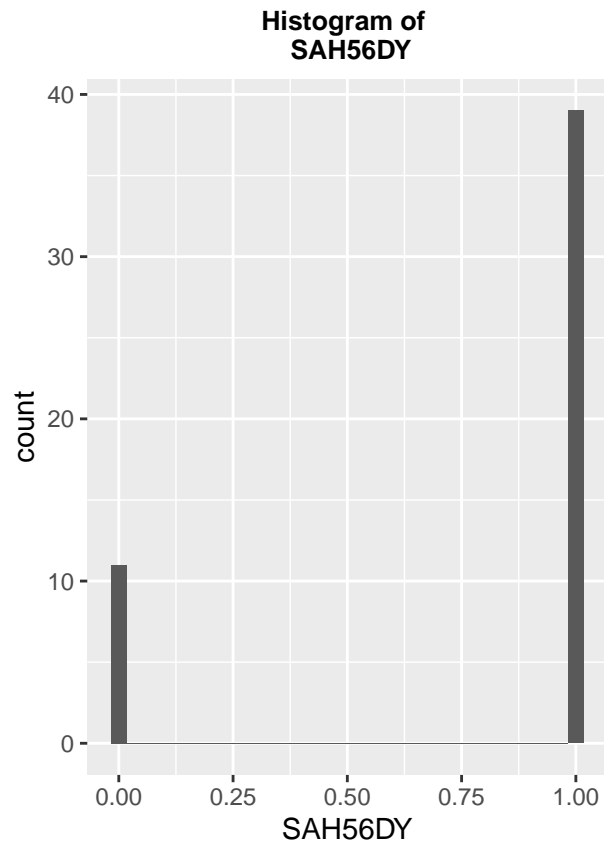


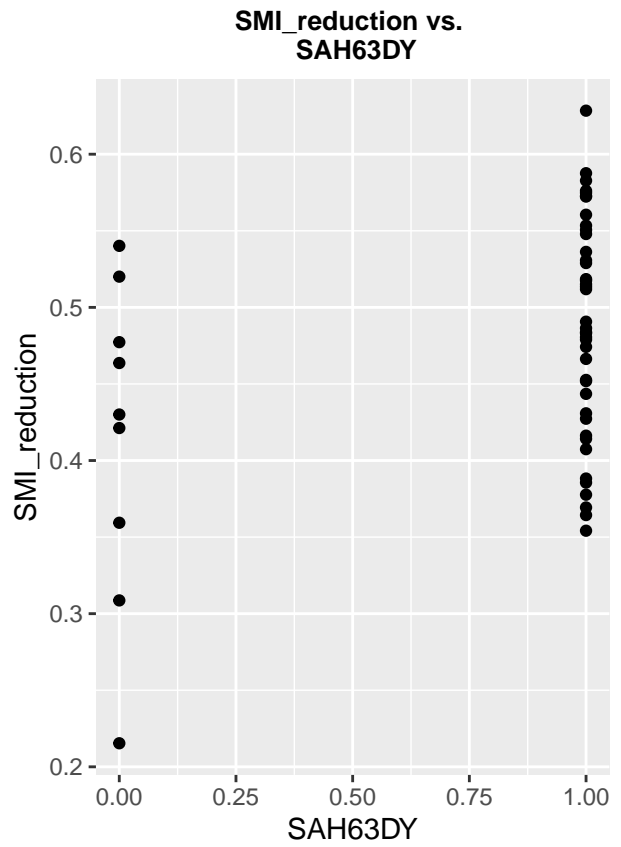
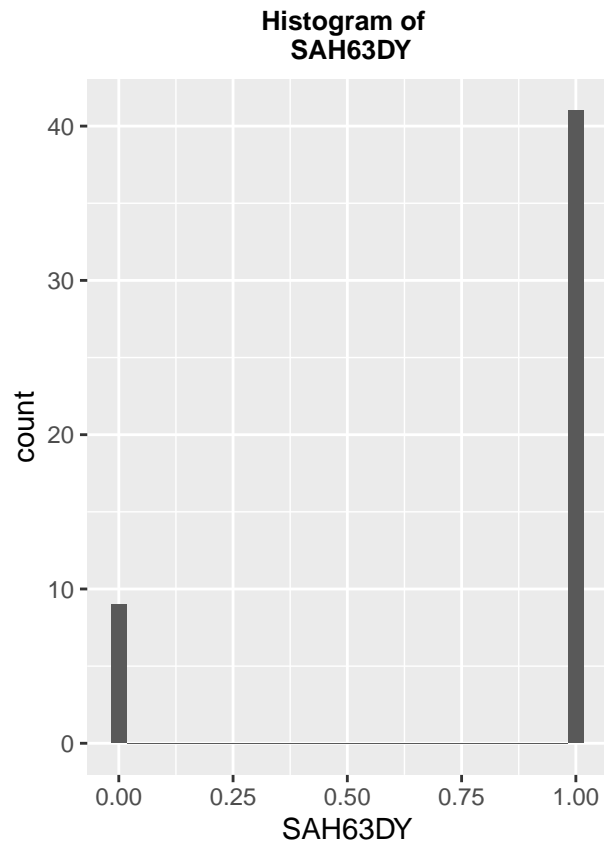


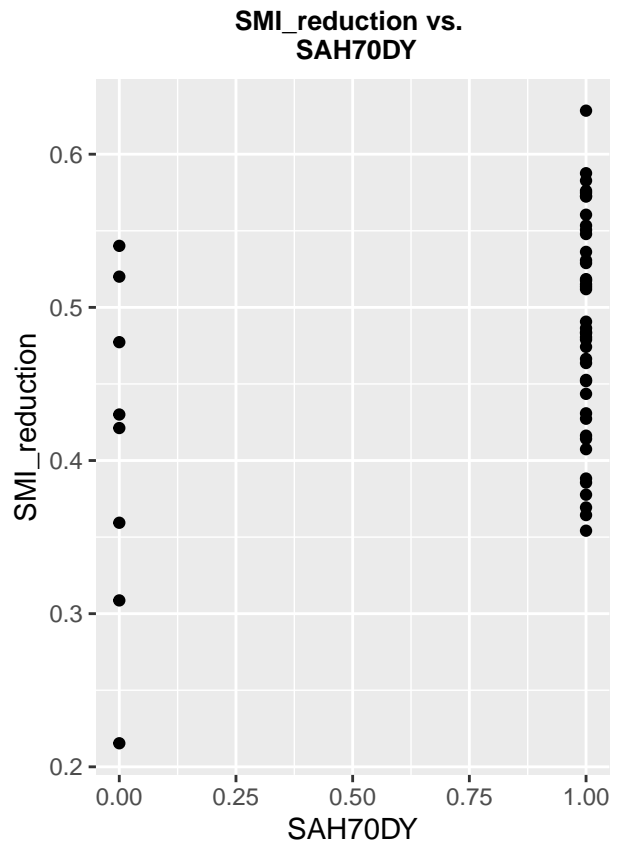
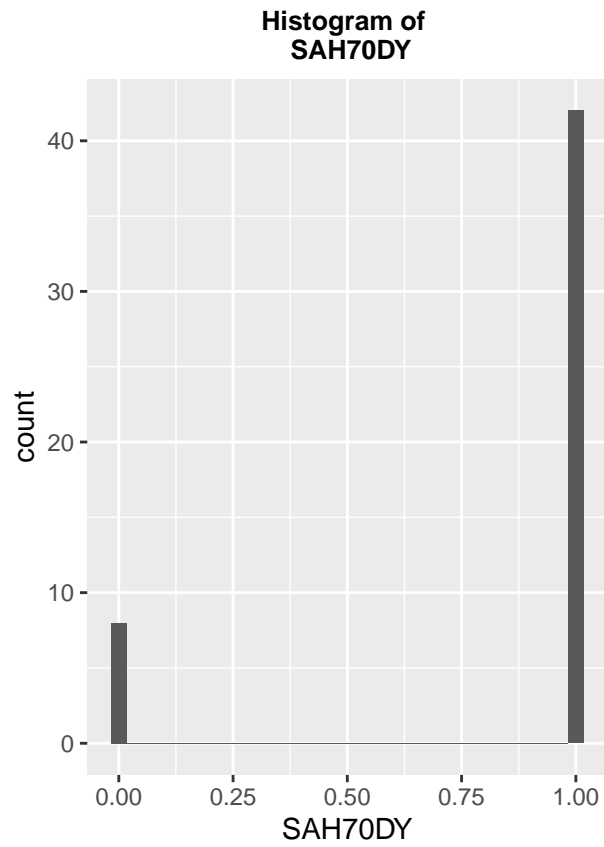


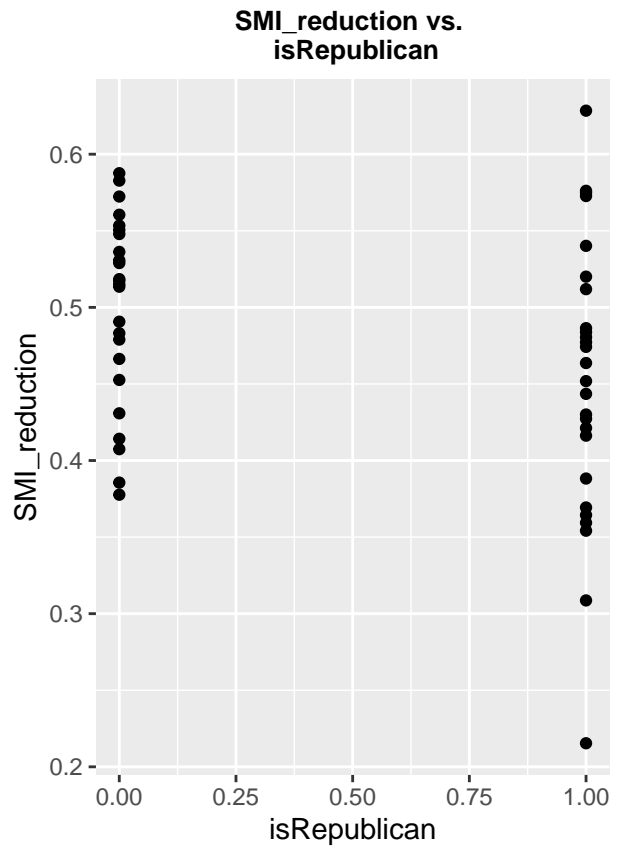
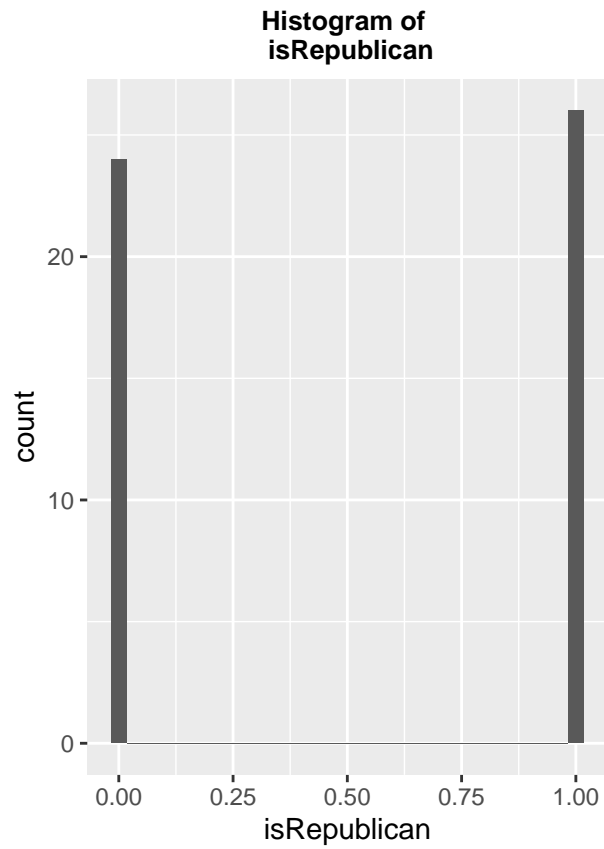


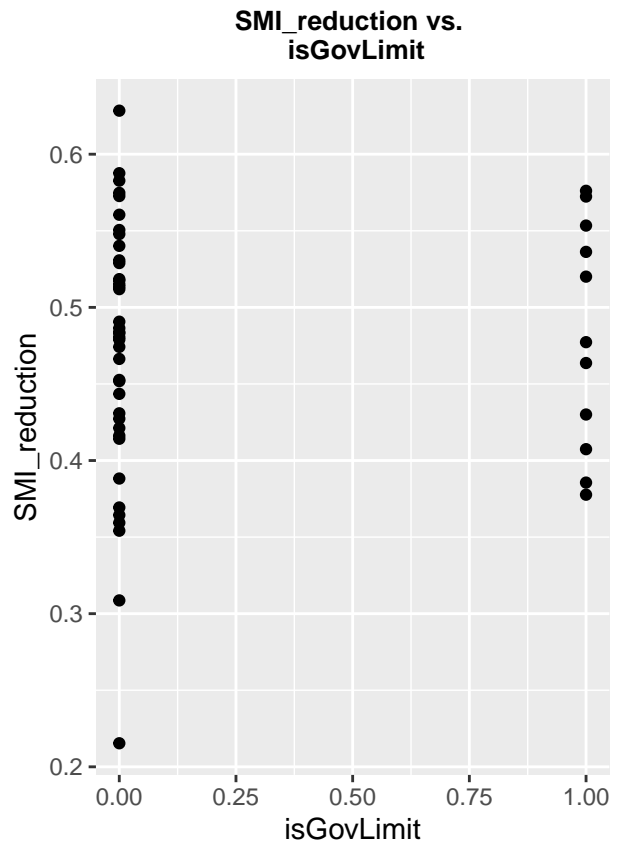
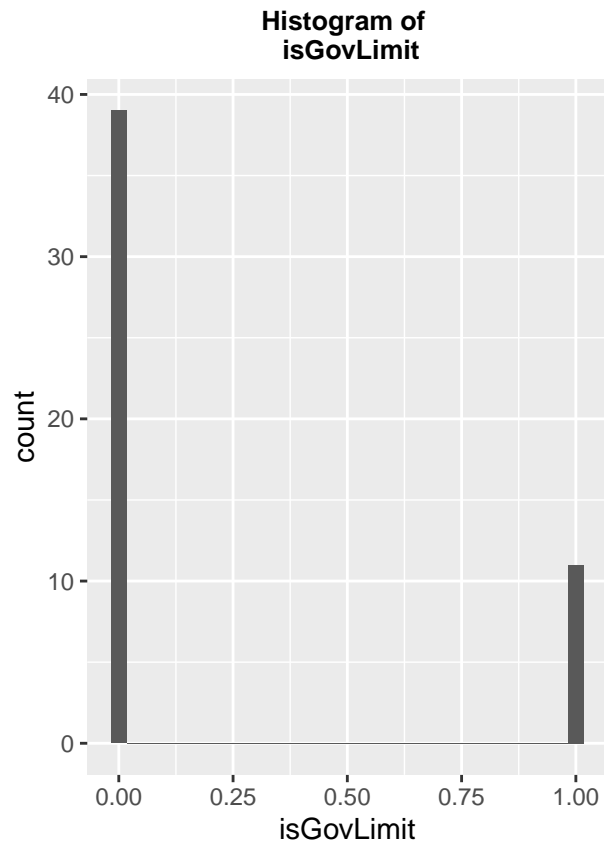


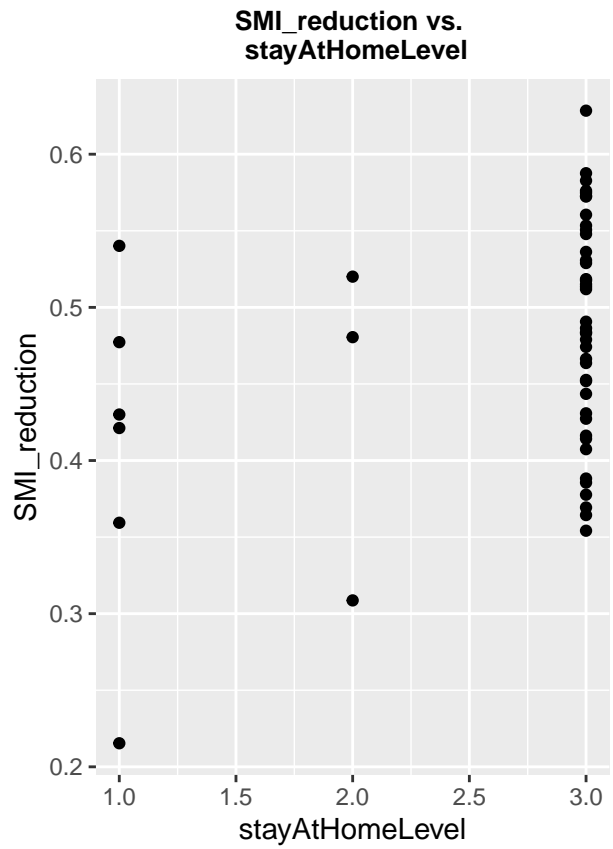
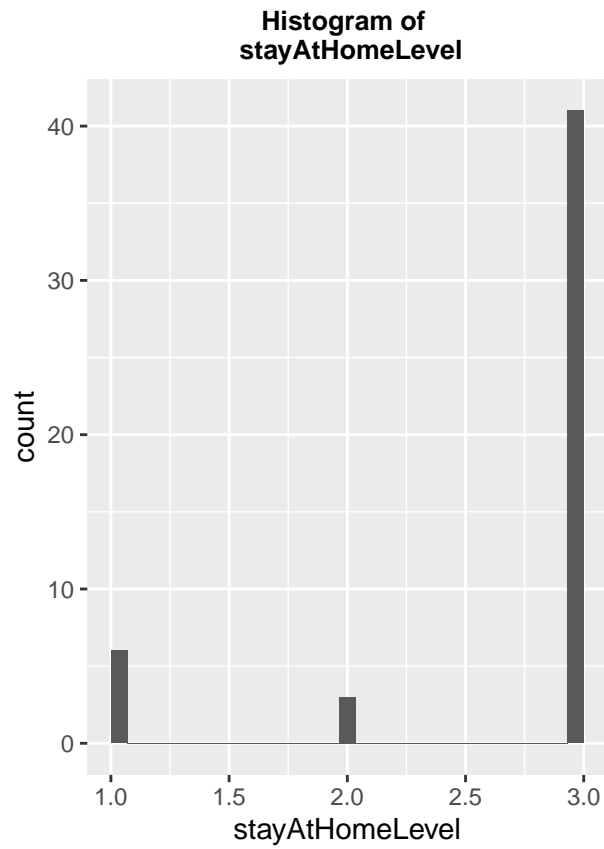


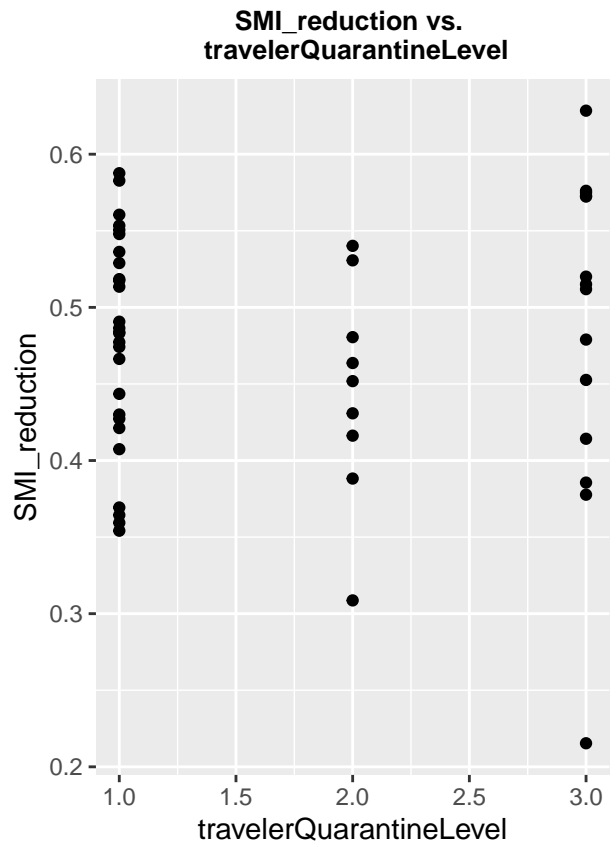
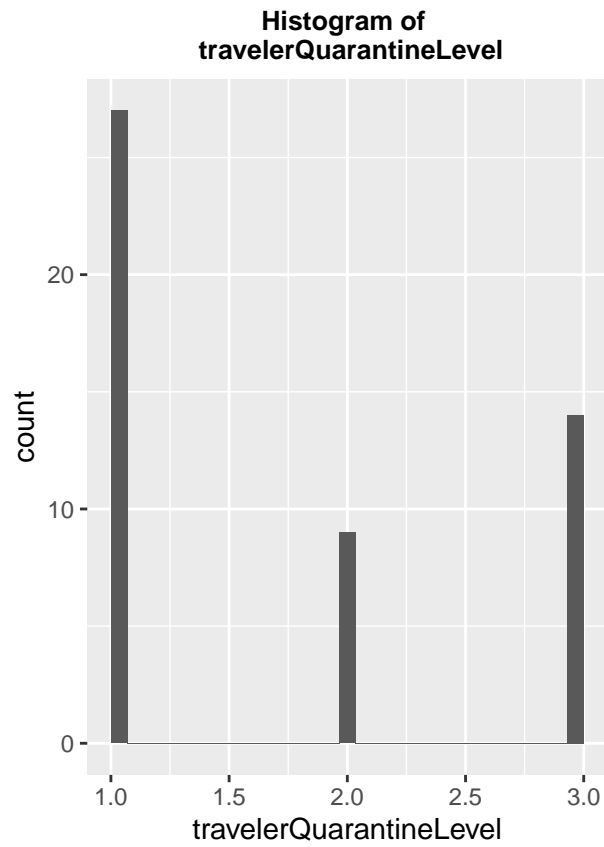


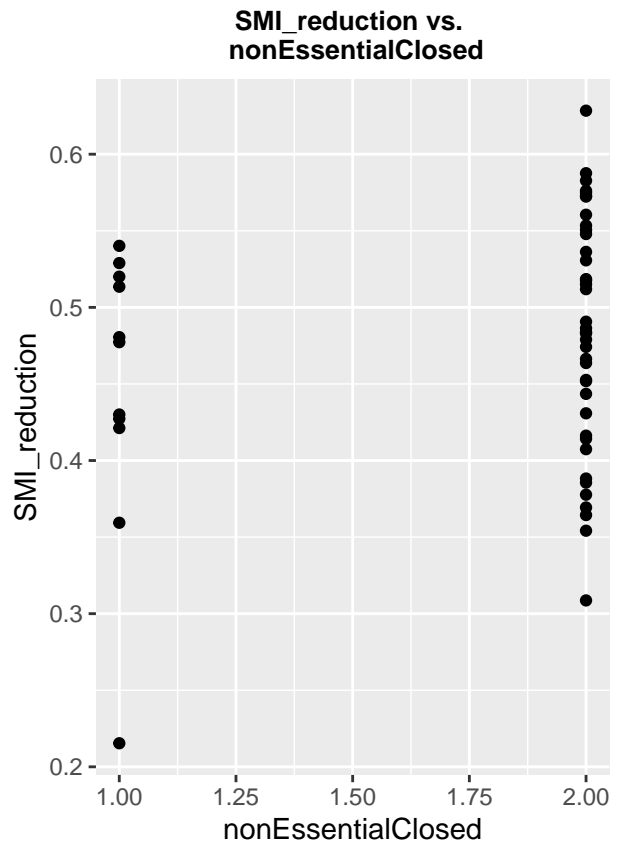
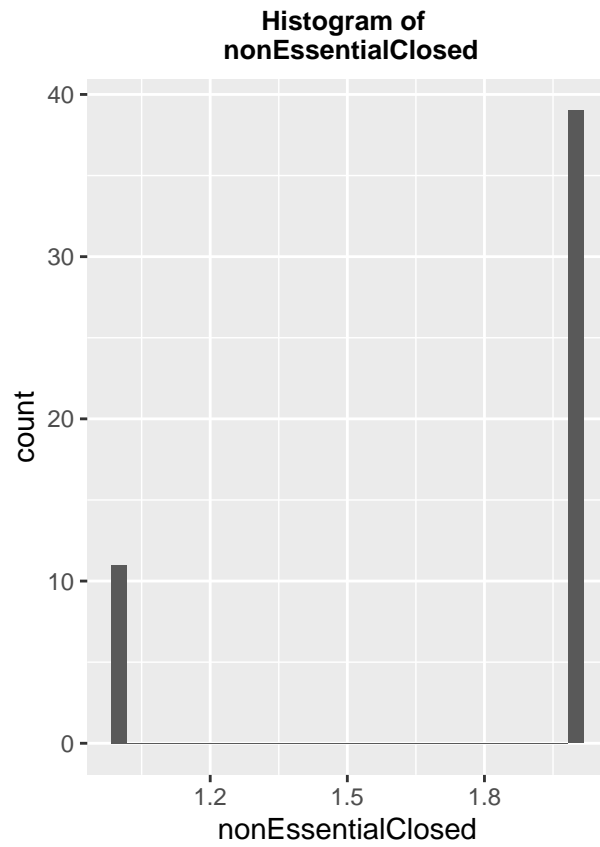


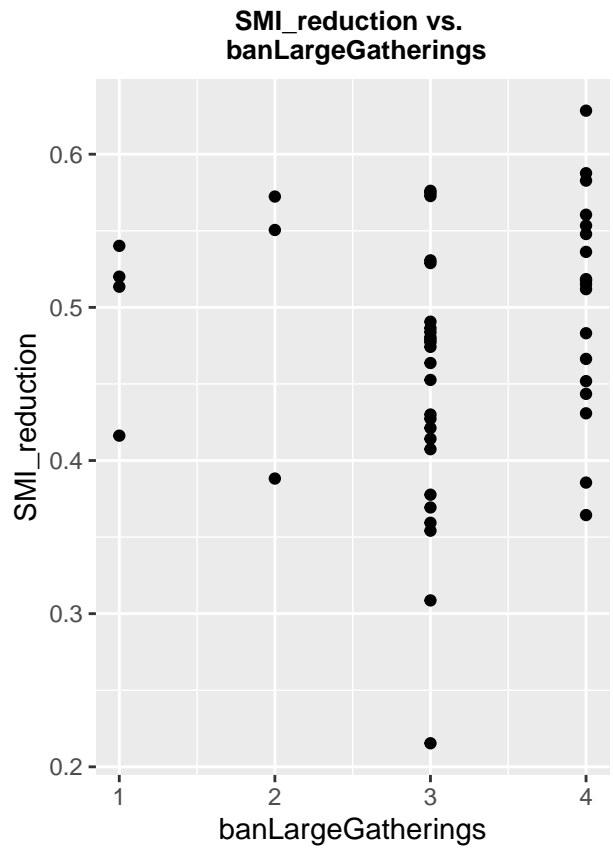
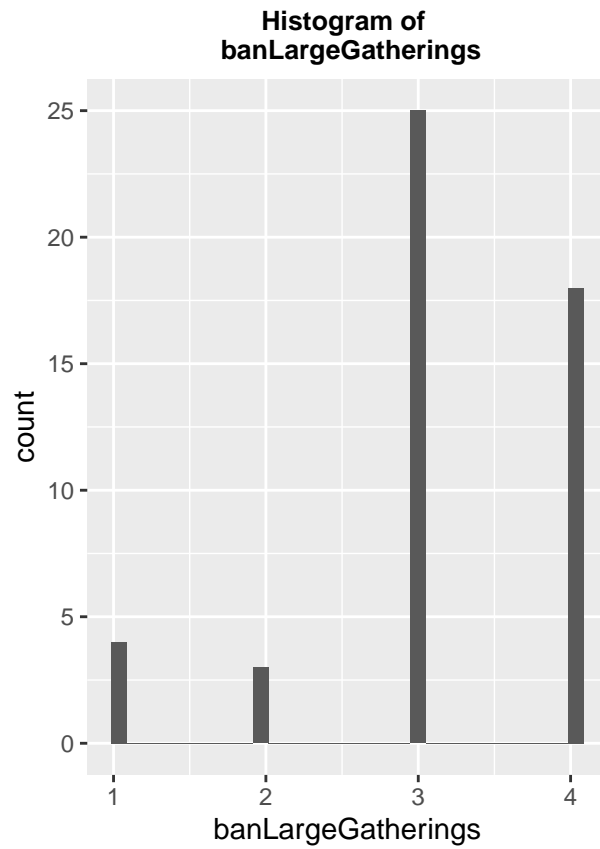


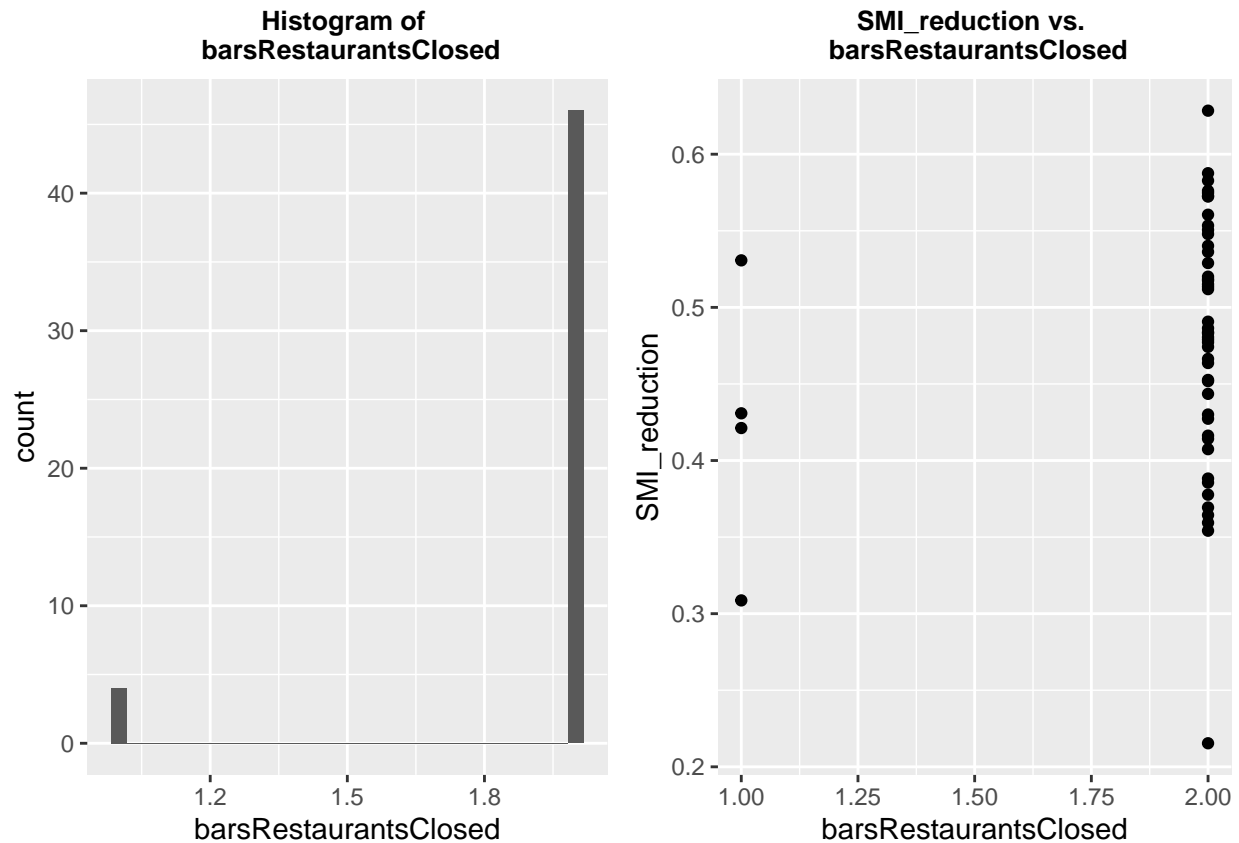












Traditional Model Selection

```
# Compute the total number of observations
n = nrow(modelPrep)

# Full model using all predictors
cog.lm = lm(SMI_reduction ~ . + isRepublican*isGovLimit + DIVISION*PerCap.Income.2019 + Days.Between*is)

# Perform BIC elimination from full model
# k = log(n): penalty for BIC rather than AIC
cog.step = step(cog.lm, k=log(n))

## Start: AIC=-207.12
## SMI_reduction ~ cases + deaths + REGION + DIVISION + POPULATION +
## LAND.AREA + DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PropAGE4 +
## PerCap.Income.2019 + CrudeMortRate + Percent.Uninsured +
## HospCount + BedsPer1000 + GOVSTART + GOVEND + Days.Between +
## SAH7DY + SAH14DY + SAH21DY + SAH28DY + SAH35DY + SAH42DY +
## SAH49DY + SAH56DY + SAH63DY + SAH70DY + isRepublican + isGovLimit +
## stayAtHomeLevel + travelerQuarantineLevel + nonEssentialClosed +
## banLargeGatherings + barsRestaurantsClosed + isRepublican *
## isGovLimit + DIVISION * PerCap.Income.2019 + Days.Between *
## isRepublican + HospCount * BedsPer1000
##
```

```

##
## Step: AIC=-207.12
## SMI_reduction ~ cases + deaths + REGION + DIVISION + POPULATION +
## LAND.AREA + DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PropAGE4 +
## PerCap.Income.2019 + CrudeMortRate + Percent.Uninsured +
## HospCount + BedsPer1000 + GOVSTART + GOVEND + Days.Between +
## SAH7DY + SAH14DY + SAH21DY + SAH28DY + SAH35DY + SAH49DY +
## SAH56DY + SAH63DY + SAH70DY + isRepublican + isGovLimit +
## stayAtHomeLevel + travelerQuarantineLevel + nonEssentialClosed +
## banLargeGatherings + barsRestaurantsClosed + isRepublican:isGovLimit +
## DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
## HospCount:BedsPer1000
##
##
## Step: AIC=-207.12
## SMI_reduction ~ cases + deaths + REGION + DIVISION + POPULATION +
## LAND.AREA + DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
## CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
## GOVSTART + GOVEND + Days.Between + SAH7DY + SAH14DY + SAH21DY +
## SAH28DY + SAH35DY + SAH49DY + SAH56DY + SAH63DY + SAH70DY +
## isRepublican + isGovLimit + stayAtHomeLevel + travelerQuarantineLevel +
## nonEssentialClosed + banLargeGatherings + barsRestaurantsClosed +
## isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
## HospCount:BedsPer1000
##
##
## Df Sum of Sq RSS AIC
## - SAH70DY 1 0.0000000 0.037561 -211.03
## - deaths 1 0.0000047 0.037565 -211.03
## - GOVEND 1 0.0000286 0.037589 -211.00
## - nonEssentialClosed 1 0.0000766 0.037637 -210.93
## - travelerQuarantineLevel 1 0.0002239 0.037785 -210.74
## - SAH7DY 1 0.0002616 0.037822 -210.69
## - SAH21DY 1 0.0003691 0.037930 -210.54
## - POPULATION 1 0.0004165 0.037977 -210.48
## - barsRestaurantsClosed 1 0.0006901 0.038251 -210.12
## - stayAtHomeLevel 1 0.0007926 0.038353 -209.99
## - CrudeMortRate 1 0.0009244 0.038485 -209.82
## - cases 1 0.0010060 0.038567 -209.71
## - Days.Between:isRepublican 1 0.0010378 0.038598 -209.67
## - DENSITY 1 0.0013586 0.038919 -209.26
## - GOVSTART 1 0.0018081 0.039369 -208.68
## - SAH35DY 1 0.0019398 0.039500 -208.52
## - HospCount:BedsPer1000 1 0.0019888 0.039550 -208.45
## - SAH28DY 1 0.0022424 0.039803 -208.13
## <none> 0.037561 -207.12
## - PropAGE3 1 0.0033130 0.040874 -206.81
## - SAH63DY 1 0.0038447 0.041405 -206.16
## - Percent.Uninsured 1 0.0048999 0.042461 -204.90
## - SAH49DY 1 0.0065489 0.044110 -203.00
## - SAH56DY 1 0.0067728 0.044333 -202.75
## - SAH14DY 1 0.0072792 0.044840 -202.18
## - banLargeGatherings 1 0.0077753 0.045336 -201.63
## - DIVISION:PerCap.Income.2019 1 0.0080298 0.045590 -201.35
## - REGION 1 0.0085687 0.046129 -200.76

```

```

## - PropAGE1          1 0.0103780 0.047939 -198.84
## - PropAGE2          1 0.0112173 0.048778 -197.97
## - LAND.AREA         1 0.0179693 0.055530 -191.49
## - isRepublican:isGovLimit 1 0.0245668 0.062128 -185.87
##
## Step: AIC=-211.03
## SMI_reduction ~ cases + deaths + REGION + DIVISION + POPULATION +
## LAND.AREA + DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
## CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
## GOVSTART + GOVEND + Days.Between + SAH7DY + SAH14DY + SAH21DY +
## SAH28DY + SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican +
## isGovLimit + stayAtHomeLevel + travelerQuarantineLevel +
## nonEssentialClosed + banLargeGatherings + barsRestaurantsClosed +
## isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
## HospCount:BedsPer1000
##
##              Df Sum of Sq      RSS      AIC
## - deaths      1  0.000005 0.037565 -214.94
## - GOVEND       1  0.000029 0.037590 -214.91
## - nonEssentialClosed 1  0.000078 0.037639 -214.84
## - travelerQuarantineLevel 1  0.000229 0.037790 -214.64
## - SAH7DY       1  0.000267 0.037827 -214.59
## - SAH21DY      1  0.000440 0.038001 -214.36
## - POPULATION   1  0.000520 0.038081 -214.26
## - barsRestaurantsClosed 1  0.000839 0.038399 -213.84
## - cases        1  0.001009 0.038570 -213.62
## - Days.Between:isRepublican 1  0.001049 0.038610 -213.57
## - CrudeMortRate 1  0.001190 0.038751 -213.39
## - DENSITY      1  0.001508 0.039069 -212.98
## - GOVSTART     1  0.001813 0.039373 -212.59
## - SAH35DY      1  0.001967 0.039528 -212.39
## - HospCount:BedsPer1000 1  0.002178 0.039739 -212.13
## - SAH28DY      1  0.002257 0.039818 -212.03
## - stayAtHomeLevel 1  0.002760 0.040320 -211.40
## <none>                0.037561 -211.03
## - PropAGE3     1  0.003452 0.041013 -210.55
## - SAH63DY      1  0.003875 0.041436 -210.04
## - Percent.Uninsured 1  0.005298 0.042858 -208.35
## - SAH49DY      1  0.006782 0.044343 -206.65
## - SAH56DY      1  0.006828 0.044389 -206.59
## - SAH14DY      1  0.007287 0.044847 -206.08
## - DIVISION:PerCap.Income.2019 1  0.008258 0.045818 -205.01
## - banLargeGatherings 1  0.008329 0.045890 -204.93
## - REGION       1  0.008638 0.046199 -204.60
## - PropAGE2     1  0.013420 0.050981 -199.67
## - PropAGE1     1  0.016407 0.053968 -196.82
## - LAND.AREA    1  0.019738 0.057298 -193.83
## - isRepublican:isGovLimit 1  0.034107 0.071668 -182.64
##
## Step: AIC=-214.94
## SMI_reduction ~ cases + REGION + DIVISION + POPULATION + LAND.AREA +
## DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
## CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
## GOVSTART + GOVEND + Days.Between + SAH7DY + SAH14DY + SAH21DY +

```

```

## SAH28DY + SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican +
## isGovLimit + stayAtHomeLevel + travelerQuarantineLevel +
## nonEssentialClosed + banLargeGatherings + barsRestaurantsClosed +
## isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
## HospCount:BedsPer1000
##
##
## Df Sum of Sq RSS AIC
## - GOVEND 1 0.000026 0.037591 -218.82
## - nonEssentialClosed 1 0.000073 0.037639 -218.75
## - travelerQuarantineLevel 1 0.000224 0.037790 -218.55
## - SAH7DY 1 0.000295 0.037860 -218.46
## - SAH21DY 1 0.000437 0.038002 -218.27
## - POPULATION 1 0.000570 0.038136 -218.10
## - barsRestaurantsClosed 1 0.000924 0.038489 -217.64
## - Days.Between:isRepublican 1 0.001045 0.038610 -217.48
## - CrudeMortRate 1 0.001274 0.038839 -217.19
## - GOVSTART 1 0.001842 0.039408 -216.46
## - SAH35DY 1 0.001969 0.039534 -216.30
## - DENSITY 1 0.001976 0.039541 -216.29
## - SAH28DY 1 0.002358 0.039924 -215.81
## - HospCount:BedsPer1000 1 0.002690 0.040256 -215.39
## - stayAtHomeLevel 1 0.002842 0.040408 -215.21
## <none> 0.037565 -214.94
## - PropAGE3 1 0.003532 0.041098 -214.36
## - SAH63DY 1 0.003901 0.041467 -213.91
## - Percent.Uninsured 1 0.006201 0.043767 -211.21
## - SAH49DY 1 0.006785 0.044350 -210.55
## - SAH56DY 1 0.006946 0.044511 -210.37
## - SAH14DY 1 0.007282 0.044847 -209.99
## - DIVISION:PerCap.Income.2019 1 0.008587 0.046153 -208.56
## - REGION 1 0.009321 0.046887 -207.77
## - banLargeGatherings 1 0.010410 0.047975 -206.62
## - cases 1 0.013494 0.051060 -203.51
## - PropAGE2 1 0.014934 0.052500 -202.12
## - PropAGE1 1 0.017071 0.054637 -200.12
## - LAND.AREA 1 0.020124 0.057689 -197.40
## - isRepublican:isGovLimit 1 0.034122 0.071687 -186.54
##
## Step: AIC=-218.82
## SMI_reduction ~ cases + REGION + DIVISION + POPULATION + LAND.AREA +
## DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
## CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
## GOVSTART + Days.Between + SAH7DY + SAH14DY + SAH21DY + SAH28DY +
## SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
## stayAtHomeLevel + travelerQuarantineLevel + nonEssentialClosed +
## banLargeGatherings + barsRestaurantsClosed + isRepublican:isGovLimit +
## DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
## HospCount:BedsPer1000
##
##
## Df Sum of Sq RSS AIC
## - nonEssentialClosed 1 0.000055 0.037647 -222.66
## - travelerQuarantineLevel 1 0.000244 0.037836 -222.41
## - SAH7DY 1 0.000323 0.037914 -222.30
## - SAH21DY 1 0.000416 0.038007 -222.18

```

```

## - POPULATION          1  0.000853  0.038444 -221.61
## - barsRestaurantsClosed 1  0.000908  0.038499 -221.54
## - Days.Between:isRepublican 1  0.001069  0.038660 -221.33
## - CrudeMortRate        1  0.001545  0.039136 -220.72
## - DENSITY              1  0.001951  0.039543 -220.20
## - SAH35DY              1  0.002012  0.039603 -220.12
## - SAH28DY              1  0.002361  0.039952 -219.68
## - HospCount:BedsPer1000 1  0.002680  0.040271 -219.29
## - stayAtHomeLevel      1  0.002816  0.040408 -219.12
## <none>                  0.037591 -218.82
## - PropAGE3             1  0.003534  0.041126 -218.24
## - SAH63DY              1  0.003910  0.041501 -217.78
## - Percent.Uninsured    1  0.006383  0.043975 -214.89
## - GOVSTART             1  0.007035  0.044626 -214.15
## - SAH14DY              1  0.007257  0.044849 -213.90
## - SAH49DY              1  0.007650  0.045241 -213.47
## - SAH56DY              1  0.007701  0.045292 -213.41
## - DIVISION:PerCap.Income.2019 1  0.008694  0.046286 -212.33
## - banLargeGatherings   1  0.010754  0.048345 -210.15
## - REGION               1  0.011124  0.048716 -209.77
## - PropAGE2             1  0.016492  0.054083 -204.54
## - PropAGE1             1  0.017370  0.054961 -203.74
## - LAND.AREA            1  0.021781  0.059372 -199.88
## - cases                1  0.023759  0.061351 -198.24
## - isRepublican:isGovLimit 1  0.034535  0.072127 -190.15
##
## Step:  AIC=-222.66
## SMI_reduction ~ cases + REGION + DIVISION + POPULATION + LAND.AREA +
##   DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
##   CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
##   GOVSTART + Days.Between + SAH7DY + SAH14DY + SAH21DY + SAH28DY +
##   SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   stayAtHomeLevel + travelerQuarantineLevel + banLargeGatherings +
##   barsRestaurantsClosed + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 +
##   Days.Between:isRepublican + HospCount:BedsPer1000
##
##
## Df Sum of Sq    RSS    AIC
## - travelerQuarantineLevel  1  0.000213  0.037860 -226.29
## - SAH7DY                   1  0.000341  0.037987 -226.12
## - SAH21DY                  1  0.000375  0.038021 -226.07
## - POPULATION               1  0.000863  0.038510 -225.43
## - barsRestaurantsClosed    1  0.000887  0.038534 -225.40
## - Days.Between:isRepublican 1  0.001098  0.038744 -225.13
## - CrudeMortRate            1  0.001790  0.039437 -224.25
## - DENSITY                  1  0.001913  0.039560 -224.09
## - SAH35DY                  1  0.001988  0.039635 -224.00
## - SAH28DY                  1  0.002324  0.039971 -223.57
## - HospCount:BedsPer1000    1  0.002641  0.040288 -223.18
## <none>                      0.037647 -222.66
## - PropAGE3                 1  0.003720  0.041367 -221.86
## - stayAtHomeLevel          1  0.003742  0.041389 -221.83
## - SAH63DY                  1  0.003874  0.041521 -221.67
## - Percent.Uninsured        1  0.006812  0.044459 -218.25
## - GOVSTART                 1  0.007099  0.044745 -217.93

```



```

## - SAH14DY          1  0.007367  0.045013 -217.63
## - SAH49DY          1  0.007597  0.045243 -217.38
## - SAH56DY          1  0.007719  0.045365 -217.24
## - DIVISION:PerCap.Income.2019  1  0.008687  0.046333 -216.19
## - REGION           1  0.011124  0.048770 -213.62
## - banLargeGatherings  1  0.011539  0.049186 -213.20
## - PropAGE2          1  0.016984  0.054631 -207.95
## - PropAGE1          1  0.018711  0.056358 -206.39
## - LAND.AREA         1  0.022392  0.060038 -203.23
## - cases             1  0.023708  0.061355 -202.15
## - isRepublican:isGovLimit  1  0.034503  0.072150 -194.04
##
## Step:  AIC=-226.29
## SMI_reduction ~ cases + REGION + DIVISION + POPULATION + LAND.AREA +
##   DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
##   CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
##   GOVSTART + Days.Between + SAH7DY + SAH14DY + SAH21DY + SAH28DY +
##   SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   stayAtHomeLevel + banLargeGatherings + barsRestaurantsClosed +
##   isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
##   HospCount:BedsPer1000
##
##           Df Sum of Sq      RSS      AIC
## - SAH7DY          1  0.000213  0.038072 -229.92
## - SAH21DY         1  0.000550  0.038410 -229.48
## - POPULATION       1  0.000694  0.038554 -229.29
## - Days.Between:isRepublican  1  0.000922  0.038782 -229.00
## - barsRestaurantsClosed  1  0.001253  0.039112 -228.57
## - CrudeMortRate    1  0.001630  0.039489 -228.09
## - SAH28DY          1  0.002244  0.040103 -227.32
## - SAH35DY          1  0.002248  0.040108 -227.31
## - DENSITY          1  0.002457  0.040316 -227.05
## - HospCount:BedsPer1000  1  0.002514  0.040374 -226.98
## <none>                                0.037860 -226.29
## - SAH63DY          1  0.003661  0.041521 -225.58
## - PropAGE3          1  0.003679  0.041538 -225.56
## - stayAtHomeLevel   1  0.003779  0.041638 -225.44
## - Percent.Uninsured  1  0.006777  0.044636 -221.97
## - SAH14DY          1  0.007177  0.045037 -221.52
## - GOVSTART          1  0.007444  0.045303 -221.22
## - SAH49DY          1  0.007919  0.045778 -220.70
## - SAH56DY          1  0.008088  0.045947 -220.52
## - DIVISION:PerCap.Income.2019  1  0.008579  0.046438 -219.99
## - banLargeGatherings  1  0.011950  0.049810 -216.48
## - REGION           1  0.013368  0.051228 -215.08
## - PropAGE2          1  0.017165  0.055025 -211.50
## - PropAGE1          1  0.019435  0.057295 -209.48
## - cases             1  0.023870  0.061729 -205.75
## - LAND.AREA         1  0.025935  0.063794 -204.11
## - isRepublican:isGovLimit  1  0.034681  0.072540 -197.69
##
## Step:  AIC=-229.92
## SMI_reduction ~ cases + REGION + DIVISION + POPULATION + LAND.AREA +
##   DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +

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##      CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
##      GOVSTART + Days.Between + SAH14DY + SAH21DY + SAH28DY + SAH35DY +
##      SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##      stayAtHomeLevel + banLargeGatherings + barsRestaurantsClosed +
##      isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
##      HospCount:BedsPer1000
##
##
##              Df Sum of Sq      RSS      AIC
## - SAH21DY          1  0.000414  0.038486 -233.29
## - POPULATION        1  0.000502  0.038574 -233.18
## - Days.Between:isRepublican  1  0.000715  0.038788 -232.90
## - CrudeMortRate      1  0.001423  0.039496 -232.00
## - barsRestaurantsClosed  1  0.001545  0.039617 -231.84
## - SAH28DY           1  0.002098  0.040170 -231.15
## - SAH35DY           1  0.002184  0.040256 -231.04
## - DENSITY           1  0.002402  0.040474 -230.77
## - HospCount:BedsPer1000  1  0.003057  0.041129 -229.97
## <none>                                0.038072 -229.92
## - SAH63DY           1  0.003517  0.041589 -229.41
## - PropAGE3          1  0.003552  0.041624 -229.37
## - stayAtHomeLevel   1  0.003584  0.041656 -229.33
## - SAH14DY           1  0.006995  0.045068 -225.40
## - Percent.Uninsured  1  0.007095  0.045167 -225.28
## - GOVSTART          1  0.007482  0.045554 -224.86
## - SAH49DY           1  0.007850  0.045922 -224.46
## - SAH56DY           1  0.007916  0.045988 -224.38
## - DIVISION:PerCap.Income.2019  1  0.008448  0.046520 -223.81
## - REGION            1  0.013776  0.051848 -218.39
## - banLargeGatherings  1  0.013928  0.052000 -218.24
## - PropAGE1          1  0.019516  0.057588 -213.14
## - PropAGE2          1  0.020462  0.058534 -212.32
## - cases             1  0.026016  0.064088 -207.79
## - LAND.AREA         1  0.026512  0.064584 -207.41
## - isRepublican:isGovLimit  1  0.035311  0.073383 -201.02
##
## Step:  AIC=-233.29
## SMI_reduction ~ cases + REGION + DIVISION + POPULATION + LAND.AREA +
##      DENSITY + PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 +
##      CrudeMortRate + Percent.Uninsured + HospCount + BedsPer1000 +
##      GOVSTART + Days.Between + SAH14DY + SAH28DY + SAH35DY + SAH49DY +
##      SAH56DY + SAH63DY + isRepublican + isGovLimit + stayAtHomeLevel +
##      banLargeGatherings + barsRestaurantsClosed + isRepublican:isGovLimit +
##      DIVISION:PerCap.Income.2019 + Days.Between:isRepublican +
##      HospCount:BedsPer1000
##
##
##              Df Sum of Sq      RSS      AIC
## - POPULATION        1  0.000593  0.039079 -236.44
## - Days.Between:isRepublican  1  0.000749  0.039235 -236.24
## - barsRestaurantsClosed  1  0.001415  0.039900 -235.40
## - SAH28DY           1  0.001706  0.040192 -235.03
## - SAH35DY           1  0.001780  0.040266 -234.94
## - CrudeMortRate      1  0.001944  0.040430 -234.74
## - DENSITY           1  0.002573  0.041059 -233.97
## - HospCount:BedsPer1000  1  0.002705  0.041191 -233.81

```

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## - SAH63DY          1  0.003105  0.041590 -233.32
## <none>              0.038486 -233.29
## - PropAGE3          1  0.003186  0.041671 -233.22
## - stayAtHomeLevel   1  0.003283  0.041769 -233.11
## - SAH14DY           1  0.007002  0.045488 -228.84
## - GOVSTART          1  0.007322  0.045808 -228.49
## - SAH49DY           1  0.007454  0.045940 -228.35
## - Percent.Uninsured  1  0.008072  0.046557 -227.68
## - SAH56DY           1  0.008139  0.046625 -227.61
## - DIVISION:PerCap.Income.2019 1  0.008157  0.046643 -227.59
## - banLargeGatherings 1  0.013590  0.052076 -222.08
## - REGION            1  0.014858  0.053343 -220.88
## - PropAGE1           1  0.019107  0.057593 -217.05
## - PropAGE2           1  0.020054  0.058540 -216.23
## - cases              1  0.025752  0.064238 -211.59
## - LAND.AREA          1  0.026475  0.064961 -211.03
## - isRepublican:isGovLimit 1  0.035412  0.073898 -204.58
##
## Step:  AIC=-236.44
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + DENSITY +
##   PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 + CrudeMortRate +
##   Percent.Uninsured + HospCount + BedsPer1000 + GOVSTART +
##   Days.Between + SAH14DY + SAH28DY + SAH35DY + SAH49DY + SAH56DY +
##   SAH63DY + isRepublican + isGovLimit + stayAtHomeLevel + banLargeGatherings +
##   barsRestaurantsClosed + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 +
##   Days.Between:isRepublican + HospCount:BedsPer1000
##
##
## Df Sum of Sq    RSS    AIC
## - Days.Between:isRepublican  1  0.000480  0.039559 -239.74
## - barsRestaurantsClosed      1  0.001255  0.040333 -238.77
## - SAH28DY                    1  0.001618  0.040697 -238.32
## - CrudeMortRate              1  0.001620  0.040699 -238.32
## - DENSITY                    1  0.002796  0.041875 -236.89
## - SAH63DY                    1  0.002916  0.041994 -236.75
## <none>                        0.039079 -236.44
## - stayAtHomeLevel           1  0.004066  0.043145 -235.40
## - PropAGE3                   1  0.004337  0.043416 -235.09
## - HospCount:BedsPer1000     1  0.005994  0.045073 -233.21
## - SAH35DY                   1  0.006049  0.045127 -233.15
## - SAH49DY                   1  0.006924  0.046003 -232.19
## - GOVSTART                   1  0.006942  0.046021 -232.17
## - SAH14DY                   1  0.007627  0.046706 -231.43
## - SAH56DY                   1  0.007940  0.047019 -231.10
## - DIVISION:PerCap.Income.2019 1  0.008226  0.047305 -230.80
## - Percent.Uninsured         1  0.011762  0.050841 -227.19
## - banLargeGatherings        1  0.013221  0.052299 -225.78
## - REGION                    1  0.015014  0.054092 -224.09
## - PropAGE2                   1  0.019480  0.058559 -220.13
## - PropAGE1                   1  0.019814  0.058893 -219.84
## - LAND.AREA                  1  0.032717  0.071796 -209.94
## - isRepublican:isGovLimit    1  0.036080  0.075159 -207.65
## - cases                      1  0.037723  0.076801 -206.57
##
## Step:  AIC=-239.74

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```

## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + DENSITY +
##   PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 + CrudeMortRate +
##   Percent.Uninsured + HospCount + BedsPer1000 + GOVSTART +
##   Days.Between + SAH14DY + SAH28DY + SAH35DY + SAH49DY + SAH56DY +
##   SAH63DY + isRepublican + isGovLimit + stayAtHomeLevel + banLargeGatherings +
##   barsRestaurantsClosed + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 +
##   HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - SAH28DY      1  0.001145  0.040704 -242.22
## - barsRestaurantsClosed      1  0.001432  0.040991 -241.87
## - CrudeMortRate      1  0.003153  0.042712 -239.82
## <none>                                0.039559 -239.74
## - stayAtHomeLevel      1  0.003596  0.043155 -239.30
## - DENSITY      1  0.003946  0.043505 -238.90
## - PropAGE3      1  0.003971  0.043530 -238.87
## - Days.Between      1  0.005142  0.044700 -237.54
## - SAH63DY      1  0.005878  0.045437 -236.72
## - SAH14DY      1  0.007180  0.046739 -235.31
## - HospCount:BedsPer1000      1  0.008736  0.048295 -233.67
## - SAH49DY      1  0.009883  0.049442 -232.50
## - GOVSTART      1  0.010057  0.049616 -232.32
## - SAH35DY      1  0.010259  0.049818 -232.12
## - DIVISION:PerCap.Income.2019      1  0.011159  0.050718 -231.23
## - Percent.Uninsured      1  0.011288  0.050847 -231.10
## - banLargeGatherings      1  0.013096  0.052655 -229.35
## - REGION      1  0.014924  0.054483 -227.65
## - SAH56DY      1  0.016180  0.055739 -226.51
## - PropAGE2      1  0.019001  0.058560 -224.04
## - PropAGE1      1  0.019445  0.059004 -223.66
## - LAND.AREA      1  0.033575  0.073134 -212.93
## - isRepublican:isGovLimit      1  0.038614  0.078172 -209.59
## - cases      1  0.039372  0.078931 -209.11
##
## Step:  AIC=-242.22
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + DENSITY +
##   PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 + CrudeMortRate +
##   Percent.Uninsured + HospCount + BedsPer1000 + GOVSTART +
##   Days.Between + SAH14DY + SAH35DY + SAH49DY + SAH56DY + SAH63DY +
##   isRepublican + isGovLimit + stayAtHomeLevel + banLargeGatherings +
##   barsRestaurantsClosed + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 +
##   HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - barsRestaurantsClosed      1  0.001803  0.042507 -243.97
## - CrudeMortRate      1  0.002407  0.043111 -243.26
## - stayAtHomeLevel      1  0.003020  0.043724 -242.56
## - PropAGE3      1  0.003279  0.043983 -242.26
## <none>                                0.040704 -242.22
## - DENSITY      1  0.003512  0.044216 -242.00
## - Days.Between      1  0.004154  0.044858 -241.28
## - SAH63DY      1  0.004922  0.045625 -240.43
## - SAH14DY      1  0.006067  0.046771 -239.19
## - HospCount:BedsPer1000      1  0.008584  0.049288 -236.57

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```

## - SAH49DY          1  0.008949  0.049652 -236.20
## - SAH35DY          1  0.009657  0.050361 -235.49
## - GOVSTART         1  0.010011  0.050715 -235.14
## - DIVISION:PerCap.Income.2019 1  0.010407  0.051110 -234.75
## - Percent.Uninsured 1  0.011392  0.052096 -233.80
## - banLargeGatherings 1  0.012591  0.053295 -232.66
## - REGION           1  0.015341  0.056045 -230.15
## - SAH56DY          1  0.016223  0.056926 -229.36
## - PropAGE1         1  0.018300  0.059004 -227.57
## - PropAGE2         1  0.022724  0.063428 -223.96
## - LAND.AREA        1  0.032439  0.073142 -216.83
## - isRepublican:isGovLimit 1  0.038387  0.079091 -212.92
## - cases            1  0.038678  0.079382 -212.74
##
## Step:  AIC=-243.97
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + DENSITY +
##   PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 + CrudeMortRate +
##   Percent.Uninsured + HospCount + BedsPer1000 + GOVSTART +
##   Days.Between + SAH14DY + SAH35DY + SAH49DY + SAH56DY + SAH63DY +
##   isRepublican + isGovLimit + stayAtHomeLevel + banLargeGatherings +
##   isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + HospCount:BedsPer1000
##
##              Df Sum of Sq      RSS      AIC
## - CrudeMortRate      1  0.002446  0.044953 -245.08
## - DENSITY            1  0.003148  0.045654 -244.31
## <none>                0.042507 -243.97
## - SAH63DY            1  0.004078  0.046584 -243.30
## - stayAtHomeLevel    1  0.004168  0.046675 -243.20
## - PropAGE3           1  0.004610  0.047117 -242.73
## - Days.Between       1  0.004727  0.047233 -242.61
## - SAH14DY            1  0.007356  0.049863 -239.90
## - HospCount:BedsPer1000 1  0.007888  0.050395 -239.37
## - SAH49DY            1  0.008086  0.050592 -239.17
## - Percent.Uninsured  1  0.009752  0.052259 -237.55
## - GOVSTART           1  0.009767  0.052274 -237.54
## - DIVISION:PerCap.Income.2019 1  0.009859  0.052366 -237.45
## - SAH35DY            1  0.010370  0.052876 -236.97
## - banLargeGatherings 1  0.014488  0.056995 -233.22
## - SAH56DY            1  0.014673  0.057180 -233.05
## - REGION             1  0.018629  0.061136 -229.71
## - PropAGE1           1  0.018649  0.061156 -229.69
## - PropAGE2           1  0.021106  0.063613 -227.72
## - LAND.AREA          1  0.032180  0.074687 -219.70
## - isRepublican:isGovLimit 1  0.038839  0.081346 -215.43
## - cases              1  0.040868  0.083374 -214.20
##
## Step:  AIC=-245.08
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + DENSITY +
##   PropAGE1 + PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + GOVSTART + Days.Between + SAH14DY +
##   SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   stayAtHomeLevel + banLargeGatherings + isRepublican:isGovLimit +
##   DIVISION:PerCap.Income.2019 + HospCount:BedsPer1000
##

```

```

##                               Df Sum of Sq      RSS      AIC
## - DENSITY                     1  0.001757  0.046710 -247.08
## - stayAtHomeLevel             1  0.002904  0.047857 -245.87
## <none>                          0.044953 -245.08
## - Days.Between                1  0.004046  0.048999 -244.69
## - SAH63DY                     1  0.004578  0.049531 -244.15
## - PropAGE3                    1  0.005999  0.050953 -242.73
## - SAH14DY                     1  0.006784  0.051737 -241.97
## - Percent.Uninsured           1  0.008112  0.053065 -240.70
## - SAH49DY                     1  0.008168  0.053121 -240.65
## - DIVISION:PerCap.Income.2019 1  0.008174  0.053127 -240.64
## - GOVSTART                    1  0.009344  0.054297 -239.55
## - SAH35DY                     1  0.009472  0.054425 -239.44
## - HospCount:BedsPer1000       1  0.009829  0.054782 -239.11
## - banLargeGatherings          1  0.012648  0.057601 -236.60
## - SAH56DY                     1  0.014626  0.059579 -234.91
## - PropAGE1                    1  0.016227  0.061180 -233.59
## - REGION                      1  0.016799  0.061752 -233.12
## - PropAGE2                    1  0.028906  0.073859 -224.17
## - isRepublican:isGovLimit     1  0.036394  0.081347 -219.34
## - LAND.AREA                   1  0.038500  0.083453 -218.06
## - cases                       1  0.038684  0.083637 -217.95
##
## Step:  AIC=-247.08
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + GOVSTART + Days.Between + SAH14DY +
##   SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   stayAtHomeLevel + banLargeGatherings + isRepublican:isGovLimit +
##   DIVISION:PerCap.Income.2019 + HospCount:BedsPer1000
##
##                               Df Sum of Sq      RSS      AIC
## - stayAtHomeLevel             1  0.003024  0.049735 -247.85
## <none>                          0.046710 -247.08
## - Days.Between                1  0.003837  0.050547 -247.04
## - SAH63DY                     1  0.005179  0.051889 -245.73
## - Percent.Uninsured           1  0.006818  0.053528 -244.18
## - PropAGE3                    1  0.007405  0.054115 -243.63
## - SAH49DY                     1  0.007445  0.054155 -243.60
## - SAH14DY                     1  0.007806  0.054516 -243.26
## - GOVSTART                    1  0.008325  0.055035 -242.79
## - DIVISION:PerCap.Income.2019 1  0.008888  0.055598 -242.28
## - SAH35DY                     1  0.009565  0.056275 -241.68
## - HospCount:BedsPer1000       1  0.010754  0.057465 -240.63
## - banLargeGatherings          1  0.013248  0.059958 -238.51
## - SAH56DY                     1  0.013902  0.060613 -237.96
## - REGION                      1  0.017309  0.064019 -235.23
## - PropAGE1                    1  0.018822  0.065532 -234.06
## - PropAGE2                    1  0.030901  0.077611 -225.60
## - isRepublican:isGovLimit     1  0.036520  0.083230 -222.11
## - LAND.AREA                   1  0.036765  0.083475 -221.96
## - cases                       1  0.038130  0.084840 -221.15
##
## Step:  AIC=-247.85

```

```

## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + GOVSTART + Days.Between + SAH14DY +
##   SAH35DY + SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   banLargeGatherings + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 +
##   HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - Days.Between      1  0.002678 0.052412 -249.14
## <none>                                0.049735 -247.85
## - SAH14DY            1  0.006031 0.055765 -246.04
## - GOVSTART           1  0.006149 0.055883 -245.94
## - SAH49DY            1  0.007095 0.056830 -245.10
## - Percent.Uninsured  1  0.007493 0.057228 -244.75
## - SAH35DY            1  0.008404 0.058139 -243.96
## - PropAGE3           1  0.008708 0.058442 -243.70
## - DIVISION:PerCap.Income.2019 1  0.009383 0.059118 -243.12
## - HospCount:BedsPer1000 1  0.010711 0.060446 -242.01
## - banLargeGatherings 1  0.012380 0.062115 -240.65
## - REGION             1  0.015742 0.065476 -238.02
## - SAH56DY            1  0.015987 0.065722 -237.83
## - SAH63DY            1  0.016225 0.065959 -237.65
## - PropAGE1           1  0.020081 0.069816 -234.81
## - PropAGE2           1  0.030458 0.080192 -227.88
## - cases              1  0.035172 0.084907 -225.02
## - isRepublican:isGovLimit 1  0.036480 0.086215 -224.26
## - LAND.AREA          1  0.037647 0.087382 -223.59
##
## Step:  AIC=-249.14
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + GOVSTART + SAH14DY + SAH35DY +
##   SAH49DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   banLargeGatherings + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 +
##   HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - SAH14DY            1  0.003358 0.055771 -249.95
## <none>                                0.052412 -249.14
## - GOVSTART           1  0.004937 0.057350 -248.55
## - Percent.Uninsured  1  0.005519 0.057931 -248.05
## - SAH49DY            1  0.005964 0.058376 -247.67
## - SAH35DY            1  0.006596 0.059008 -247.13
## - DIVISION:PerCap.Income.2019 1  0.006967 0.059379 -246.81
## - HospCount:BedsPer1000 1  0.009281 0.061694 -244.90
## - PropAGE3           1  0.010487 0.062899 -243.94
## - banLargeGatherings 1  0.012069 0.064481 -242.69
## - SAH63DY            1  0.013552 0.065964 -241.56
## - REGION             1  0.015489 0.067901 -240.11
## - SAH56DY            1  0.017685 0.070097 -238.52
## - PropAGE1           1  0.023670 0.076083 -234.42
## - PropAGE2           1  0.034056 0.086468 -228.02
## - cases              1  0.034151 0.086563 -227.97
## - LAND.AREA          1  0.035185 0.087597 -227.38

```

```

## - isRepublican:isGovLimit      1  0.035398 0.087810 -227.25
##
## Step:  AIC=-249.95
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + GOVSTART + SAH35DY + SAH49DY +
##   SAH56DY + SAH63DY + isRepublican + isGovLimit + banLargeGatherings +
##   isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - GOVSTART      1  0.003852 0.059623 -250.52
## - SAH49DY        1  0.003980 0.059751 -250.41
## <none>                                0.055771 -249.95
## - DIVISION:PerCap.Income.2019  1  0.006328 0.062099 -248.49
## - HospCount:BedsPer1000        1  0.006861 0.062632 -248.06
## - SAH35DY                1  0.008005 0.063776 -247.16
## - PropAGE3                1  0.009397 0.065168 -246.08
## - banLargeGatherings        1  0.010391 0.066161 -245.32
## - Percent.Uninsured         1  0.010941 0.066711 -244.91
## - REGION                  1  0.012214 0.067985 -243.96
## - SAH63DY                  1  0.012940 0.068711 -243.43
## - SAH56DY                  1  0.015250 0.071020 -241.78
## - PropAGE1                 1  0.020325 0.076096 -238.32
## - cases                    1  0.030795 0.086565 -231.88
## - PropAGE2                 1  0.030965 0.086735 -231.78
## - isRepublican:isGovLimit     1  0.032559 0.088330 -230.87
## - LAND.AREA                 1  0.035919 0.091689 -229.00
##
## Step:  AIC=-250.52
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + SAH35DY + SAH49DY + SAH56DY + SAH63DY +
##   isRepublican + isGovLimit + banLargeGatherings + isRepublican:isGovLimit +
##   DIVISION:PerCap.Income.2019 + HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - SAH49DY        1  0.002511 0.062134 -252.37
## <none>                                0.059623 -250.52
## - DIVISION:PerCap.Income.2019  1  0.005435 0.065058 -250.07
## - HospCount:BedsPer1000        1  0.006570 0.066193 -249.21
## - SAH35DY                1  0.007797 0.067420 -248.29
## - banLargeGatherings        1  0.008126 0.067749 -248.05
## - PropAGE3                1  0.010090 0.069713 -246.62
## - REGION                  1  0.012411 0.072033 -244.98
## - Percent.Uninsured         1  0.012992 0.072615 -244.58
## - SAH56DY                  1  0.014657 0.074280 -243.44
## - SAH63DY                  1  0.018546 0.078169 -240.89
## - PropAGE1                 1  0.021121 0.080744 -239.27
## - cases                    1  0.027892 0.087515 -235.25
## - isRepublican:isGovLimit     1  0.030309 0.089932 -233.88
## - PropAGE2                 1  0.031282 0.090905 -233.35
## - LAND.AREA                 1  0.039026 0.098649 -229.26
##
## Step:  AIC=-252.37

```



```

## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + SAH35DY + SAH56DY + SAH63DY + isRepublican +
##   isGovLimit + banLargeGatherings + isRepublican:isGovLimit +
##   DIVISION:PerCap.Income.2019 + HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - DIVISION:PerCap.Income.2019  1  0.003397 0.065531 -253.62
## - HospCount:BedsPer1000        1  0.004258 0.066392 -252.97
## <none>                          0.062134 -252.37
## - banLargeGatherings           1  0.007176 0.069310 -250.82
## - PropAGE3                     1  0.008901 0.071035 -249.59
## - REGION                       1  0.010541 0.072675 -248.45
## - Percent.Uninsured            1  0.011318 0.073452 -247.92
## - SAH56DY                      1  0.013899 0.076033 -246.19
## - SAH35DY                      1  0.016878 0.079012 -244.27
## - SAH63DY                      1  0.017241 0.079375 -244.04
## - PropAGE1                     1  0.019154 0.081287 -242.85
## - cases                        1  0.025403 0.087537 -239.15
## - PropAGE2                     1  0.028958 0.091092 -237.16
## - isRepublican:isGovLimit      1  0.030810 0.092943 -236.15
## - LAND.AREA                   1  0.037662 0.099796 -232.59
##
## Step:  AIC=-253.62
## SMI_reduction ~ cases + REGION + DIVISION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   HospCount + BedsPer1000 + SAH35DY + SAH56DY + SAH63DY + isRepublican +
##   isGovLimit + banLargeGatherings + isRepublican:isGovLimit +
##   HospCount:BedsPer1000
##
##
##           Df Sum of Sq      RSS      AIC
## - DIVISION                     1  0.000337 0.065868 -257.28
## - HospCount:BedsPer1000        1  0.002576 0.068107 -255.61
## <none>                          0.065531 -253.62
## - PerCap.Income.2019          1  0.005673 0.071204 -253.38
## - banLargeGatherings           1  0.005866 0.071397 -253.25
## - Percent.Uninsured            1  0.008587 0.074118 -251.38
## - SAH56DY                      1  0.010631 0.076162 -250.02
## - PropAGE3                     1  0.011767 0.077298 -249.28
## - REGION                       1  0.011799 0.077330 -249.26
## - SAH35DY                      1  0.013561 0.079092 -248.13
## - SAH63DY                      1  0.017611 0.083142 -245.63
## - PropAGE1                     1  0.017793 0.083324 -245.52
## - cases                        1  0.022096 0.087628 -243.01
## - PropAGE2                     1  0.025607 0.091138 -241.04
## - isRepublican:isGovLimit      1  0.031408 0.096939 -237.96
## - LAND.AREA                   1  0.034726 0.100257 -236.27
##
## Step:  AIC=-257.28
## SMI_reduction ~ cases + REGION + LAND.AREA + PropAGE1 + PropAGE2 +
##   PropAGE3 + PerCap.Income.2019 + Percent.Uninsured + HospCount +
##   BedsPer1000 + SAH35DY + SAH56DY + SAH63DY + isRepublican +
##   isGovLimit + banLargeGatherings + isRepublican:isGovLimit +
##   HospCount:BedsPer1000

```

```

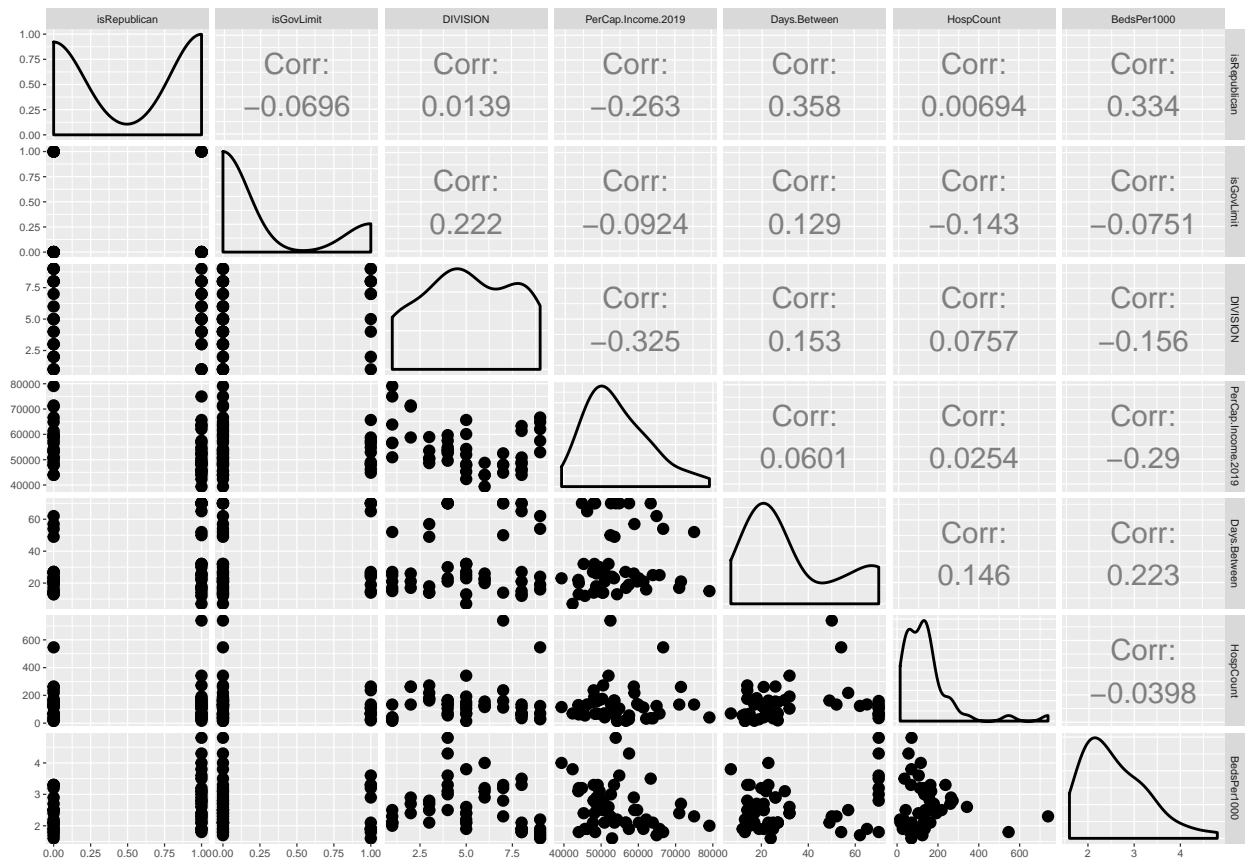
##
##              Df Sum of Sq      RSS      AIC
## - HospCount:BedsPer1000      1  0.002323 0.068191 -259.46
## <none>                        0.065868 -257.28
## - PerCap.Income.2019        1  0.006132 0.072000 -256.74
## - banLargeGatherings        1  0.006162 0.072030 -256.72
## - Percent.Uninsured         1  0.008905 0.074773 -254.85
## - SAH56DY                   1  0.010608 0.076476 -253.72
## - PropAGE3                  1  0.011772 0.077641 -252.97
## - SAH35DY                   1  0.013415 0.079283 -251.92
## - SAH63DY                   1  0.017351 0.083219 -249.50
## - PropAGE1                  1  0.017652 0.083520 -249.32
## - cases                     1  0.021826 0.087694 -246.88
## - PropAGE2                  1  0.025731 0.091599 -244.70
## - isRepublican:isGovLimit    1  0.032087 0.097955 -241.35
## - LAND.AREA                 1  0.039587 0.105455 -237.66
## - REGION                    1  0.063170 0.129038 -227.57
##
## Step:  AIC=-259.46
## SMI_reduction ~ cases + REGION + LAND.AREA + PropAGE1 + PropAGE2 +
##   PropAGE3 + PerCap.Income.2019 + Percent.Uninsured + HospCount +
##   BedsPer1000 + SAH35DY + SAH56DY + SAH63DY + isRepublican +
##   isGovLimit + banLargeGatherings + isRepublican:isGovLimit
##
##              Df Sum of Sq      RSS      AIC
## - HospCount                1  0.000686 0.068878 -262.87
## - BedsPer1000              1  0.004506 0.072697 -260.17
## <none>                      0.068191 -259.46
## - banLargeGatherings       1  0.005819 0.074011 -259.27
## - PerCap.Income.2019       1  0.007393 0.075584 -258.22
## - SAH56DY                  1  0.008376 0.076567 -257.58
## - Percent.Uninsured        1  0.009535 0.077726 -256.82
## - PropAGE3                 1  0.010691 0.078882 -256.09
## - SAH35DY                  1  0.011093 0.079284 -255.83
## - SAH63DY                  1  0.015291 0.083482 -253.25
## - PropAGE1                 1  0.018198 0.086389 -251.54
## - cases                    1  0.023461 0.091653 -248.58
## - PropAGE2                 1  0.026235 0.094427 -247.09
## - isRepublican:isGovLimit   1  0.035554 0.103745 -242.39
## - LAND.AREA                1  0.039063 0.107255 -240.72
## - REGION                   1  0.063839 0.132030 -230.33
##
## Step:  AIC=-262.87
## SMI_reduction ~ cases + REGION + LAND.AREA + PropAGE1 + PropAGE2 +
##   PropAGE3 + PerCap.Income.2019 + Percent.Uninsured + BedsPer1000 +
##   SAH35DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   banLargeGatherings + isRepublican:isGovLimit
##
##              Df Sum of Sq      RSS      AIC
## - BedsPer1000              1  0.004226 0.073103 -263.80
## <none>                      0.068878 -262.87
## - banLargeGatherings       1  0.005786 0.074664 -262.75
## - PerCap.Income.2019       1  0.007364 0.076241 -261.70
## - SAH56DY                  1  0.007724 0.076601 -261.47

```

```
## - Percent.Uninsured      1  0.009163 0.078041 -260.54
## - PropAGE3               1  0.011889 0.080767 -258.82
## - SAH35DY               1  0.012829 0.081706 -258.24
## - PropAGE1              1  0.018777 0.087655 -254.73
## - SAH63DY               1  0.019017 0.087895 -254.59
## - cases                 1  0.022914 0.091792 -252.42
## - PropAGE2              1  0.025866 0.094743 -250.84
## - isRepublican:isGovLimit 1  0.035493 0.104371 -246.00
## - LAND.AREA             1  0.039811 0.108689 -243.97
## - REGION                1  0.067960 0.136838 -232.46
##
## Step: AIC=-263.8
## SMI_reduction ~ cases + REGION + LAND.AREA + PropAGE1 + PropAGE2 +
##   PropAGE3 + PerCap.Income.2019 + Percent.Uninsured + SAH35DY +
##   SAH56DY + SAH63DY + isRepublican + isGovLimit + banLargeGatherings +
##   isRepublican:isGovLimit
##
##               Df Sum of Sq      RSS      AIC
## <none>                0.073103 -263.80
## - banLargeGatherings  1  0.006153 0.079256 -263.67
## - SAH56DY             1  0.006941 0.080044 -263.18
## - Percent.Uninsured   1  0.009066 0.082170 -261.87
## - PropAGE3            1  0.011370 0.084473 -260.49
## - SAH35DY            1  0.011579 0.084682 -260.36
## - PerCap.Income.2019  1  0.011917 0.085020 -260.16
## - PropAGE1           1  0.016831 0.089934 -257.36
## - cases              1  0.024865 0.097969 -253.08
## - PropAGE2           1  0.025199 0.098302 -252.91
## - SAH63DY           1  0.025637 0.098740 -252.68
## - LAND.AREA          1  0.037269 0.110372 -247.12
## - isRepublican:isGovLimit 1  0.045166 0.118270 -243.66
## - REGION             1  0.063736 0.136839 -236.37
```

AIC Predictor EDA

```
#EDA for chosen Predictors
cleanerModelPrep <- modelPrep %>%
  select(SMI_reduction, cases, REGION, LAND.AREA, PropAGE1, PropAGE2,
    PropAGE3, PerCap.Income.2019, Percent.Uninsured, isRepublican, isGovLimit, SAH35DY, SAH56DY, SAH63D
interacting<- modelPrep %>% select(isRepublican, isGovLimit, DIVISION, PerCap.Income.2019, Days.Between
ggpairs(interacting)+ theme_grey(base_size = 5)
```



```

#Case eda
title <- ggdraw() +
  draw_label(
    "EDA for SMI reduction vs. Cases",
    fontface = 'bold',
    x = 0,
    hjust = 0
  ) +
  theme(
    # add margin on the left of the drawing canvas,
    # so title is aligned with left edge of first plot
    plot.margin = margin(0, 0, 0, 7)
  )
p1<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=cases, y=SMI_reduction))+geom_point()+xlim(
p2<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=cases, y=SMI_reduction))+geom_point()+ggtit
row<- plot_grid(p2,p1)

h1<- plot_grid(title, row, ncol=1, rel_heights = c(0.2,1))

#Region eda
h2<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=REGION, y=SMI_reduction))+geom_point()+ggti

#Land Area eda

title <- ggdraw() +

```

```

draw_label(
  "EDA for SMI reduction vs. Land Area",
  fontface = 'bold',
  x = 0,
  hjust = 0
) +
theme(
  # add margin on the left of the drawing canvas,
  # so title is aligned with left edge of first plot
  plot.margin = margin(0, 0, 0, 7)
)
p1<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=LAND.AREA, y=SMI_reduction))+geom_point()+xlab("Land Area"))
p2<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=LAND.AREA, y=SMI_reduction))+geom_point()+ylab("SMI reduction"))
row<- plot_grid(p2,p1)

h3<- plot_grid(title, row, ncol=1, rel_heights = c(0.2,1))

#PropAGE1 eda
h4<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=PropAGE1, y=SMI_reduction))+geom_smooth(method="lm"))

#PropAGE2 eda
h5<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=PropAGE2, y=SMI_reduction))+geom_smooth(method="lm"))

#PropAGE3 eda
h6<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=PropAGE3, y=SMI_reduction))+geom_smooth(method="lm"))

#Per Capita Income eda
h7<-ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=PerCap.Income.2019, y=SMI_reduction))+geom_smooth(method="lm"))

#Percent Uninsured eda
h8<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=Percent.Uninsured, y=SMI_reduction))+geom_smooth(method="lm"))

#isRepublican eda
h9<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=isRepublican, y=SMI_reduction))+geom_point()+ylab("SMI reduction"))

#isGovLimit eda
h10<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=isGovLimit, y=SMI_reduction))+geom_point()+ylab("SMI reduction"))

#SAH35 eda
h11<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=SAH35DY, y=SMI_reduction))+geom_point()+ggtitle("SAH35"))

#SAH56 eda
h12<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=SAH56DY, y=SMI_reduction))+geom_point()+ggtitle("SAH56"))

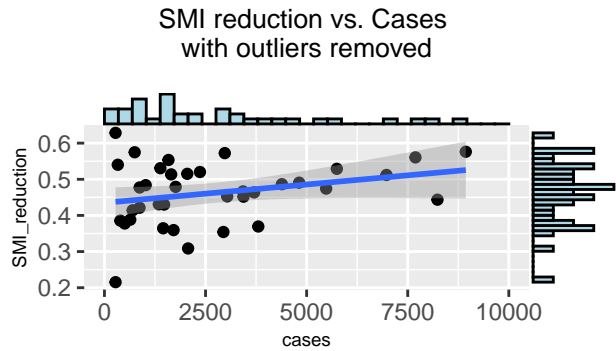
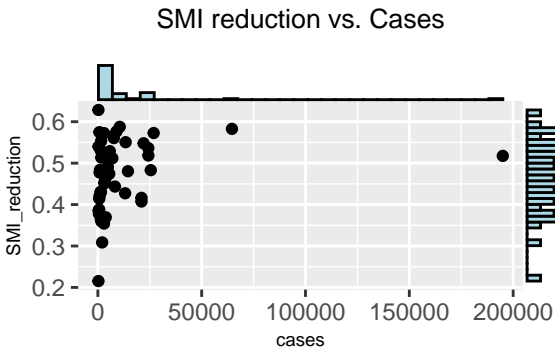
#SAH63 eda
h13<-ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=SAH63DY, y=SMI_reduction))+geom_point()+ggtitle("SAH63"))

#banlargegatherings
h14<- ggMarginal(ggplot(data=cleanerModelPrep, mapping=aes(x=banLargeGatherings,y=SMI_reduction))+geom_point()+ggtitle("banLargeGatherings"))

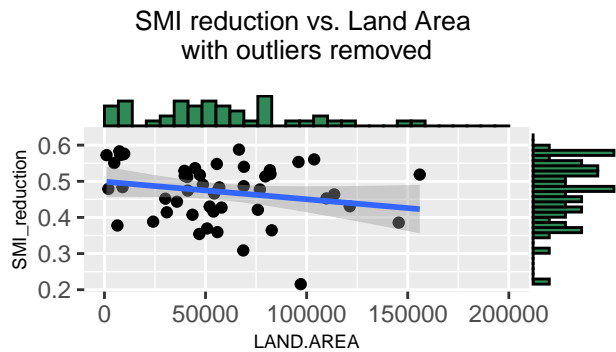
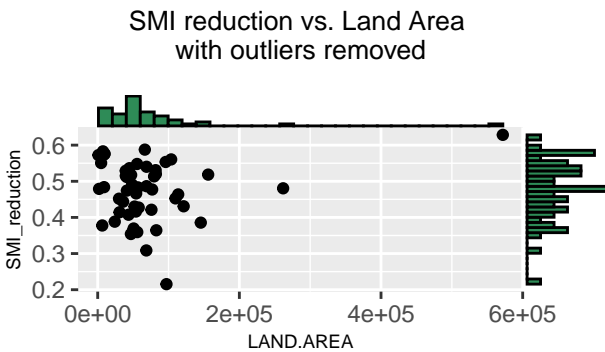
plot_grid(h1,h3,nrow=2)

```

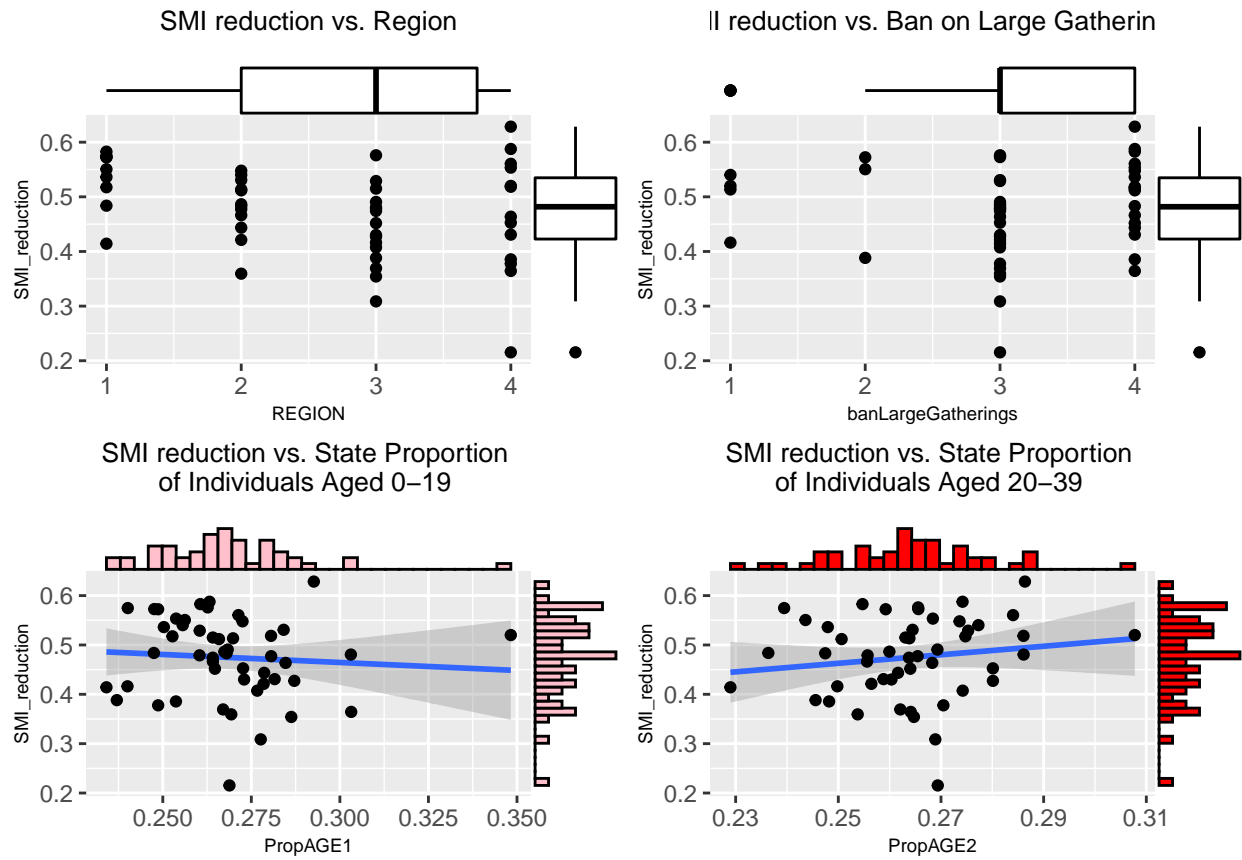
EDA for SMI reduction vs. Cases



EDA for SMI reduction vs. Land Area

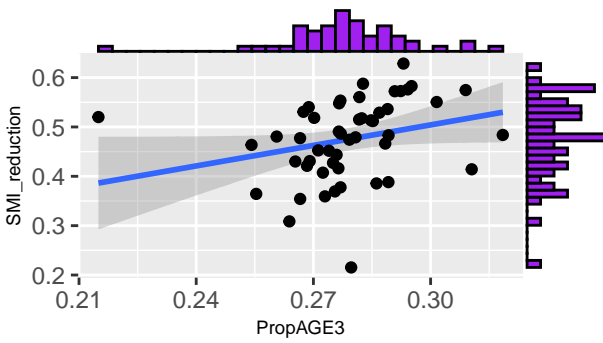


```
plot_grid(h2,h14,h4,h5,ncol=2)
```

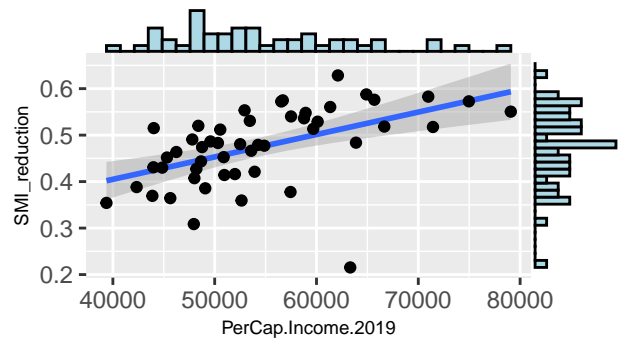


```
plot_grid(h6,h7,h8,h9)
```

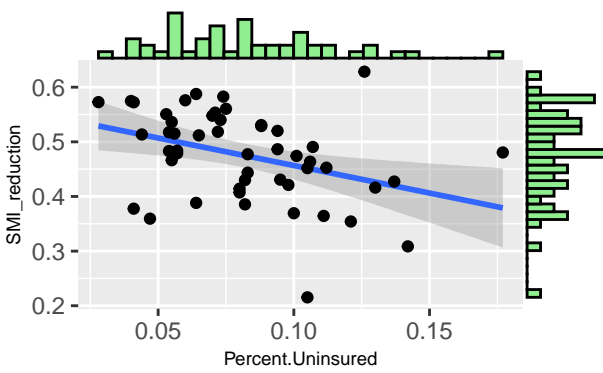
SMI reduction vs. State Proportion
of Individuals Aged 40–59



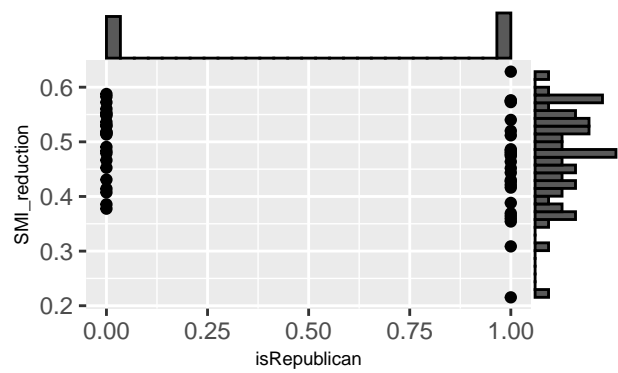
SMI reduction vs.
State Per Capita Income (2019)



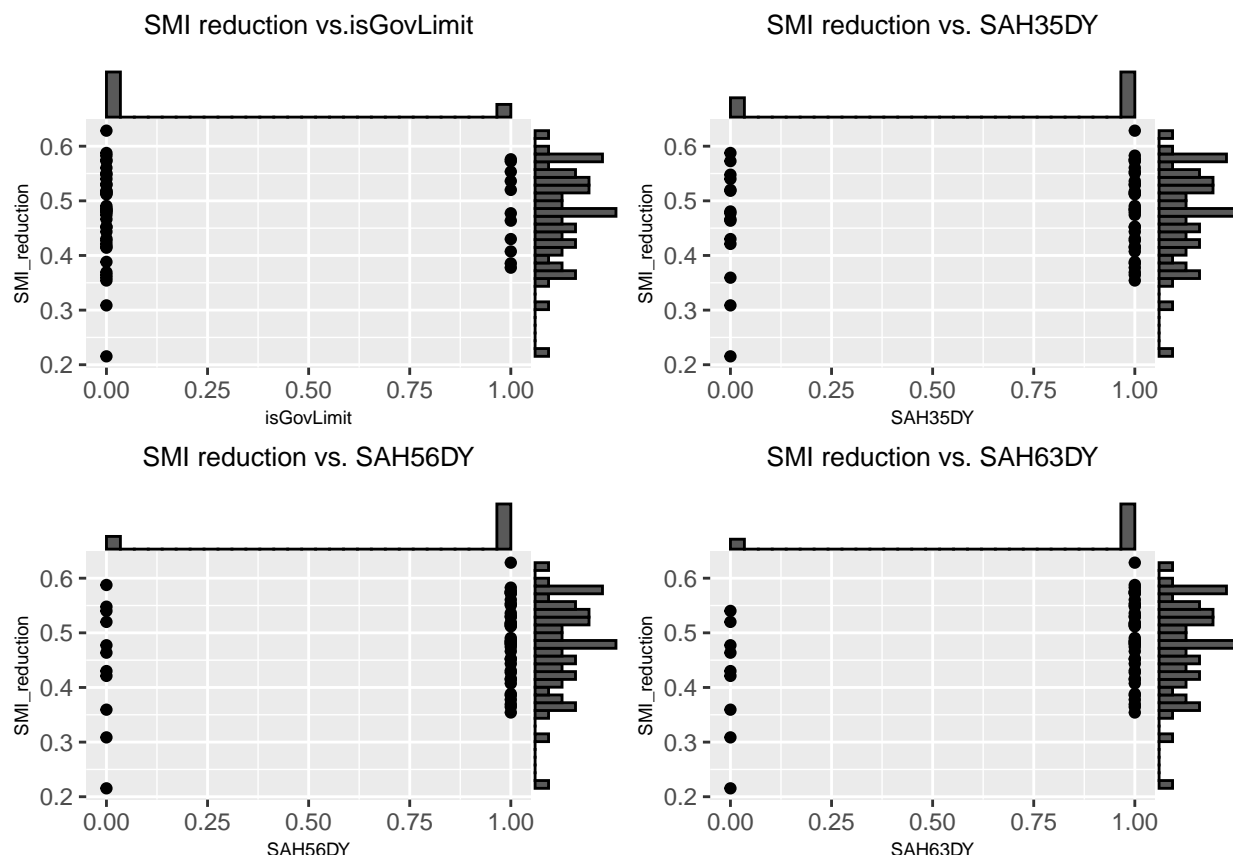
SMI reduction vs. Percent Uninsured



SMI reduction vs. isRepublican



```
plot_grid(h10,h11,h12,h13)
```

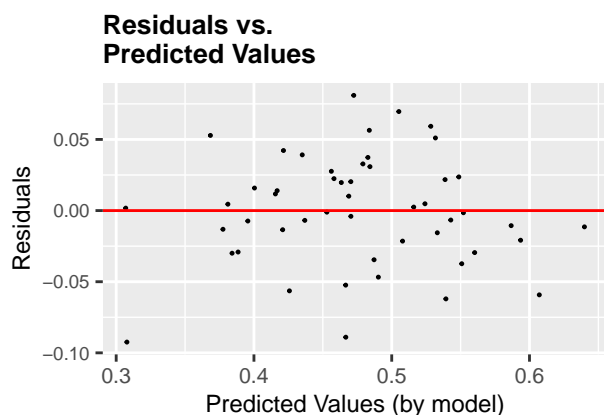
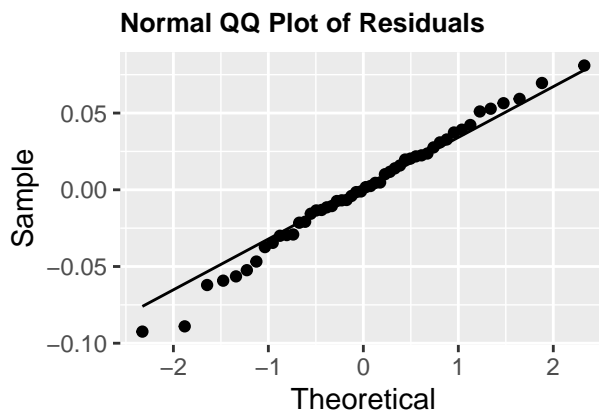
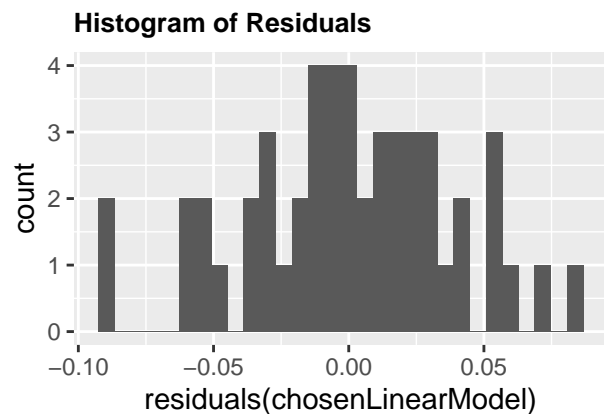
```
chosenLinearModel <- lm(SMI_reduction ~ cases + REGION + LAND.AREA + PropAGE1 + PropAGE2 +
  PropAGE3 + PerCap.Income.2019 + Percent.Uninsured + SAH35DY +
  SAH56DY + SAH63DY + isRepublican + isGovLimit + banLargeGatherings +
  isRepublican:isGovLimit, data = modelPrep)
summary(chosenLinearModel)
```

```
##
## Call:
## lm(formula = SMI_reduction ~ cases + REGION + LAND.AREA + PropAGE1 +
##   PropAGE2 + PropAGE3 + PerCap.Income.2019 + Percent.Uninsured +
##   SAH35DY + SAH56DY + SAH63DY + isRepublican + isGovLimit +
##   banLargeGatherings + isRepublican:isGovLimit, data = modelPrep)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.092416 -0.021308  0.000311  0.023344  0.080966
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.068e+00  6.078e-01   1.757 0.087973 .
## cases         -1.241e-06  3.648e-07  -3.401 0.001733 **
## REGION        -6.392e-02  1.174e-02  -5.445 4.54e-06 ***
## LAND.AREA      4.930e-07  1.184e-07   4.163 0.000202 ***
## PropAGE1      -2.555e+00  9.131e-01  -2.798 0.008411 **
## PropAGE2       3.293e+00  9.618e-01   3.423 0.001629 **
```

```
## PropAGE3          -3.289e+00  1.430e+00  -2.300  0.027739 *
## PerCap.Income.2019  3.283e-06  1.394e-06   2.354  0.024476 *
## Percent.Uninsured  -7.015e-01  3.416e-01  -2.053  0.047785 *
## SAH35DY           6.865e-02  2.958e-02   2.321  0.026440 *
## SAH56DY          -7.535e-02  4.194e-02  -1.797  0.081273 .
## SAH63DY           1.540e-01  4.461e-02   3.453  0.001503 **
## isRepublican      -2.170e-02  1.813e-02  -1.197  0.239682
## isGovLimit        -5.478e-02  2.548e-02  -2.149  0.038807 *
## banLargeGatherings  1.838e-02  1.087e-02   1.692  0.099864 .
## isRepublican:isGovLimit 1.815e-01  3.960e-02   4.583  5.92e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04637 on 34 degrees of freedom
## Multiple R-squared:  0.779, Adjusted R-squared:  0.6815
## F-statistic:  7.99 on 15 and 34 DF,  p-value: 2.968e-07
```

```
c1<-ggplot(data=modelPrep, mapping=aes(x=residuals(chosenLinearModel))) + geom_histogram() + ggtitle("Histogram of Residuals")
c2<- ggplot(data= modelPrep, mapping=aes(sample=residuals(chosenLinearModel))) +
  stat_qq() +
  stat_qq_line()+
  labs(title="Normal QQ Plot of Residuals") + xlab("Theoretical") + ylab("Sample")+theme(plot.title = element_text(size = 10, face = "bold"))
c3  <- ggplot(data=modelPrep, mapping=aes(x=predict(chosenLinearModel),y=residuals(chosenLinearModel))) +
  geom_point(size=0.2) +
  geom_hline(yintercept=0,color="red")+
  labs(title="Residuals vs. \nPredicted Values",
        x="Predicted Values (by model)",
        y="Residuals")+theme(plot.title = element_text(size = 10, face = "bold"))+theme(axis.text.x=element_text(size = 10, face = "bold"))
plot_grid(c1,c2,c3, nrow=2)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



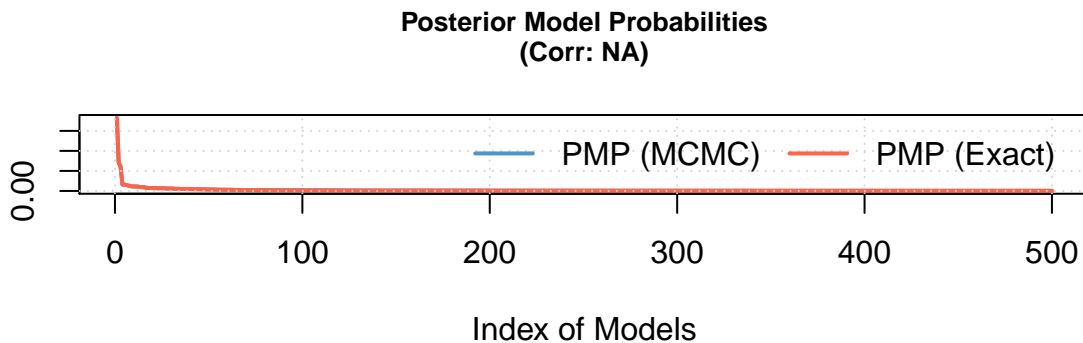
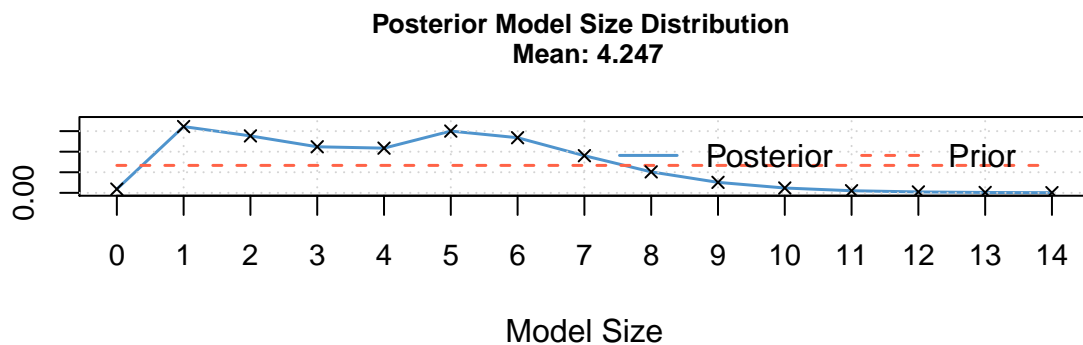
Bayesian Model Selection

```
#Attempted Bayesian Model Selection with 18 predictors - max allowed without crashing
cleanModelPrep <- modelPrep %>%
  select(SMI_reduction, cases , REGION , LAND.AREA , PropAGE1 , PropAGE2 ,
    PropAGE3 , PerCap.Income.2019 , Percent.Uninsured , SAH35DY ,
    SAH56DY , SAH63DY , isRepublican , isGovLimit , banLargeGatherings, isRepublican:isGovLimit)

bms(X.data = cleanModelPrep)
```

##	PIP	Post Mean	Post SD	Cond.Pos.Sign	Idx
## PerCap.Income.2019	0.58235411	2.240693e-06	2.280972e-06	1.00000000	7
## PropAGE2	0.57720677	1.650622e+00	1.633342e+00	1.00000000	5
## SAH63DY	0.55821275	4.494234e-02	4.973456e-02	1.00000000	11
## REGION	0.53890340	-1.902480e-02	1.999333e-02	0.00000000	2
## Percent.Uninsured	0.49854474	-5.190322e-01	5.984132e-01	0.00000000	8
## LAND.AREA	0.41780692	1.283342e-07	1.744130e-07	0.99940535	3
## SAH56DY	0.17225008	-5.001641e-03	2.766461e-02	0.31977220	10
## PropAGE3	0.16762096	1.948166e-01	8.068088e-01	0.80746481	6
## cases	0.15383010	-6.726788e-08	2.191263e-07	0.02697231	1
## isGovLimit	0.15340036	4.341485e-03	1.377465e-02	0.99481366	13
## SAH35DY	0.12678932	2.931036e-03	1.405466e-02	0.86795011	9
## PropAGE1	0.10616272	3.115728e-02	3.020781e-01	0.60466636	4

```
## isRepublican      0.10612868 -1.443211e-03 8.962361e-03    0.14334904 12
## banLargeGatherings 0.08778755 9.217972e-05 3.662864e-03    0.52756112 14
##
## Mean no. regressors      Draws      Burnins      Time
##      "4.2470"      "16384"      "0"      "1.283661 secs"
## No. models visited      Modelspace 2^K      % visited      % Topmodels
##      "16384"      "16384"      "100"      "3.1"
##      Corr PMP      No. Obs.      Model Prior      g-Prior
##      "NA"      "50"      "random / 7"      "UIP"
##      Shrinkage-Stats
##      "Av=0.9804"
##
## Time difference of 1.283661 secs
```



Based on Posterior inclusion probabilities, top predictors for SMI reduction are PerCap.Income.2019, PropAGE2, SAH63DY, REGION, Percent.Uninsured, and Land Area. These predictors had significantly higher probabilities of being included in the posterior model than the other predictors based on the bms method.

```
cleanerModelPrep <- modelPrep %>%
  select(SMI_reduction, cases , REGION , LAND.AREA , PropAGE1 , PropAGE2 ,
    PropAGE3 , PerCap.Income.2019 , Percent.Uninsured , SAH35DY ,
    SAH56DY , SAH63DY , isRepublican , isGovLimit , banLargeGatherings , Days.Between, HospCount, BedsP

# Use `bas.lm` to run regression model
bayes.BIC = bas.lm(SMI_reduction ~ . + isRepublican:isGovLimit + DIVISION:PerCap.Income.2019 + Days.Bet
```

```
summary(bayes.BIC)
```

##	P(B != 0 Y)	model 1	model 2	model 3
## Intercept	1.0000000	1.00000	1.0000000	1.0000000
## cases	0.4418131	0.00000	0.0000000	0.0000000
## REGION	0.6755309	1.00000	0.0000000	1.0000000
## LAND.AREA	0.9428680	1.00000	1.0000000	1.0000000
## PropAGE1	0.3547353	0.00000	0.0000000	0.0000000
## PropAGE2	0.9831865	1.00000	1.0000000	1.0000000
## PropAGE3	0.1752297	0.00000	0.0000000	0.0000000
## PerCap.Income.2019	0.3451813	0.00000	0.0000000	0.0000000
## Percent.Uninsured	0.6838877	1.00000	1.0000000	1.0000000
## SAH35DY	0.1677854	0.00000	0.0000000	0.0000000
## SAH56DY	0.2991903	0.00000	0.0000000	1.0000000
## SAH63DY	0.6822024	1.00000	1.0000000	1.0000000
## isRepublican	0.1909460	0.00000	0.0000000	0.0000000
## isGovLimit	0.1745565	0.00000	0.0000000	0.0000000
## banLargeGatherings	0.1327483	0.00000	0.0000000	0.0000000
## Days.Between	0.1661087	0.00000	0.0000000	0.0000000
## HospCount	0.1746185	0.00000	0.0000000	0.0000000
## BedsPer1000	0.3574324	0.00000	0.0000000	0.0000000
## DIVISION	0.3567466	0.00000	1.0000000	0.0000000
## isRepublican:isGovLimit	0.9506648	1.00000	1.0000000	1.0000000
## PerCap.Income.2019:DIVISION	0.2300952	0.00000	0.0000000	0.0000000
## isRepublican:Days.Between	0.4373499	0.00000	0.0000000	0.0000000
## HospCount:BedsPer1000	0.2115061	0.00000	0.0000000	0.0000000
## BF	NA	1.00000	0.7661103	0.7218045
## PostProbs	NA	0.00530	0.0041000	0.0039000
## R2	NA	0.64520	0.6414000	0.6676000
## dim	NA	7.00000	7.0000000	8.0000000
## logmarg	NA	39.87109	39.6046634	39.5450915
##	model 4	model 5		
## Intercept	1.0000000	1.0000000		
## cases	0.0000000	0.0000000		
## REGION	1.0000000	0.0000000		
## LAND.AREA	1.0000000	1.0000000		
## PropAGE1	0.0000000	0.0000000		
## PropAGE2	1.0000000	1.0000000		
## PropAGE3	0.0000000	0.0000000		
## PerCap.Income.2019	0.0000000	0.0000000		
## Percent.Uninsured	1.0000000	1.0000000		
## SAH35DY	0.0000000	0.0000000		
## SAH56DY	0.0000000	1.0000000		
## SAH63DY	1.0000000	1.0000000		
## isRepublican	0.0000000	0.0000000		
## isGovLimit	0.0000000	0.0000000		
## banLargeGatherings	0.0000000	0.0000000		
## Days.Between	0.0000000	0.0000000		
## HospCount	0.0000000	0.0000000		
## BedsPer1000	1.0000000	0.0000000		
## DIVISION	0.0000000	1.0000000		
## isRepublican:isGovLimit	1.0000000	1.0000000		
## PerCap.Income.2019:DIVISION	0.0000000	0.0000000		

```
## isRepublican:Days.Between      0.0000000  0.0000000
## HospCount:BedsPer1000          0.0000000  0.0000000
## BF                             0.6967396  0.5688033
## PostProbs                      0.0037000  0.0030000
## R2                             0.6671000  0.6644000
## dim                            8.0000000  8.0000000
## logmarg                        39.5097489 39.3068720
```

```
# Find the index of the model with the largest logmarg
```

```
best = which.max(bayes.BIC$logmarg)
```

```
# Retreat the index of variables in the best model, with 0 as the index of the intercept
```

```
bestmodel = bayes.BIC$which[[best]]
```

```
bestmodel
```

```
## [1]  0  2  3  5  8 11 19
```

```
# Best predictors: (Intercept), REGION, LAND.AREA, PropAGE2, Percent.Uninsured, SAH63DY, and isRepublican
```

Based on `bas.lm` regression modelling, the model with the highest logmarg (best model) includes (Intercept), REGION, LAND.AREA, PropAGE2, Percent.Uninsured, SAH63DY, and `isRepublican:isGovLimit`. This model includes all of the predictors with the highest PIP (as computed in `bms`) except for `PerCap.Income.2019` and an interaction term. This confirms that the optimized singular predictors are REGION, LAND.AREA, PropAGE2, Percent.Uninsured, and SAH63DY for SMI reduction. The interaction between `isRepublican:isGovLimit` should also be considered.

```
#credible intervals for coefficients
```

```
coef.bas<- confint(coef(bayes.BIC))
```

```
predictor<-c(rownames(coef.bas)[1],rownames(coef.bas)[3],rownames(coef.bas)[4],rownames(coef.bas)[6],rownames(coef.bas)[12],rownames(coef.bas)[19])
```

```
coef<- rbind(coef.bas[1,], coef.bas[3,], coef.bas[4,], coef.bas[6,], coef.bas[9,], coef.bas[12,], coef.bas[19,])
```

```
# Best predictors: (Intercept), REGION, LAND.AREA, PropAGE2, Percent.Uninsured, SAH63DY, and isRepublican
```

```
coefcred<- as.data.frame(cbind(predictor,coef))
```

```
coefcred[c(1,4,2,3)]
```

##		predictor	beta	2.5%
## 1		Intercept	0.474849739639997	0.459446204911112
## 2		REGION	-0.03430408940333	-0.0886441415860461
## 3		LAND.AREA	3.35381567099629e-07	0
## 4		PropAGE2	2.91375320119129	0.873083003980154
## 5		Percent.Uninsured	-0.603974166210951	-1.53813245252468
## 6		SAH63DY	0.0795931530453548	-0.000391936425313617
## 7		isRepublican:isGovLimit	0.100520379375725	0
##		97.5%		
## 1			0.489669369488508	
## 2			0	
## 3			5.62016512757911e-07	
## 4			5.37602072073952	
## 5			0	
## 6			0.212220227315201	
## 7			0.169746226099759	

Above is the table of coefficients from the optimized Bayesian linear regression model.

Run Bayesian Model and Perform Posterior Predictive Sampling

The `stan_glm` tries to fit a Gaussian family multivariate regression model to estimate the predictor effects for the regression model given above. Predictor estimates seen below are relatively consistent to the values given above indicating we can use these as estimates of parameter effects on `SMI_reduction`.

```
chosenBayesGaussian <- stan_glm(SMI_reduction ~ REGION + LAND.AREA + PropAGE2 + Percent.Uninsured+SAH63)
```

```
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 1).
## Chain 1:
## Chain 1: Gradient evaluation took 0.0001 seconds
## Chain 1: 1000 transitions using 10 leapfrog steps per transition would take 1 seconds.
## Chain 1: Adjust your expectations accordingly!
## Chain 1:
## Chain 1:
## Chain 1: Iteration:    1 / 2000 [  0%] (Warmup)
## Chain 1: Iteration:   200 / 2000 [ 10%] (Warmup)
## Chain 1: Iteration:   400 / 2000 [ 20%] (Warmup)
## Chain 1: Iteration:   600 / 2000 [ 30%] (Warmup)
## Chain 1: Iteration:   800 / 2000 [ 40%] (Warmup)
## Chain 1: Iteration:  1000 / 2000 [ 50%] (Warmup)
## Chain 1: Iteration:  1001 / 2000 [ 50%] (Sampling)
## Chain 1: Iteration:  1200 / 2000 [ 60%] (Sampling)
## Chain 1: Iteration:  1400 / 2000 [ 70%] (Sampling)
## Chain 1: Iteration:  1600 / 2000 [ 80%] (Sampling)
## Chain 1: Iteration:  1800 / 2000 [ 90%] (Sampling)
## Chain 1: Iteration:  2000 / 2000 [100%] (Sampling)
## Chain 1:
## Chain 1: Elapsed Time: 0.095449 seconds (Warm-up)
## Chain 1:                0.079345 seconds (Sampling)
## Chain 1:                0.174794 seconds (Total)
## Chain 1:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 2).
## Chain 2:
## Chain 2: Gradient evaluation took 1.1e-05 seconds
## Chain 2: 1000 transitions using 10 leapfrog steps per transition would take 0.11 seconds.
## Chain 2: Adjust your expectations accordingly!
## Chain 2:
## Chain 2:
## Chain 2: Iteration:    1 / 2000 [  0%] (Warmup)
## Chain 2: Iteration:   200 / 2000 [ 10%] (Warmup)
## Chain 2: Iteration:   400 / 2000 [ 20%] (Warmup)
## Chain 2: Iteration:   600 / 2000 [ 30%] (Warmup)
## Chain 2: Iteration:   800 / 2000 [ 40%] (Warmup)
## Chain 2: Iteration:  1000 / 2000 [ 50%] (Warmup)
## Chain 2: Iteration:  1001 / 2000 [ 50%] (Sampling)
## Chain 2: Iteration:  1200 / 2000 [ 60%] (Sampling)
## Chain 2: Iteration:  1400 / 2000 [ 70%] (Sampling)
## Chain 2: Iteration:  1600 / 2000 [ 80%] (Sampling)
## Chain 2: Iteration:  1800 / 2000 [ 90%] (Sampling)
## Chain 2: Iteration:  2000 / 2000 [100%] (Sampling)
## Chain 2:
```

```

## Chain 2: Elapsed Time: 0.093277 seconds (Warm-up)
## Chain 2:           0.077075 seconds (Sampling)
## Chain 2:           0.170352 seconds (Total)
## Chain 2:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 3).
## Chain 3:
## Chain 3: Gradient evaluation took 9e-06 seconds
## Chain 3: 1000 transitions using 10 leapfrog steps per transition would take 0.09 seconds.
## Chain 3: Adjust your expectations accordingly!
## Chain 3:
## Chain 3:
## Chain 3: Iteration:    1 / 2000 [  0%] (Warmup)
## Chain 3: Iteration:   200 / 2000 [ 10%] (Warmup)
## Chain 3: Iteration:   400 / 2000 [ 20%] (Warmup)
## Chain 3: Iteration:   600 / 2000 [ 30%] (Warmup)
## Chain 3: Iteration:   800 / 2000 [ 40%] (Warmup)
## Chain 3: Iteration:  1000 / 2000 [ 50%] (Warmup)
## Chain 3: Iteration:  1001 / 2000 [ 50%] (Sampling)
## Chain 3: Iteration:  1200 / 2000 [ 60%] (Sampling)
## Chain 3: Iteration:  1400 / 2000 [ 70%] (Sampling)
## Chain 3: Iteration:  1600 / 2000 [ 80%] (Sampling)
## Chain 3: Iteration:  1800 / 2000 [ 90%] (Sampling)
## Chain 3: Iteration:  2000 / 2000 [100%] (Sampling)
## Chain 3:
## Chain 3: Elapsed Time: 0.096601 seconds (Warm-up)
## Chain 3:           0.082821 seconds (Sampling)
## Chain 3:           0.179422 seconds (Total)
## Chain 3:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 4).
## Chain 4:
## Chain 4: Gradient evaluation took 1.1e-05 seconds
## Chain 4: 1000 transitions using 10 leapfrog steps per transition would take 0.11 seconds.
## Chain 4: Adjust your expectations accordingly!
## Chain 4:
## Chain 4:
## Chain 4: Iteration:    1 / 2000 [  0%] (Warmup)
## Chain 4: Iteration:   200 / 2000 [ 10%] (Warmup)
## Chain 4: Iteration:   400 / 2000 [ 20%] (Warmup)
## Chain 4: Iteration:   600 / 2000 [ 30%] (Warmup)
## Chain 4: Iteration:   800 / 2000 [ 40%] (Warmup)
## Chain 4: Iteration:  1000 / 2000 [ 50%] (Warmup)
## Chain 4: Iteration:  1001 / 2000 [ 50%] (Sampling)
## Chain 4: Iteration:  1200 / 2000 [ 60%] (Sampling)
## Chain 4: Iteration:  1400 / 2000 [ 70%] (Sampling)
## Chain 4: Iteration:  1600 / 2000 [ 80%] (Sampling)
## Chain 4: Iteration:  1800 / 2000 [ 90%] (Sampling)
## Chain 4: Iteration:  2000 / 2000 [100%] (Sampling)
## Chain 4:
## Chain 4: Elapsed Time: 0.084315 seconds (Warm-up)
## Chain 4:           0.076974 seconds (Sampling)
## Chain 4:           0.161289 seconds (Total)
## Chain 4:

```

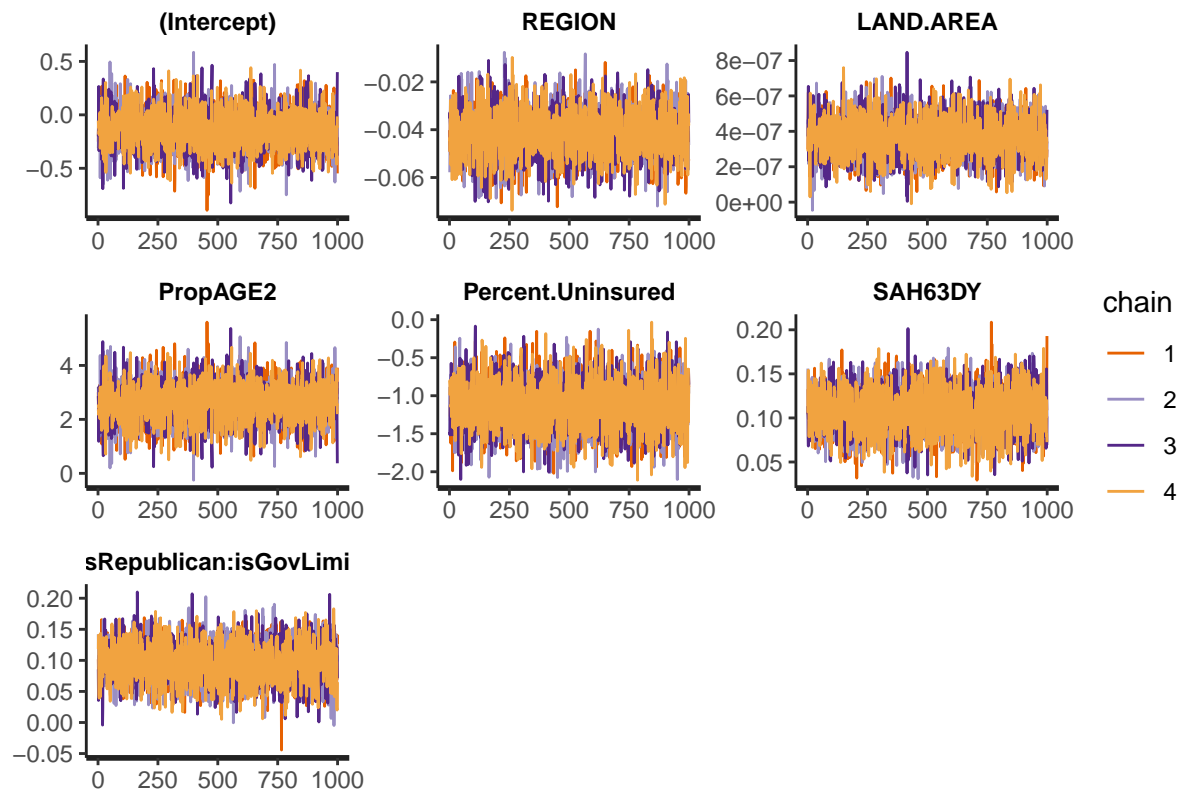


```
#Use Monte Carlo simulations to fit a Gaussian linear model in order to output posterior predictive val
summary(chosenBayesGaussian)
```

```
##
## Model Info:
## function:      stan_glm
## family:        gaussian [identity]
## formula:       SMI_reduction ~ REGION + LAND.AREA + PropAGE2 + Percent.Uninsured +
##               SAH63DY + isRepublican:isGovLimit
## algorithm:     sampling
## sample:        4000 (posterior sample size)
## priors:        see help('prior_summary')
## observations:  50
## predictors:    7
##
## Estimates:
##               mean    sd  10%   50%   90%
## (Intercept)   -0.1    0.2 -0.4  -0.1   0.1
## REGION         0.0    0.0 -0.1   0.0   0.0
## LAND.AREA      0.0    0.0  0.0   0.0   0.0
## PropAGE2       2.6    0.7  1.7   2.6   3.5
## Percent.Uninsured -1.1   0.3 -1.5  -1.1  -0.7
## SAH63DY        0.1    0.0  0.1   0.1   0.1
## isRepublican:isGovLimit 0.1   0.0  0.1   0.1   0.1
## sigma          0.1    0.0  0.0   0.1   0.1
##
## Fit Diagnostics:
##               mean    sd  10%   50%   90%
## mean_PPD 0.5    0.0  0.5   0.5   0.5
##
## The mean_ppd is the sample average posterior predictive distribution of the outcome variable (for de
##
## MCMC diagnostics
##               mcse Rhat n_eff
## (Intercept)   0.0  1.0  3593
## REGION         0.0  1.0  3335
## LAND.AREA      0.0  1.0  4048
## PropAGE2       0.0  1.0  3615
## Percent.Uninsured 0.0  1.0  4172
## SAH63DY        0.0  1.0  3813
## isRepublican:isGovLimit 0.0  1.0  3634
## sigma          0.0  1.0  2676
## mean_PPD       0.0  1.0  4347
## log-posterior  0.1  1.0  1445
##
## For each parameter, mcse is Monte Carlo standard error, n_eff is a crude measure of effective sample

predLabels <- c("(Intercept)","REGION","LAND.AREA", "PropAGE2", "Percent.Uninsured", "SAH63DY", "isRepu

#trace plots to assess Monte Carlo efficacy
stan_trace(chosenBayesGaussian, pars=predLabels)
```



```
##Draw Posterior Predictive Check Graphs
#y=vector of outcome values from the data
#yrep=draws from posterior predictive distribution
pp_check(chosenBayesGaussian)
```

